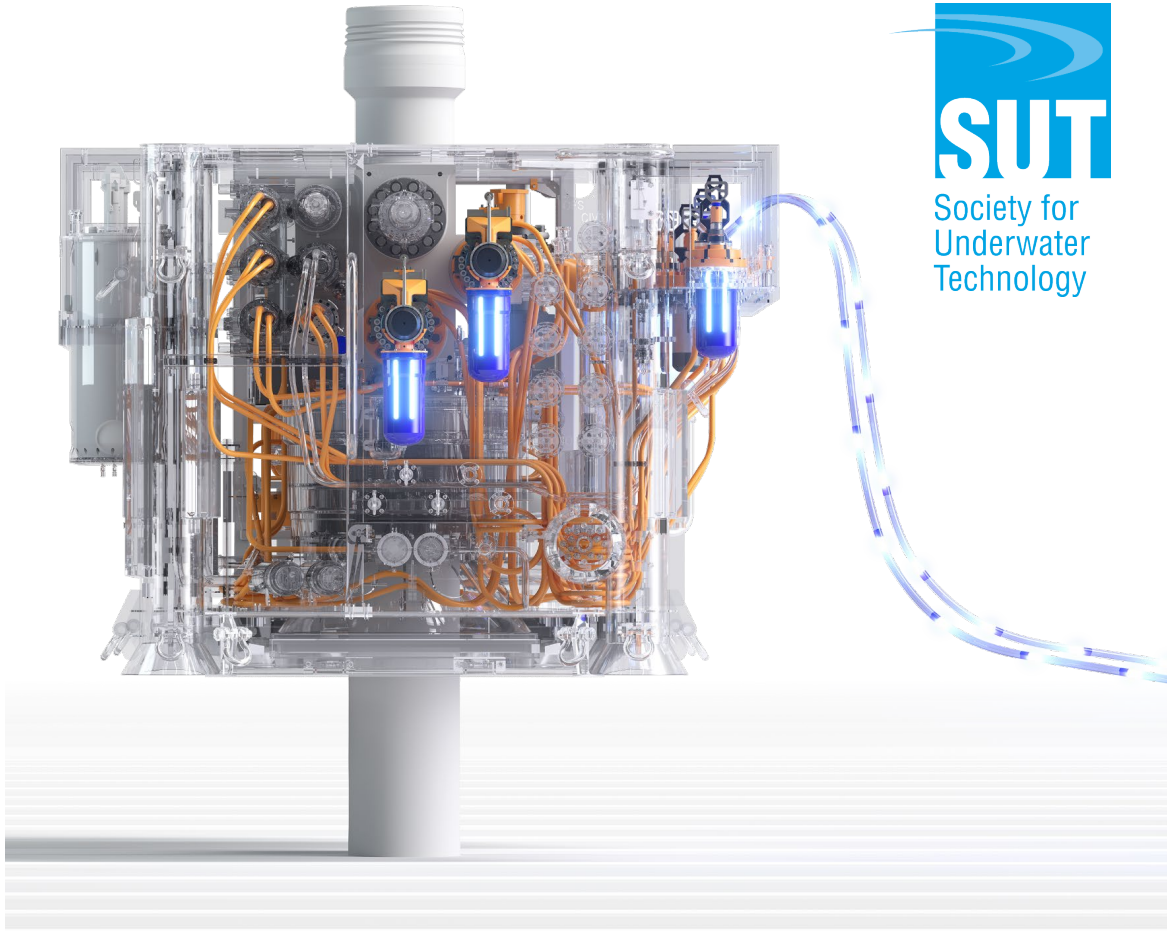
SUBSEA CONTROLS DOWN UNDER 2024

Jon Turner

Diamould Product Champion



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OneSubsea Diamould Electrical Flying Lead's (EFL's)

Hose, cable & termination management for long term reliability

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Hose, cable and termination management

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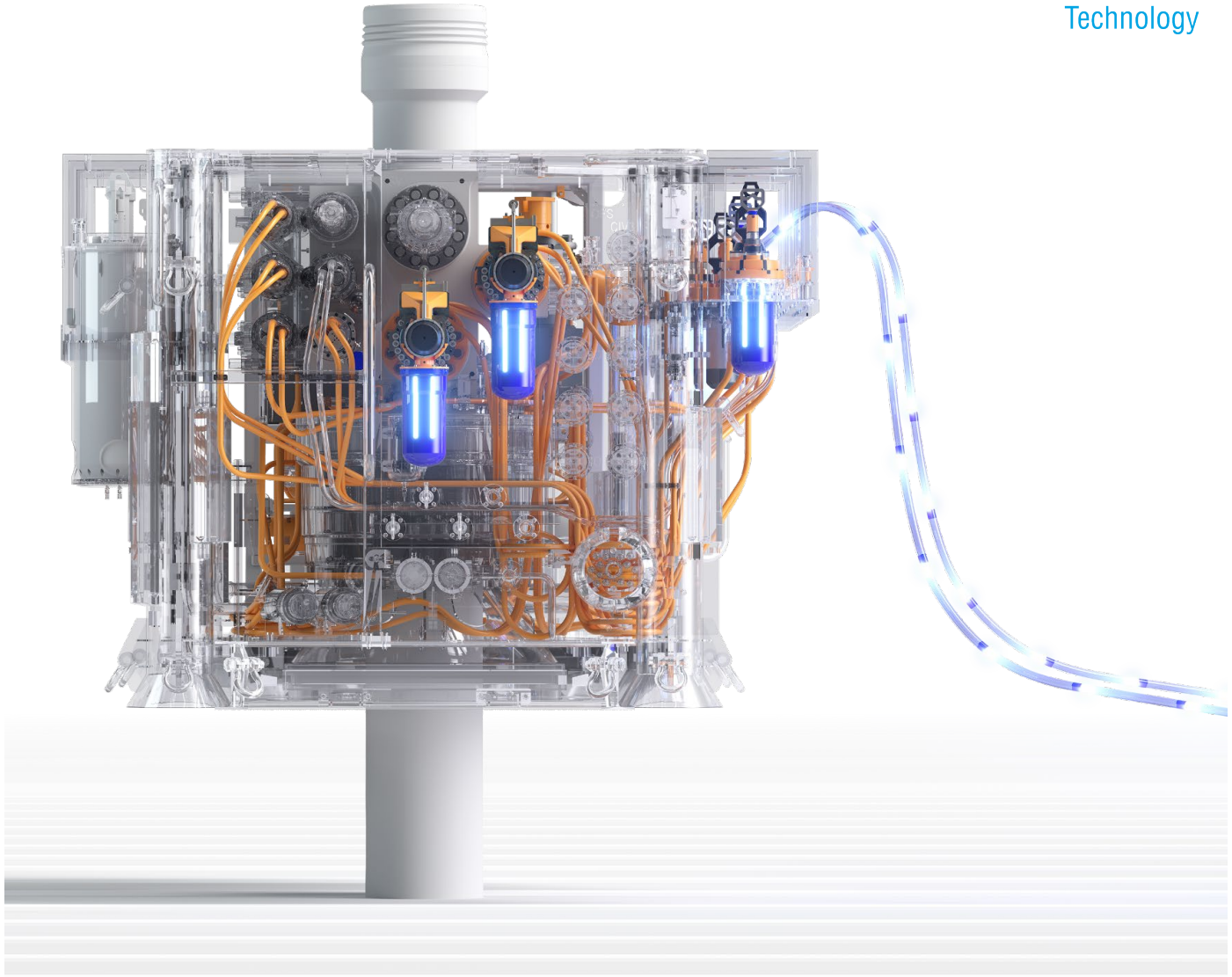
Key to long term reliability



