Sellafield Ltd

GAMECHANGERS
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CHALLENGE:
Non-invasive Imaging of In-ground Structures

Sellafield Ltd is seeking technologies and approaches to identify the presence and composition of subsurface structures in the vicinity of buildings on the Sellafield site.

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Introduction

Like many industrial sites of its age, Sellafield has a complex history of site use including the addition and removal of buildings over an extended period of time. This has resulted in a legacy of redundant physical forms both above and below ground level. Whilst a great deal is known about these structures from existing drawings and previous survey information, Sellafield Ltd have a need to better understand the presence of any subsurface or in-ground structures. Additional information is needed to inform modelling and problem-solving processes as the site is decommissioned. In-ground structure data may also have a bearing on future works.

Sellafield Ltd are seeking emerging technologies and approaches to identify the presence and composition of any subsurface structures.

Industrial sites, particularly those that have been developed in various phases throughout time, are often congested and complex in nature. Information about the construction of buildings and services is required to manage the site, but also to be able to plan for new developments and of course the task of decommissioning.

Periodically, information may be collected to update engineering models to be used in planning, but there may also be occasions where information is required relating to investigating issues on site.

Due to the highly congested nature of the Sellafield site and restricted access to certain areas, gathering additional information about the site is challenging, less so for above ground structures but more so for subsurface or in-ground structures. This task is particularly difficult where additional works are needed to deploy devices or techniques.

Utilisation of existing monitoring infrastructure may provide an opportunity to deploy equipment beneath ground level in order to gather further information. There are a number of boreholes and blind tubes across the Sellafield site, which are used for environmental monitoring purposes.

This challenge is focussed on techniques and technology which may be used to image structures beneath ground, and in particular legacy waste storage facilities, such as the Magnox Swarf Storage Silos (MSSS).

Current Practice

Excavations to enable inspections are only possible in certain areas of the site and therefore are not a viable solution for a large proportion of the areas of interest. This is certainly the case around MSSS.

Sellafield Ltd currently employ and/or have trialled a number of known techniques for subsurface investigations, such as the use of standard geophysics techniques. Ground penetrating radar has provided some information, but the technique doesn't give the level of information required where there is a presence of other materials such as metals and cobbles.

Challenge Aims

Sellafield Ltd are looking for a solution to provide a 3D image/model of the subsurface around buildings where as-built records may not be as comprehensive as desired.

It is anticipated that successful solution providers should be able to provide a desk study to demonstrate the feasibility of a non-invasive technique.

Sellafield Ltd are interested in emerging technologies and techniques such as muon tomography, quantum hall sensing and quantum micro gravity. Please note that the scope of this challenge is not restricted to making use of these specific examples.

It may be possible to deploy a device in one of the blind tubes, within the wider Sellafield blind-tube network, for a number of weeks before moving it to another in order to build up information and potentially stitch together surveys. It is acknowledged that there would likely be the need to reconstruct a significant amount of information for presentation or interrogation.

A solution to this challenge would be considered to have broad applicability across the site and the mapping of buried services would provide an additional benefit.

However, there is a current imperative to gather better information in relation to a known leak from a building on the Sellafield site, which is the single biggest source of in-ground contamination. The current leak from the Magnox Swarf Storage Silo Original Building (MSSS OB) and first extension was declared in 2019. The Magnox Swarf Storage Silos (MSSS) at Sellafield comprise an Original Building constructed in 1962 and three subsequent extensions constructed between 1972 and 1982. The silos contain magnesium cladding or 'swarf' that was stripped from Magnox fuel prior to reprocessing and stored under a layer of cover water. The leak rate is around 2.5m^3 per day from the Original Building, which is embedded in the ground by approximately 6m.

Due to the method of building construction and subsequent, poorly documented, interventions in the ground around the MSSS OB and first extension, the form of in-ground engineering is poorly constrained. There is evidence to suggest that engineering features may be influencing the migration of contamination away from the leak site, and gaining a better understanding of these features would help with developing mitigation strategies.

The Original Building goes about 6m underground. Concrete screeding to stop the collapse of excavated slopes was used during construction and these features may be influencing leak migration. The first evidence of a leak occurred when building the first extension at which time considerable excavation and backfilling was undertaken. However, only limited records of the full extent of these works are available. The construction method used changed between the first extension and second extension being built.

Constraints

The primary area of interest is in a congested area with restricted access and high radiation dose rates. Locations around the building are very high dose areas of up to 750 milli-grays per hour in some areas.

- High in-ground activities around the MSSS preclude direct investigation.
- On surface deployment is not excluded, but may be a challenge due to the congested nature of the area and high worker dose in some areas.
- MSSS walls of the building are of interest.
    - Previous excavation details are unknown/limited.
- Complexity of underground may suggest that blind-tube deployment is the best option.
    - There are blind tubes which could be utilised and are located within 2 to 10m of the building. Successful solution providers that are awarded feasibility funding will be provided with details including a map of blind tube locations.
    - The blind tubes are generally steel lined (one is HDPE lined).
    - Most blind tubes are vertical in orientation, some are angled at 40°.
    - Some blind tubes are slightly below water table for circa 3m.
    - The tubes are of nominal diameter 90 or 100mm.
    - The blind tubes should be dry, but may contain rainwater.
    - The blind tubes are 10m deep on average.
- Depth of image desired from 0m (normal ground level) to circa 10m below ground (this may be constrained to the depth of blind tubes if utilised).

Functional Requirements

- The west end and southside of MSSS are the main areas of interest, but an image from all around the building would be of interest.
- There is no specification of the resolution; however, Sellafield Ltd are looking for solutions that provide the best possible resolution.
- Identification of features.
- The solution should provide condition/ information relating to composition.
- The capacity to provide periodic monitoring for future groundwater observations may be an advantage.
- Monitoring during/after "heavy movements" or major construction works would be advantageous.

Find Out More

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.

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).

The deadline for applications for this challenge is 4pm on Friday 19th April 2024.

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