Sellafield Ltd

GAMECHANGERS
DELIVERING NUCLEAR INNOVATION

CHALLENGE:

Internal inspection of long and narrow pipework

Sellafield Ltd seeks a technology capable of conducting internal visual inspection of long, narrow, convoluted pipework, providing live HD colour video to assess condition, identify any defects, and manage the risk of failure.

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United Kingdom
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Introduction

Sellafield is a large nuclear facility that has been active since 1947. Sellafield Ltd is responsible for the safe and cost-effective decommissioning of this complex site. Routine visual inspection of existing assets across the Sellafield site is important to understand their condition, identify any defects, and manage the risk of failure. Internal inspection of narrow pipework can be particularly challenging due to bends, corrosion debris, lack of lighting, and the length of pipes.

One example of such pipework is an overflow drain line that services the Sellafield Sealines. If there is any damage to the primary pipe, water will be contained within the secondary containment and outflow through the drain line to a monitoring pit. This drain line must be inspected every 2 years to ensure there is no damage or blockage.

Commercially available equipment cannot inspect the full length of the pipe as they cannot pass through the full length due to multiple bends, debris and welds. Access to the start of the pipe is within a hut, which is pedestrian-only access, walking over rugged terrain from the main site. Working space around the pipe entry is somewhat limited. The pipe has a horizontal entry and, once outside of the hut, travels underground for up to 60m, with an assumed slight downward gradient to the monitoring pit in the hut. A 110v power supply (2 sockets) is available in the hut (orange box shown in Figure 1.1).

Although this challenge relates to one pipeline in particular, there are various similar examples of narrow restricted spaces to inspect across Sellafield and the whole NDA estate.

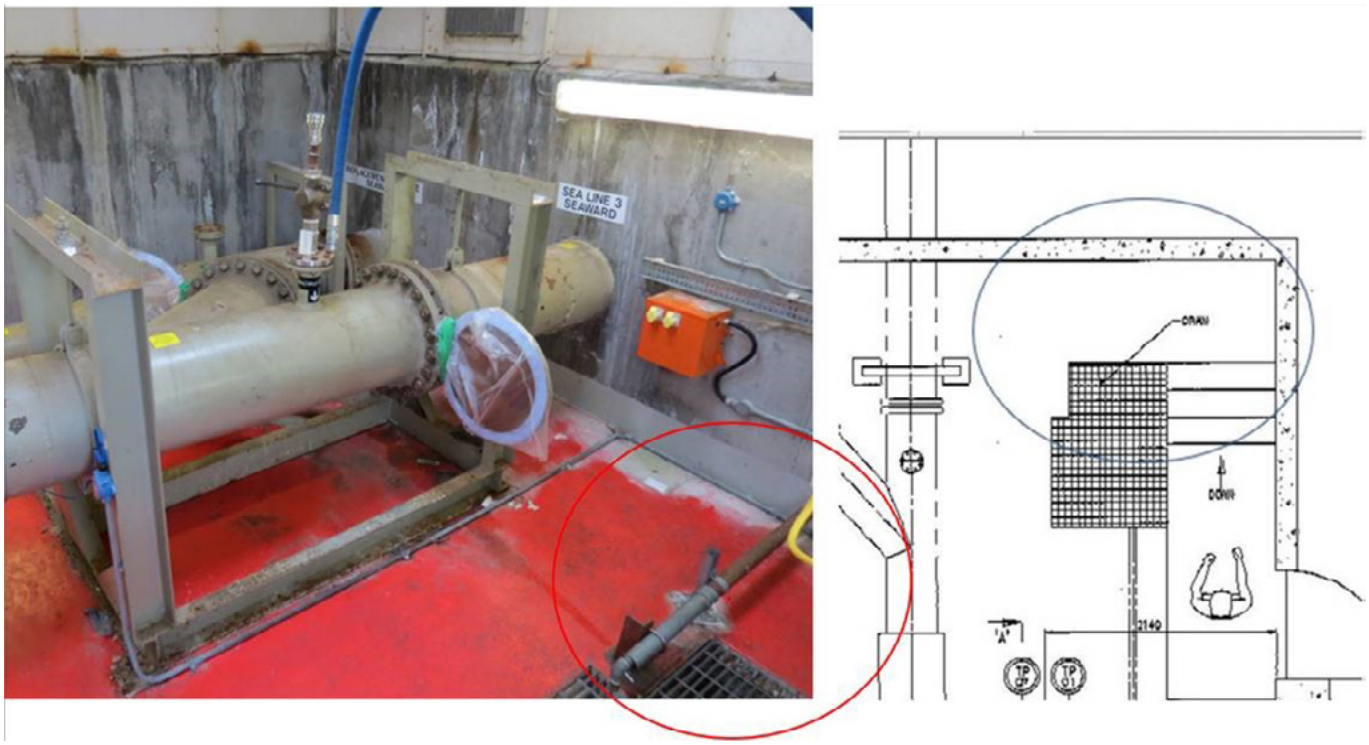

Figure 1.1: Close-up of access (elbow is screwed off for access).

