Floating Wind Solutions

New Design Approach to Filling Gaps of Industry Codes for Submarine Power Cables

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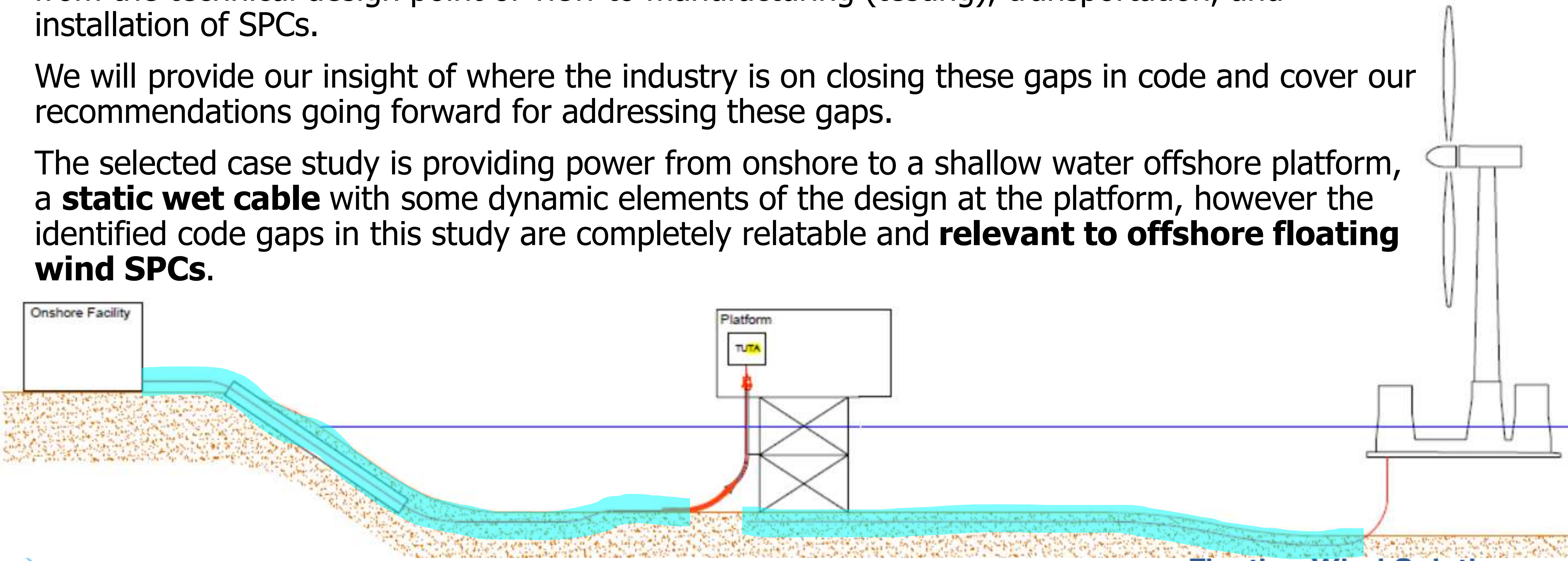
Organized by

Introduction

The increased need for longer Submarine Power Cables (SPCs) is exposing gaps in current industry infrastructure and codes. We will present the lesson learns from one of our study cases from the technical design point of view to manufacturing (testing), transportation, and installation of SPCs.

We will provide our insight of where the industry is on closing these gaps in code and cover our recommendations going forward for addressing these gaps.

The selected case study is providing power from onshore to a shallow water offshore platform, a **static wet cable** with some dynamic elements of the design at the platform, however the identified code gaps in this study are completely relatable and **relevant to offshore floating wind SPCs**.



