ONE SIZE FITS NONE: IDENTIFYING STANDARDS TO FACILITATE FUTURE CONNECTIONS OF UNDERSEA FIBER OPTIC NETWORKS TO OFFSHORE OIL AND GAS PLATFORMS

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Abstract: Commercial transoceanic cable systems rely on product and infrastructure standards which serve to streamline the deployment and installation of complex undersea systems. Now that submarine fiber networks are being installed to offshore oil and gas platforms, these familiar infrastructure standards no longer exist. As a result, network deployment to offshore platforms often requires product customization, the creation of one-off designs or modifications made in the field during installation. Each of these carries schedule and cost penalties which impacts the entire project.

The establishment of a common telecom infrastructure standard by the offshore community may streamline future networks much in the same way standardization has contributed to the efficient delivery of complex transoceanic networks. This paper examines the impacts of multiple infrastructure requirements to the delivery of an offshore submarine system, demonstrates how existing standards have benefited commercial networks, and offers suggestions to standardize and streamline future submarine fiber optic installations to offshore oil and gas platforms.

1 INTRODUCTION

Over the past two decades, providers of undersea fiber optic networks have established and benefited from product and infrastructure standards that allow for timely and cost effective installations around the globe. As undersea networks expand into the oil patch, we are faced with different and unique situations to overcome. Instead of bore pipes we have riser tubes, cable stations have been replaced by comms-rooms, and beach manholes are now riser hang-offs. The impact of these new requirements is compounded when specifications vary from rig to rig. Moreover, offshore platforms are also heavily regulated by classification societies and government agencies, each of which adds additional layers of requirements and approvals.

When a new transoceanic cable system is being planned, suppliers understand what to expect: At the beach, four inch conduits and a large manhole to land the cable. At the cable station, there are open aisles for equipment and a DC plant with adequate -48V power. There may be raised flooring, overhead fiber trays and steel racks; all waiting for the next installation. Even with the trend to smaller buildings, the basic infrastructure of a cable station varies little from country to country, or owner to owner. These standards were developed over time, and allow for the timely and cost effective installation of submarine networks around the globe. Unfortunately, such uniformity doesn't exist just a few kilometers offshore.

2 OFFSHORE ENVIRONMENT

An offshore platform is one of the most technologically advanced structures on the planet. Each one is custom engineered to complete specific tasks at discrete locations, often in remote, extreme environments. Each new platform commissioned includes modifications over its predecessors to take advantage of newer technology and increasingly harsh environmental loads. The result is no two platforms are alike. The differences can be subtle, such as the layout of working and communication spaces to major design changes in the superstructure and hull. Even similar platforms within a single company are differently managed, with varying requirements for offshore personnel, installation procedures and documentation.

To further compound the problems for undersea communications providers, many of the designs for even the newest offshore platforms currently in operation did not anticipate the requirements of telecommunication cables landing on the platform. Historically, satellite and microwave installations only required topside installations. Suddenly new topside, between decks and below the waterline infrastructure is required for fiber optic cables. While easily accommodated in a new design, retrofitting riser tubes to existing platforms is costly and time consuming and specialized transmission equipment must fit into already tight rooms. Often there is limited space to expand.

"Location, location, location" is the golden rule for real estate, and it applies offshore too. But when offshore, oil takes priority. The majority of the space onboard a platform is dedicated to the production of oil and gas. The oil priority also applies when it comes to accommodating telecom personnel as well. It is difficult to get extra bodies onboard, and the amount of time they can stay is often limited to just a few days at a time. Even with the recognized need for robust communications after two difficult storm seasons, telecommunications installations must still stand in line for space.

Such is the landscape facing the latest generation of “offshore” submarine networks being installed today. For system suppliers, the varying infrastructure, space and procedures make an already challenging problem that much more complex. Customizing products to meet the unique requirements of individual platforms adds to the design effort, increases the number of site visits, and lengthens time spent onboard, all of which increase cost. By establishing basic standards for some of the key infrastructure items necessary to support fiber optic offshore installations, the delivery process could be streamlined without changing the “oil priority”. In fact, by adopting a standard infrastructure and procedures for submarine fiber optic cables, the amount of time spent onboard the platform can be reduced, thus freeing up resources for oil production.

