

Study Committee B1 Insulated Cables

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Effective Strategic Planning in the Restoration of a Submarine Cable Fault

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Motivation

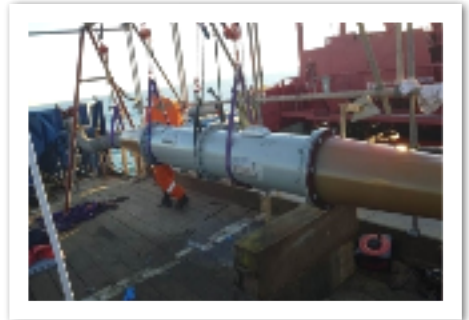
- Strategic readiness roadmap for submarine cable repair readiness, implemented by a leading oil and gas company is presented.
- Adopted philosophy towards submarine cable assets and its direct impact to maintain the predicted MTTR below six weeks.
- Detailed accounts of a rapid 17-day repair of a 115kV submarine power cable are given.
- Demonstrating the correlation between reaching an advanced readiness stage and the ability to consistently complete subsea cable repair rapidly.

Incident and Repair

- An anchor damaged an energized and critical 115 kV submarine cable, resulting in a power interruption to a critical offshore facility.
- Cable damaged at a 20m water depth.
- Fault localization.
- Step-by-step repair mobilization.
- Extensive water travel through over 800m of cable.
- Unusual phenomena of protrusion of conductors and shrink back of XLPE insulation.

Approach

- Paper provides an overview of the company's expanding submarine cable network that feeds its offshore facilities.
- A specific dimension of risk in oil and gas offshore fields is the increase in offshore construction activities in proximity to the in-service cables.
- Progressing the key four pillars of readiness:
- Repair vessel tracking and cable-required equipment.
- Executed a submarine cable network survey.
- Secured repair service contact and training of personnel.

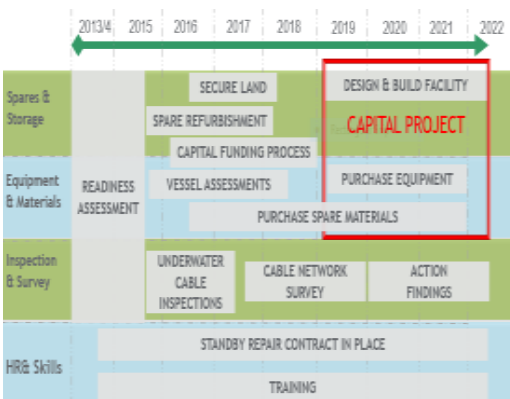


• Figure 2. Completed Joint #1 prior to laydown

- Extensive water travel in cable resulted in a three-joint repair



• Figure3: Graphic of the three completed joints



• Figure 1. Submarine Cable Readiness Roadmap



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Findings

Key findings of a third party laboratory forensic analysis follow

- Fault was caused by the anchor penetrating one cable up to the conductor.



- The huge mechanical force on the submarine cable led to abnormal phenomena of extensive water travel, protrusion of the conductors, shrink back of the insulation, and loose adhesion force between the conductor and the XLPE insulation.



• Figure 6. Cross section of subject cable

Conclusion

- The availability of spares was a key factor in achieving successfully repair.
 - The subject cable had been surveyed during 2018 as part of the network survey referenced in the readiness roadmap.
 - The availability and accessibility of a suitable repair vessel was a key factor in the rapid mobilization.
 - The implemented repair readiness road map played its part in the achievement of what is believed to be a world record repair time for a submarine power cable.
 - MTTR of this cable was completed in 17 days from trip to re-energization, which could be considered a worldwide record for the repair of a submarine power cable.
- Cable was stretched due to the huge mechanical force exerted by the ship's anchor, which created a channel between the conductor and insulation.
 - The water penetrated the cable core through the hole caused by the anchor and flowed relatively freely in the channel between the conductor and insulation.
 - The aforementioned abnormal activities stretched the cable copper conductor beyond the plastic limit and XLPE insulation below the plastic limit
 - Cable manufacturing is in accordance with the design specifications.



• Figure 7. Completed Joint#3 during laydown to seabed