Figure 1.2: Close-up of access.

Figure 2: Image of working space.

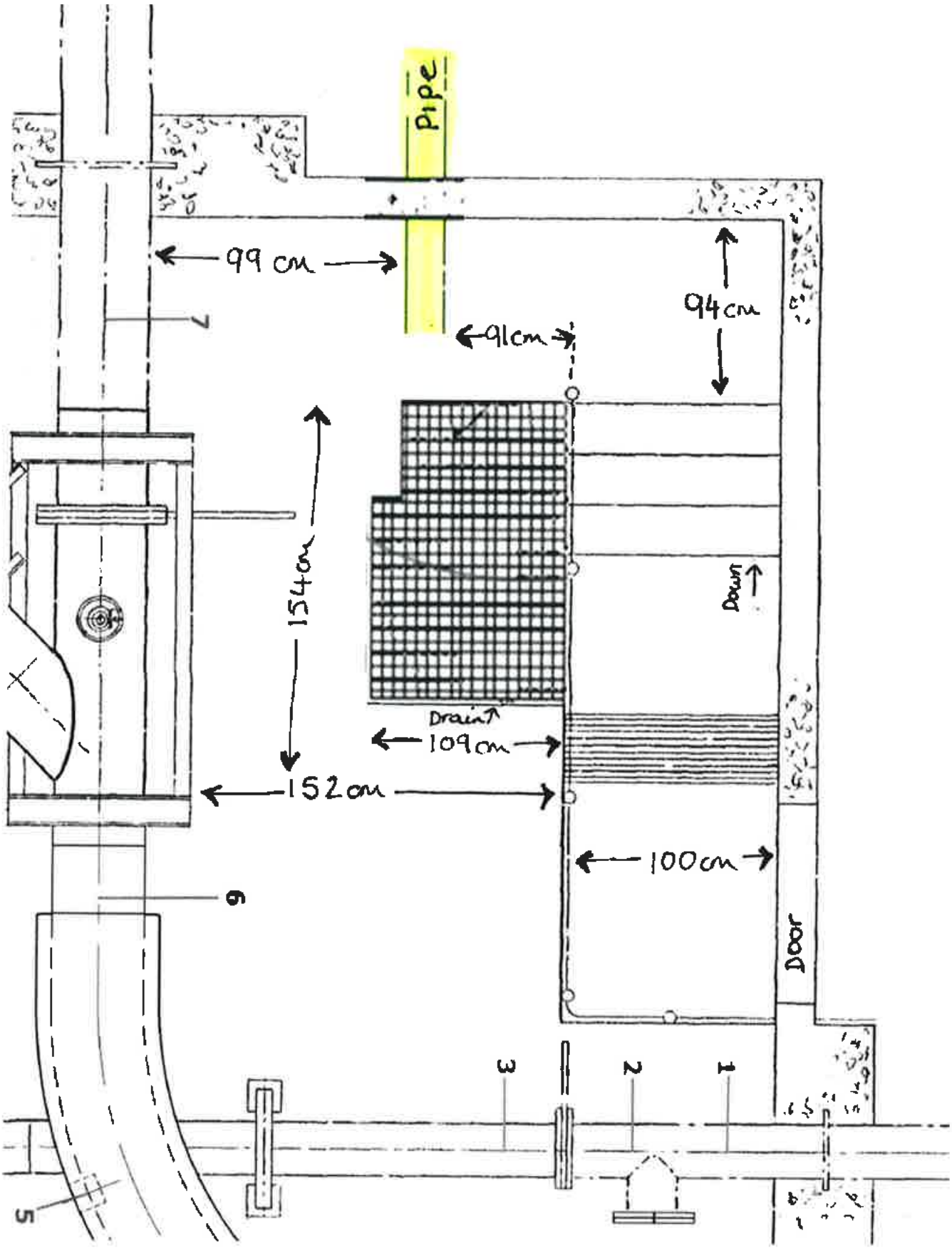

Figure 3: Access image and drawing showing steps down and area for deployment.