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Agenda

Introduction and company overview

Subsea systems – A typical scope

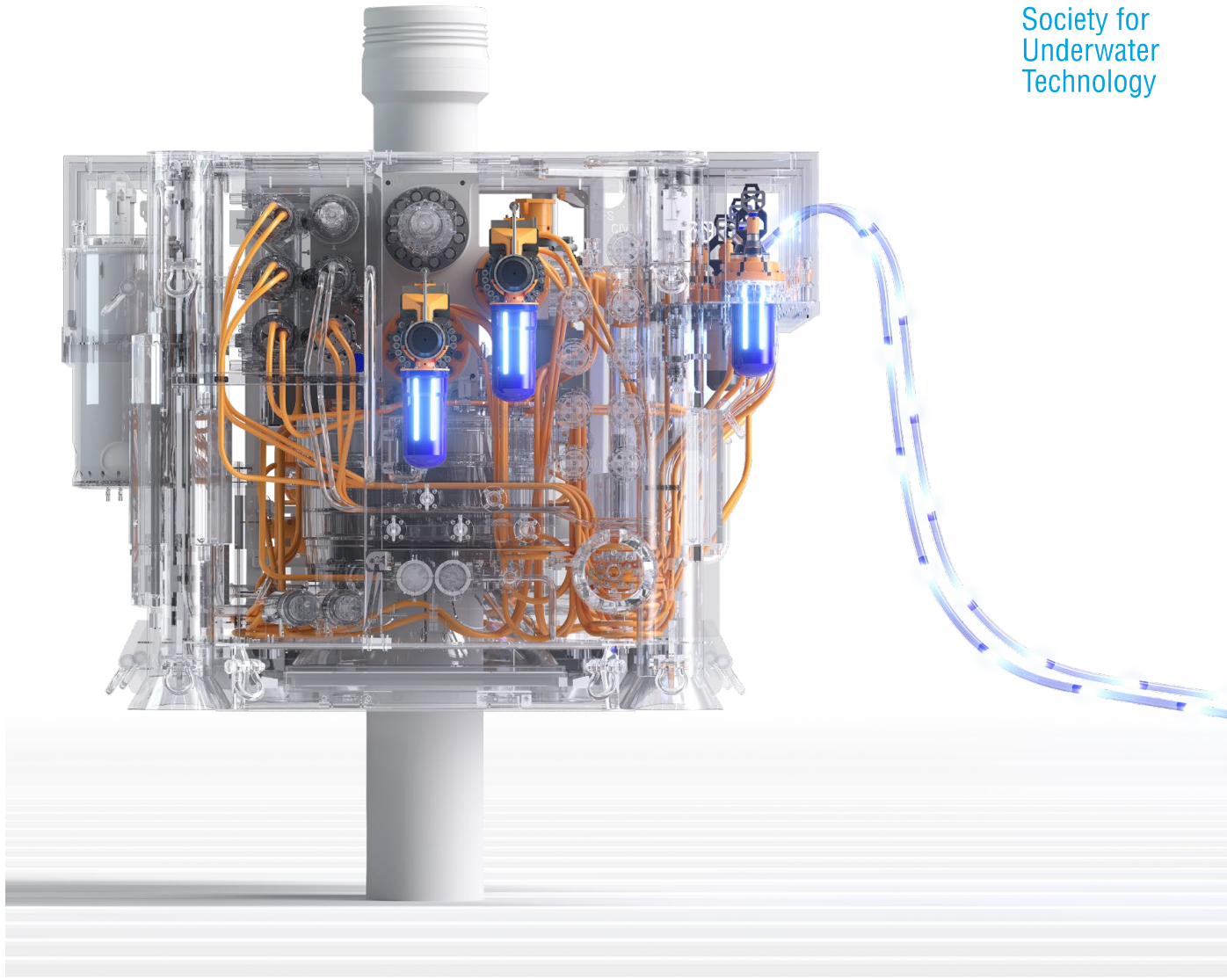
Key EFL components

Hose assemblies – Potential failure modes
– Advanced reliability by process

Cable terminations – Potential failure modes
– Advanced reliability by design

Demonstrating technical robustness

Questions



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Introduction

OneSubsea Diamould

SLB & OneSubsea centre of excellence for connectors

Celebrating 25 years in the industry

Northwest, United Kingdom

Electrical and optical connectors

Subsea and downhole applications

In-house design and manufacture

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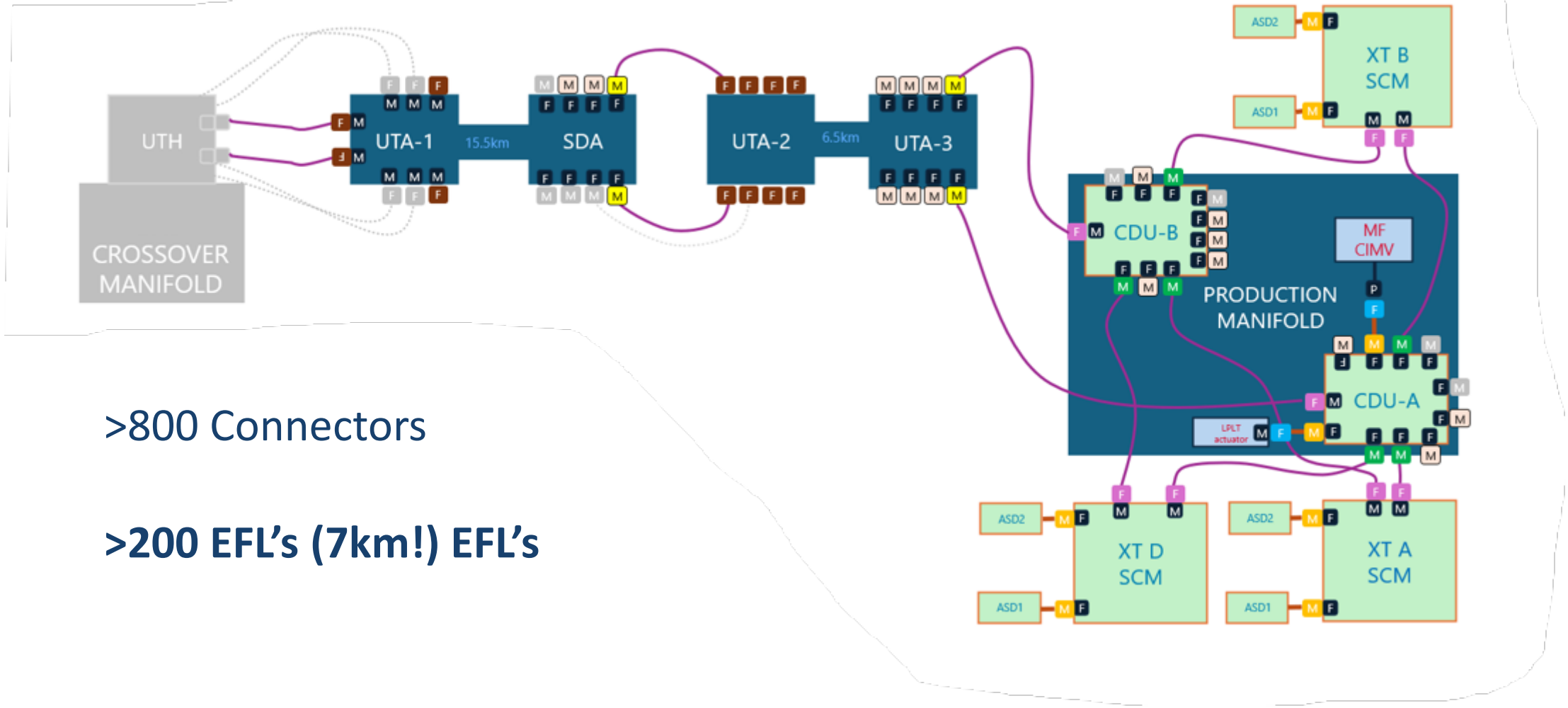
Reliability is key