3 KEY TARGETS ITEMS FOR STANDARDIZATION

Some items that may benefit from standardization are:

Communications Rooms

Oil and gas platforms have small and crowded communications spaces which forces Submarine Line Terminating Equipment (SLTE) equipment to coexist with other platform equipment, often in the same rack. Moreover, these rooms are often filled with rudimentary racks, which are perfectly fine for a router or computer, but not practical for complex SLTE equipment which often requires dedicated frames and bays.

Even something as simple as removing the existing racks and anchoring a new SLTE bay to the floor becomes an engineering exercise. In the Gulf of Mexico, some platforms required the use of existing studs in the floor. What sounds like a simple request evolves to multiple site visits and the creation of unique adapter plates to match the floor studs to the SLTE bay. Other platforms, however, allow the drilling and tapping of new holes or the use of an impact gun to "shoot" new studs into the floor, a much simpler approach requiring far less advanced planning.

Ceiling heights also vary between each location. The overhead is often shared with steel structure, pipes, ducts and other cables which also limit the available space. The “cable station” standard of 4.0m is not available at all locations, so the SLTE bays were customized to accommodate a lower ceiling height. See Figure 1 below.

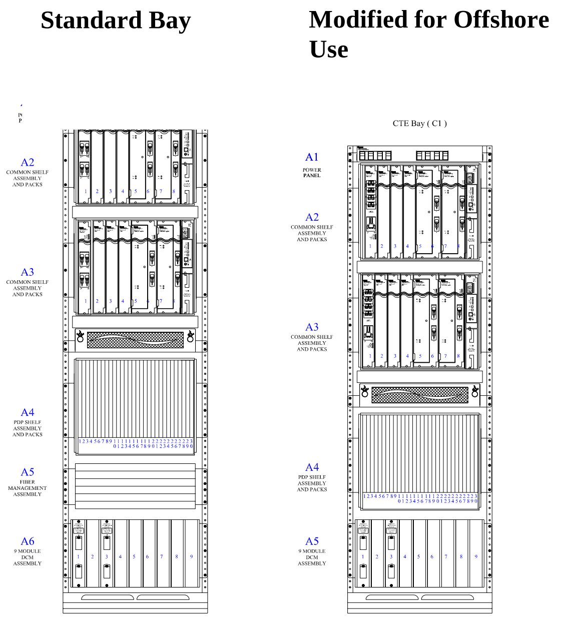

Figure 1: Customized SLTE bay solution

Not all rigs are equipped with -48V power requiring additional power conversion equipment and batteries squeezing into already crowded bays. Future platforms could benefit from allocating raw space for telecom users rather than pre-installing racks for universal use. A -48V DC power plant can be easily incorporated into the platform power plant during the design phase with minimal additional space requirements.

Riser tubes **–** The size and layout of riser tubes vary from rig to rig, requiring modifications to riser terminations and hang-off assemblies. “I” tubes and “J” tubes are used to contain the fiber cable and anchor the cable to the platform. An “I” implies a straight pipe resembling the letter for which it is named; unfortunately this is not always the case. An “I” tube, used for dynamic risers, has its entrance and exit in a vertical orientation. A “J” tube entrance and exit are offset 90 degrees. In either installation the middle of the pipe is free to twist, turn and snake through the platform structure. Pipes of this style were likely old oil pipes, or originally designated for other non-telecom uses. See Figure 2 which shows a typical riser tube installation attached to platform structure.

