SEA CON®–Precision's Development of Umbilical Distribution

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Umbilicals & Tethering

Umbilicals are a critical link to an ROV's functionality as much as they are to Umbilical Distribution Assemblies (UDA). The more both technologies are creatively expanded, the more technological advancements can go from science fiction to fact. Both technologies share a common feature: they allow for communication between topside facilities (multi-service vessels, rigs, etc.) and subsea architecture (X-mas trees, subsea pumps, etc.), expanding the capabilities for data distribution.

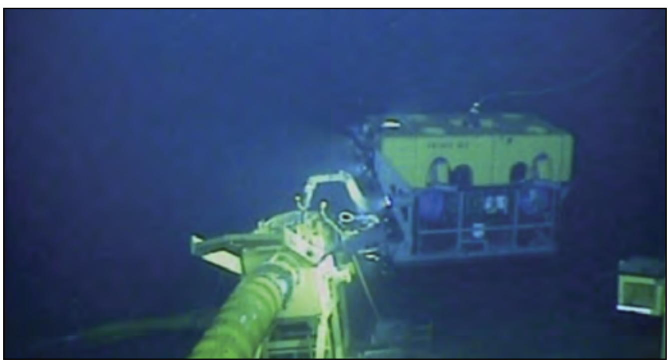

Figure 1: *Visual of UDA with ROV tether*

Unification of Tethering

The work of an Ultra-Deepwater ROV begins when it is "overboarded" via a Launch and Recovery System (LARS). The ROV will be tethered to a Top Hat or Cage Assembly via a Tether Management System (TMS) where the umbilical terminates. Once the ROV reaches operational depth, the ROV can "tether out" to its subsea focal point. The production umbilical is terminated at the UDA and serves as the communication link between mudline and surface. The UDA is similarly overboarded and installed into its designated position on the ocean floor. Upon landing, the UDA can be utilized as a distribution center for data and power (hydraulic capabilities can also be applied). Both data and power are distributed through flying leads with subsea-deployable connectors on both ends and are linked by a "Pressure Balanced Oil Filled" (PBOF) conduit hose. The PBOF hose (typically 13mm or 20mm) with connectors extends the UDA by allowing communication with subsea assets.

Figure 2: *LARS deployment of ROV*

Figure 3: *Umbilical reel*

Despite apparent similarities between the deployment of ROVs and UDAs, there are many differences. For example, an ROV's TMS is terminated on the surface at the umbilical to enable tethered travel, but UDA terminations do not have a built-in TMS; therefore, flying leads serve as the critical component to connect UDAs to existing subsea assets. Such connections are complex because they are done in open water, but a successful connection ensures operators can maximize the potential of a single umbilical.

Figure 4: *Flying lead with splice box*

Both ROV and production umbilicals extend communication paths, enhancing the capability of subsea equipment and fields. Subsequently, current flying lead connector technology expands a field's capability by eliminating the need to build, manufacture, and deploy additional umbilicals

Optical & Electrical Flying Leads

Before electrical and optical flying leads became a staple for open-water communication, the PBOF conduit hose underwent extensive analysis and development via qualification testing, design, and engineering. John Johansen, Technical Manager for SEA CON®–Precision, was instrumental in the development of PBOF hoses to ensure they met the offshore demands of the early 90s. Today, the PBOF hose assemblies continue to meet operational requirements for deepwater operations.

ROV pilots continue to demonstrate the worth of PBOF hoses, as flying leads have to be engaged and recovered from deployment frames while being handled by an ROV's manipulator to install at destination points. Pilots must manage the tether as it travels on an XYZ axis with a flying lead, increas-

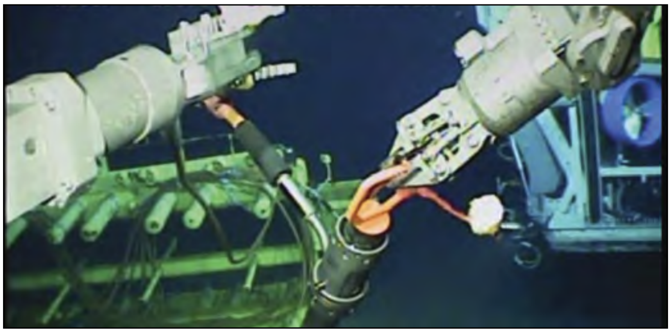

Figure 5: *Handling of PBOF hose with SEA CON® HydraLight*

ing the possibility of tangling the ROV's tether or the flying lead. The flying lead is also at risk of being dropped to the ocean floor or becoming snagged and inadvertently damaged.