Case Study

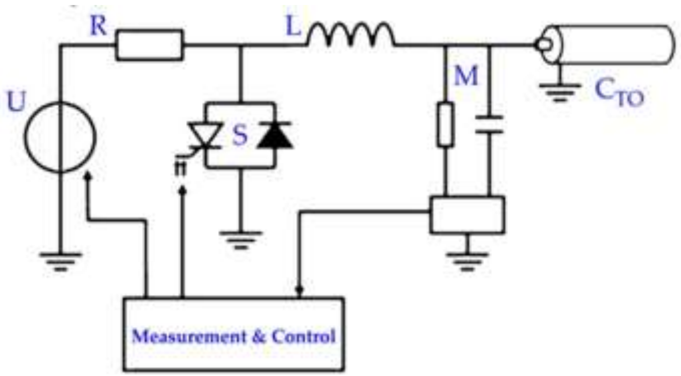
Case Study – Doris was initially engaged to review the technical data on a SPC to investigate what had gone wrong (SPC was built, transported, installed, and interconnected, but never passed the commissioning tests - energizing) to understand how seven (7) faults in the power core had occurred. Doris has then provided owner's engineering assistance in redesign thru to installation of the new SPC, which is >30 km MV 3 core AC + 2 FO cables SPC with no factory splices. Applying both API SPEC 17E and ICEA S-97-682-2013, as primary code requirements.

Background regarding the original cable:

- ***Manufacturing*** – Power Cores were constructed in one country and then shipped to another country where the fiber optic cables were constructed and the final assembly of the SPC stock was completed.
- ***Transport and Storage*** - Finished cable was placed on a transportation reel, shipped and stored at a dock near the field installation location until the installation vessel was available. The cable was transpooled into the installation vessel basket. Total transpoolings: five (5)
- **Installation** - The SPC was installed in the onshore crossing in an HDD conduit and then laid to the offshore platform. Burial to 1m depth was performed after the initial lay.

Note that 9 out 10 failures occur from handling the SPC after receipt from the supplier.

Manufacturing



Regarding the New SPCs:

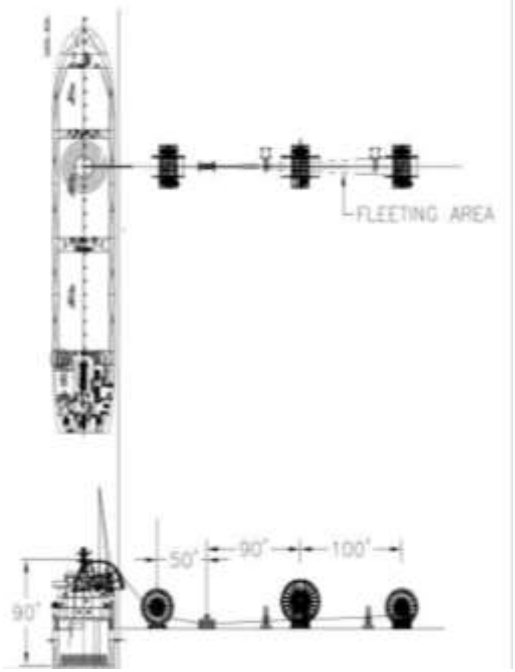
Gaps Description

- ***Partial Discharge Test*** – Code requires test with entire length of completed cable, however suppliers have limited capacity Faraday cages and resist testing performed with electromagnetic interference present (Source: API SPEC 17E).
  - ***Path forward*** – All parties agreed to test sample lengths taken from both ends in a Faraday cage environment.
- ***Insulation Resistance Test*** - Code requires testing performed in a water bath (Source: API SPEC 17E). One code that was not a normative reference suggested a sample could be used, but not definitively.
  - ***Path forward***

    - All parties agreed to test sample lengths in a lab environment.

    - Opened the door to include non-traditional unproven testing requirements with ambiguous results, with no testing history or comparable data.

