Lessons Learned: Offshore Cable Installation

September 2010
Andy Readyhough
Global Marine Energy
Cable Installation has caused a lot of trouble in Europe

Will this be avoided in North America?
Cable installation is a **small** part of project cost

### Average Offshore Wind Turbine Installation Costs - Split

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbines &amp; Sub Structures</td>
<td>73%</td>
</tr>
<tr>
<td>Cable</td>
<td>10%</td>
</tr>
<tr>
<td>Cable Installation</td>
<td>7%</td>
</tr>
<tr>
<td>Grid Connection</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: Global Marine Systems
Cable installation is a small part of project cost

...but provides a surprisingly large part of project problems

“I was told by one major developer that 80% of their problems in offshore installation, is the cables. Because it's just very difficult to do.”

It is widely recognised in the industry that difficulties have been encountered with the export cables for a number of offshore wind farm sites. Although some of these problems that have occurred may be attributed to the inherent uncertainties of marine operations, some can be traced back to the planning stage and a lack of understanding of key issues.

Source: A Risk Based Approach to Cable Installation for Offshore Wind Farms: SE Tech
Cable installation issues have resulted in significant losses

### Major Offshore Insurable Losses

<table>
<thead>
<tr>
<th>Project</th>
<th>Event</th>
<th>Estimated cost - PD only (EUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danish windfarm – CAR</td>
<td>Anchor drag on cable – contractor vessel</td>
<td>1m - 5m</td>
</tr>
<tr>
<td>UK windfarm - CAR</td>
<td>Damage to cable caused by plough tipping</td>
<td>1m – 5m</td>
</tr>
<tr>
<td>UK windfarm - CAR</td>
<td>Water damage to cable following capping</td>
<td>1m - 5m</td>
</tr>
<tr>
<td>UK windfarm - CAR</td>
<td>Transformer damage following testing</td>
<td>1m – 5m</td>
</tr>
<tr>
<td>UK windfarm - CAR</td>
<td>Damage to cable during onshore laying</td>
<td>1m – 5m</td>
</tr>
<tr>
<td>Dutch windfarm – CAR</td>
<td>Blade damage during rock dumping</td>
<td>Less than 1m</td>
</tr>
<tr>
<td>Dutch windfarm – CAR</td>
<td>Storm damage to railings</td>
<td>1m – 5m</td>
</tr>
<tr>
<td>Belgian windfarm - CAR</td>
<td>Foundations / J tube</td>
<td>20m +</td>
</tr>
<tr>
<td>Danish windfarm – Operating</td>
<td>Step-up transformer damage</td>
<td>1m – 5m</td>
</tr>
<tr>
<td>Irish windfarm - Operating</td>
<td>Dragged anchor</td>
<td>1m – 5m</td>
</tr>
<tr>
<td>UK windfarm - Operating</td>
<td>Cable fault</td>
<td>5m +</td>
</tr>
</tbody>
</table>

+ warranty losses (Horns Rev / Scroby etc)
Global Marine Systems: Subsea Power Cable Installation Specialists

- Our area of expertise is in project design, installation, burial and maintenance of inter-field cables, export cables and inter-connectors.
- At the forefront of the alternative energy market for several years, specifically offshore wind.
- Experience at many of the world’s largest offshore projects.

Locations:
- Beatrice
- StatoilHydro Gjoa
- Horns Rev
- Horns Rev 2
- Alpha Ventus
- Nord Eon 1
- Sheringham Shoal
- BritNed
- London Array
- Gunfleet Sands
- Thornton Bank
- Kentish Flats
In short, we handle cable: our vessels & equipment are somewhat different than what you normally see in offshore wind photos.
Why Does this happen? Consider this *Idyllic* scene

A windfarm can be over 25 square miles or larger... What has the survey told me about all of that real estate?

**Experienced personnel (with a long resume of project work) are in very short supply**

**The weather offshore is often harsh & unpredictable making for a very complicated working window**

**Much of the project equipment used today (J-tubes, Substations, etc) are non-standardized**

**Properly configured vessels & barges are also in very short supply**

**Cable installation equipment is highly specialized**
Don’t let 7% of your project derail the other 93%...

These days, due to **Largely Preventable** problems:
- Most projects experience some serious problems with their cable installation
- **Bankruptcy** for cable installers is not at all unusual
- Much of our business comes through **Remedial** work...

While that may be personally **Good** for us in the short-term, it is **Bad** for the industry long-term

**AVOID** allowing cable installation to becoming a Project bottleneck
Togethet let's learn from experience

Offshore wind may be relatively new, but cable has been installed under the water for well over 150 years.

