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SPE workshop

Strengthening Marginal and Mature Field Ecosystems: Technology, Innovation, and Collaboration

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Cost-Effective Electrical Remediation Strategies for Managing Umbilical Degradation in Mature Subsea Gas Fields

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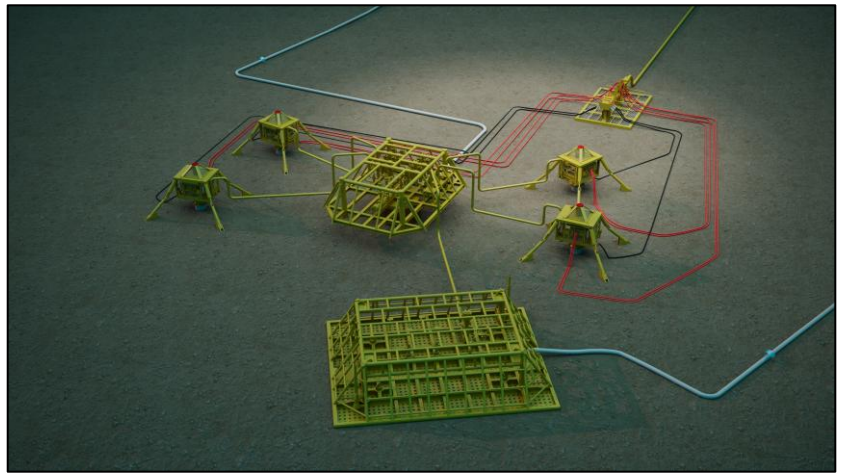


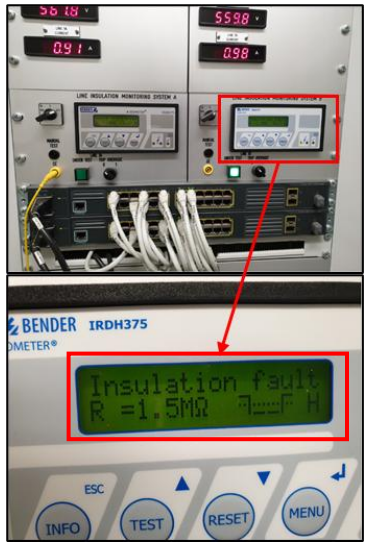
Rising Electrical Risk in Mature Subsea Fields

- Aging subsea control infrastructure
- Progressive insulation resistance (IR) degradation
- Rising intervention cost
- Production deferment risk
- Reduced system redundancy
- Late-life asset management constraints

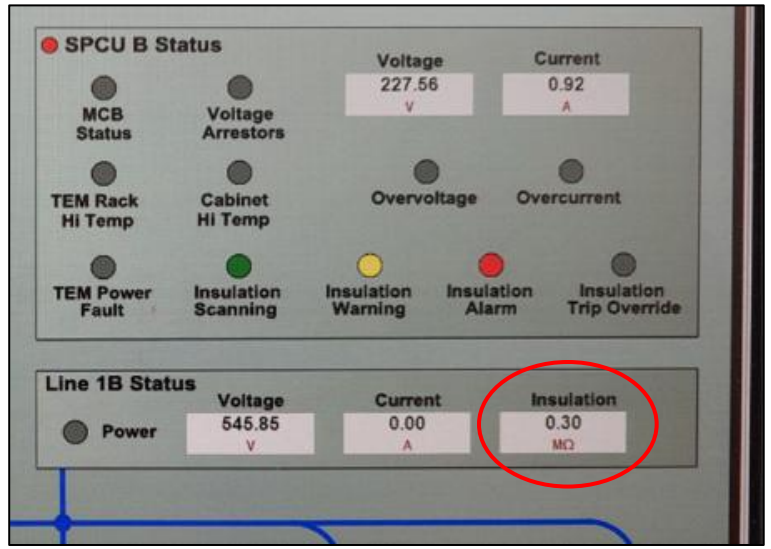
IR Degradation: Why It Matters

IR degradation threatens subsea communication and well control

- Progressive insulation resistance decline
- **Repeated IR trips (0.5 MΩ trip limit)**
- Reduced communication redundancy
- Subsea control system vulnerability
- Production availability risk



