Joining Offshore Composite Multi-Core Cables

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Abstract

For offshore cable applications such as in the production of traditional oil & gas energy and renewable energy sources (wind, wave and tidal), and as in distributed monitoring systems for marine research and coastal security, the engineering performance targets for the physical infrastructure (wet-plant) are efficient transportation of energy and accurate transmission of information at minimum cost. Offshore cable is vulnerable to damage and can fail in service. Catastrophic failure is a significant risk to project economies. To ensure a high level of operational reliability and stability, investment in greater network sophistication is made „attractive" to lower the overall system costs.

The innovation to join composite multi-core cables enables the offshore industry to discover new project advantages of affordability, flexibility (variations) and reliability in systems engineering, marine installation, and operations & maintenance (O&M). Based on a value-added modular design philosophy, strategic product configurations including transition joint, branching unit, signal conditioning unit, and looped-back end seal can be realized. The submersible packaging of commercial in-line splice and connection technologies yields the benefits of low investment costs and reduced lead-times. This development strengthens the offshore industry's ability to manage project schedule and budgetary constraints.

Introduction - Systems Engineering

The physical infrastructure (wet-plant) may integrate a hybrid of cable design-type-functions offering strategic attributes; armored and non-armored, single-core and composite multi-core, low and high optical fiber counts, powered and non-powered, active and remote signal conditioning.

Ranking the cost of ownership factors, the largest component is the realization investment cost (procurement & installation), the second largest component is the operations and maintenance (O&M) costs distributed over the system's lifetime.

The investment costs are influenced by the cable network system design and the system's Straight-Line Diagram. The SLD defines the cable type(s), route, deployment depth(s), seabed protection, length and distance from shore.

A significant cost factor is the utilization of specialized cable laying vessels with integral cable storage, cable tensioning equipment, trenching and burial equipment, precision navigation-positioning capabilities, and an experienced staff. For cable that cannot be manufactured and/or transported in one length, reliable field splicing operations including equipment, facilities and trained personnel are then necessary.

The impact of probable fault repair on O&M budgets is difficult to assess. Coastal applications represent aggressive environments, cables are threatened by the local marine traffic including ships' anchors and fishing trawler equipment. Depending on the seabed conditions, trenching and burial of the cable is a system installation option. Or, in the manufacture, additional layers of armor protection are also to be considered. However, the cost of the additional protection may not be justified.

Components of the repair process include network re-configuration for fault isolation, access to site(s) to de-terminate, cable recovery, cable deployment, re-terminate, and verification acceptance.

Due to availability of a suitable repair vessel and suitable weather conditions, the repair operation may require months to complete. This process yields significant variations of cost and system performance penalties.

To facilitate O&M services, systems engineers evaluate the integration of options including redundant fault-tolerant systems, monitored „loop“ systems with manual, remote, or automatic reconfiguration, and additional back-up technologies and reserve capacities. The network system complexity has no direct effect on the cable repair costs. The cable fault has to be repaired and the cost is the same irrespective of the network design. However, the conservative network system design is a significant investment cost factor.

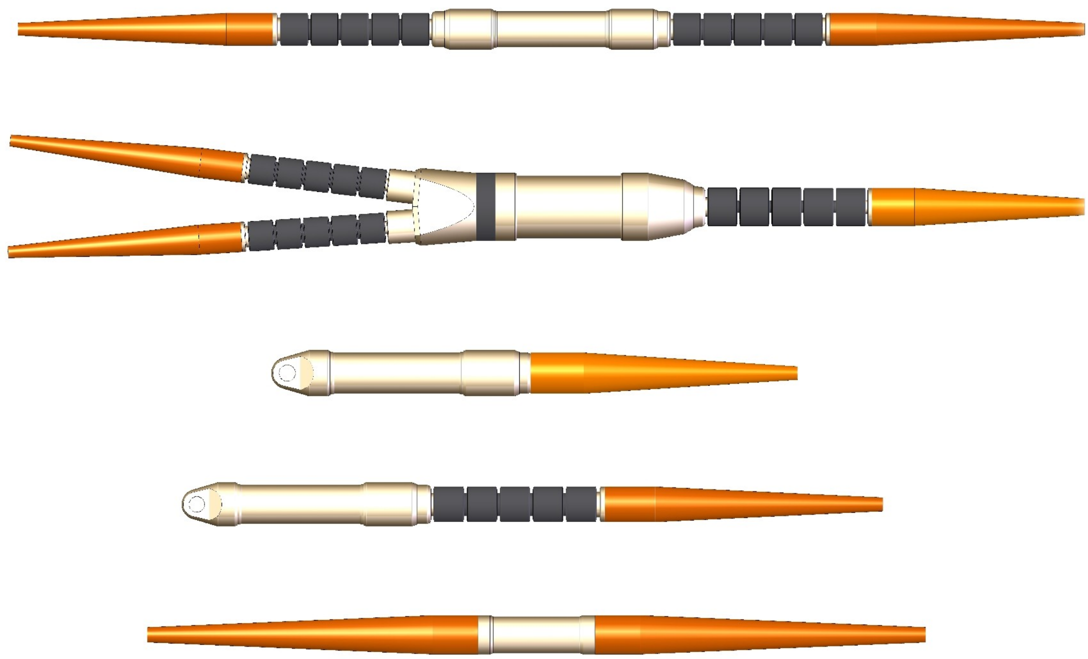
Joining of Cable

Impacting the system realization investment and O&M costs, an alternative method to maintain maximum system performance stability is the ability to join cable.

