UK TO ICELAND HVDC INTERCONNECTOR: KEY PROJECT CONSIDERATIONS

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ABSTRACT

The paper will provide the reasoning for the choice of cable and installation methodology as well as the approaches to environmental constraints as well as the impact of fault finding, spares strategy and disaster recovery.

KEYWORDS

Submarine cable, Submarine installation, HVDC Cable Interconnectors.

INTRODUCTION

The HVDC subsea connection to Iceland has been considered since the 1950s and regular feasibility studies are written and costed when market conditions or technology change or the risk profile of the cable. Historically there are four main consideration that have impact on the project:

- Length/route (scale of the project)
- Cost of losses
- Reliability (availability)
- Metocean conditions

These four aspects have impact on the cable design, installation and repair strategy.

BACKGROUND

Long length subsea HVDC connection at 1000MW or above is still the domain of the Mass Impregnated (MI) cable technology. The longest HVDC interconnector energised to date is NorNed [1] at 534km and 450kV. Energised in 2008, therefore it has had 10 years in service. NSL which is in construction will be 740km long and transmit 1200MW. HVDC XLPE has not achieved the same voltage level but confidence is growing and progress is rapid. NorBalt connecting Sweden and Lithuania via 700MW 300kV subsea cables is in operation and COBRA (Holland to Denmark) at 320kV, 700MW and 325km [3] is under construction. NEMO at 400kV and 1000MW has achieved a voltage and power milestone, however the length is relatively small. It is clear that XLPE with higher conductor operational temperature, wider supply chain and technology that is less dependent on artisan skillsets associated with paper cables, will at some point mean the phasing out of MI as has happened to SCFF cables on land.

HVDC MI is however perceived as robust and mature. HVDC XLPE has still not been through the whole of its life cycle and not even experienced the early wear-out stage of the bathtub curve [2]. New technology is sometimes introduced into projects early as the technology risk is considered less than the perceived risk or weakness from the mature technology.

PROJECT REQUIREMENTS

Due to the location of the connection points the route length of the HVDC cable is double that of the longest commissioned interconnectors to date. The key requirements can be summarized as:

- Circuit length 1500km
- Power at sending point 1000MW
- Depth (up to 1200m)
- Cable Losses below 6%

In order to comply with these parameters, the cable design, system design and installation have to be investigated.

ROUTING AND INSTALLATION

For a successful HVDC cable installation, the cable laying vessel has to comfortably operate in sea states predicted for the route during the installation period.

These conditions have been investigated and some conclusions reached.

Metocean Conditions

The conditions between UK and Iceland are beyond the European continental shelf and therefore in sustained 'open sea' conditions not experienced by any other HVDC power projects. In North Sea and European waters, the weather front changes every 2-4 days and the weather conditions change. The open sea conditions are worse than the North Sea which means that a vessel capable of laying cable and deploying joints in 4m Hs waves is necessary. Beyond the continental shelf the 'weather' windows as such are minimal, the opportunity to cut and run every 48 hours is not a practical solution.

A viable cable laying vessel will have to have a large cable carrying capacity to minimise loadouts at the end of each cable laying stage and there are cable laying options (Figure 1) that have to be evaluated. This has to be optimised for the minimum number of field joints and transfer times. For a 1500km route length with a 100km stage lay, 15 loadouts would be necessary!

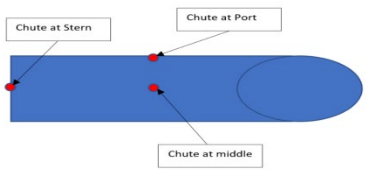

Figure 1 Vessel layout options

Bathymetry

As can be seen from Figure 1, the maximum depth of the present route is 1100m which is substantially less than the depths achieved for SAPEI [4].