< Mya-N Ch-B IR Value in Oct, 2022 >

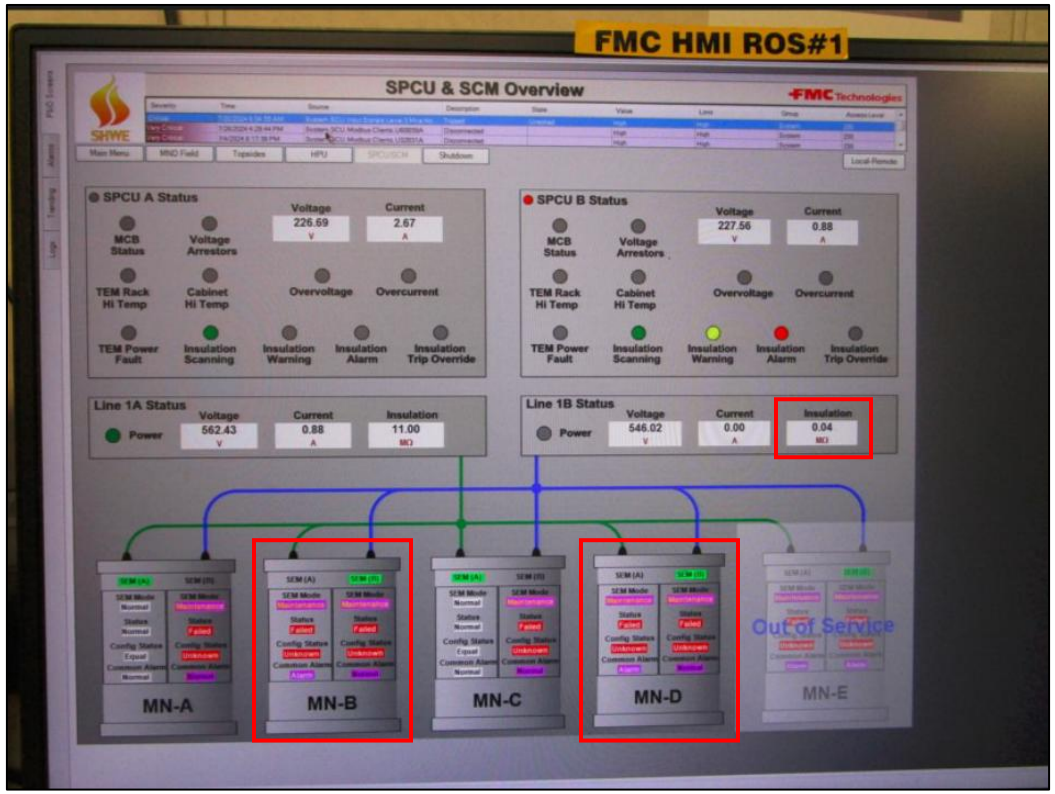


< IR Dropped Below Trip Limit 0.5 MΩ in Feb. 2023 >

When Communication Redundancy Fails

Loss of communication redundancy can directly affect well operability

- Channel-B IR trip (early 2024)
- Loss of communication redundancy
- Some wells lost SEM-A communication
- Reduced operational flexibility



< Loss of SEM-A Communication in Several Wells after Channel-B IR Trip in Sep. 2024 >

Replace or Remediate? Engineering Decision Point

[EFL Replacement]

- ROV campaign required
- Subsea cable replacement
- Production shutdown risk
- Extended offshore vessel time

Estimated Cost > US$ 2M

[Electrical Remediation]

- IR recovery technology
- Electrical reconfiguration
- Platform-based electrical intervention
- Limited offshore scope