As mentioned earlier, offshore network infrastructure can include a combination of cable design-types, in specific single-core and composite multi-core designs. Where jointing technology specific for single-core undersea cable is commercially available, a similar service for offshore composite multi-core cable is new to the market.

With direct influence on the realization investment, a cable joint allows for efficient management of cable segment manufacture, transportation and handling logistics. The joined cables need not be identical. As defined in the system‘s Straight-Line Diagram SLD, a transition joint may connect desired lengths of protected (extra armor) and non-protected cable. Transition jointing allows the system purchaser to seek competitive tenders of both new and replacement cable including the benefit to option for multiple sources to secure cable supply. Thus, making effective depot management (sharing of available spare cable) possible.

Additional product variations of this jointing technology are branching units and end seals. For strategic system applications, together with the ability to transition cable types, the branching unit can be configured to perform selected signal conditioning functions including amplification, distribution or multiplexing. The option to utilize looped-back end seals accommodates planned future system expansion, and allows for acceptance testing procedures supporting phased project administration.



This jointing technology offers a significant benefit to offshore AC power systems. Respective to the voltage and cable type, the predominant transmission efficiency loss component is capacitance, attributed to the voltage induced between the conductor(s) and metal sheath(s). The resulting reduction in current carrying capacity limits their offshore cable application lengths. The ability, within the cable joint, to interrupt and cross-bond the individual power core sheaths suppresses the induced voltage(s) and makes possible the realization of extended cable routes.

Product Design Philosophy

In principle, the joint is necessary to reinstate the functional properties of the cable, making the connection as transparent to the system as possible. The cable joint ensures the optical, electrical and mechanical connections between the cable(s) and is waterproof for the maximum seabed laying depth. The cable joint design includes three major components; the pressure housing with patented cable feedthrough seal, cable armor termination and cable bend-limiting system. The pressure housing provides submersible protection of commercial in-line splice and connection technologies for power cores, coaxial cable, optical fibers, mechanical tubing and hose. The cable armor termination anchors the cable to the joint housing. The cable bend-limiting system protects the cable and joint from excessive bending.

The NORDSEE WELLER design philosophy is based on a foundation of modern Total Quality Management, directed to satisfy customer performance requirements for Profitability, Customer Service, Logistics, Productivity, Quality, and Innovation.

The design platform is modular, scaleable and adaptable, thus available in multiple product variations. Our continuous improvement program for optimum cost reduction, quality control & reliability management drives the necessity for a minimum number of components, materials, and processes. This methodology results in a minimum number of quality parameters with a minimum degree of respective variation.

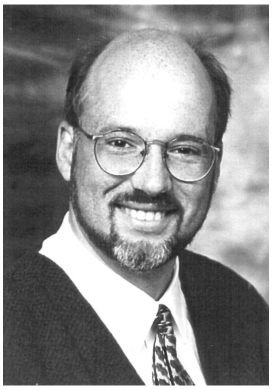
The design platform is not based on traditional production technologies such as welding, casting and over-molding. These processes are development and quality control intensive, and in today‘s project oriented marketplace are difficult to justify.

The systems engineering objective is to maintain high network availability with limited access for repair and limited system redundancy. NORDSEE WELLER through the Pedigree Review Process offers to the customer an active reliability management system used to certify performance compliance.

Conclusion

The ability to join offshore composite multi-core cable and to transition cable types optimizes the stability of system performance parameters. NORDSEE WELLER aims to continue to enhance its overall capability by managing innovative development and advance effective offshore cable jointing technology. The goal of these initiatives is to reduce the cost of project administration, through reduced component and equipment costs, reduced order delivery lead-times and reduced on-board jointing times. The continuous improvement strategy includes closer integration of cable manufacturers, marine installers, and system purchasers, in an effort to improve the value-added benefits to the customer.

Biography



From 1985-1995 Jeffrey Hans Weller as Product Engineer was responsible for the supply of certified undersea quality discrete electrical, optical, and mechanical components used in AT&T's manufacture of transoceanic fiber-optic cable repeaters. Following, he transferred to AT&T Advanced Technologies as Senior Procurement Specialist with the responsibility for the cost estimation process of undersea project proposals in compliance with the Federal Acquisition Requirements. In 2000, he joined NSW (A Corning Cable Systems Company) as Deputy Director of R&D for cable hardware and repair technology where he championed the realization of the patented multi-purpose closure technology. And, he functioned as the UJ/UQJ technical interface to Global Marine Systems Ltd..