Typical subsea system



>800 Connectors

>200 EFL's (7km!) EFL's

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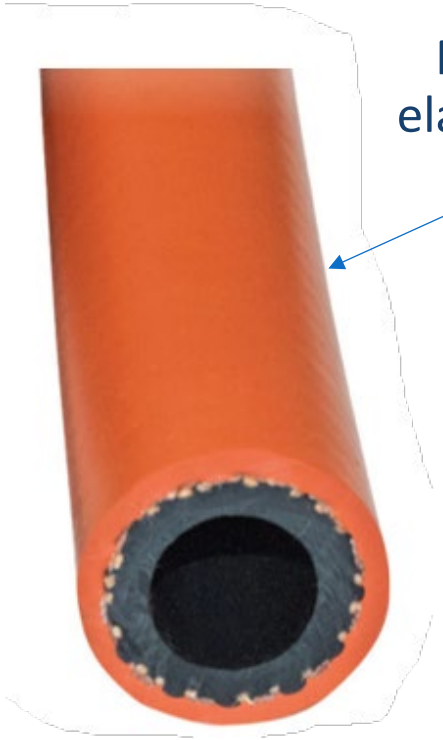
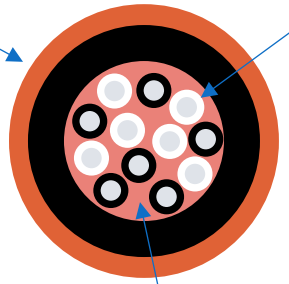
EFL technology

Key EFL components



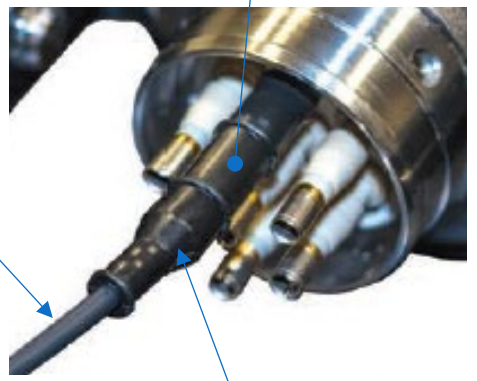
Multi-layered elastomeric hose



Dielectric oil

Insulated cable

Cable termination



Termination insulation

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Addressing failures – Potential failure modes

Multi-layered elastomeric hose (Dielectric oil filled)

- Chemical contamination
  - Processing chemicals
  - Sebaceous fluid (sweaty hands)

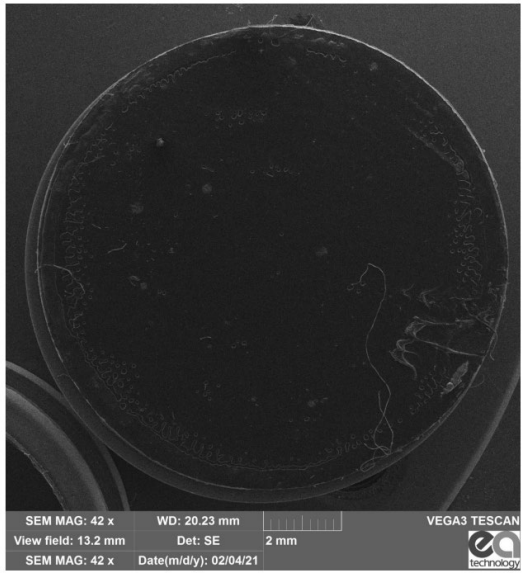


Figure 1 CLEAN SAMPLE REDA No.5 ID: 36333

- Particulate contamination
  - Polymeric particles
  - General airborne particles

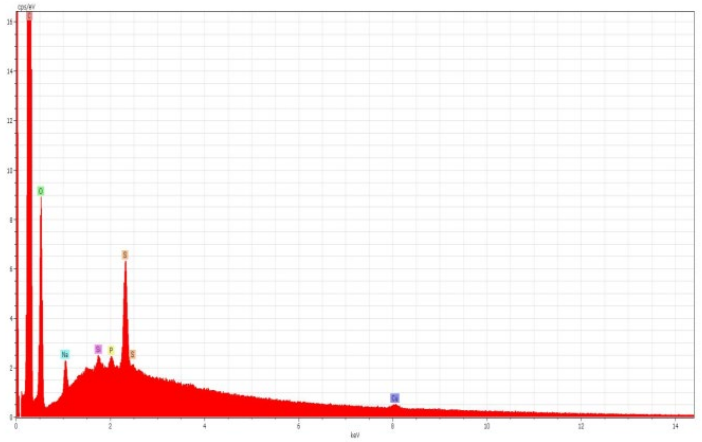
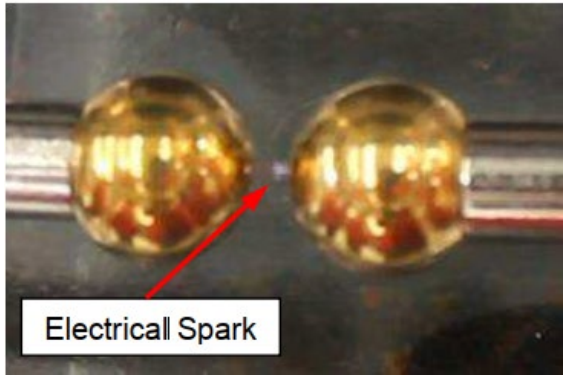


Figure 2 CLEAN SAMPLE REDA No.5 ID: 36333

- Water contamination
  - Environmental humidity
  - Water absorption in oil
  - Water ingress in service



