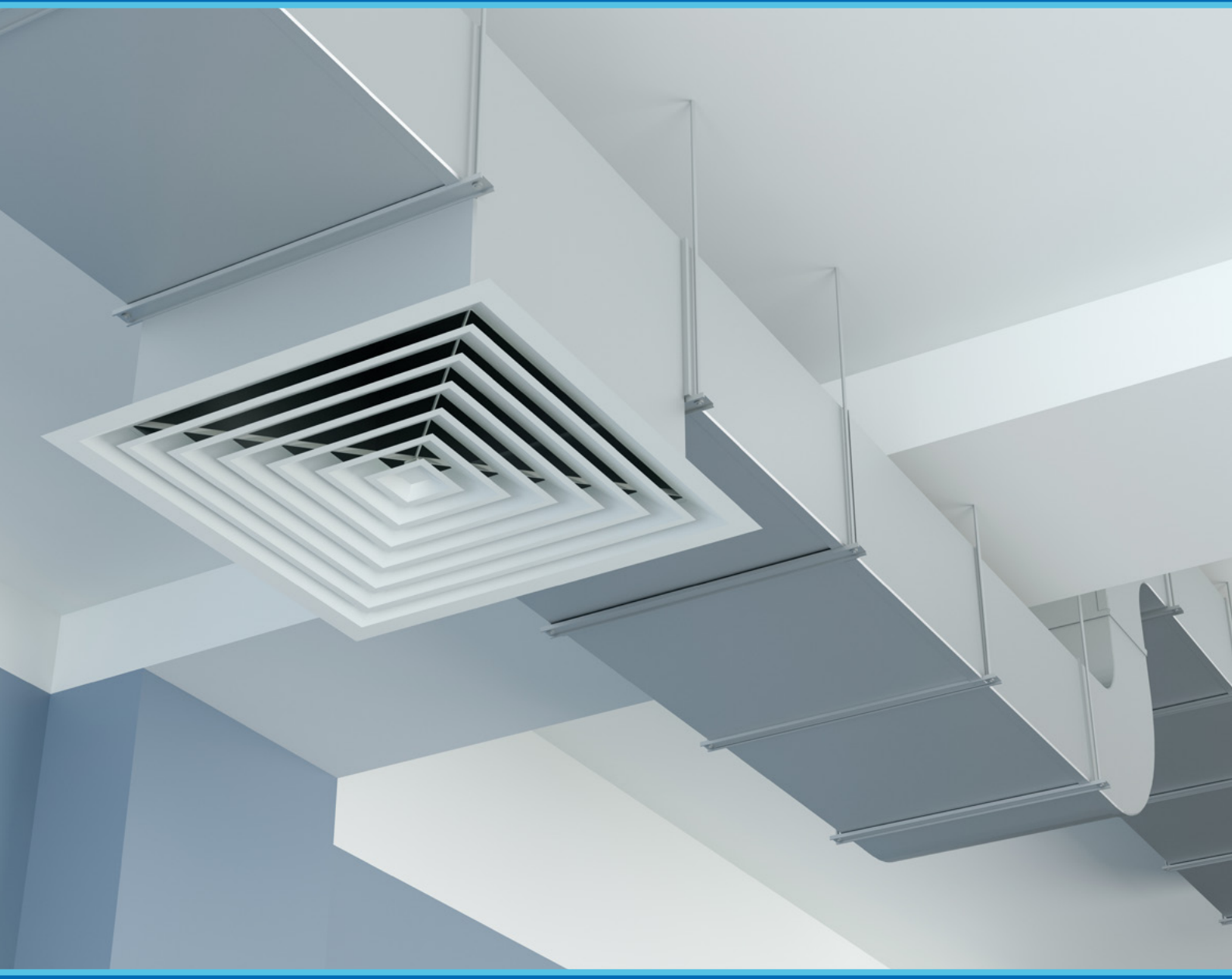
Sellafield Ltd

GAMECHANGERS
DELIVERING NUCLEAR INNOVATION



CHALLENGE:

Long term monitoring of air ducts

Sellafield Ltd would like to explore long-term sensor solutions which will allow them to remotely monitor the condition of the inside of ventilation ducts in storage facilities. Techniques which offer early indications of duct degradation or corrosion are of interest.

