The GIL Innovation Partnership - Reducing Visual Impact

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LCNI Telford
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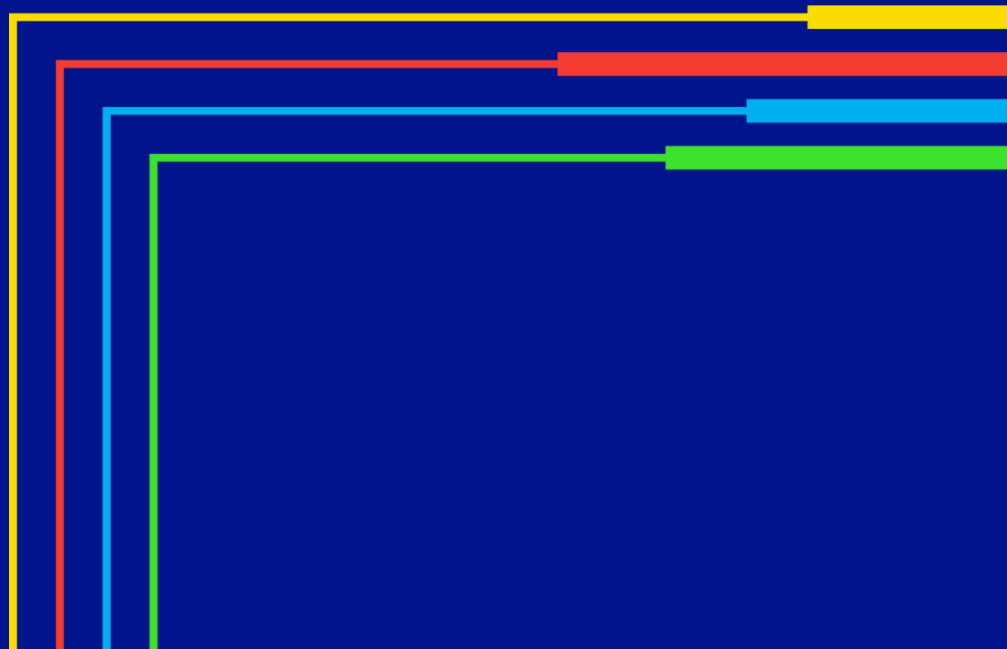
Reducing the Visual Impact of Power Transmission



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Reducing Visual Impact for Communities

Why

- Areas of Outstanding Natural Beauty
- Densely populated areas

Reducing Visual Impact for Communities

Goal

Provide a reliable, flexible, safe and secure underground system of power transmission wherever it is preferable or necessary to avoid the use of overhead lines

REQUIREMENTS

- Energy-efficient
- High transmission capacity
- Minimal maintenance
- High safety (nonflammable/ no fire hazard)
- Low environmental impact

Reducing Visual Impact for Communities

Undergrounding Challenges

- Operational impact on the environment
  - delicate ecosystems
  - access
- Densely populated areas
  - available space
  - access
- Cost approximately 5 - 6 times more than OHL

The Visual Impact Provision (VIP)

The VIP is an incentive (£500m) made available by Ofgem to reduce the visual impact of power transmission by undergrounding sections of overhead transmission lines.

This represents a major opportunity to conserve and enhance the natural beauty, wildlife and environmental heritage within our most protected landscapes

National Grid identified twelve transmission lines within English and Welsh Areas of Outstanding Natural Beauty (AONBs) and National Parks as possible candidates for undergrounding.

In September 2015 the Project's Stakeholder Advisory Group chose four schemes be taken forward for engineering work

National Grid's preferred choice of technology for some of these schemes is Gas Insulated Line (GIL).

GIL for the Peak District VIP Scheme

Two 400 kV Overhead Line (OHL) circuits run through an area of outstanding natural beauty (AONB) in the Peak District National Park

The outcome of an options review carried out as part of the visual incentive provision (VIP), was to underground ~2 km of OHL along part of the trans-Pennine trail.

