
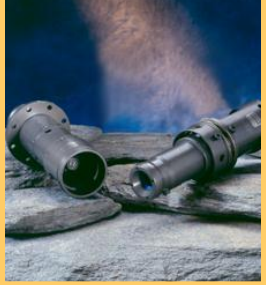
















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Underwater Fiber Optic Connectors for Neutrino Telescope systems

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Underwater Fiber Optic Connectors for Neutrino Telescope systems

- Fiber Optic Underwater connectors are well proven Over a Few Thousand Deployed Subsea
- Have a good field history and track record
- Still there is much work to be done in Specifying and Defining Requirements
- Advanced optically based VLVnT systems utilizing fiber optic dry-mate and wet-mate underwater connectors become an increased focus on reliability to ensure that these technologies are ready for the market.

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Typical underwater connector development programs include:

- Design and feasibility studies
- Prototyping, concept reviews, critical design reviews (CDR's)
- Failure mode, effects, and criticality analysis (FMECA's)
- Final design reviews (FDR's), test readiness reviews (TRR's)
- Detailed qualification programs, and pilot project deployments

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Underwater Connector Development Programs

A typical underwater connector development project from concept phase to deployment will typically consist of:

1. A Funding Source
2. Industry Partnership
3. Development of Operating Specification
4. Design Modeling
5. Prototype Manufacturing
6. Qualification Testing
7. Manufacturing Tooling
8. Manufacturing Procedures, Laboratory Configuration for Mass Production
9. Process Repeatability – Build units many times over in a production environment
10. Development of a successful field history over multiple deployments (typ. 3yr+) - TR

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Standards?

There are no known current industry standard specifications for underwater connectors.

However, there are a variety of organization specific requirements documents created by oil and gas operators and associated major equipment providers.

To Date these specifications are the main documents used in the initial development and qualification of underwater interconnect equipment.

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What is being Done to Fill the Gap

There are industry working groups such as Subsea Fiber Optic Monitoring systems (SEAFOM), that are creating subsea industry recommended practices for subsea interconnect systems. Recommendations through SEAFOM are currently being developed and should become available to the industry over the next few years.

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System Archetechure

Most all underwater wet-mate fiber optic connectors in current offshore deployments are for use with umbilical termination assemblies (UTA's) and remotely operated vehicle (ROV) operated optical flying lead jumper assemblies (OFLs) connecting to optical routers in the subsea control modules (SCM's).

These offshore projects that widely use the fiber optic underwater connectors have differing architectures than that of VLVNT systems.

