



## CHALLENGE:

# Alternative skip handler for nuclear storage ponds

Sellafield Ltd is seeking an alternative to the Skip Handling Machine for the First Generation Magnox Storage Pond – currently the only means of moving skips within the pond and allowing export to other facilities. The solution should increase throughput and operational efficiency by working alongside the Skip Handling Machine to accelerate skip exports and enable High Hazard and Risk Reduction in the degrading facility.

## Introduction

The Legacy Ponds Programme at Sellafield is a 20-year mission to retrieve material stored in two ponds and their associated supporting plants: First Generation Magnox Storage Pond (FGMSP) and Pile Fuel Storage Pond (PFSP), built in the 1940s and 1950s. Whilst the main focus of this challenge is on finding a solution for FGMSP, solutions that can be applied to PFSP or other ponds across the Nuclear Decommissioning Authority (NDA) estate would also be desirable.

The FGMSP is an ageing and degrading complex of buildings and associated ponds, including decanner bays (areas where nuclear fuel elements are stripped of their outer metal cladding). There are three interconnected ponds which, in total, are approximately 130m in length, 17m wide and have a water depth of roughly 5m. Visibility within the pond is intermittently poor as a result of sludge disturbance or algal blooms. The pond temperature varies seasonally from 5–20°C and the pH is approximately 11.6. Images of the pond are shown in Figure 1 right.

The FGMSP ponds contain:

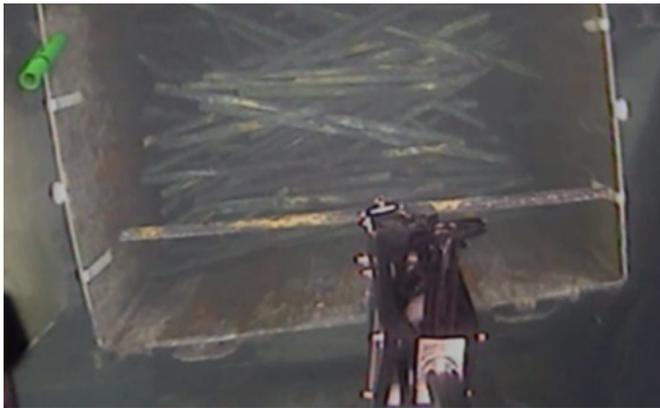
- Spent nuclear fuel, and sludge (which has been generated from corroded fuel, corroded cladding materials and contains dead algae and wind-blown detritus)
- Debris consisting of items such as contaminated drums and metal sheeting, known as miscellaneous beta gamma waste (MBGW) and components of fuel rods such as Magnox, steel and ceramic
- Zeolite skips containing ion exchange resin pellets which were used to remove activity from the pond water prior to the Site Ion Exchange Plant coming online in the 1980s
- Empty skips, which inhibit the placement of higher hazard skips on the lower levels of the pond



*Figure 1: Images of FGMSP pond*

The Pile Fuel Storage Pond (PFSP) is a complex of decanning bays and a pond containing an inventory of historic fuel, sludge and MBGW. The main pond is approximately 100m long by 25m wide and approximately 5.5m deep. The pond temperature varies seasonally from 5–20°C and is approximately pH 9.6.

*Figure 2: Examples of skip types*



*a. Self-draining fuel skip*



*b. Uranium bit bins within a skip*



*c. Zeolite skip*

### **The Need for Skip Handling**

The FGMSP is considered the second highest Hazard and Risk Reduction priority to Sellafield Ltd. The NDA's priority is to remove the legacy fuel and waste to safe, secure long-term storage.

The Skip Handling Machine (SHM) is being maintained for maximum throughput; however, both planned maintenance and unplanned breakdowns result in long periods of time where no skips can be exported from the FGMSP.

The SHM is a crane required to move and position skips within the pond, within the export cell entrance ramp bogie (a wheeled platform used to transport skips along rails from the pond into the export cell) and within various side bay bogies used for preparation and transfer activities. Additionally, the SHM is required to deploy the Bulk Sludge Retrieval Tool (BSRT) and Crevice Sludge Retrieval Tool (CSRT) to enable removal of radioactive sludge from the pond.

An alternative SHM for both Legacy Ponds (FGMSP and PFSP) would enable faster High Hazard and Risk Reduction for the site as well as enabling exports whilst the SHM's are in outage. In the event of a total SHM failure, it would provide risk mitigation to ensure export operations could continue. In order to meet the target reduction in numbers of skips stored within the ponds, improved methods of skip positioning to accelerate exports would be advantageous.

## Current Practice

Skips within the FGMSP weigh up to 500kg when empty, and up to ~2500kg when loaded (although skips have a safe working load of 3.8 tonnes). There is a target to reduce the number of skips held within FGMSP by ~50% within the next 10 years.

