

Rating of HVDC submarine cable crossings

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With the construction of a European wide super grid, long-distance bulk power transmission is planned between maritime nations through high voltage dc (HVDC) submarine cable circuits. As the cable route is normally constrained due to bathymetric conditions, fishing activities, etc., submarine cable crossings can occur in various occasions. Unlike the directly buried land cable crossing, the submarine cable crossing normally requires extra protection measures (e.g. rock berm, concrete mattress installation) to resist seabed activities such as scouring. Therefore, the thermal environment is significantly different after the crossing installation, which may affect the thermal rating of both crossing circuits.

At present, the analytical crossing rating calculation (IEC60287-3-3) is inapplicable for submarine crossing ratings because the key assumption of an isothermal ground surface (i.e. to satisfy the use of 'image' theory) does not hold under a rock berm installation. Therefore, the numerical FEA modelling becomes the only alternative to approach this problem. More specifically, FEA provides a more reasonable and accurate solution, by removing the idealistic assumptions in the IEC method. For instance, 'hybrid' heat transfer (conduction, convection) within rock berm pores can be calculated and arbitrary protection layer structures can be examined. In summary, this work has shown through FEA modelling that the lower circuit is normally pushed over its thermal limit in a crossing, while the upper circuit can still operate safely with its original standalone rating. However, the reason for an escalated temperature in the lower circuit is often the overall protection layer installed above, but not the upper circuit.

This paper will analyze the thermal implications of using a variety of different crossing designs. Various rating combinations are examined and practical implications are presented. It is believed that this work provides a useful preliminary study on HVDC submarine cable crossing ratings, which can be beneficial for cable system operators.

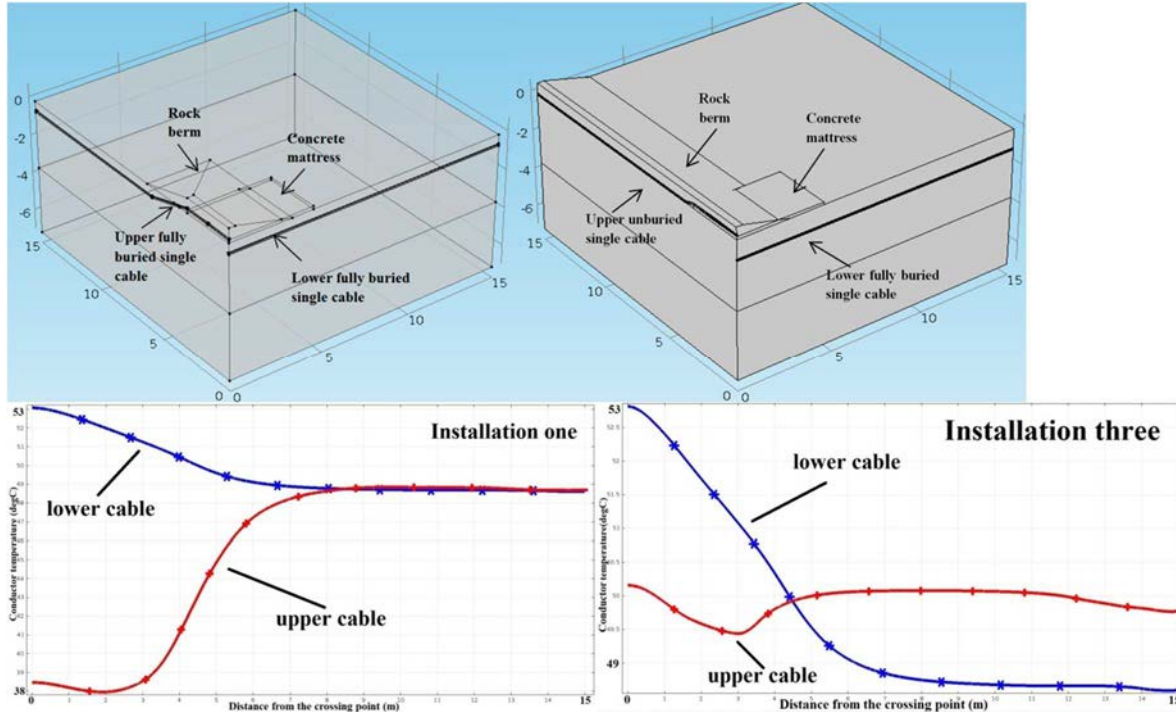


Illustration of 3D cable crossing installation and longitudinal temperature distribution