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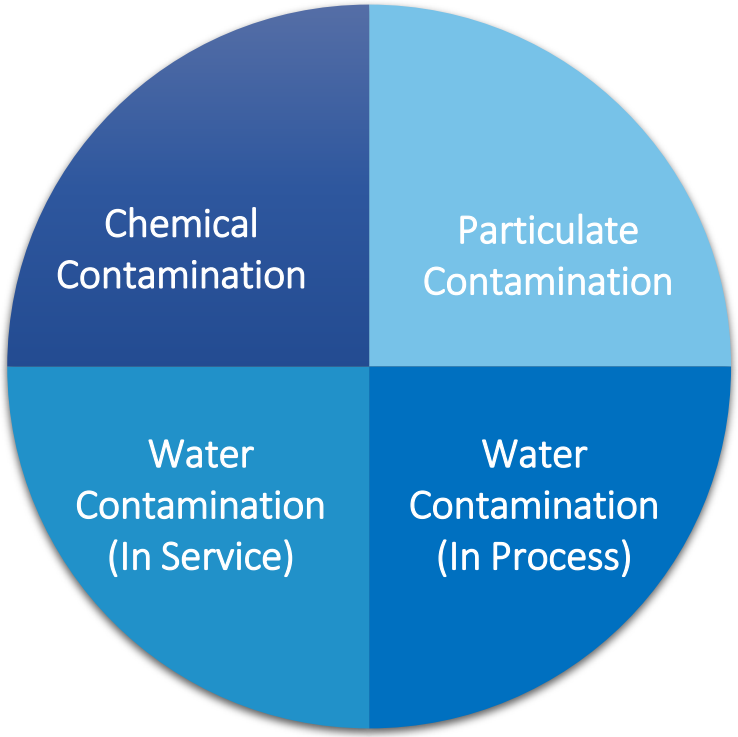
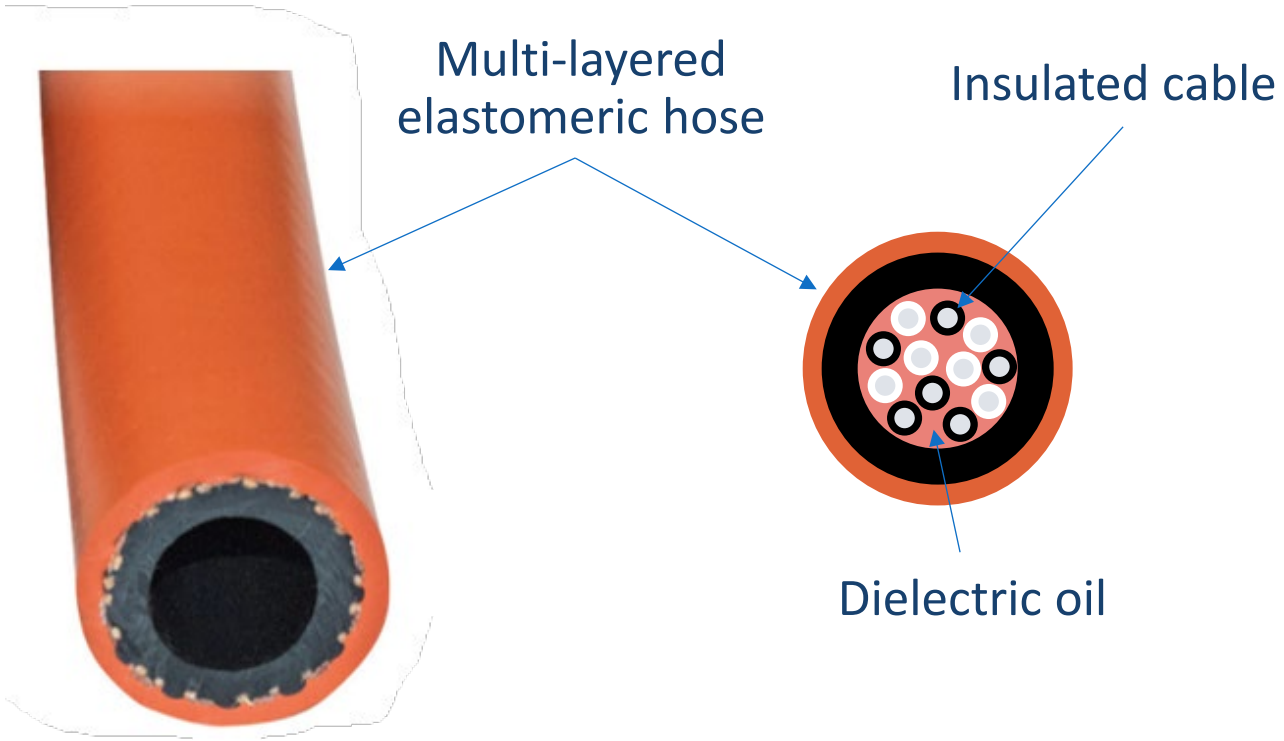
Advanced reliability by process

Multi-layered elastomeric hose (Dielectric oil filled)





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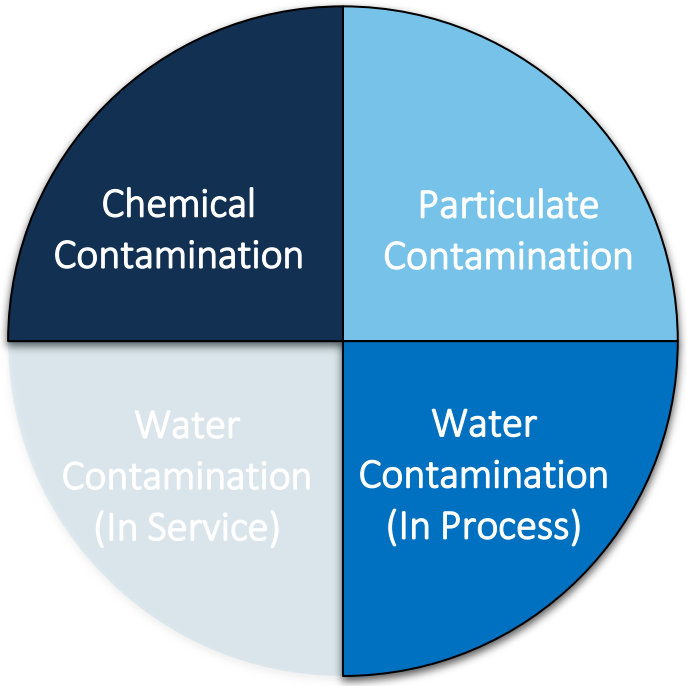
Advanced reliability by process

Multi-layered elastomeric hose (Dielectric oil filled)

Dielectric breakdown strength



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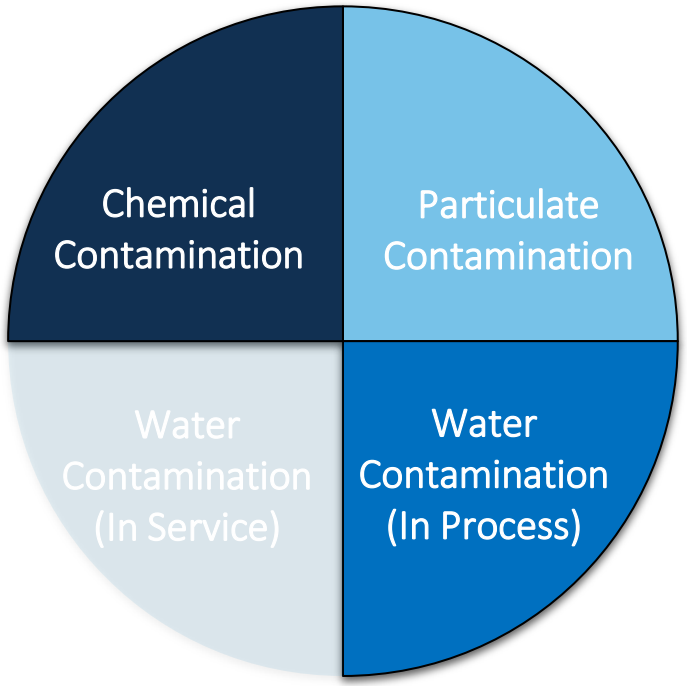
Advanced reliability by process

Multi-layered elastomeric hose (Dielectric oil filled)

Dielectric breakdown strength



Sample	Raw Oil (from Barrell)	Processed Oil, circulated 2 hours at $9x10^{-2}$ Torr
Date of sample	2/7/19	8/7/19
Date of Testing	9/7/19	9/7/19
Gas Content (vpm)		
Hydrogen	9.8	0.5
Oxygen	24711	2357
Nitrogen	52575	4612
Carbon Monoxide	13	0.1
Methane	10	0.2
Carbon Dioxide	247	24
Ethylene	27	<0.1
Ethane	5.2	<0.1
Acetylene	10	<0.1
Particle Count (µ / 100mL)		
2 – 5	24000	6000
5 – 15	12000	3000
15 – 25	3000	750
25 – 50	0	
50 – 100	0	
> 100	0	
Moisture (mg/kg)	8	8
Electric Breakdown (kV)	39	57
Electric withstand (22kV 1 min.)	Pass	Pass
Notes	Gas contents higher than expected Breakdown lower than expected	Gas content is low Oil quality is good Particle count is low Good breakdown strength