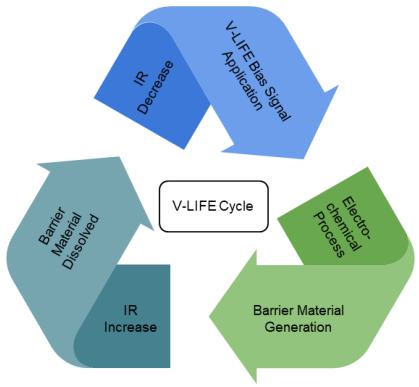
Estimated Cost < US$ 0.3M

Engineering remediation avoided a major subsea intervention campaign

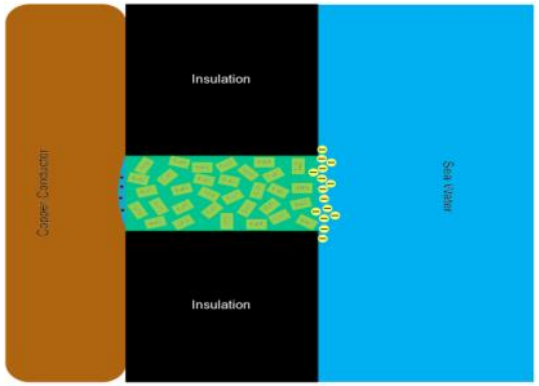
Limitations of IR Recovery Technology

IR recovery improved resistance temporarily but did not resolve the root cause

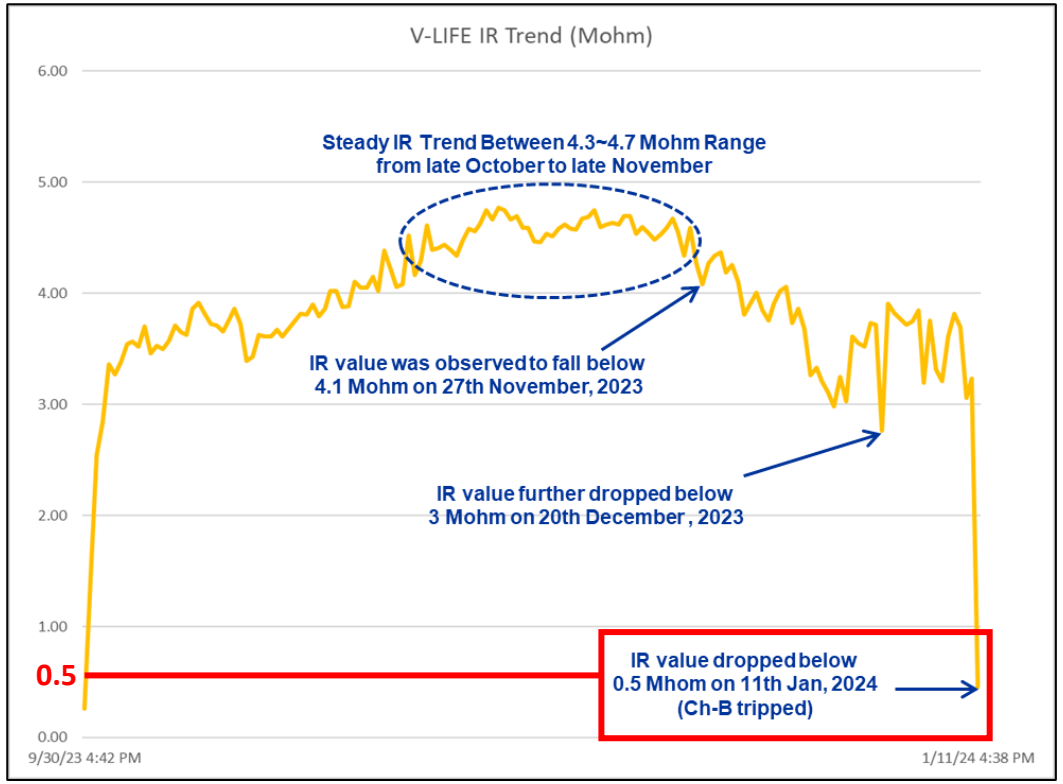
- Temporary IR recovery observed
- Degradation recurrence over time
- V-LIFE cannot resolve short-circuit faults
- Fault location remained unknown
- Overall system reliability still limited



< V-LIFE Recovery Mechanism >



< V-LIFE Process >



< Mya-N Ch-B IR after Implementing IR Recovery Technology >

Structured Diagnostic Before Major Intervention

Engineering diagnostics enabled targeted intervention

- Stepwise electrical fault localization
- Platform-ROV coordinated diagnostics

Platform IR Testing

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Subsystem Isolation

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ROV-Assisted Electrical Fault Localization