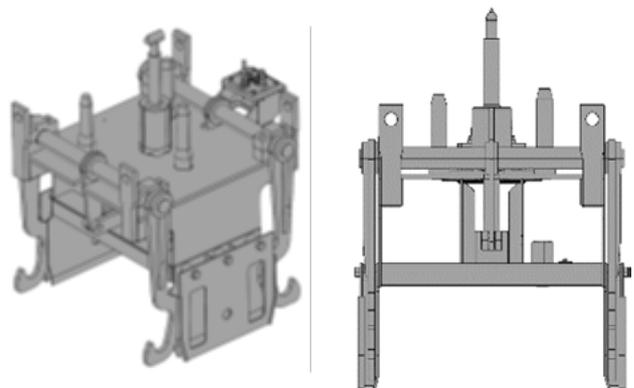
Long skips have dimensions (l x w x h): 1357mm x 989 m x 1092mm; and short skips have dimensions: 1180mm x 989mm x 1092mm. The skips are fitted with four lifting trunnions on the side of the skip; these are mounting points that enable the SHM to attach, lift and manoeuvre the skips as required. The lifting trunnion arrangement is shown in Figure 4 and is the same for both types of skips.

Skips are stacked within the pond (up to 3 high) as shown in Figure 3. The gaps between stacks of skips are roughly 200mm in the north-south direction and 80mm in the east-west direction. The gap between stacks of skips and the pond walls is 600mm-900mm. The water cover above stacks of skips stacked 3 high is approximately 2m.



**Figure 3: Stacks of skips in grid arrangement: vertical axis of image is north-south orientation**

The SHM comprises the main pond crane, a fixed mast and an inner removeable mast where various tooling can be installed: for example, in “skip handling mode” it can use the standard skip retrieval tool on the end of the SHM to interface with skips in the pond, as shown below in Figure 4 and 5; or chains for larger lifting operations in “crane mode”. The SHM travels at ~0.8mph.



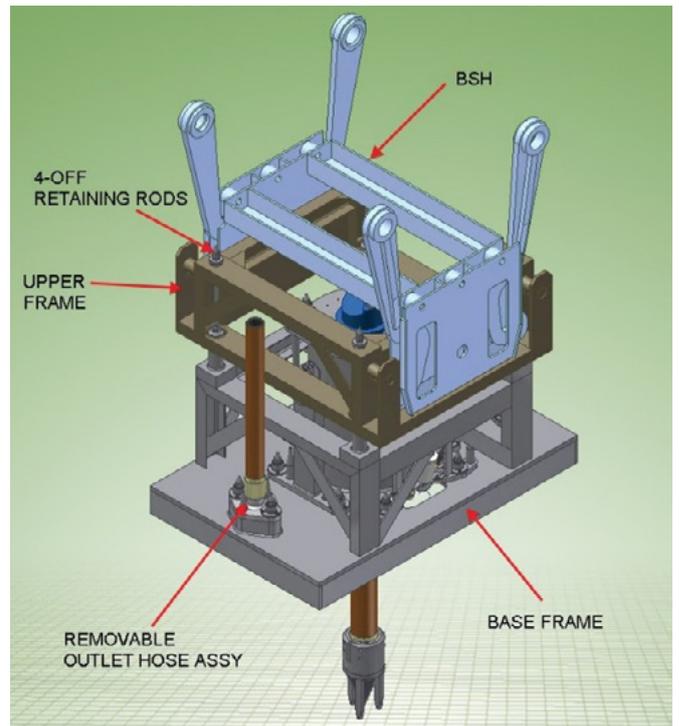
**Figure 4: Example images showing skip retrieval tool and interface with skip trunnions**



**Figure 5: Image showing SHM With skip retrieval tool**

The skips need to be moved and accurately positioned in several different areas within the ponds, including the main pond, the export cell bogie and various side bay bogies.

For sludge retrieval, the BSRT and CSRT are deployed via the SHM and are attached using the same lifting features as the skips themselves.



**Figure 6: BSRT (bottom left) and CSRT (above)**

The uranium bit bins, shown in Figure 2.b, weigh approximately 300kg (but can be up to 500kg) and are loaded directly into skips by smaller cranes within the bay areas of the pond using the lifting feature on the bin.

#### **Previous Alternatives Considered**

Alternatives to the SHM such as Modified Off The Shelf (MOTS) marine salvage pontoons with winch or mast systems to lift skips have been proposed, and whilst never pursued, have not been ruled out.

Crawlers/excavators on the pond floor were considered as short-term solutions but were discounted due to the availability of space on the pond floor; however, this should not be discounted for a longer-term solution.

## Challenge Aims

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Sellafield Ltd is seeking solutions that can effectively interface with skips, move and reposition them within the ponds, and allow recovery of those skips into safer storage.