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Introduction

There are a number of stores on the Sellafield site which contain Special Nuclear Material (SNM) packages. Each of the packages contains materials that are the result of nuclear reprocessing activities over the past 60 years.

The packages are in long term storage in concrete cells. The environment within the stores is carefully controlled and the buildings are equipped with ventilation systems which provide a cooling system and a secondary containment barrier through a series of HEPA filters. Primary containment is provided by the main structure of the stores.

Sellafield Ltd would like to explore long-term sensor solutions which will allow them to remotely monitor the condition of the inside of the ducts in the storage facilities. Techniques which offer early indications of duct degradation or corrosion are of interest.

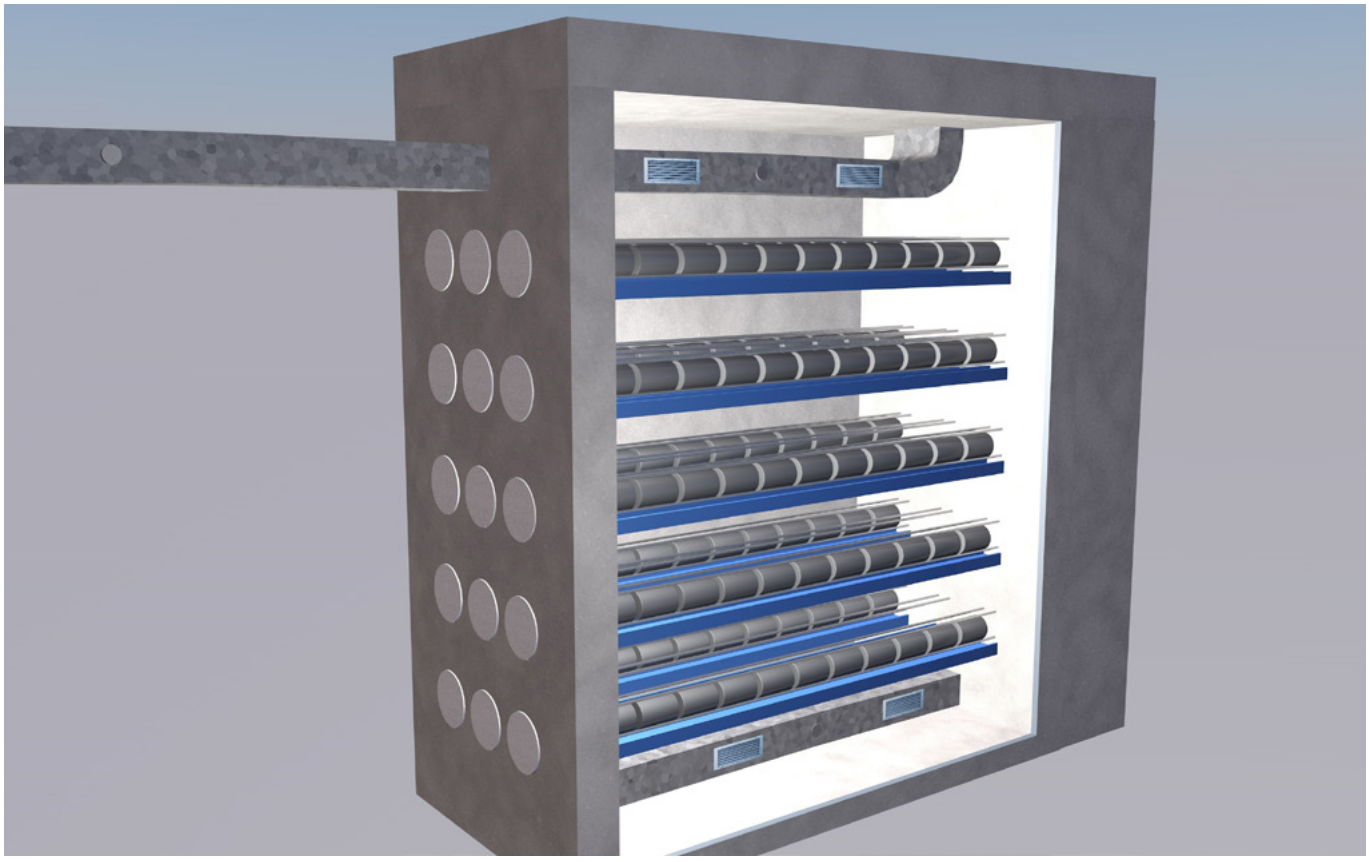
Current Practice

The ventilation systems primarily comprise galvanised mild steel ducts. There are approximately 0.5km of ducts in each store, which provide a continuous flow of air.

The duct work travels around and outside the store. The SNM packages are contained within open racking systems which are floor to ceiling. Ventilation ducting passes through the racks at both high (ceiling) level and low (floor) level.

The duct sizes vary throughout the facility but are typically >1000mm wide x >230mm high with a thickness of approximately 3mm.

Ducts are currently visually inspected to detect signs of corrosion. Internal inspection of the ducts is conducted using an endoscope technique with a light attached to a camera to provide a view of the inside of the ducts. Inspections are carried out via duct intrusions, circular openings which are roughly 10cm in diameter. Intrusions are spaced at approximately 10m intervals. This technique provides inspection data which is limited to areas of duct in the immediate vicinity of intrusions.



Schematic of a cell containing stored SNM packages with a ventilation system

Challenge Aims

Sellafield are seeking remote monitoring solutions which will enable them to detect any change, or potential for change, in the condition of the inside of the galvanised mild steel ducts. Solutions must have a long lifespan (a minimum of 20 years) and be capable of communicating data to a central receiver. The data received from each sensor must be combined and displayed on an interface which can be easily interpreted by operators. Solutions must be capable of providing inspection data to sub-metre resolution.