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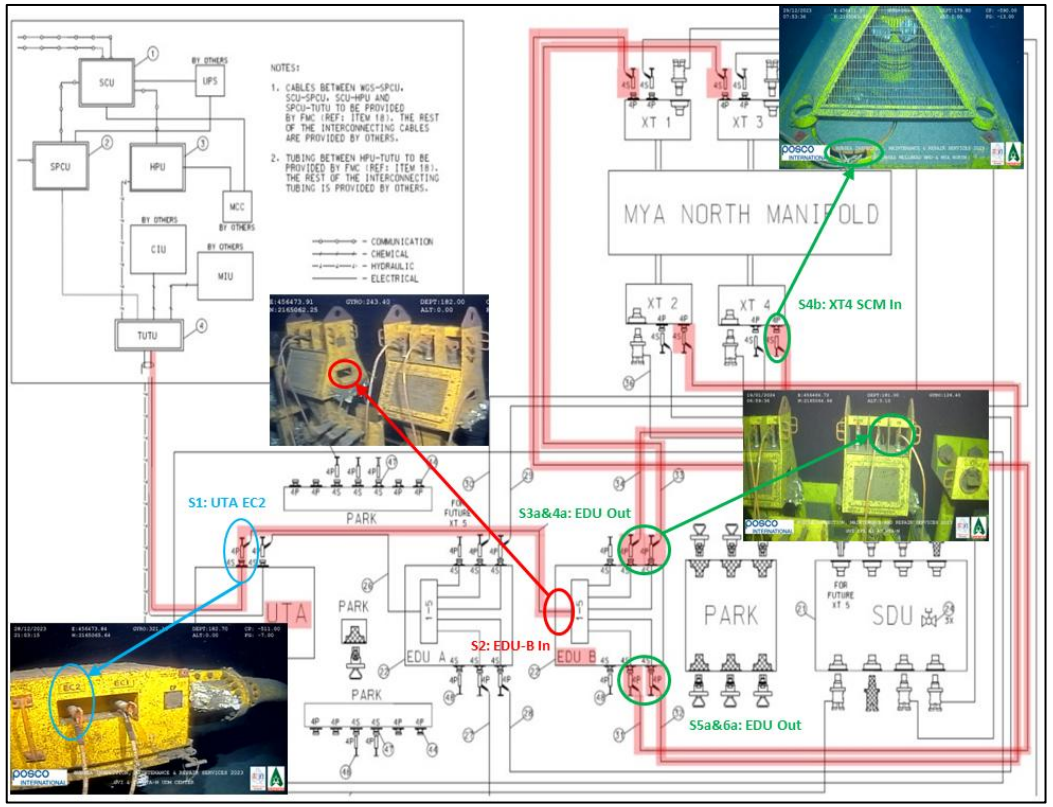
Production-Safe Intervention Planning



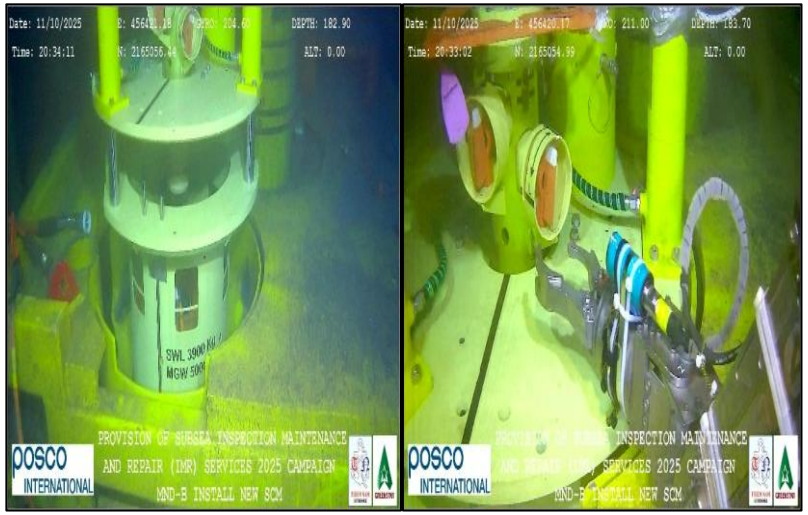
< Stepwise Electrical Diagnostic Process >

ROV-Based Electrical Intervention Strategy

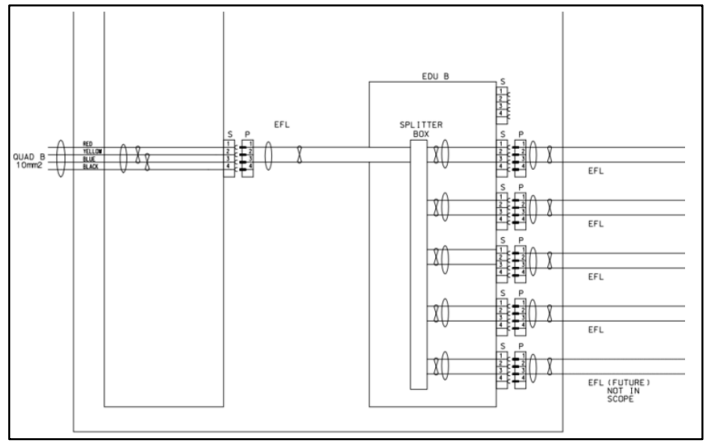
ROV intervention restored electrical redundancy without umbilical replacement

- Utilization of spare umbilical cores
- Cross-wired EFL installation
- Targeted EFL / SCM replacement