Electric Breakdown (kV)	39	57

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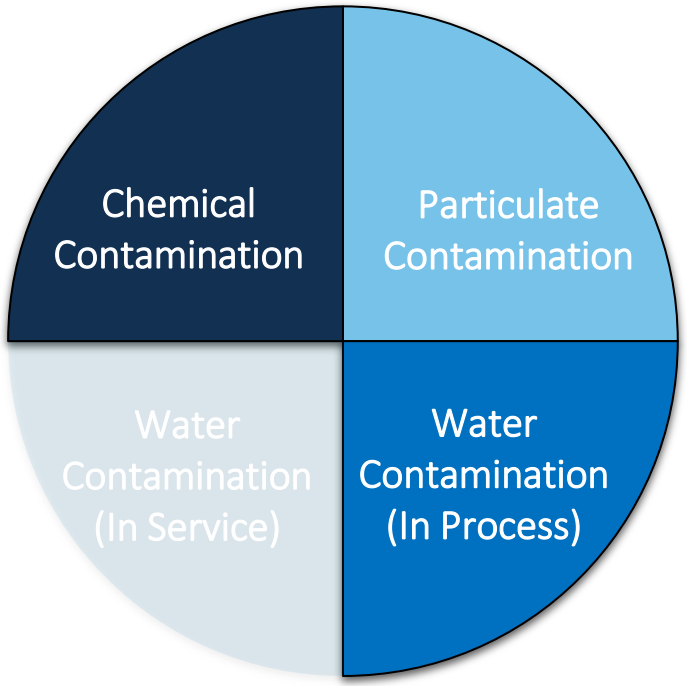
Advanced reliability by process

Multi-layered elastomeric hose (Dielectric oil filled)

Repeatability globally



https://upload.wikimedia.org/wikipedia/commons/9/9f/Malaysia_on_the_globe_%28Southeast_Asia_centered%29.svg

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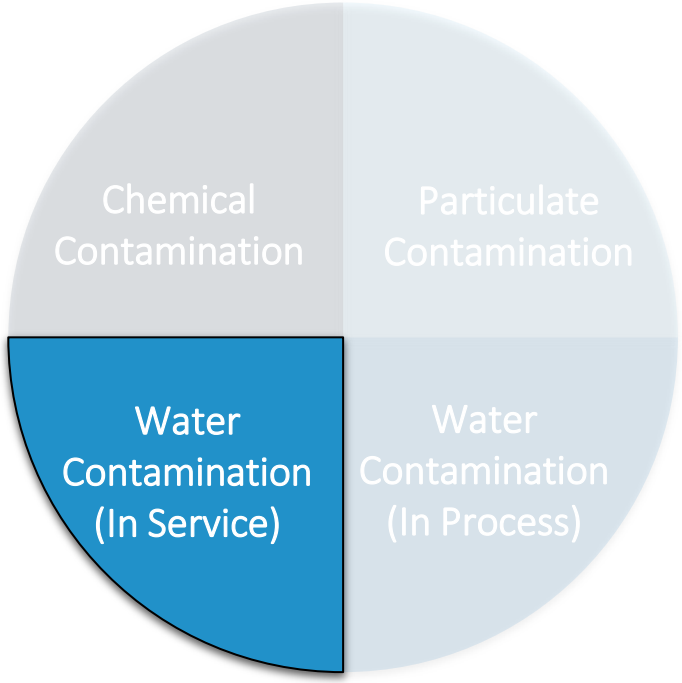
Advanced reliability by process

Multi-layered elastomeric hose (Dielectric oil filled)



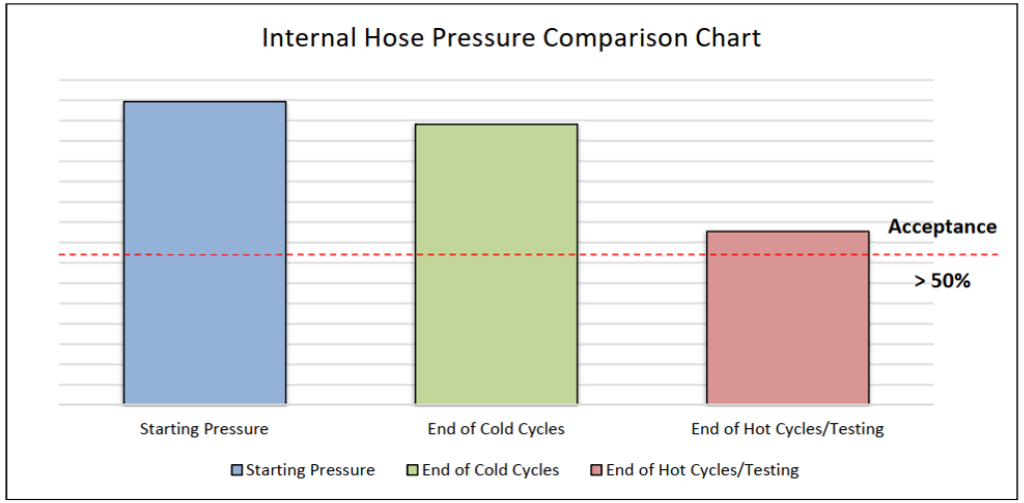


Chart 1 – Internal Hose Pressure Comparison

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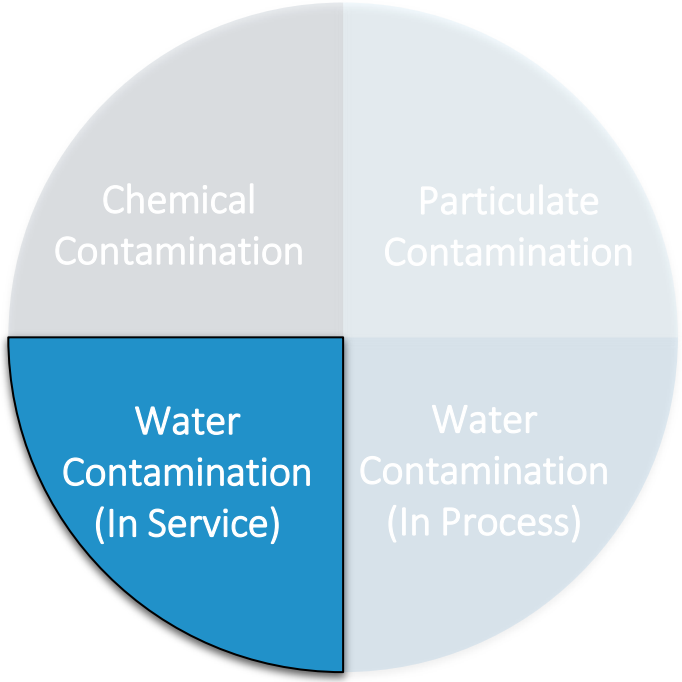
Advanced reliability by process

Multi-layered elastomeric hose (Dielectric oil filled)



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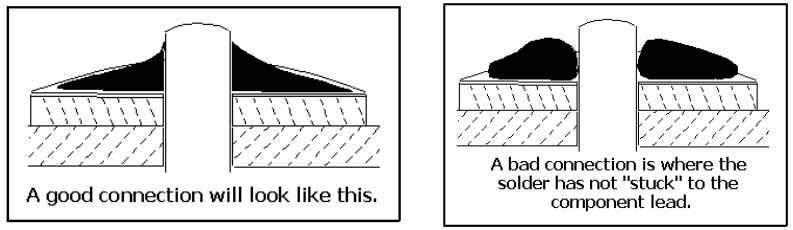
Addressing failures – Potential failure modes

Cable termination & insulation

- Solder joint
  - Conductive media for joint cleaning
  - Solder spikes
  - Dry joints
  - Dendrite formation



