Impact of HVDC cable configuration on compass deviation

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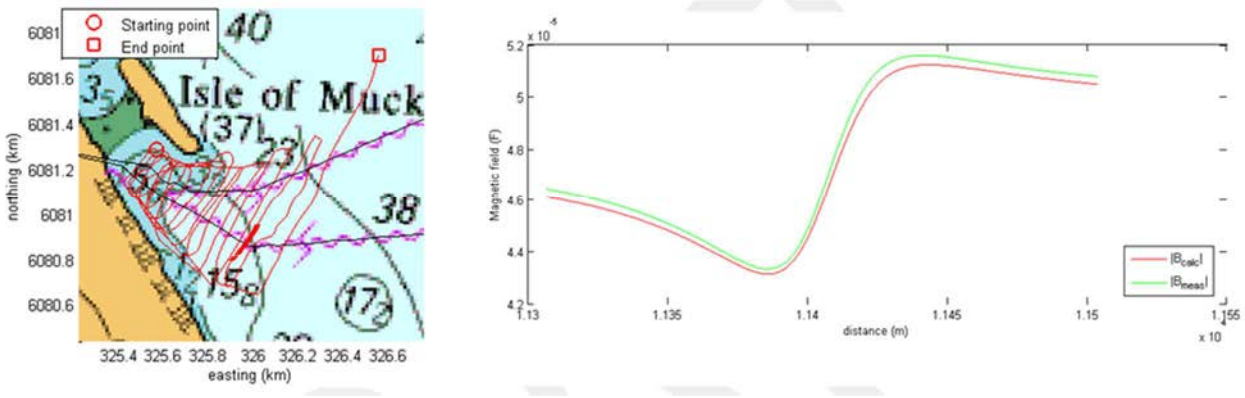
The Moyle Interconnector between Ireland and Scotland is a 500 MW Dual Monopole HVDC link. Due to four recent cable faults on the Moyle Interconnector, all caused by the same type of failure of the integrated return conductor (IRC) insulation, Moyle has examined three options to either replace or remove the need for the low voltage integrated return conductors:

1. Application of one of the HV conductors as LV return conductor, achieving a single 250MW monopole (as an emergency fall back in the event of simultaneous LV cable faults on both poles);
2. Installation of new separate LV Cables to reestablish 500 MW dual monopole operation (using the existing HV and new LV);
3. Amendment of the convertor station controls for bipole operation, at 500MW.

Besides many other aspects, the impact of such configuration change on the magnetic fields was assessed for each of the above options. This contribution discusses the implication of those changes to EMF characteristics regarding onshore and offshore legislation and regulations, in particular compass deviation. Because of the special coaxial design of the HVDC cable with the integrated return conductor, the magnetic fields induced by the current in the high-voltage and low voltage conductors mostly cancel each other. However, by changing the cable system configuration to a situation with a new external return conductor, theory shows a potentially significant change in the magnetic fields, depending on the exact location of the new return conductor in relation to the existing high voltage conductor. In particular in lower waters, this can result in significant compass deviation. To verify the theoretical results, Mutual Energy decided to conduct a subsea ground truthing in temporary bipole configuration. Results of this ground truthing will be described and discussed. A close match between theory and measured values was observed, see figure below.



Finally, the installation of new separate LV cables was selected as the preferred solution for reasons of redundancy and transmission capacity. With the validated theoretical models, different configurations were investigated to optimize the location of the LV cables. Of course, the distance between the existing HV and new LV cable plays a significant role. Therefore, compass deviations for different realistic scenarios were calculated, taking into account the presence of rock dump, the accuracy limits of submarine cable placement, and while avoiding the risk of damaging the existing cables. The resulting solution will be discussed with the relevant agencies to get approval for final reconfiguration and operation of the Moyle Interconnector.