Deriving an experimental and analytical relation between the core and fiber temperatures of a 3P XLPE cable

PO.068

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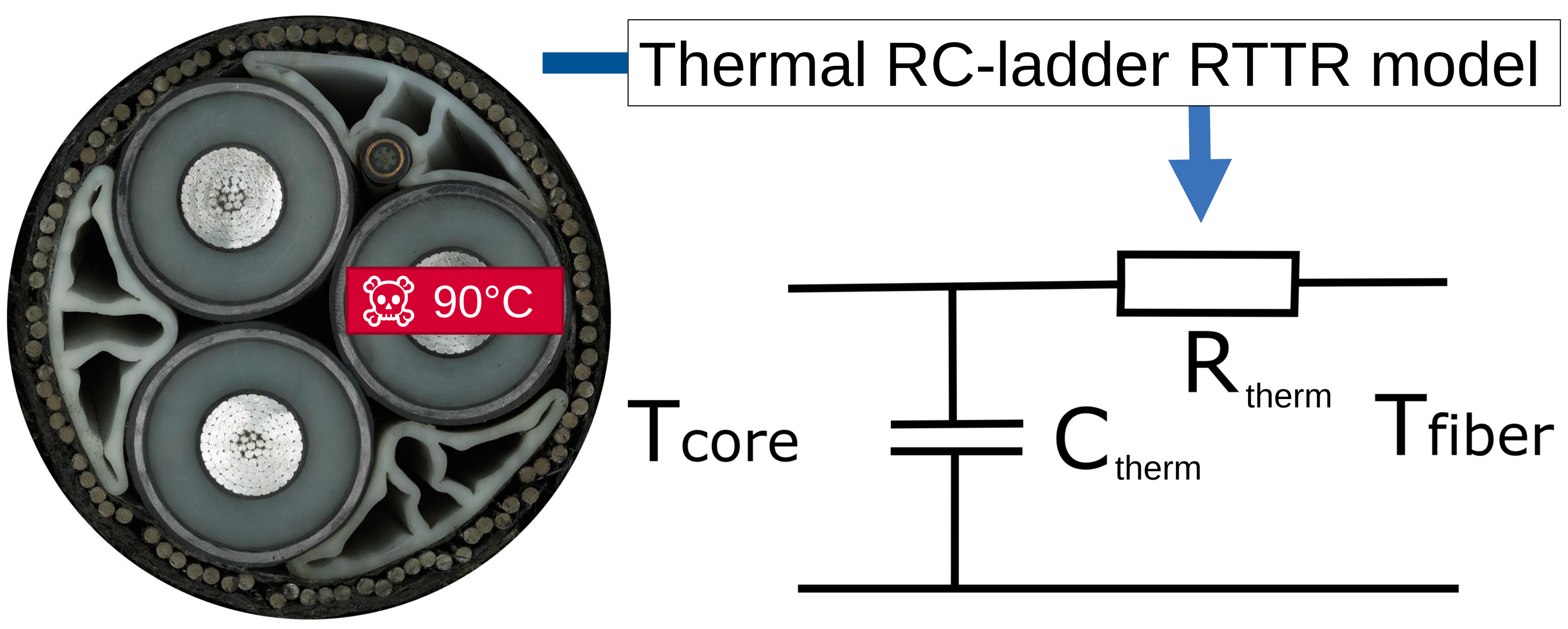
Abstract

Every submarine power cable contains a fiber optic assembly. Most windfarms have a distributed temperature sensing (DTS) device for continuous temperature monitoring. Using real-time thermal rating (RTTR) the performance of subsea cables can be increased or a less expensive cable can be installed.

The experiments aimed to establish the relation between the fiber and core (or conductor) temperatures in the cable. Fiber temperature was obtained using a DTS interrogator; thermocouples installed in the conductors yielded the core temperature data. The cable used in this test was a 20 meter-long 1800mm², 1000A export cable.