The main aim is to allow movement of skips within the FGMSP without reliance on the SHM (i.e. so skips can still be moved when the SHM is in outage). Any solution must be able to work under the pond water conditions and accurately move the skips from stacks to the export cell and bay bogies around the pond.

Additionally, the solution should be able to deploy with the sludge retrieval tools to enable the removal of radioactive sludge from the ponds.

Within the stacks, it is acknowledged that some solutions may not be able to access skips adjacent to the pond walls or in the corners, and, whilst this would be preferable, Sellafield Ltd still would be open to solutions that can only manage a limited number of skips.

Whilst the FGMSP is the main focus, solutions that can be applied to the PFSP would also be desirable.

The Legacy Ponds Programme is currently considering short-term solutions to enable skip movements for export from FGMSP due to the SHM repair outage, with the focus on short time to implementation. This Game Changers challenge is intended to address the longer-term need for performance and reliability as well as the ability to undertake all functions required of the current SHM.

As Sellafield Ltd's legacy ponds retrievals programme is currently ongoing, solutions that can be implemented within a 1–2 year timeframe would be advantageous. Full solutions or partial solutions that can enable a suite of different technologies in a retrievals toolkit are welcomed.

## Benefits to Sellafield

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Development of an alternative platform to the SHM could enable pond operations to continue whenever the SHM is unavailable, avoiding delays.

The solution could also work in tandem with the SHM to accelerate skips exports.

Acceleration of skip exports would benefit the Sellafield Ltd and NDA targets for High Hazard and Risk Reduction. Not only would this reduce the risk associated with the ageing legacy facilities, but it would also bring a significant cost saving.

As other plants utilise the same waste routes as the waste exported from the Legacy Ponds, a reduction in down-time of exports from the Legacy Ponds would allow for better planning of export operations across site.

## Constraints

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- There are a number of sub-ponds/bays with dividing walls that protrude above the water surface (as seen in Figure 1). Movement and accurate control of the skips around these walls is required, including passage through the sluice gates. The sluice gates are approximately 2.5m wide and 4.5m deep with approximately 2m of dividing wall rising from the pond floor beneath each gate
- Solutions must be able to operate under pond water, of depths up to 5m with visibility intermittently poor as a result of sludge disturbance or algal blooms
- Solutions must be able to operate in the water cover above stacks of skips (3 high), which is approximately 2m deep
- Pond temperature varies seasonally from 5–20°C. FGMSP is approximately pH 11.6, and PFSP is approximately pH 9.6
- Particulate within the pond is potentially abrasive so mitigations should be considered
- Solutions must be able to operate under a radioactive environment of up to 4.1 Sv/hr
- The pond is a very congested area, therefore space is limited. This includes the footprint of the pond itself and the space around the pond where equipment could be installed
- The solution could be deployable via the SHM crane (8 tonne limit), through the import/export cell (roughly the size of a skip), through one of the bays using a 12-tonne crane, or if necessary, an over-the-wall crane could be used to deploy the solution

## Functional Requirements

### Essential

- Ability to accurately and repeatably pick up and reposition the majority of skips in FGMSP (whilst the ability to access all skips within FGMSP would be advantageous, it is possible that some skips will be inaccessible), including:
  - Both long and short skips
  - Empty, fuel-bearing and Zeolite skips
- Skips are stacked in the main pond in a pre-defined, set-location grid arrangement. Any solution should be able to position the skips accordingly such that they could be retrieved by the SHM later if required
- Ability to move skips between all ponds within FGMSP
- Ability to accurately place skips on the bogies on the export cell ramp and the bays
- Ability to accurately stack a skip on top of another skip. This is required for both the second and third level of skips as per FGMSP normal operations

### Desirable

- Ability to manage skips adjacent to walls and in corners
- Ability to handle zeolite skips connected at stations (removal of installed pumps)
- Ability to handle Uranium Bit Bins, along with other binned wastes, and manoeuvre them between different skips
- Ability to handle sludge removal tools
- Applicable to PFSP
- To be able to manage out of position skips and tipped skips (see Figure 7)
- Ability to retrieve various solid waste from the pond floor and relocate to a skip
- Ability to manage skips within the Deluge Skip Wash Box or the ability to wash skips
- Ability to weigh skips and/or various solid waste items



*Figure 7: Examples of skips out of position (top) and tipped skips (bottom)*

## Find Out More

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Game Changers are hosting a workshop for this challenge where delegates will have the opportunity to meet challenge owners. Details are available on the Game Changers website [www.gamechangers.technology](http://www.gamechangers.technology).

If you have new ideas or innovations which can be applied to address this challenge, we invite you to join us. If you'd like more information about the funding available through the Game Changers programme, please visit [Our Funding Process](#) ([gamechangers.technology](http://gamechangers.technology)).

**The deadline for applications for this challenge is 3pm on Tuesday 27th January 2026.**

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