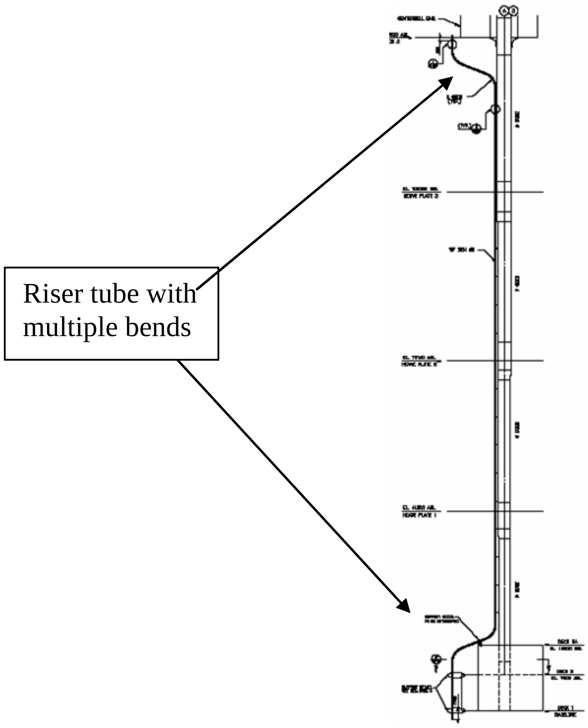

Figure 2: Riser tube installation

Unfortunately, the combination of pipe diameter and bend radius limits the size of pre-installed terminations. When existing "I" or "J" tubes are undersized, pre-terminated heads must be removed and specially reconstructed after the cable is installed. Unique spares are also required to for these special installations.

The amount of space topside of the riser tube is critical for a safe cable installation. The topside flanges are often crowded with other riser installations or platform structures as shown in Figure 3.

Figure 3: Riser top flange

Unlike a cable shore landing where the cable is floated to the beach, a riser installation requires a large quantity of cable suspended between the cable ship and the platform, increasing the cable tension. Where a simple backhoe or tractor can pull a cable ashore and anchor a turning sheave on a beach site, a custom engineered support is required for winches and sheaves onboard a platform. Each platform has different deck arrangements thus each requires a unique solution for installing equipment and installing the termination.

The underwater ends of the tubes also vary from platform to platform. Some are flush with the keel of the platform hull, while some extend below the keel. Figure 4 shows a riser tube with pre-installed bellmouth on the underside of the Holstein platform.

Figure 4: Holstein Platform – Communications Bellmouth

Some have bolt flanges with sharp edges requiring bend limiters and chafing gear, yet others are equipped with bell mouths requiring nothing more.

Future installations will benefit from riser tubes that are purposefully designed for fiber optic cables and terminations. These riser tubes will be of sufficient diameter, with minimal bends and be fitted with a bell mouth on the bottom end. Certainly accommodations are more easily incorporated while the platform is being designed or still in dry dock. Making these modifications at sea is much more difficult and required sophisticated diving operations or ROV intervention.

Existing Fiber

While submarine fiber communications systems are relatively new to offshore platforms, there is existing fiber to be found onboard rigs, or inside existing umbilicals. Much of this fiber is typically installed to terrestrial standards and may not be suitable for submarine systems. Often this fiber is multimode or has too high attenuation for use on a high capacity 10gb/s network. However installing new cables onboard the platform is not trivial either. The U.S. Coast Guard along with classification societies regulates cables installed offshore. Cables must be specially rated to pass though the hazardous and possibly explosive environments found onboard.

In addition, regulatory requirements extend to battery plants as well, and in the case of the Gulf of Mexico project, special visa requirements for personnel working offshore. While it maybe impossible to fully standardize compliance to regulatory bodies, prudent suppliers must be aware of this additional layer of regulations.

Independent Platform Management

Offshore platforms are cities at sea, and like cities around the world, each has its own management style and politics. Platforms are often joint ventures between multiple oil companies. Even platforms within a single company have varying documentation requirements, approval procedures and safety requirements that influence each cable installation. Product customization costs time and money. Multiple modifications negatively affect a project's budget and schedule, often with significant impacts that ripple throughout the project. Increased design efforts, testing, installation and spares levels often result.

4 CONCLUSION

We have seen how industry standards have benefited transoceanic cable networks. Even with the complexities of multiple landing parties each located in separate countries; standardization allows even the most complex networks to be efficiently installed. Future planning can similarly prepare offshore platforms for submarine fiber optic installations.

The benefits of fiber's ability to survive harsh weather conditions combined with its inherent high capacity and low latency make fiber communications critical to the success of deep water installations. Submarine providers do not want to interfere with the complex operation of these offshore cities, and the new offshore fiber networks being installed today will prepare the way for future systems and identify areas where the application of common standards can benefit both the platform owners and system suppliers alike.