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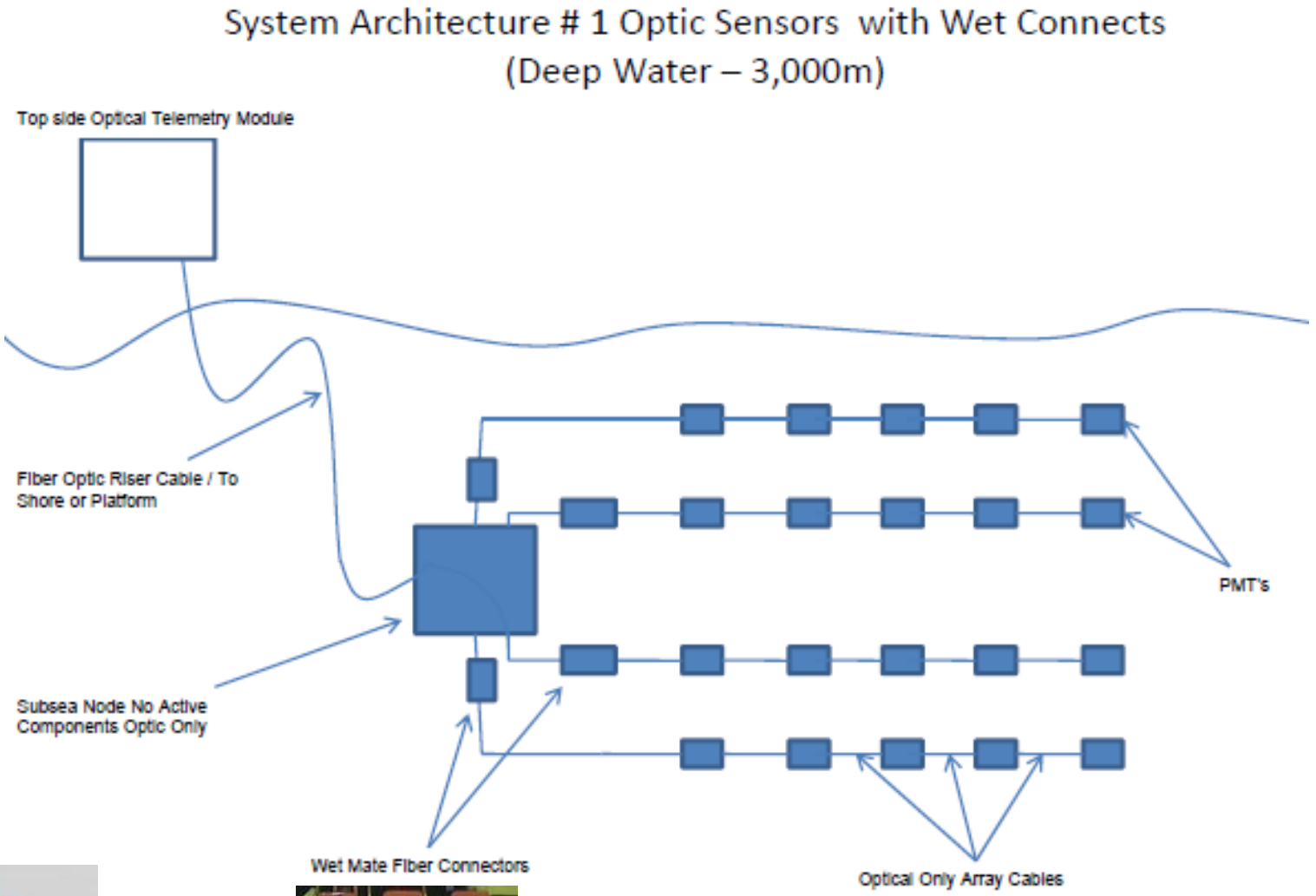

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Operating Parameters

Considering the differing architectures for VLVNT systems there will also be considerations for varying operating parameters.

An underwater connector used in an offshore umbilical typically will be used for data communications.

The operating performance for the underwater connectors will be evaluated for insertion loss (IL) typically less than .5dB per contact.

Other parameters for these communication systems will be less important such as contact back reflection (BR) and optical power handling.

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Description	**Parameter**
Design Life	25 years
Optical Performance – Single Mode	
Insertion Loss (IL) 1310nm & 1550nm	Better than -0.50 dB (Average –0.12dB)
Back Reflection (BR) 1310nm & 1550nm	Better than –45.0dB
Pressure Rating	
Operational Depth	7,000m (23,000 feet)
Header Differential Pressure Rating / Test	230 Bar (3,333psi) / 345 Bar (5,000psi)
Temperature Rating	
Operating	-5ºC to +45ºC (23ºF to +113ºF)
Storage	-40ºC to +60ºC (-40ºF to +140ºF)

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Mate / De-Mate	
Minimum Number Mate/De-Mate Cycles	100
Maximum Mate / De-Mate Speed	0.3 meters per second (12 inches/second) [Qualified for 0.6m/s (24 inches per second)]
Latch	Linear Mate/De-Mate, positive visual indication
Maximum mate/de-mate force	M 622N (140 lbs). D 222N (50lbs).
Mate / De-Mate	
Typical mate stroke length	121mm (4.8 inches)
Maximum Rotational / Angular / Radial misalignment	Rotational 10º / Angular 5º / Radial 6.4mm (0.25inches)
Maximum applied mating force	5000 N (1124 lbs.)
Chemical Compatibility	
Materials and components to be compatible with the following fluids:	Dow Corning DC200 Silicon Oil, Mineral Oil, Diesel, Castrol Brayco Micronic 864HT200 synthetic base hydraulic fluid, Marsten Bentley HW443 water based hydraulic fluid, Glycol, 50% Citric acid, 50% Acetic acid, Xylene, Methanol, Mono Ethylene Glycol (MEG), Water, Seawater

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Conclusions

While underwater fiber optic connectors are widely used in the subsea industry, much work is still needed for their specification in applications such as VLVnT systems.

Organizations such as SEAFOM are working to create recommended practices for equipment, however industry input is still desired as the latest VLVnT systems are developed.

Underwater fiber optic connectors will continue to be a critical part of the VLVnT system functionality and correctly identifying their requirements are essential to long term reliability when deployed subsea.