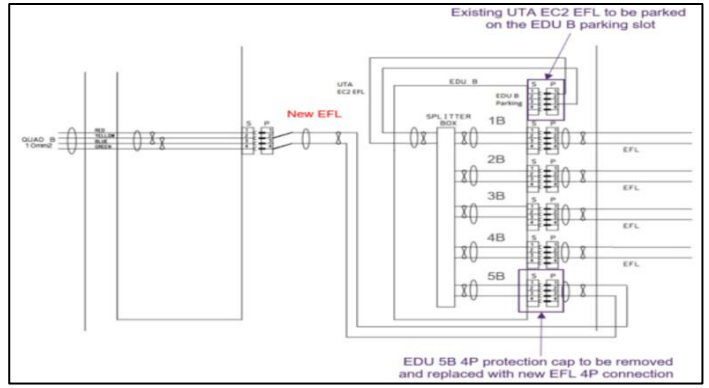
< Spare EFL Deployment Basket >



< SCM Retrieval and Installation>



< Original electrical configuration between UTA & EDU-B >



< Reconfigured electrical architecture using spare cores >

Operational and Economic Outcomes

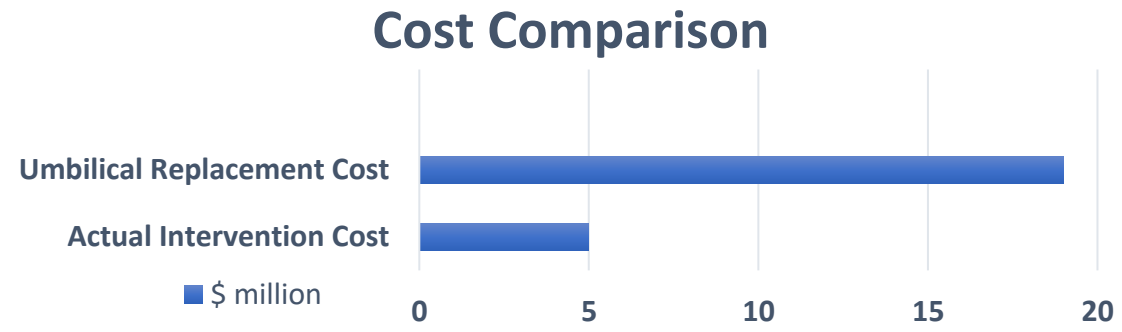
Engineering intervention avoided a multi-million umbilical replacement

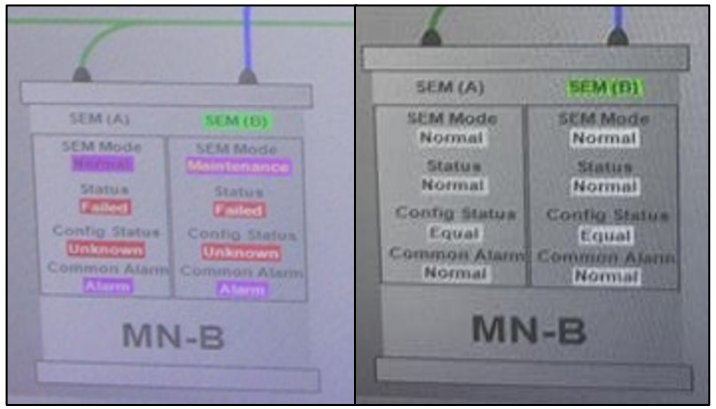
Operational Outcomes

- Subsea communication recovered
- Electrical redundancy restored
- Production continuity maintained

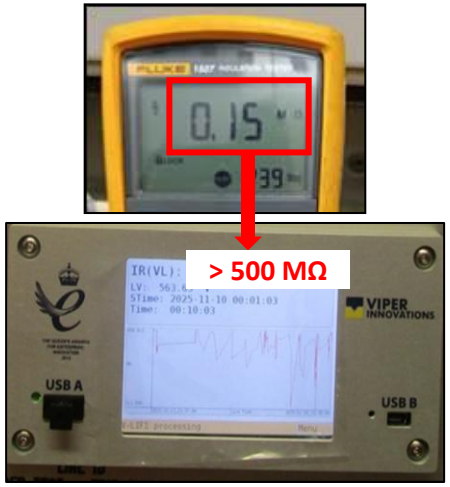
Economic Impact

- Umbilical replacement avoided
- Estimated replacement cost > **US$ 19M**
- Actual intervention cost < **US$ 5M**





< Restored Dual Communications of MND-B Well >



< Significantly Increased IR Value >

Discussion Questions

- Which criteria should determine remediation vs. umbilical replacement?
- What level of IR degradation is operationally acceptable?
- Can predictive monitoring realistically prevent subsea electrical failure?
- How many spare umbilical cores should be planned during field development?