- The undergrounded section can match the existing OHL rating with a single GIL tube per phase for each circuit.
- Innovative installation techniques will be introduced to ensure works are completed in short time scales with minimum disruption to the trail

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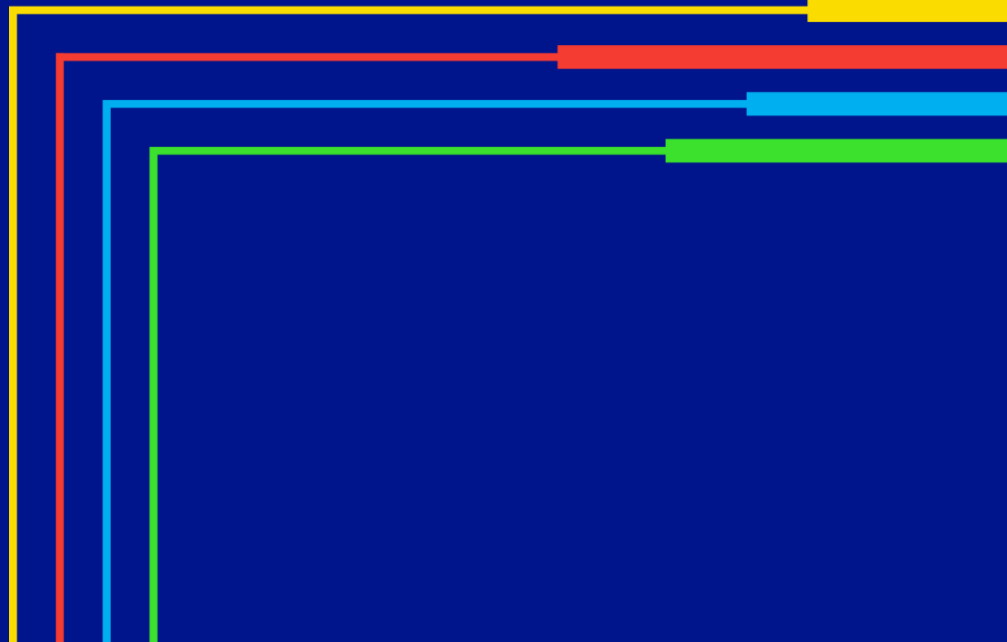
What is GIL



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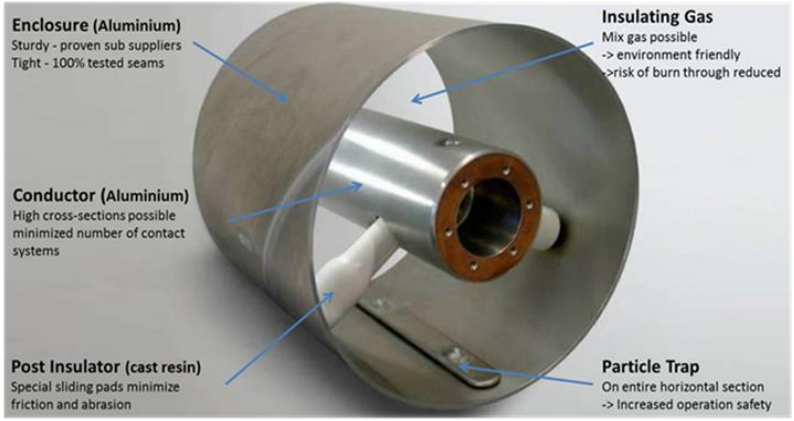
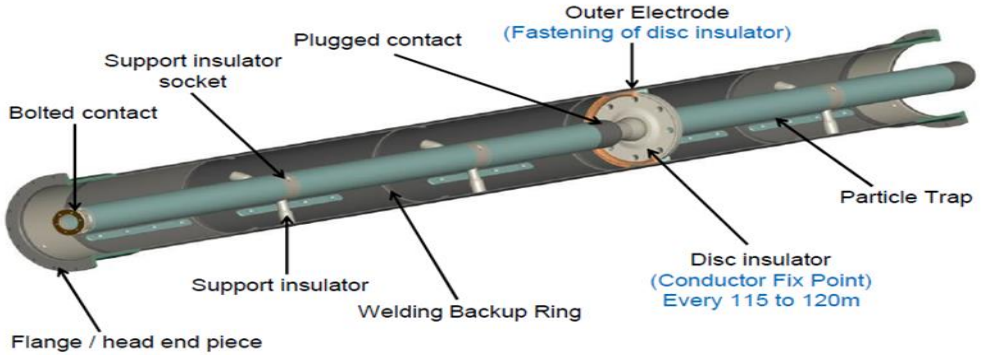
What is GIL

GIL consist of two concentric aluminum tubes. The inner conductor rests on cast resin insulators which centre it within the outer enclosure.

The enclosure is formed from aluminum, which provides a solid mechanical and electro-technical containment for the system.