To allay these concerns, the outer jacket, inner liner, strain elements, and armor elements of the PBOF hose assembly underwent extensive development. SEA CON®–Precision's PBOF hoses are now designed to handle inadvertent stretching during subsea operations to mitigate potential damage to fiber or copper lines. Extensive stress and pull tests ensure that a 2% stretch of hose is permissible during operations.

MKII Fitting Assembly

The engineering of the MKII fitting assembly was instrumental in ensuring sustainability of the PBOF hose. The MKII assembly is a two-layer design with tension and pressure armor in between and a break-load tension of 10,000 newton meters. Engineered to handle volumetric expansion and elongation, the MKII assembly, coupled with PBOF hoses, decreases the risk of potential downtime during the installation of flying leads in a dynamic application. SEA CON®–Precision would revisit the MKII fitting and associated PBOF assembly to apply such technology to a static application.

Figure 6: *SEA CON®–Precision MKII offerings*

This answer was found in the development of an 8mm MKII fitting with a proprietary hose that resembles clear, flexible tubing for ROV static and limited special applications.

ROV Intervention

The small profile of the 8mm MKII assembly reduces harm to fibers or connection points in constrained areas and allows it to serve as a bridge for the skid and tooling to tap into the power and telemetry of an ROV's umbilical. It also allows for distribution within the constrained area between an ROV intervention skid and tooling.

Figure 8 illustrates the spatial constraints when an ROV and skid are mated, caused by the skid being enclosed between the LARS deck and ROV. Skid technology has been influenced by the need for these skids to host additional equipment when ROV tooling and intervention equipment exceeds the space an ROV has for auxiliary components. Hydraulic lines (hard-plumbed/soft-plumbed) and electrical and fiber optic "whips" for equipment on skids are under the same spatial limitations. Should a drymate connector or fiber optic whip be placed under excessive stress in order to fit in a confined area, the stress can severely damage a bulkhead connector or cause the whip to break from the mating area. The potential for further damage increases when equipment must be removed to carry out repairs or maintenance, which requires the removal of components and compact equipment, including fiber optic and electrical whips.

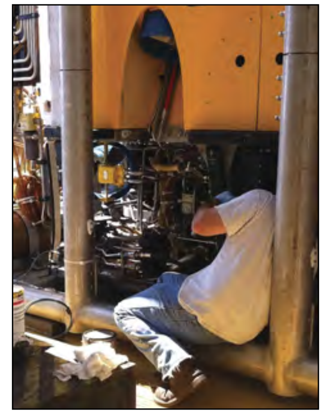

Figure 7: *Work on ROV without skid*

Figure 8: *ROV with mounted skid*

Despite the limitations of using ROV skids, skid technology continues to be a necessary extension for ROVs. Skids have been developed for contingent and non-contingent situations that involve actuation of BOPs, hydrate remediation, dewatering of flowlines, auxiliary functionality to control modules, etc. Therefore, when telemetry and power are essential for these operations, flying lead technology can be applied to this static application to expand the ability of an umbilical.