- Chemical contamination
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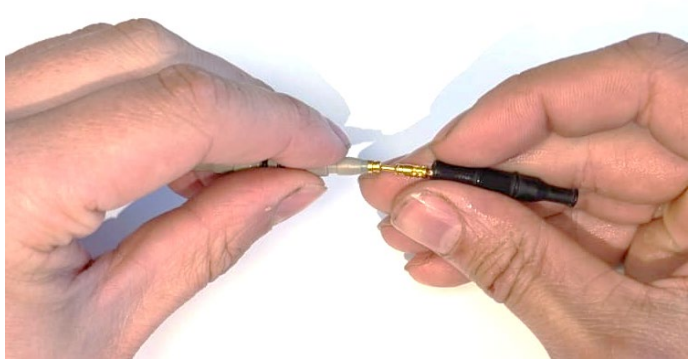
  - Sebaceous fluid (sweaty hands)



- Moisture contamination
  - Environmental humidity

https://www.talkingelectronics.com/projects/5-Projects/Projects13.html

https://www.amazon.co.uk/dsheng-Thermometer-Refrigerator-Temperature-Thermometers/dp/B0CL1B442Y

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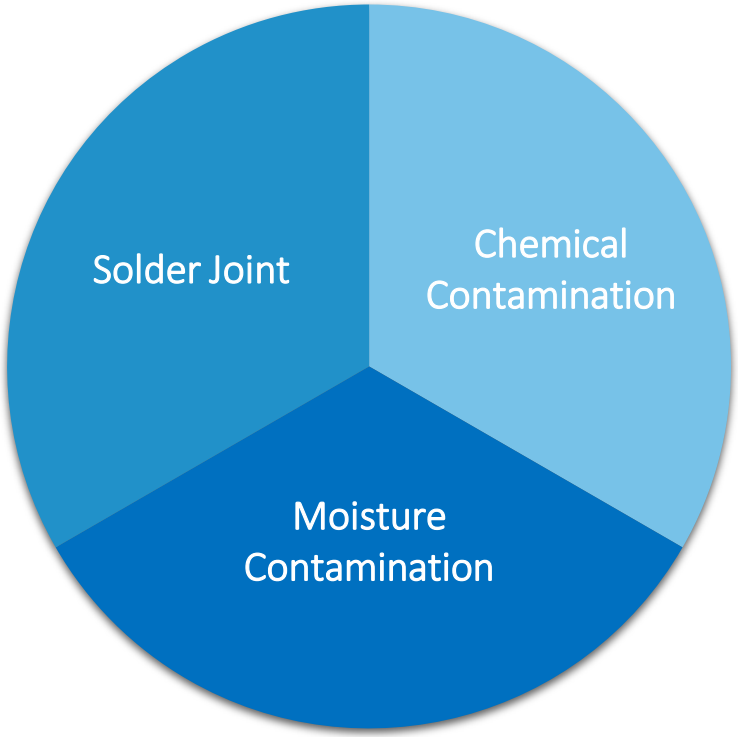
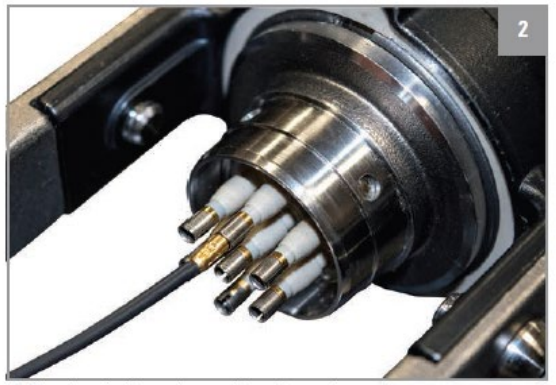
Advanced reliability by design

Cable termination & insulation



1. Crimp pin introduced to crimp socket



2. Crimp pin pushed into and engaged in to crimp socket

3. Latch boot termination sleeve pushed onto crimp joint

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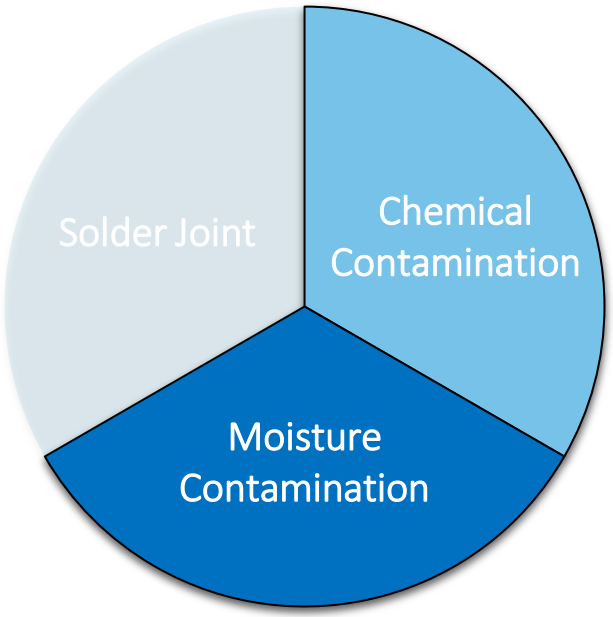
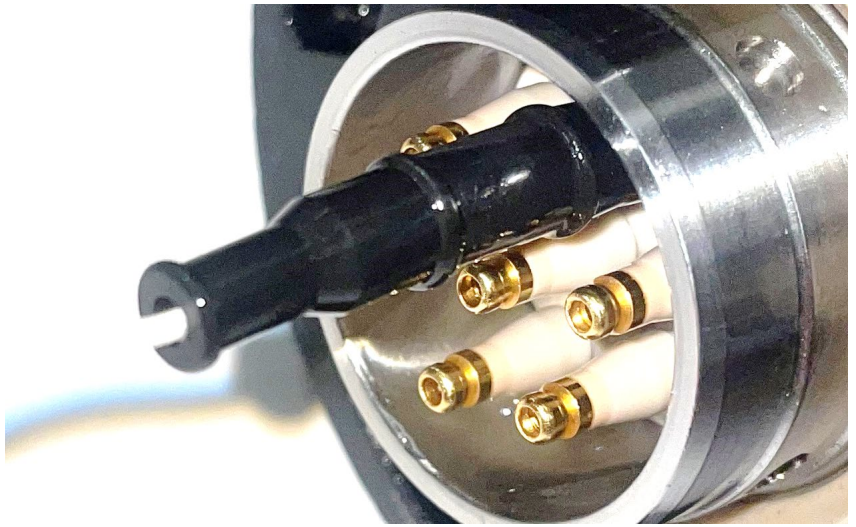
Advanced reliability by design

Cable termination & insulation





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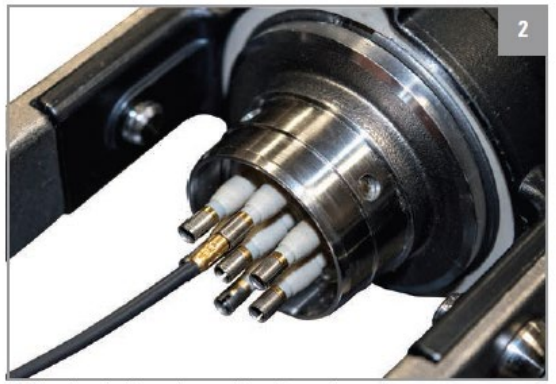

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Advanced reliability by design