- To meet environmental drivers, GIL are filled with an insulating gas mixture of mainly N_2 (nitrogen) and a smaller percentage (20%) of SF_6 (sulphur hexafluoride).
- Therefore minimum of SF_6 in a weld tight, sealed for life system

Potential Benefits of GIL

Invasive maintenance not required - external inspection only

Sealed for lifetime, Insulation gas doesn’t age (reduced risk of internal failures)

Continuously welded minimal risk of leaks

enables higher ratings for underground installations

Less space required in highly populated areas due to higher capacity

Large surface area for heat dissipation, minimises cooling requirements in tunnels (eg Snowdonia)

No reactive compensation (<100km)

Very low external electromagnetic fields therefore maximum flexibility for network planning in EMC-sensitive environments where magnetic fields have to be avoided (lowest emissions).

High operational safety (no fire risk, no external impact in case of internal failure)

Low transmission losses

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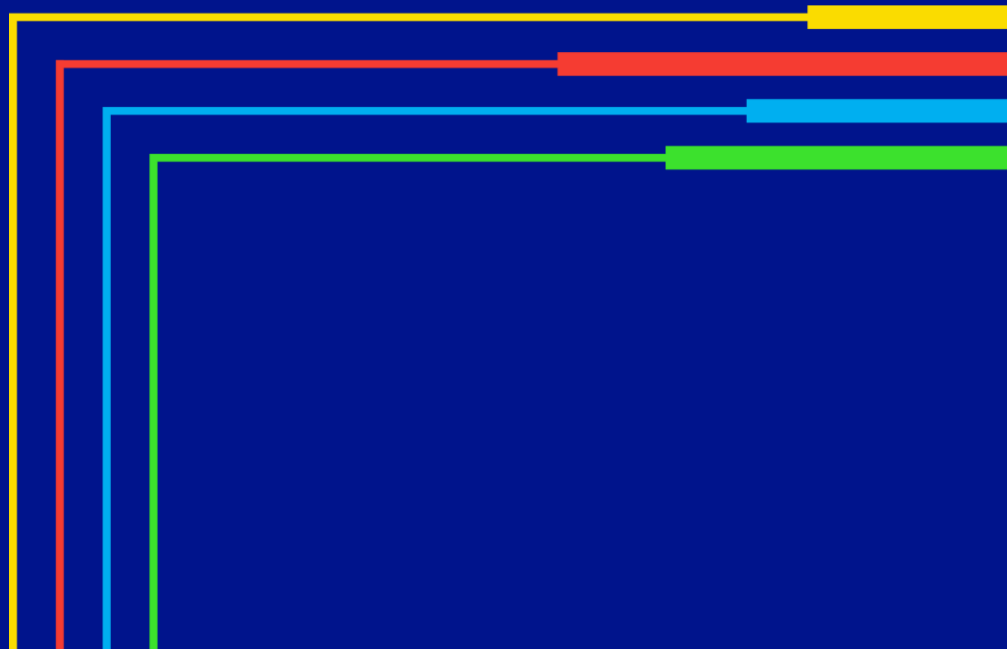
The GIL Innovation Partnership



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Overview of the Innovation Partnership

The GIL Innovation Partnership will:

research, trial and purchase new or improved Gas Insulated Lines for Direct Buried, Non-direct buried and Tunnelled installations through a number of workstreams

WS1. Develop direct buried GIL for short distances for a target £/km

WS2. Develop direct buried GIL for long distances for a target £/km

WS3. Develop Tunnelled or non-direct buried installation including GIL for a target £/km

WS4. Develop a gas with a very low Global Warming Potential of to replace SF_6

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SIEMENS
Innovation Partnership

Collaboration via an Innovation Partnership to improve the viability of underground power transmission.