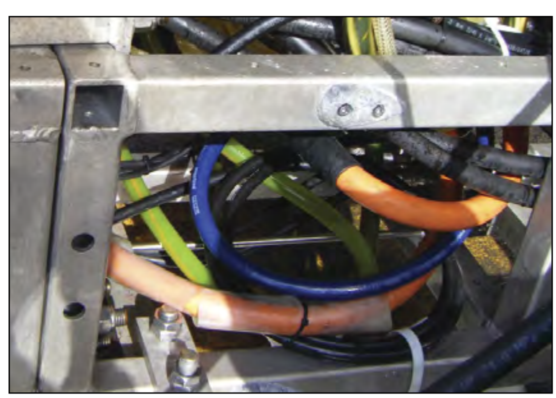

Figure 9: *PBOF hose constraints on intervention skid*

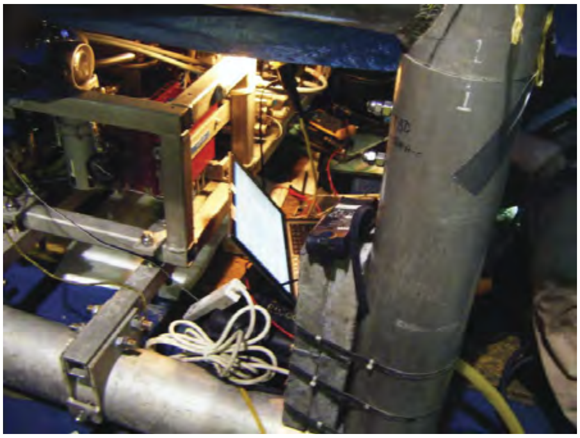

Figure 10: *Troubleshooting of intervention skid*

8mm, 13mm, and 20mm PBOF Assemblies

SEA CON®–Precision's intimate involvement with data distribution led to the development of 8mm, 13mm, and 20mm conduit hoses with MKII technology. These advancements led to the development of another product, the IDA (Inline Distribution Assembly), to creatively distribute data to actual subsea assets such as X-mas trees and Subsea Pumps. This ability is credited to the field-installable IDA's hybridization of the 8mm, 13mm, and 20mm technologies, which can be applied to those assets that need internal, non-open water (drymate) distribution.

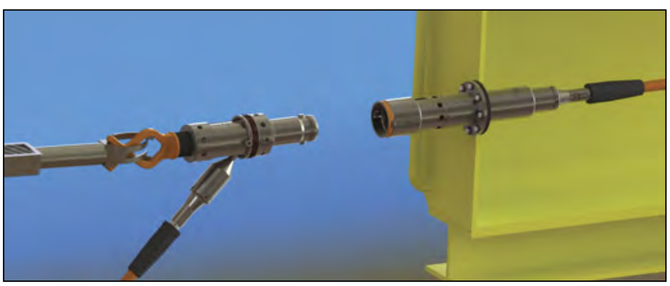

Figure 11: *Cross-section of typical bulkhead mounting*

To achieve this, the IDA is terminated to a bulkhead on an asset that matches the opposite end of a bulkhead on a UDA in order to correspond with the bridging flying lead. When communication is bridged to an independent subsea asset, the IDA can have a single 13mm PBOF that comes from an asset's bulkhead. By terminating the bulkhead on an asset to the IDA assembly, an operator can distribute data and power through two different paths using 8mm, 13mm, or 20mm hoses on either end. Figure 12 illistrates the application of such combination options. The accumulation of these technologies is essential in bridging static and dynamic operational requirements and creates a viable solution for open-water and drymate/surface-terminated communication.

Figure 12: *IDA with 13mm and 8mm PBOF*

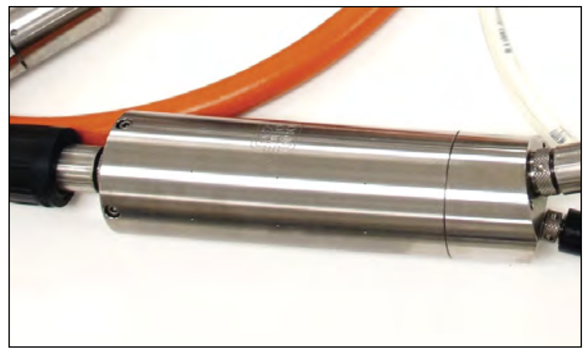

Figure 13: *IDA assembly*

48-Channel HydraLight

Advancement of subsea distribution continues today as demand increases for this technology to do even more. To accomplish this, great energy is focused on connector development. The concept of utilizing a higher-channel capacity for an already proven technology led to the development of the 48-channel HydraLight. The 48-channel connector has already been designed to meet these needs, and a 24-channel version of this design is in its qualification stage. The 48-channel fiber optic connector builds on the proven track record and field-tested technology of its 8-channel predecessor – a connector that is already internationally-recognized and qualified – and will offer a greater degree of confidence and success in the field. What developments this will lead to in the future remain unknown, but promises to be interesting regardless.

For more information, visit www.seaconworldwide.com.

Figure 14: *24 channel HydraLight during testing*