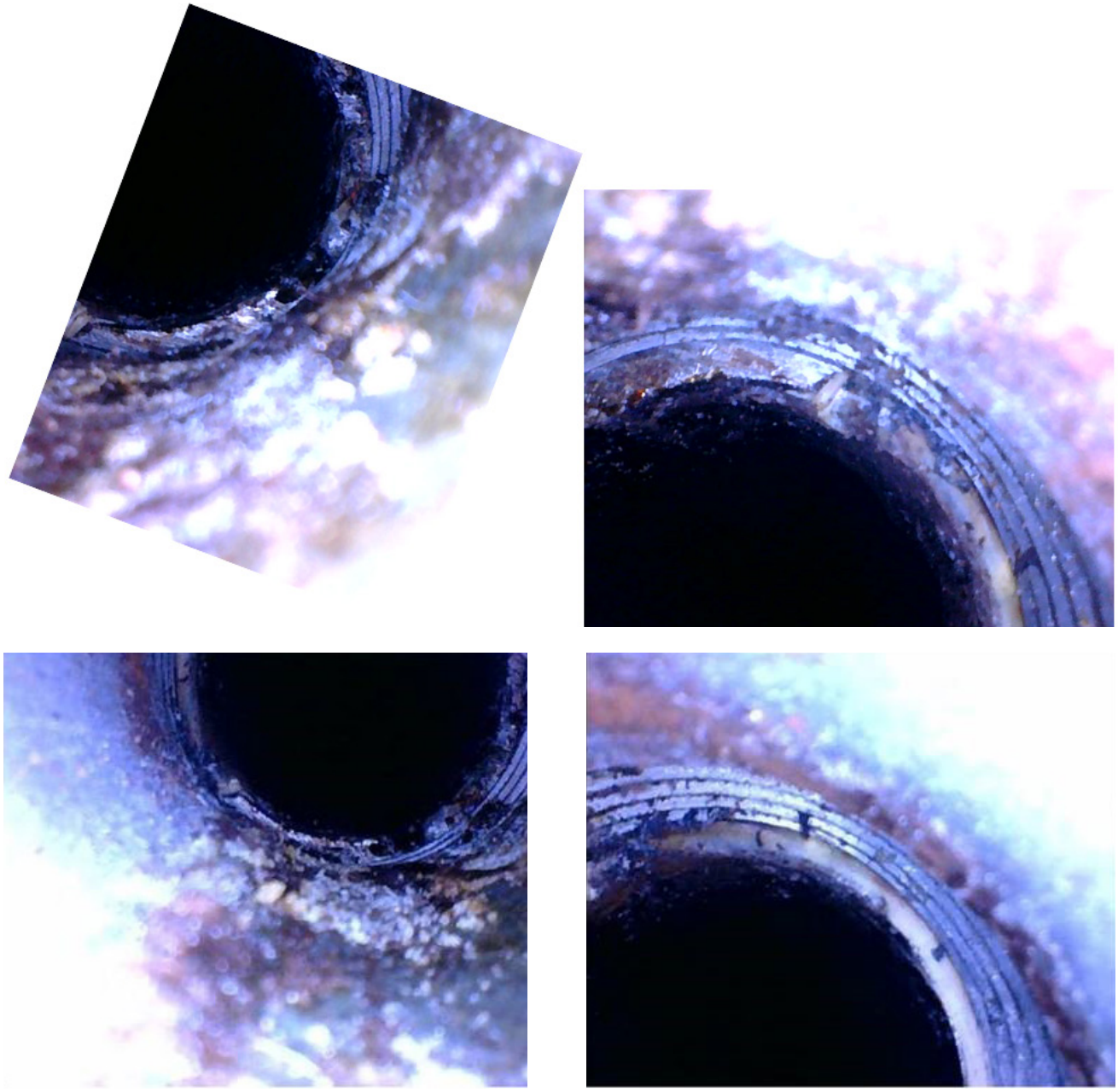

Figure 4: Example images of threaded section.

