AIM High

Autonomous Inspection & Monitoring of High Voltage Assets

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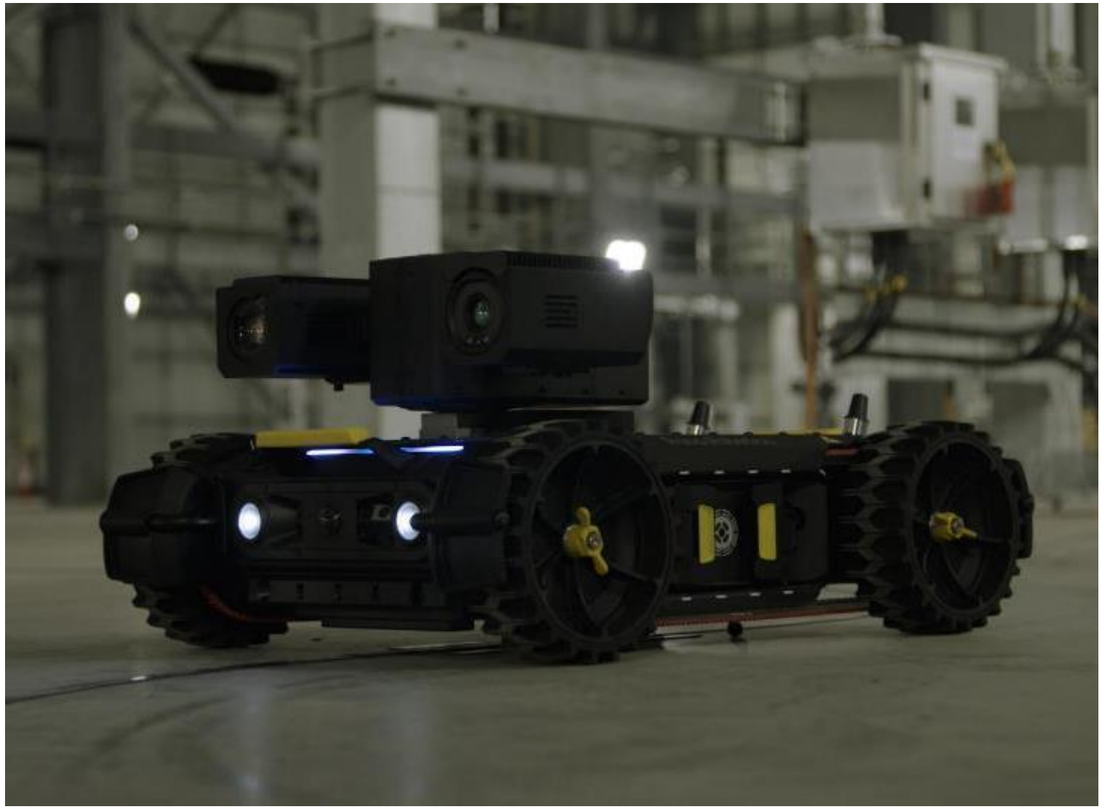
Scottish & Southern Electricity Networks

TRANSMISSION

Project Requirement



- SSEN Transmission identified a requirement to have innovative condition monitoring from within inaccessible HVDC halls to improve condition-based asset management. This has led to the requirement to integrate robotics to our operations for real time monitoring inside HVDC valve and DC halls.
- The objective of the innovation project is to demonstrate value and develop usable data metric evaluation for the adoption of the technology for robotic integration for future HVDC links.
- Build our understanding of the condition of the assets, reduce risks of forced outages and improved outage planning.
- Ross Robotics robot developer working alongside us for this project.
- Robot connectivity is segregated from company networks.

Robot Specification

HVDC halls can go between 12 - 24 months for outage access for inspection and maintenance.

Identification of the need for mobile sensor platform in HVDC halls as fixed cameras and sensors have limited views and can be costly for suitable coverage.

Enables timed, automated inspections to take place, without disruption of service, and with no human intervention – set times of inspection missions.

Execute customised autonomous inspections, repeatable inspections, can be used for closer interrogation of any areas of concerns. Send alerts when anomalies are detected.

Enables HVDC operators to have greater understanding of the operational conditions and health of the assets.

Instruments include UV camera, thermal imaging, visual inspection 4K camera, microphone and temperature and humidity sensors.

Purpose built robot - highest EMI immunity combined with low emissions. Low profile to reduce flashover risk.

Robot has recently been called “Haggis” following local school visit & naming competition.

Trial Outputs

Work Package 1 - DC Switching Station

- Proof of Concept (PoC) conducted for 10 days – Ross Robotics platform version Mk4.1.
- Selected for access reasons for hands on experience and able to intervene / no sensitive equipment in terms of EMF etc.
- Handheld UV camera trialled to understand DC capability for corona and partial discharge detection.
- Test track deployed and simple comms network installed.
- Robot alerts, notifications and remote capability tested.
- Connectivity challenges at this site using cellular networking the remote North of Scotland for the remote capability testing.