Transportation

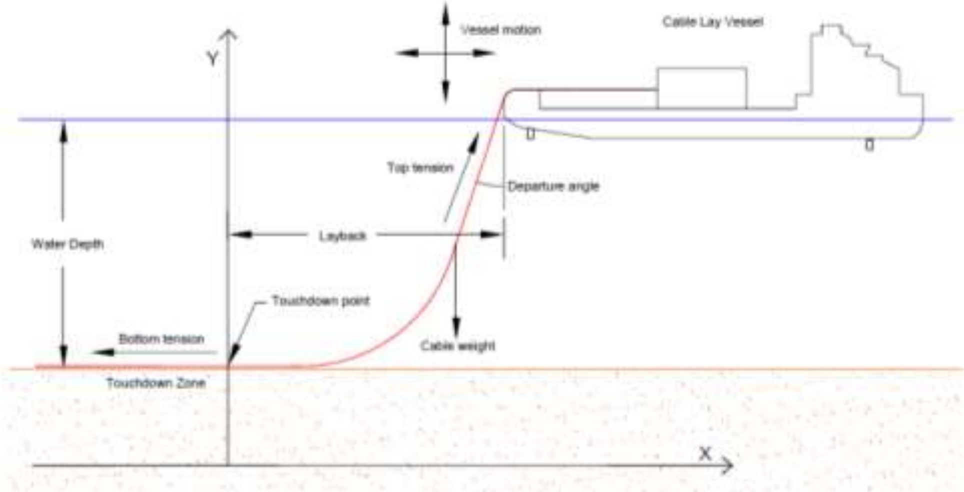


Gaps Description

- ***Torsion Monitoring*** – Codes identify in addition to monitoring tension and minimum bend radius that the twist in the cable should be monitored. However, no guidance is provided in the codes on how to accomplish this. All SPC manufacturers (invited to bid) did not include torsion capacity of the cable, nor is testing required by code to determine this parameter (Source: API SPEC 17E).
- ***Fleeting*** – How fleeting from the storage reel to tensioner is to be monitored or controlled is not captured in codes. The codes instead focus on monitoring parameters of the cable. The fleeting process method was found in the original cable to be a source of exceeding the minimum bend radius. A longer cable just increases exposure to damage (Source: API SPEC 17E).
  - ***Path forward*** – Include the SPC manufacturer in the design process of the transportation and loadout of the cable onto the installation vessel. Avoid manual processes during load out when possible. Take a system engineering approach to design of processes.

Installation

Gaps Description



- ***Touchdown Monitoring*** – Codes identify the umbilical touch-down point shall be continually visually monitored by ROV (Source: API SPEC 17E). What is often found in installation procedures is, ”Cable profile between chute and touchdown as observed by ROV (if required)”.
- ***Torsion Monitoring*** – Codes identifies in addition to monitoring tension and minimum bend radius that the twist in the cable should be monitored (Source: API SPEC 17E). However, no guidance is provided in the codes on how to accomplish this. Cable manufacturers do not include torsion capacity of the cable, nor is testing required by code to determine this parameter.
- ***Burial Monitoring*** – Codes are clear about maintaining the minimum bend radius, but not clear about how to monitor the burial process as they tend to be focused on the installation of the cable.
  - ***Path forward*** – Include the SPC manufacturer in the design process of the installation and burial of the cable. Taking a system engineering approach to the design of the process.

Industry Snapshot

- Code development is ongoing but is limited to three year or longer refresh cycles.
- There is active transfer of lessons learned between code bodies. Some members also sit across more than one code task group, but the primary focus of each group tends is slightly different and need more coordination between groups.
- Recent code releases and updates, such as IEC 63026:20192019 Submarine power cables with extruded insulation and their accessories for rated voltages from 6 kV up to 60 kV - Test methods and requirements and CIGRE TB 722:2018 Recommendations for additional testing for submarine cables from 6 KV (UM=7.2 KV) up to 60 KV (UM = 72.5 KV) are helping in closing some gaps.
- API RP 17Z Recommended Practice for Medium Voltage Equipment Used on Subsea Production Systems, First Edition issued January 2024.
- Some code bodies have been developing codes of practice, such as, the IMCA recommended code of practice on environmental sustainability, which is a voluntary document issued in May 2021 that is focused on marine construction providing recommend practice to address installation issues with laying cable.

Process Forward

What has Doris been doing to close the gaps:

- Developing a suite of project specifications that bridge the gaps.
- Actively working on task groups to improve the existing codes.
- Development of white papers and presentations to highlight the gaps.
  - Static wet cable
  - Electrical dynamic sizing and evaluation of existing software loosely based on IEC60287
- Application of Supervised Machine Learning to preform text comparisons checking to identify gaps in codes. In-house development of these algorithm tools.
- Help create SPC working groups (final users + manufacturers + engineering consulting firms), to create and keep a common and public database to gather all possible technical data of each project, in order to help identifying "industry practices" and possible failures points for these applications (i.e: SCP length, depth, voltage, insulation, standards used, splices used or not, etc).
  - Project related informal group sessions
  - JIP hosting

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