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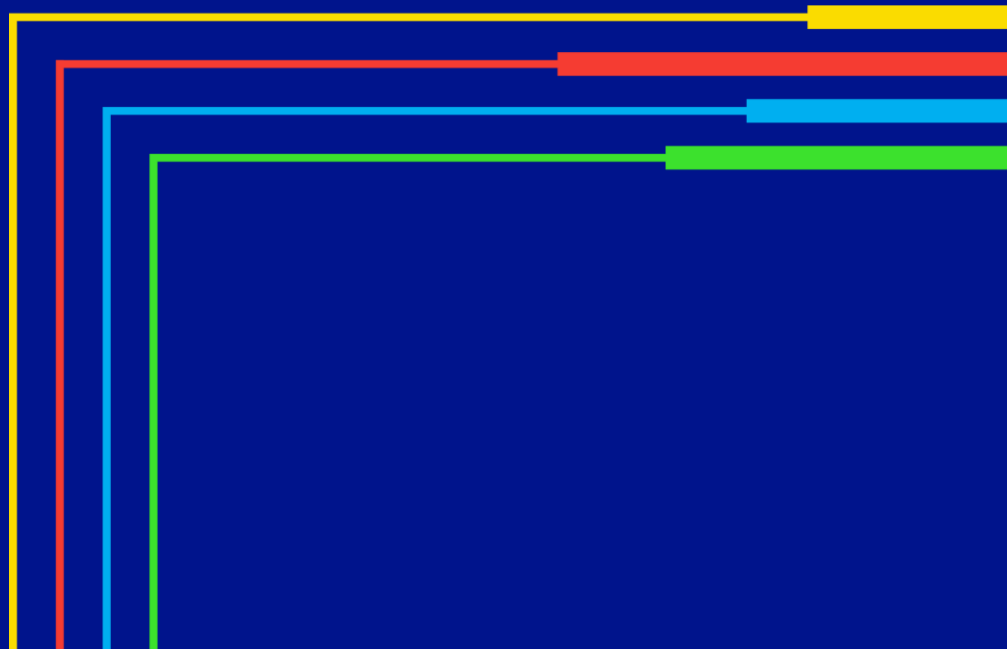
Key Innovations



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Key Innovations Across all Workstreams – Software

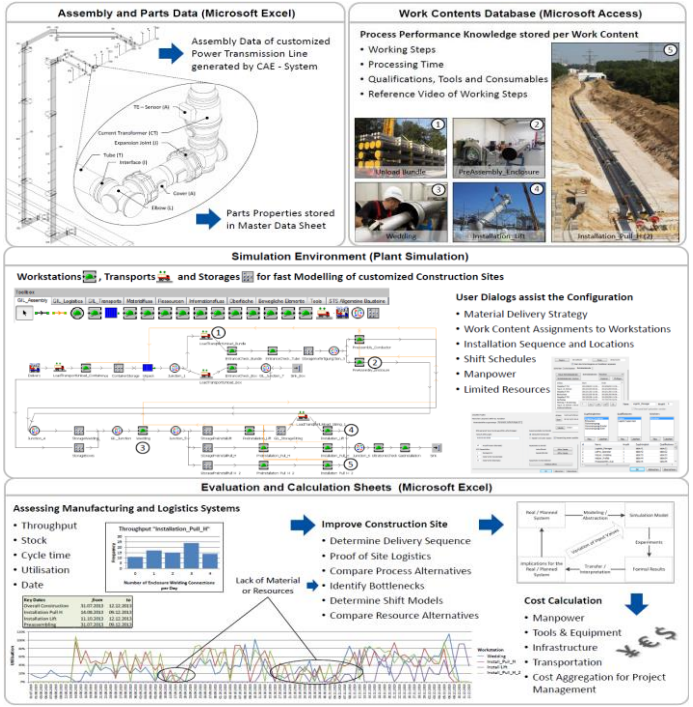
Software will be developed in this innovation topic to support all workstreams and is divided into three work packages (WP)

1. WP1: GIL Project Execution Tool (PET) will provide a GIL parts sourcing database and show current state of knowledge concerning the GIL.

2. WP2: A digital twin of the construction process and installed asset will be developed so it can be asset managed through its whole life cycle.

- spatial simulation of all existing and planned objects that could impact on each other during construction. will allow evaluation of the entire production cost and processes of a GIL in advance

- georeferenced as-built model will show location of each part of the installed GIL.



3. WP3 Simulation Model

Key Innovations Workstream 1 – Conical Insulators

Gas permeable and gas-tight conical insulators will be adapted for use in horizontal GIL to ensure greater stability of the conductor and ongoing system integrity:

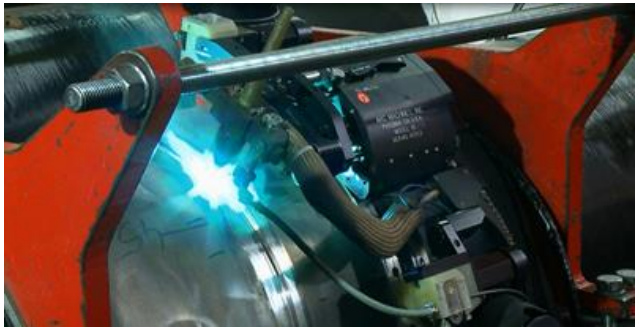
On completion, the following benefits are anticipated:

- Improved efficiency in the pre-installation and construction phases.
- Standardisation of insulator types
- Increased resistance towards mechanical forces
- Solution for gas compartmentalisation in welded sections and standardised to optimise costs.
- Elimination of the need for bursting plates resulting in increased safety of personnel through the use of conical insulators for construction of large buffer zones around a GIL test pit.