The Industry in Europe is over a decade old, with all of the lumps to prove it - they have experience.

Many of the processes and project management issues are similar in both Telecommunications & Offshore Power.
What are some lessons we can learn from Europe?
Lesson: Vessel Selection is a big deal

NOT about installing one cable and then replication – a successful plan will accommodate all of the (100 or so cables) holistically

- Common issues/costs to consider re: cable installation vessel on an offshore wind project
- Availability
- Weather window
- Speed of installation
- Accommodation (60 people)
- Barge management system
- Anchor handlers
- Anchor patterns – innovative to maneuver around foundations to keep time to a minimum
- Transfer vessels and planning
- Insurance
- Contractor interface (foundation, j-tube design – vessel coordination)
- Communications (v-sat or similar to transmit large amounts of data on a daily basis)
- Overall project logistics
- Turntable
- Manning strategy
Lesson: Cable Planning areas requiring detail

Know Areas
- Route Survey
- Route Planning
- Engineering Detail Turbine
- Permitting
- Engineering at Substation
- Cable Selection
- Vessel Scheduling
- Engineering at Power Grid
- Vessel Selection
- Engineering at Interconnect

Unique to the Great Lakes
- Ice scour anticipated impacts
- Hazardous waste buried in Sediment
- GL Weather window
Lesson: Discovering cable problems on site is expensive, try to avoid it

Example:
Is there enough space near the J tube to accommodate the cable necessary?

Is there enough cable being supplied as part of the customer order?

What about calculating cable pull-in tensions?

How much headroom is there and what possible conflicts are there with the equipment needed to pull in?
Preferred Method: 3D cable installation modeling
Use the virtual world to minimize cable mistakes in the real world.
Lesson: Once Installation begins, be flexible & prepared for the unexpected

A good installation project team will have planned for the following:

- Survey Issues
- Weather delays
- Equipment issues
- Cable issues
- Cable burial
- Delays by preceding suppliers
- Site inspection
- Approval processes
- Permitting issues
Lesson: Once operational what is the Maintenance Plan?

In the telecommunications industry, a well thought out subsea cable maintenance plan is a core element to their business model.

In Oil & Gas Life of Field (Riser Monitoring) is a major priority.

Maintenance will make the difference between maintaining output or prolonged interruptions and downtime.
Lesson: Maintenance: What is the plan?

Most offshore wind farms are too new to have proven maintenance models in place. Maintenance is costly, some type of group arrangement with groups of wind farms in a region should be considered.

- Cable Monitoring & Integrity
- Spare Cable Availability
- Spare Joint Availability
- Cable Re-laying
- Jointing/Splicing Expertise
- Vessel Availability
- Personnel Transport
Lesson: Offshore Wind is Too Expensive!

We must collectively look for ways to improve installation quality & drive down costs

All of our projects & business are interdependent
As we learn to work together we will find plenty of areas where we can improve overall efficiencies and control costs
Summary

Keep cable installation from becoming a bottleneck on your project

Lets learn what we can from the European experience, for example...

• Selecting the correct installation vessel is a big deal
• Discovering cable problems on site is expensive, try to avoid it
• Once Installation begins, be flexible and prepared for the unexpected
• Once operational what is the maintenance plan?
• We must collectively look for ways to improve installation quality & drive down overall industry costs

QUESTIONS?
China is expected to lead the global wind power market in the coming 5 years, driven by government appetite for renewable energy. Chinese government commitment to derive 20% of energy from renewable sources by 2020 will result in the required thrust towards the future growth of wind power market.

**September 2010: SOUTH KOREA**
South Korea will soon launch a 9 trillion won (US$7.8 billion) project to build the country’s largest offshore wind power complex, government officials said Sunday.

**August 2010: CHINA**
China is expected to lead the global wind power market in the coming 5 years, driven by government appetite for renewable energy. Chinese government commitment to derive 20% of energy from renewable sources by 2020 will result in the required thrust towards the future growth of wind power market.

**May 2010: JAPAN**
The government targets the installation by 2020 of more than 2000 wind turbines offshore with combined capacity of at least 10GW.
Odd as it sounds... is there an opportunity to think bigger?

Maybe **Network Design** is the real issue at hand...
Isn’t what we are **REALLY** building? A **FREE FUEL** energy network?

... If the Great Lakes Region was able to build an inter-connected power grid through the lakes
... If the East Coast kept moving towards **Regional** solutions

The result would be the ability to supply a lot of electricity with **No-Variable Fuel** cost

- wouldn’t that be:
  - A major, regional, economic growth engine
  - An Industry in itself
  - A very large threat to the status-quo?
Thank You