Cable termination & insulation

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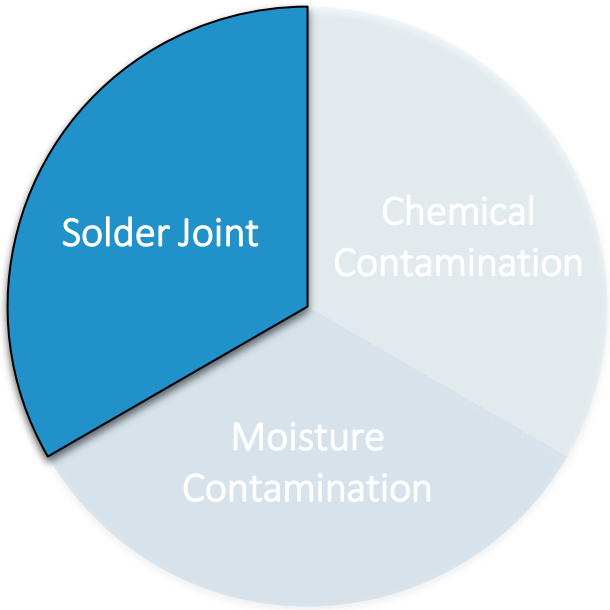
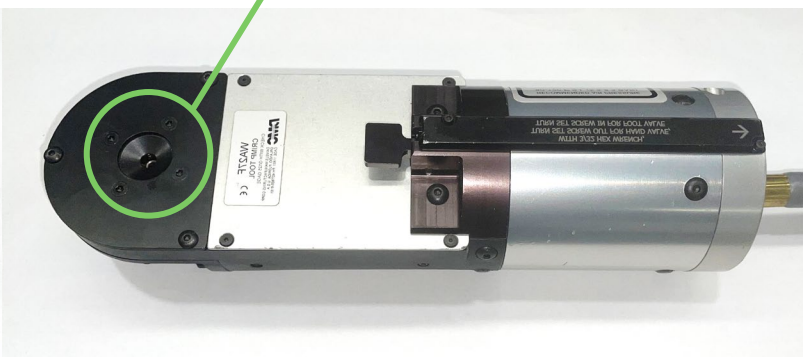
Removing the human factor!



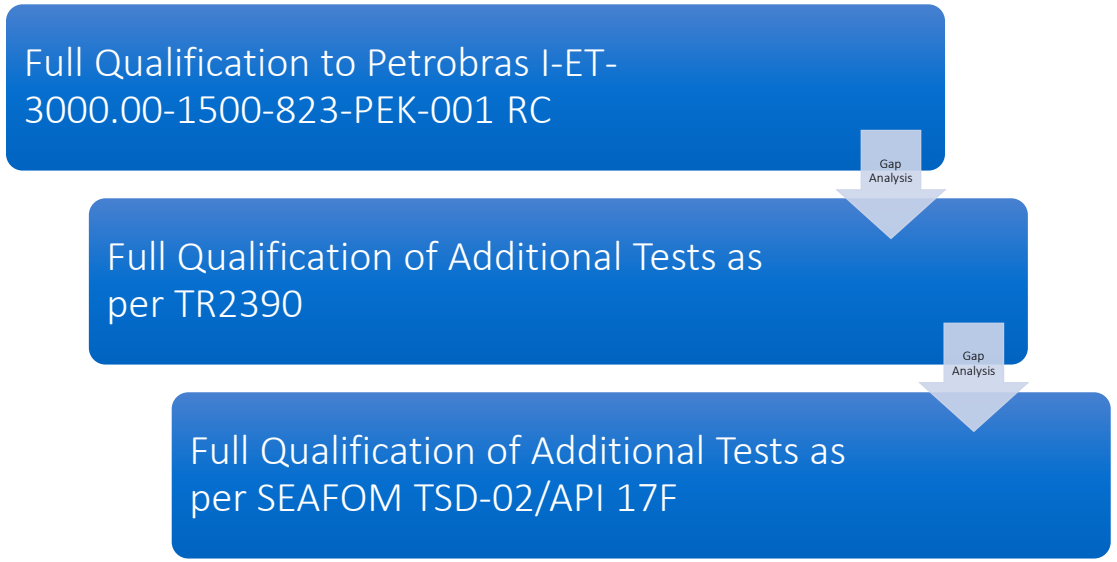


Demonstrating technical robustness

Alignment to standards

Designed in accordance with specifications

- Petrobras I-ET-3000.00-1500-823-PEK-001
- Statoil TR2390 Rev 1-2
- API 17F*
- SEAFOM TSD-02



*Ongoing gap closure to 5th edition

Demonstrating technical robustness

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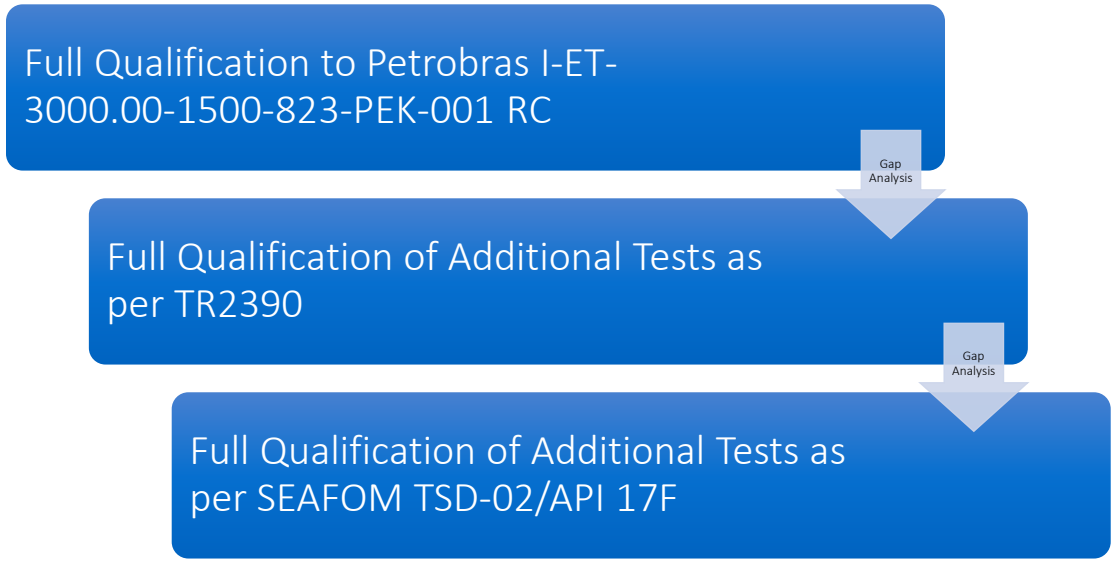

*4th edition

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Demonstrating technical robustness

Alignment to standards

Society for Underwater Technology

Designed in accordance with specifications

- Petrobras I-ET-3000.00-1500-823-PEK-001
- Statoil TR2390 Rev 1-2
- API 17F*
- SEAFOM TSD-02

Plus additional product specific qualification

7-Way Alternative Gender ROV Connectors	•Additional Mechanical Tests as per SEAFOM TSD-02 •Additional Mechanical Tests as per Petrobras I-ET-3000.00-1500-823-PEK-001 RC
7-Way Bulkhead Mounted ROV Connectors	•Additional Mechanical Tests as per SEAFOM TSD-02 •Additional Mechanical Tests as per Petrobras I-ET-3000.00-1500-823-PEK-001 RC
7-Way Stab Connectors	•Additional Mechanical Tests as per OneSubsea X-065408-01-95 •Additional Environmental Tests as per OneSubsea X-065408-01-95
7-Way Diver Connectors	•Additional Mechanical Tests as per OneSubsea Standard for Pressure Retaining Equipment (Internal Specification)
12-Way ROV Connectors	•Additional Mechanical Tests as per SEAFOM TSD-02 •Additional Electrical Tests as per SEAFOM TSD-02 •Additional Environmental Tests as per SEAFOM TSD-02
12-Way alternative gender ROV Connectors	•Additional Mechanical Tests as per SEAFOM TSD-02 •Additional Mechanical Tests as per Petrobras I-ET-3000.00-1500-823-PEK-001 RC
12-Way Stab Connectors	•Additional Mechanical Tests as per OneSubsea X-065408-01-95 •Additional Environmental Tests as per OneSubsea X-065408-01-95
12-Way Diver Connectors	•Additional Mechanical Tests as per OneSubsea Standard for Pressure Retaining Equipment (Internal Specification)
Bespoke Connectors	•Additional Mechanical Tests as per SEAFOM TSD-02 •Additional Mechanical Tests as per Petrobras I-ET-3000.00-1500-823-PEK-001 RC