Trial Outputs

Work Package 2 - HVDC Converter Hall

- Deployed a single robot into one of the HVDC valve halls – robot can also access the DC hall.
- Platform Mk4.1 deployed – installation and commissioning – 3 days duration.
- Engagement with Hitachi on flashover risk inside the HVDC valve halls.
- Robot has a restricted route until further testing and mitigations are employed due to high EMF near the converter valves.
- Robot connectivity is via a standalone Starlink internet connection and remote access application. Perhaps more robust OT solution in the future.
- Thermal images obtained from within the energised HVDC halls for the first time.
- Track is laid between phase arm and around the halls in preparation for deployment 3 (robot version Mk 4.2).

Benefits

We have obtained thermal images from within the energised HVDC halls for the first time.

Can understand operational temperatures.

Ability to see and hear inside the halls – quicker fault identification and diagnostics.

Ability to see majority of the hall with the field of view with the PTU. Limited quality fixed cameras currently installed.

Remote capability to operate and for operator control room computer to operate the robot.

Opportunity to observe and validate conditions during commissioning – reducing commissioning time. Hired additional robot to support commissioning - Shetland HVDC project.

Work in progress – UV camera interfacing – deployment 3 planned for October 2024.

Deployment Challenges

- Lack of consistent operations due to wider system commissioning.
- Robot needs to be robust to require minimum intervention.
- Access into the halls is intrusive to operations as the station must be deenergised to interrogate physically within the halls.
- Robot communication power supply sockets inside the halls are not on a UPS.
- Quantifying what does “normal” look like inside the environment.
- HVDC OEM engagement to work alongside asset owners.
- Mitigation – Ross Robotics are agile and responsive to customer feedback.

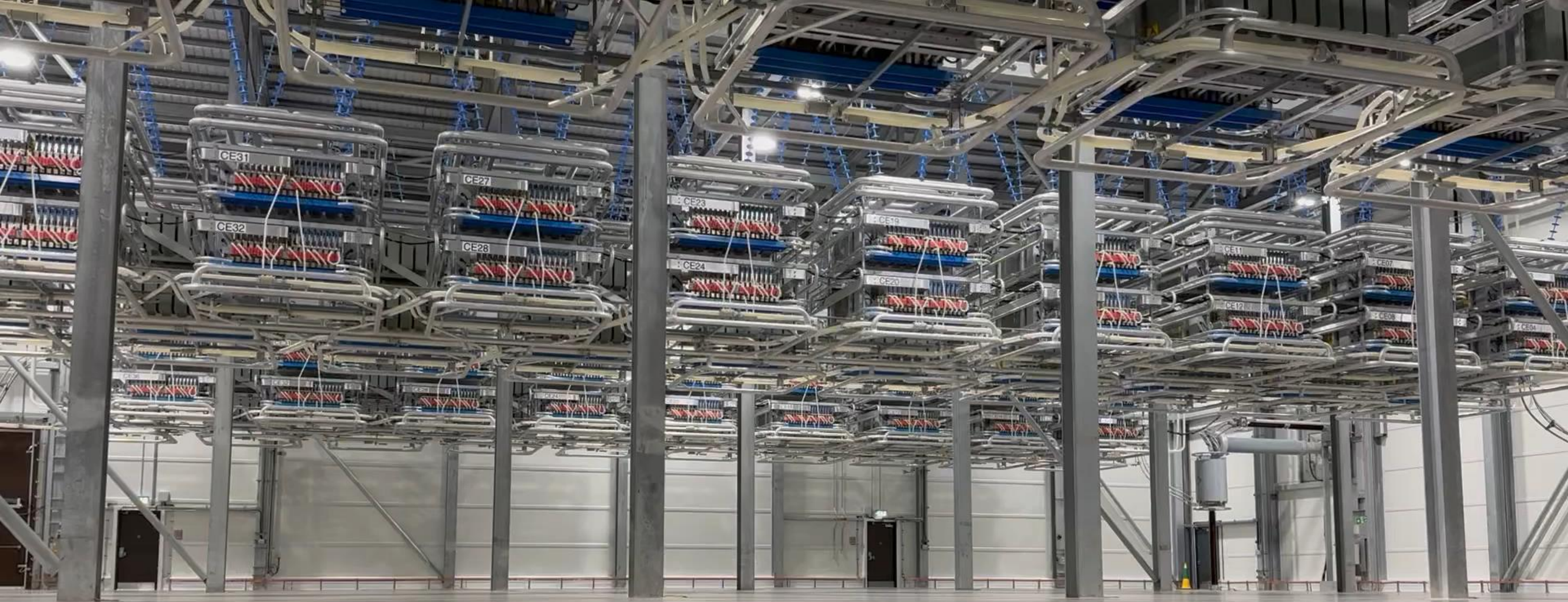
Future Projects / Specifications

SSEN Transmission including robotics in our specifications for our future HVDC converter stations. This innovation project is to assist with learning and defining specification of robotics and hall interfaces.

SSEN Transmission HVDC Operations seeking funding for further robots for remaining Caithness Moray Shetland multi terminal HVDC valve halls for the RIIO-T3 price control period.

Looking to export data to support HVDC condition monitoring systems. Engaging with Ross Robotics on AI and data analytics.

Continued robotics development for the ASTI / EGL HVDC links.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Thank you

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