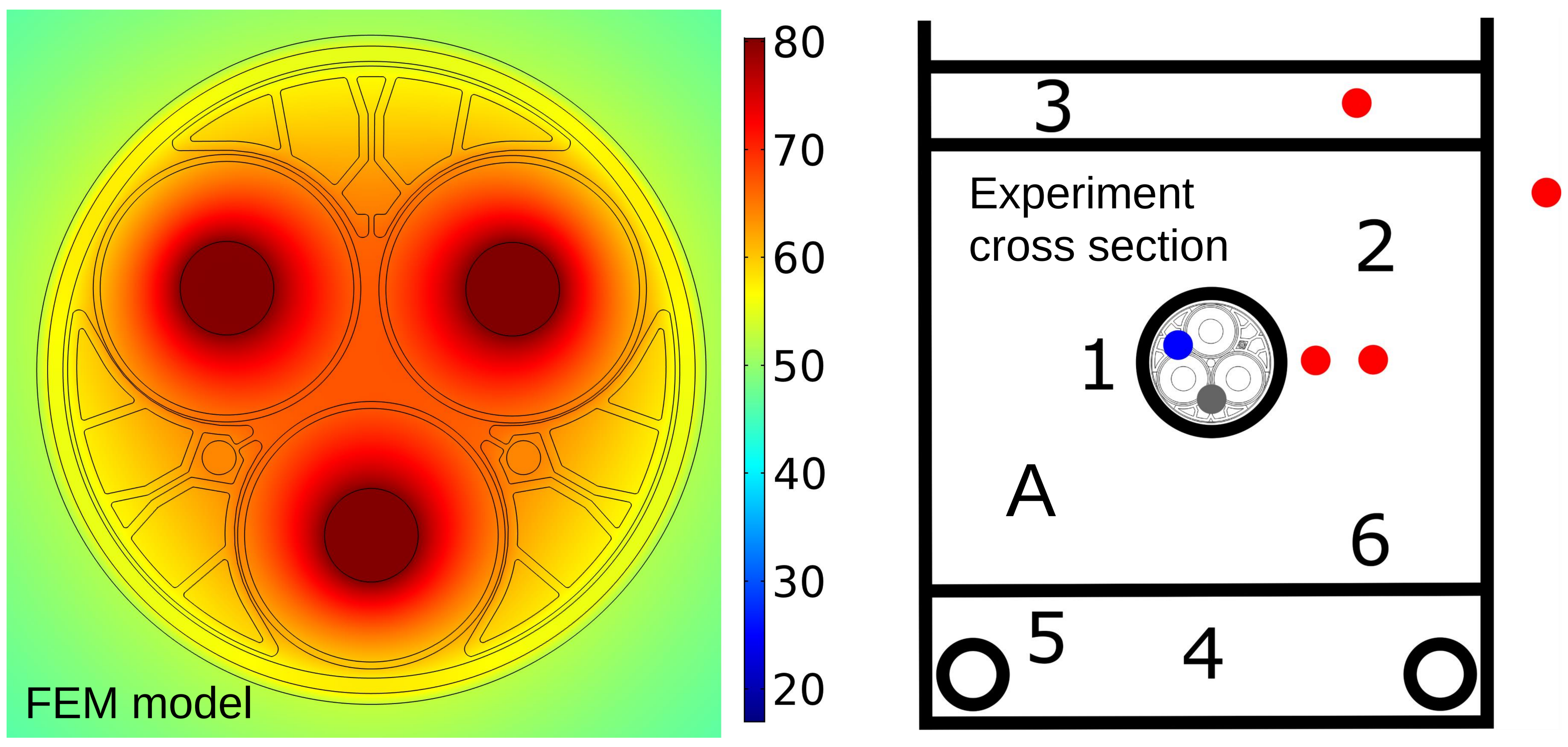
These experiments validated a new RTTR model proposed by Marlinks: a thermal RC-ladder model based on finite-element (FEM) calculations. Better suited to the complexity of the spacer geometry and the fiber temperature node, the Marlinks-developed model is considered to be more accurate than the industry standard.

Objectives

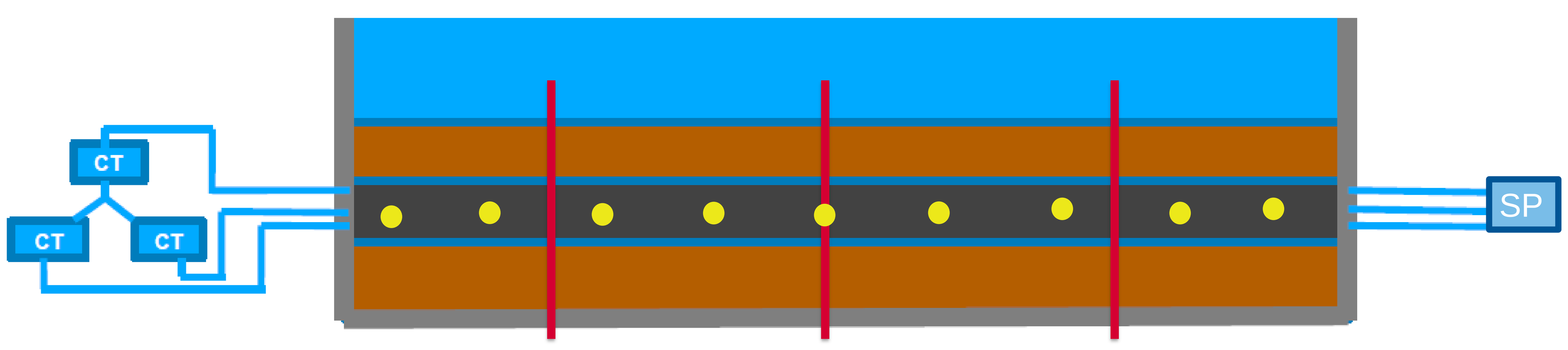


Methods

Marlinks' RC-ladder model is based on an FEM calculation. To validate this approach, an experiment is set up with thermocouples measuring the actual conductor temperature. The cable is buried in the center of a sand bed of 80x80cm.