*4th edition

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Demonstrating technical robustness

Alignment to standards

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Designed in accordance with specifications

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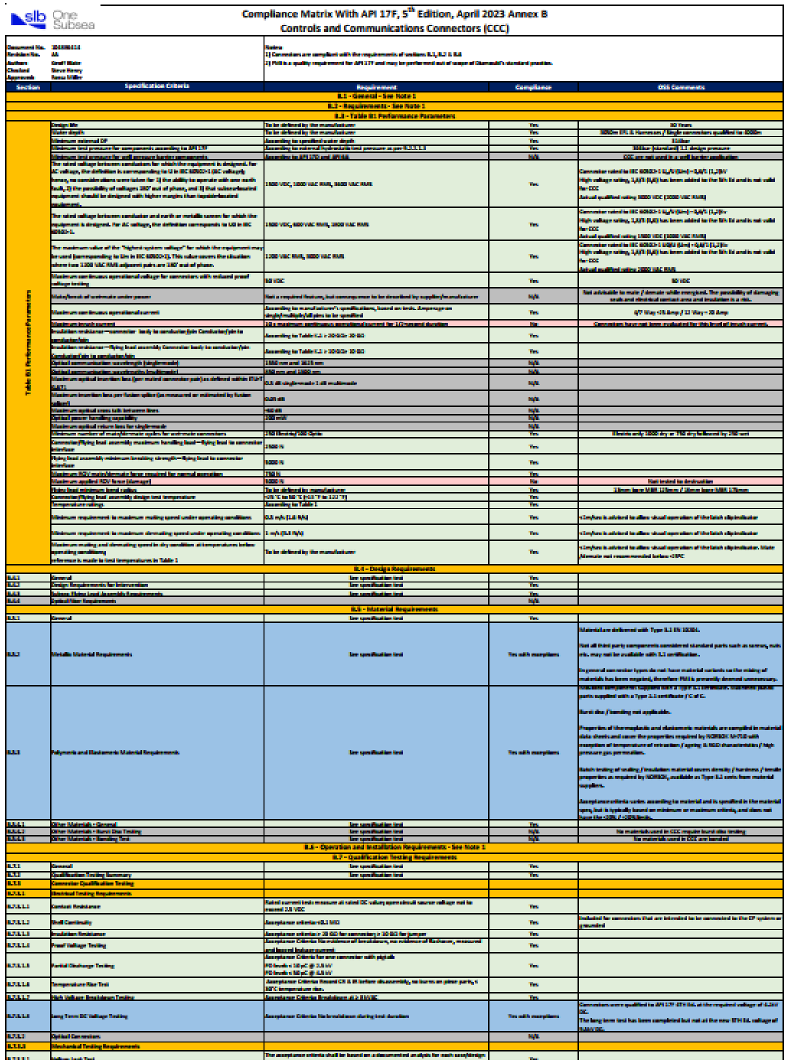
Plus additional product specific qualification

With ongoing gap closures to API17F 5th edition



*4th edition

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Hose, cable and termination management

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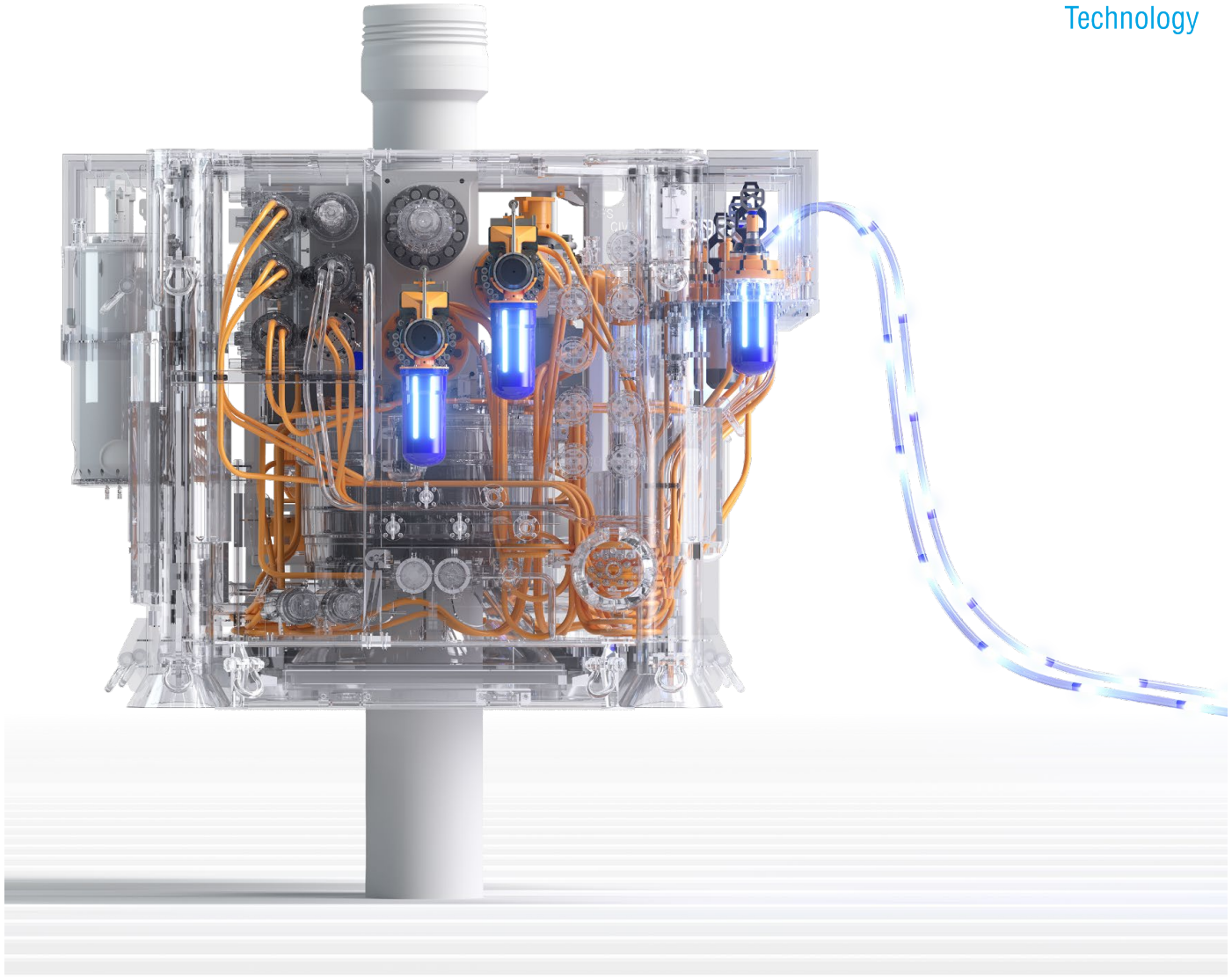
Key to long term reliability



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Acknowledgements

The author would like to thank all those within the OneSubsea and wider SLB organisations who have supported the controls connector portfolio developments

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