Benefits to Sellafield

It is expected that remote monitoring solutions will enable early intervention and the prevention of problems with the ventilation system. Minimising the requirement for physical inspections will reduce worker exposure to radiation. Regular condition monitoring reporting will also increase regulator confidence.

Constraints

- The SNM stores are dark and humid (up to 70-80% humidity)
- The temperature of the stores typically ranges from 10-40°C
- The temperature inside the ducts typically ranges from 10-25°C
- The ducts inside the stores are in an active environment, with radiation levels in the proximity of the ducts in the region of 110 µSv/h alpha/beta, 60 µSv/h neutron
- Ducts outside the stores have nominal C2 background radiation levels (above the range of normal everyday radiation levels, but no health effects expected)
- Air flows through the ducts at an average rate of 23m^3/s

Functional Requirements

Solutions deployed inside ducts must:

- be securely fixed to the duct surface and capable of withstanding the air flow
- be capable of operating in temperatures between 10-40°C
- provide periodic monitoring data on a monthly basis. Monitoring parameters should include but not be limited to temperature and humidity
- communicate with a central receiver located remotely in the stores
- have a long lifespan (minimum of 20 years)
- be reliable
- require zero or minimal maintenance
- not occupy more than 10% of the surface area of the ducts
- be deployed through small circular duct intrusions (approximately 10cm diameter) whilst the vents are in operation with air flowing
- include consideration of the mass of the devices

The data provided by each of the sensors must be combined and displayed on a user interface which can be easily interpreted by operators.

Solutions which are self-powered are of interest.

The number of sensors required to monitor the vents will depend on the nature of the proposed solution and its performance in the ducting.

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 Friday 15th July at 12 noon.

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Twitter @GC_Innovators
email: apply@gamechangers.technology