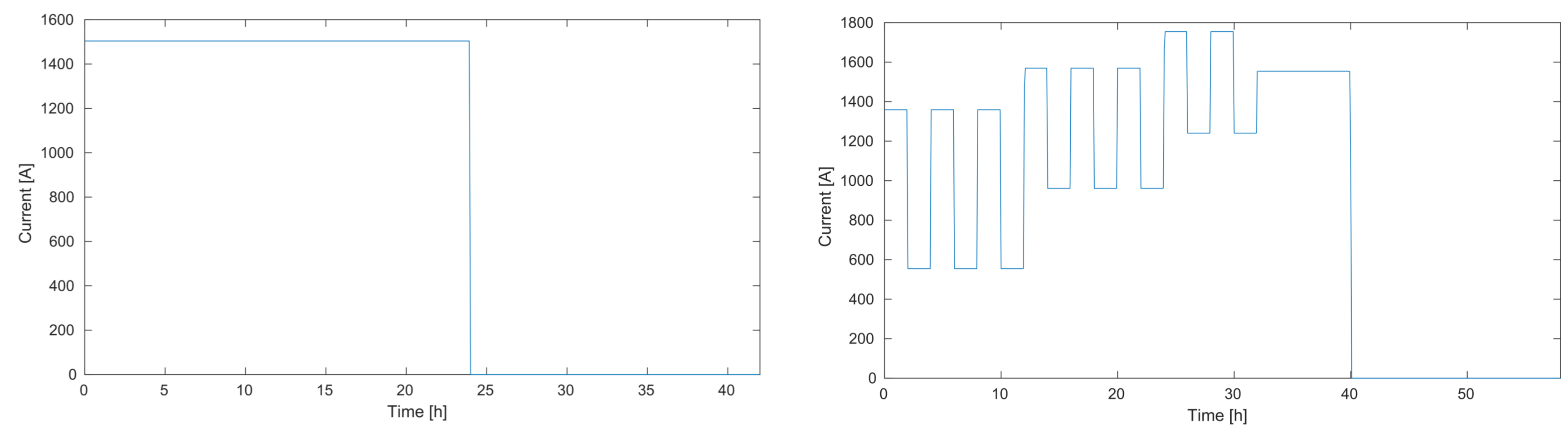
1) Cable 2) sand 3) water level 4) lava stone 5) drainpipe 6) canvas.
Red dots: thermocouples outside the cable



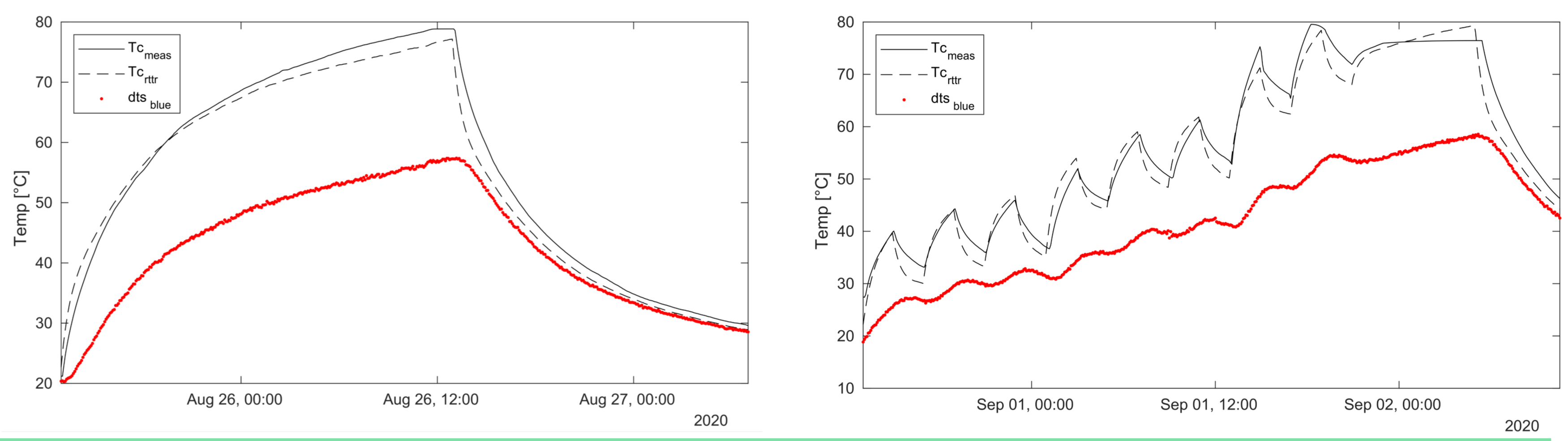
Yellow dots: thermocouples inside the conductor. Red line: positions of wooden frames holding thermocouples (A). CT: current transformer. SP: star point.

Results

Current profiles applied during the experiment: Left panel 24h constant current, Right panel synthetic dynamic load. It was necessary to challenge the generally accepted industry standards by applying 180% of the maximum allowed current in order to generate enough heat.



Comparison of the measured core temperature and the one found by our in-house developed RTTR model based on the measured DTS temperature.



Conclusions

The RC-ladder values determined by an FEM calculation show very strong predictive power for RTTR. This method was experimentally validated.

It was demonstrated that a good RTTR model enables cables to transport much higher currents than the maximums dictated by the industry standard.

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