leanwind

Logistic Efficiencies And Naval architecture for Wind Installations with Novel Developments

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Definitions

ADCP	Acoustic Doppler Current Profiler
CTV	Crew Transfer Vessel
GOCM	GeoSea Maintenance
DGPS	Differential Global Positioning System
FOG	Fiber Optic Gyrocscope
GBF	Gravity Based Foundation
HDPE	High-density polyethylene
H_s	Significant wave height
H_{max}	Maximum wave height
LAT	Lowest Astronomical Tide
O&M	Operation and maintenance
OTS	Offshore Transformer Station
PCA	Principal Component Analysis
ROV	Remotely Operated Vehicle
T_p	Peak period
T&I	Transport and Installation
WP	Work Package

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Executive Summary

This document outlines the Testing and Validation activities performed by WP7 (Testing and validation of tools and technologies).

The following activities identified as candidates for testing and validation within LEANWIND WP7:

1. NAAS: Remote presence system installation and testing activity.
2. PLOCAN: Monitor the fabrication and installation operation related to a self-installed GBS including wave height monitoring.
3. ACCIONA: Wave pressure monitoring at the self-installed GBF during T&I and during operations phase.
4. DEME: Three Crew Transfer Vessel tested on similar real scenarios to compare vessel performances, including crew comfort, access limits, etc.

The main summary of the differed test are resumed on the following section:

NAAS remote presence system: The NAAS remote presence system consists of an instrumentation platform installed inside a wind turbine nacelle, which collect sensor information that an operator on land can use to assess the current condition of the turbine. Sensor information include visual and thermographic images in addition to audio. The system was installed in two different wind turbines to test and demonstrate its capabilities for O&M improvements and gain experience with working in realistic environments. The installation and testing of the system was performed during 2015 and 2017. Problems and other experiences encountered during the first test were used to improve the system towards future commercialization. Data analysis methods, as principal component analysis and random forest, were used to analyze the sensor information collected in the first test, which demonstrated some potential uses of the data in the future. Unfortunately, no operational data was available from the turbine, thus it was only possible to compare the collected information with weather data. The second test was started towards the end of the LEANWIND project, and no analysis of collected data was available for this report. Instead, some examples are presented. However, early in the test the system was able to detect an issue in the turbine, the hatch door was left open after a visit, which is an example of something that this system would be better suited for than other remote tools and condition monitoring. Experiences from this second test will be used to further improve the system and to achieve a commercial product level in the close future.

PLOCAN: Monitor the fabrication and installation operation for a GBF: The support structure for and offshore test area at the Canary Islands (Spain) was developed and installed by ACCIONA and PLOCAN. The design is based on the same technology used by

ACCIONA to design the Offshore wind GBF at LEANWIND WP2. This action has provided relevant data regarding fabrication, transportation, installation and operation of the structure. The installation date was November 2016 and relevant tests regarding installation load, operational sea load measurement as well as a new access method test have been conducted since then. The monitoring of the different offshore activities has been done with the support of Remote Operated Vehicles operated by PLOCAN as part of the trials.
This trial has provided relevant lesson learnt on this novel type of support structure; the ballast system initially designed needed to be improved by temporary steel floaters to overcome a problem with the watertight capability of concrete joints between ballast cells. Although this is a common and known issue on prefabricated concrete caisson for port infrastructure, in this case, it was a critical issue that was solved by the proposed solution (temporary floaters).
The new access system proposed for this type of GBS has proven to be successful in terms of access weather limits and ease of operation. Although the system is not designed for extreme water condition it provides a flexible use for non-trained personnel accessing the platform (similar experience as a side by side transfer operation)

ACCIONA: GBF wave pressure monitoring: Acciona has installed and operated a wave pressure measurement system based on pressure sensor installed during the structure fabrication process to monitor the wave pressure around and bellow the structure. The system has been in operation during the installation operation providing significant data during such operation on platform behaviour. The system continues on operation and data are been collected to provide a future correlation between wave height and wave pressure on such kind of structure, the data gathered from this study will provide a relevant information for the structural design and optimization of this type of structures.

GeoSea Maintenance: CTV offshore trials
GOCM has carried out CTV offshore trials to compare vessel motions and therewith comfort levels for crew members during sailing time, idle time and boat-landing activities. Three CTVs of different size and/or design have been equipped with sensors to measure accelerations and displacements in order to evaluate against wave parameters. All three CTVs apply the bump and jump people transfer methodology. The post processing phase is almost finished. The setup, data acquisition and approach of data assessment has been described in this report. Some examples of preliminary results are included. Final results and conclusions will be included in an upcoming version of this deliverable.