Innovations for Underground and Submarine High Voltage Cable Fault Location

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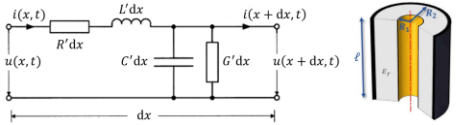
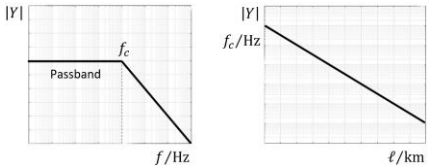
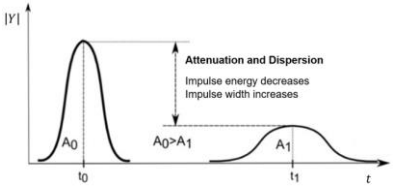
Background:

- Approx. 83% of offshore financial losses and insurance claims are associated to failures of power cable infrastructure.
- Subsea HVAC and HVDC cables fail commonly.
- Cable parameters of HVAC and HVDC cables are challenging and have a significant impact on fault location technologies and on the difficulty of the fault-finding process.







Impact of cable parameters and application:

Cable capacitance ↔ Stored energy ↔ Safety, discharge unit
Cable impedance ↔ Impulse propagation ↔ TDR/Cable radar
Cable length ↔ Fault distance ↔ High voltage prelocation methods
Cable insulation ↔ Fault types ↔ Pinpointing methods
Cable route ↔ Geography and maritime logistics ↔ Subsea tracking and pinpointing

Cable fault location sequence:

Identification
Type of fault (flashing or non-flashing)

Prelocation
Distance to fault and define area for pinpointing

Pinpointing
Finding exact fault position

Burning
Fault conversion (changing the fault)

Innovations in cable fault location:

Safety and operations

- Ability to discharge high energy (MJ)
- Protect personnel and equipment
- Need to do it fast, safely, repeatably
- Support workflow and productivity

TDR and improved SNR

- Dynamic distance-dependent de-attenuation
- Bipolar impulse generation
- Advanced noise suppression and averaging
- Pulse compression and signatures

HV prelocation

- Conventional HV methods: Arc Reflection, Current Decoupling, Voltage Decoupling
- Physical range limitations
- DC burning, Burn Arc Reflection
- High voltage bridge with voltage drop method

Tracking and pinpointing

- Magnetic-acoustig method for high resistance faults
- Audio frequency method for low resistance faults; powerful tone generator needed
- ROV-mounted tracking/surveying and pinpointing system, rated for deep sea

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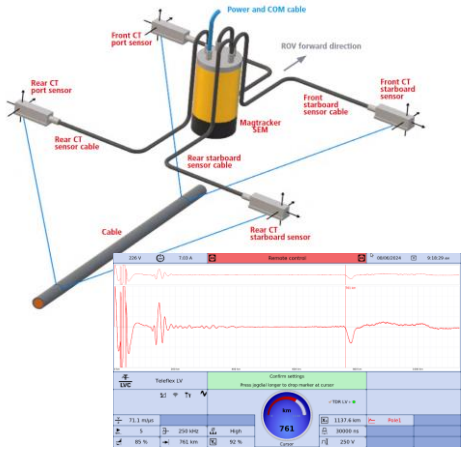

Conclusions:

- Overall, fault location on long HVAC and HVDC cables is a true challenge.
- Necessity for innovative modification of well-known techniques and innovative new technologies.
- Dedicated, specialized **high-performance heavy-duty fault location equipment** is needed and should be part of the planning considerations of any long cable project right from the start.