Key Innovations Summary – Work Stream 1

Overall Goal to install GIL over a short distance.

- Software PET, & Digital Twin for planning
- Active Corrosion Protection (Cathodic Protection)
- Arc location system: refinement and streamlining of existing technology.
- Innovative Backfill solutions



- Manufacturing innovations
- Cleaning Robot to replace manual process, Particle Trap installation robot, precision tube saw
- Welding Methods including process & production efficiency
- Installation Methods for projects equal to or less than 3km
- GIL Optimisation – Product improvement - reduced enclosure wall thickness

Key Innovations – Work Stream 2

Overall Goal to install GIL over a long distance.

- Fully embed manufacturing innovations
- Welding Methods (Laser, Laser Hybrid, FSW) including process and production efficiency
- Installation Methods for long distance projects of 10 km plus

- Mobile and sub-ground welding, pipe bending
- GIL Optimisation
- Technical advances in design to allow cross country installation
- Advanced Digital Twin – BIM design and Oversight in operation
- Project Execution Tool

Key Innovations – Work Stream 3

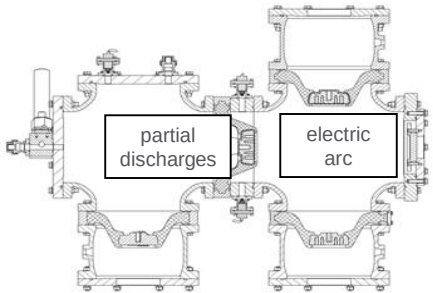
Overall Goal to install GIL in a tunnel

- Tunnel Installation methods
- River/Road/Utility crossings
- Constrained site installations
- Long distance testing
- Component Optimisation

Key Innovations – Work Stream 4

Overall Goal to develop an insulating gas mixture with a Very Low Global Warming Potential (GWP).

- Replacement low GWP Insulating Gases
- Alternative gases currently close to market, GWP ~400
- Replace existing SF_6/N_2 mix in current equipment with minor modifications
- Ongoing development towards overall goal gas with very low GWP



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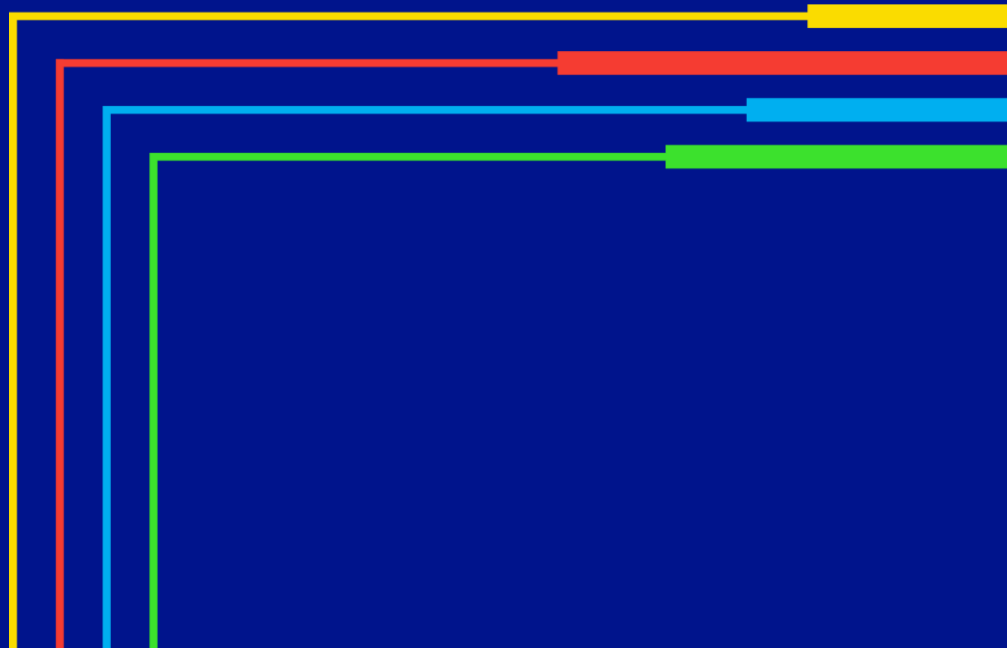
Questions?



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