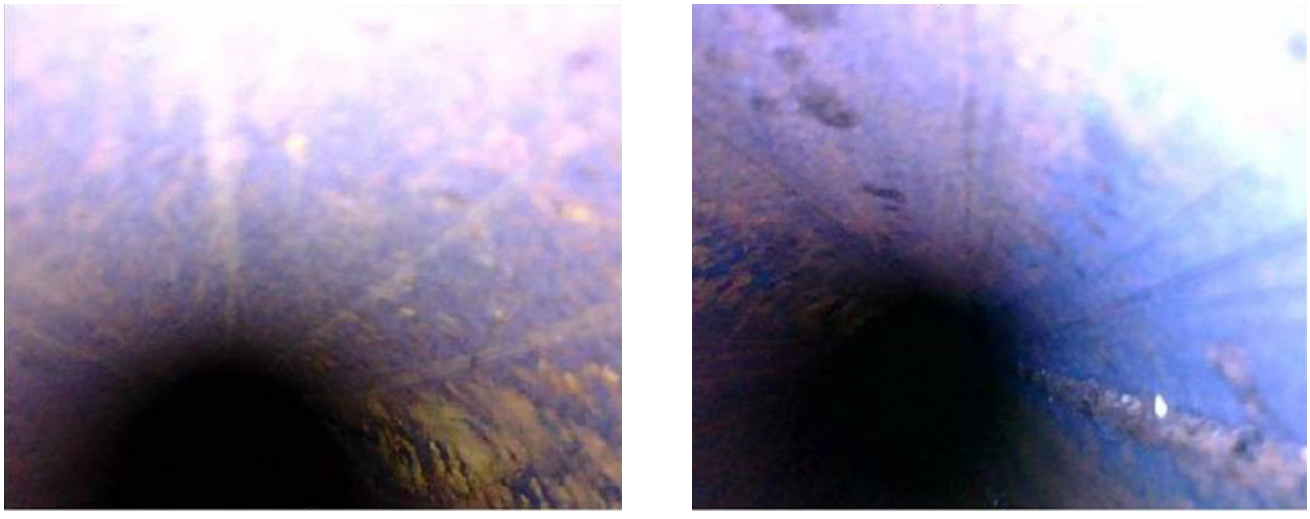

Figure 5: Example images of corrosion and discolouration in pipework.

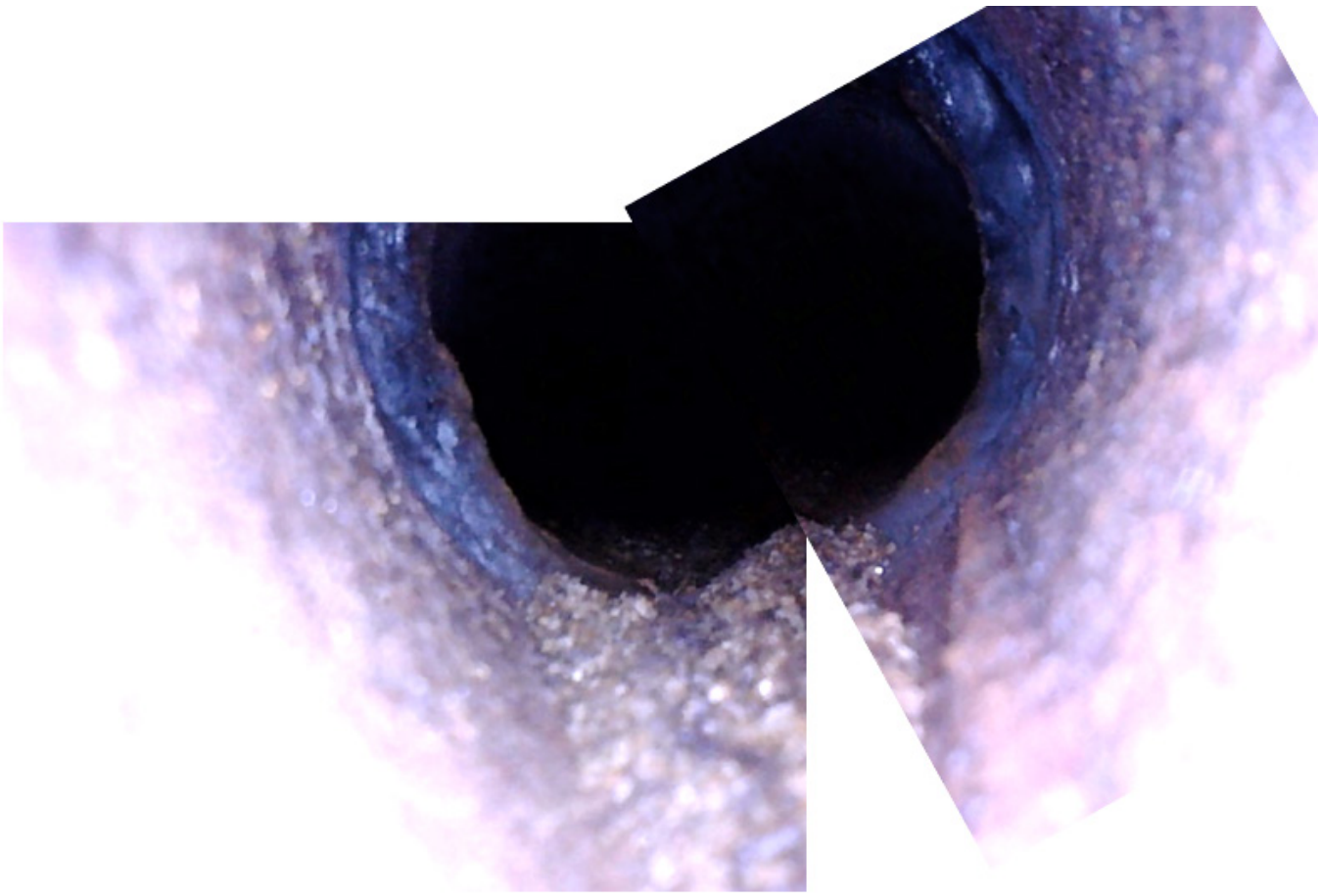

Figure 6: Large circumferential weld with grit/sand.

Current Practice

Currently, endoscopes are used for the routine internal pipe inspections that take place every 2 years. In 2015, the line was examined using a 15m steel braided articulating endoscope, which was inserted to its full length but did not reach the end of the pipe. In 2017, a purpose-made 30m-long mini-CCTV system was use; however, the camera could only be pushed approximately 9m down the pipe due to the debris, corrosion and welds causing friction between the camera assembly and the inside of the pipe. From 2019 to date, improved CCTV systems have been used with PTFE (polytetrafluoroethylene) deployment sleeves, designed to minimise friction and push rods to assist the rigidity of the camera cable. However, due to friction within the line, and the difficulty of pushing the camera around multiple 90° bends, the camera systems have not reached any further than approximately 15m.

Challenge Aims

The solution must provide live HD colour video of over 40m of pipework with an internal diameter of 20mm, navigating grit/sand, protruding circumferential welds and multiple bends. The footage is to feed into a recorder.

This pipework is inspected every 2 years, with the next inspection due in 2025. The pipeline is expected to be operational for the next 40 years.

Sellafield Ltd are seeking a solution that can be developed for the 2027 inspection but would look to deploy for the 2025 inspection if that was possible.

Sellafield Ltd welcome solutions from all sectors.

Benefits to Sellafield

The ability to get high-quality images of the full length of the pipework identified within this challenge supports Sellafield Ltd's mission to manage assets and decommission the site safely and cost-effectively. Thorough inspection ensures any defects are detected and risk is managed. A solution developed for this specific challenge would have widespread uses across Sellafield site, including: inspection of pipework in inaccessible areas, internal inspection of retired vessels, and general characterisation of difficult-to-access areas across the plant.

Constraints

- Pipework is narrow, down to 20mm internal diameter.
- Internal restrictions or artifacts, such as threaded areas or welds.
- Internal pipe surface is not smooth, with general surface corrosion and localised area of loose corroded material and delamination.
- Presence of dust or corrosion debris within the pipe.
- A detailed drawing of the pipe is not available. The length, location of bends and number of bends is estimated and uncertain.
- Pitch black environment to inspect.
- Multiple (could be 10+) bends, including over and/or 90°.
- Pipework is underground, or otherwise inaccessible from the outside.
- Only one access point, from inside the hut.
- Solution must be walked to the hut for deployment. This route is over rugged terrain, under bridges that restrict height to 4ft approx., and includes multiple steps up and down.
- Solution must be designed to consider contamination control.
- There is roughly 154cm x 152cm flat surface space in front of the pipe for deploying any solution. The end of the pipe is housed within a hut with steps down, a part metal grid floor, and other pipework present (Figure 2).

Functional Requirements

- Provide real-time, HD quality, colour live video feed with image capture and recording.
- Inspect over 40m length of steel pipework, ideally with capability up to 60m.
- Lighting required for pitch black environment that may have reflective surfaces (mains power is available).
- Dust tight/tolerant.
- Water resistant if splashed. If the solution can be temporarily immersed, it would open wider applications but is not required for this challenge.
- Able to be deployed horizontally.
- Tolerate slopes, bends and branch routing within pipework.
- Digital signal is preferred over analogue signal.

Radiation and heat tolerance, vertical deployment and a zoom or tilt function on the camera would be desirable for other applications, but are not required for this challenge.

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 3pm on Friday 28th February 2025.

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