Atlantas
MARINE
CLARITY AT DEPTH

PHOTOGRAMMETRY – CASE STUDY

OSP-EAST CABLE – [redacted]

Phase II – Post Rock Dump

Introduction

This case study explores Phase II of the photogrammetry campaign at [redacted], initially carried out in July 2024 (Phase I) by Atlantas Marine using the V8 M500 ROV and IVM's Hydro 300 stereo photogrammetry camera system.

Phase II of the campaign was conducted in October 2024 at the [redacted] on the OSP-East (CPS) cable. The goal was to evaluate and build a 3D model of the entire CPS and Rock Dump area around and beneath the CPS, paying particular attention to the latch mechanism at the top of the CPS around the bellmouth area where the anomaly was originally found.

Project Background

The [redacted] windfarm is located west of [redacted] and is connected by an extensive network of CPS cables. Regular inspection and maintenance are critical to ensure the efficiency and safety of the windfarm's operations. Traditional inspection methods, such as ROV video footage and still images have limitations in terms of clarity, resolution and accuracy.

Following on from the previous inspection in July 2024 (Phase I) on the OSP-East Cable at [redacted] the latches at the top of the CPS were not engaged and locked in inside the bellmouth thus causing unknown strains and stresses on the cable.

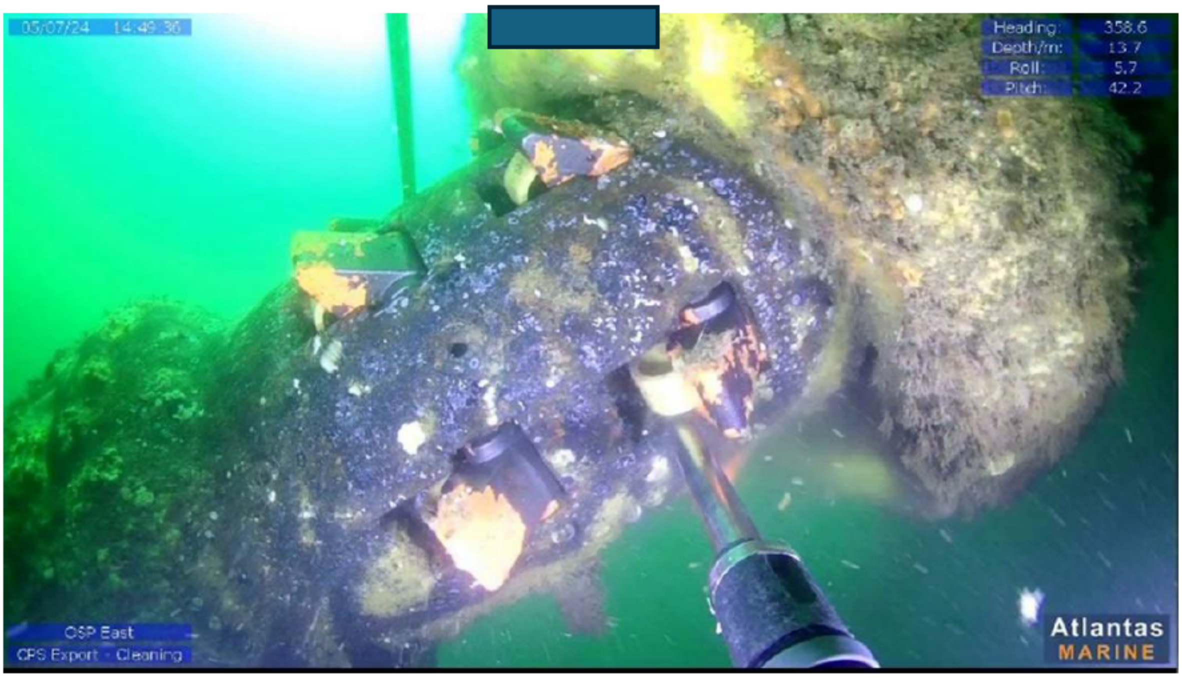

Image showing the OSP East-Export Cable CPS entering the OSP bell mouth, with two complete rows of latches visible, indicating that the CPS is not correctly docked into the bellmouth of the Export J-Tube

Phase II Objectives

- To assess the condition of the CPS Cable and to identify any potential signs of wear, movement, damage, or deterioration.
- Assess the area of Rock Dump on and around the CPS.
- Assess the anomaly found around the Latch and Bellmouth area checking for any further movement, and to determine the measurement and angle between the bottom collar of the latch to the face of the bellmouth.
- Compare the results from the Dimensional Control drawings from both phases of the campaigns to determine any further movement in the CPS and around the latch area.
- Create a 3D model from phases I & II, layering both pre and post rock dump operations to ascertain the level of rock dump area.

Methodology

Preparation:

Photogrammetry: To perform the subsea Photogrammetry, Atlantas Marine's V8 M500 ROV was integrated with IVM's Hydro 300 High-Resolution stereo digital camera system to perform the subsea photogrammetry of the CPS and rock dump area from burial to the monopile, paying particular attention to the latch area in realtion to the bellmouth

Data Collection

Image Capturing:

Thousands of high-resolution images were taken from the Hydro 300. Using IVM's SLAM technology a 3D point cloud is built whilst the ROV surveys the entire CPS and rock dump area from the monopile to burial, including part of the monopiles structure, whilst focusing on the anomaly area to get sharp detailed images 360 degrees around the latch/bellmouth area.

For this campaign an IVM engineer worked remotely in Marseille to co-ordinate the photogrammetry operations and perform the data acquisition. The ROV Pilot and Photogrammetry Engineer continuously monitored the 3D point cloud as the 3D model was being generated during the survey. Any gaps in the data were seen live on the model being created and were re-surveyed to ensure all the data of the model was collected.

Data Processing:

Thousands of images were exported to IVM's HQ via Atlantas Marine's Starlink Satellite system onboard the vessel during the campaign. IVM uploaded the images and worked on the post processing during the campaign.
IVM's custom built Photogrammetric Software created the 3D model of the entire CPS and rock dump area, which took approx. 4 days to build the 3D model and 1 day to complete the Dimensional Control drawings.

Analysis

High-Resolution 3D Model: The photogrammetry campaign produced a detailed 3D model of the CPS cable and the rock dumped area. This model provided a clear view of the CPS from multiple angles.

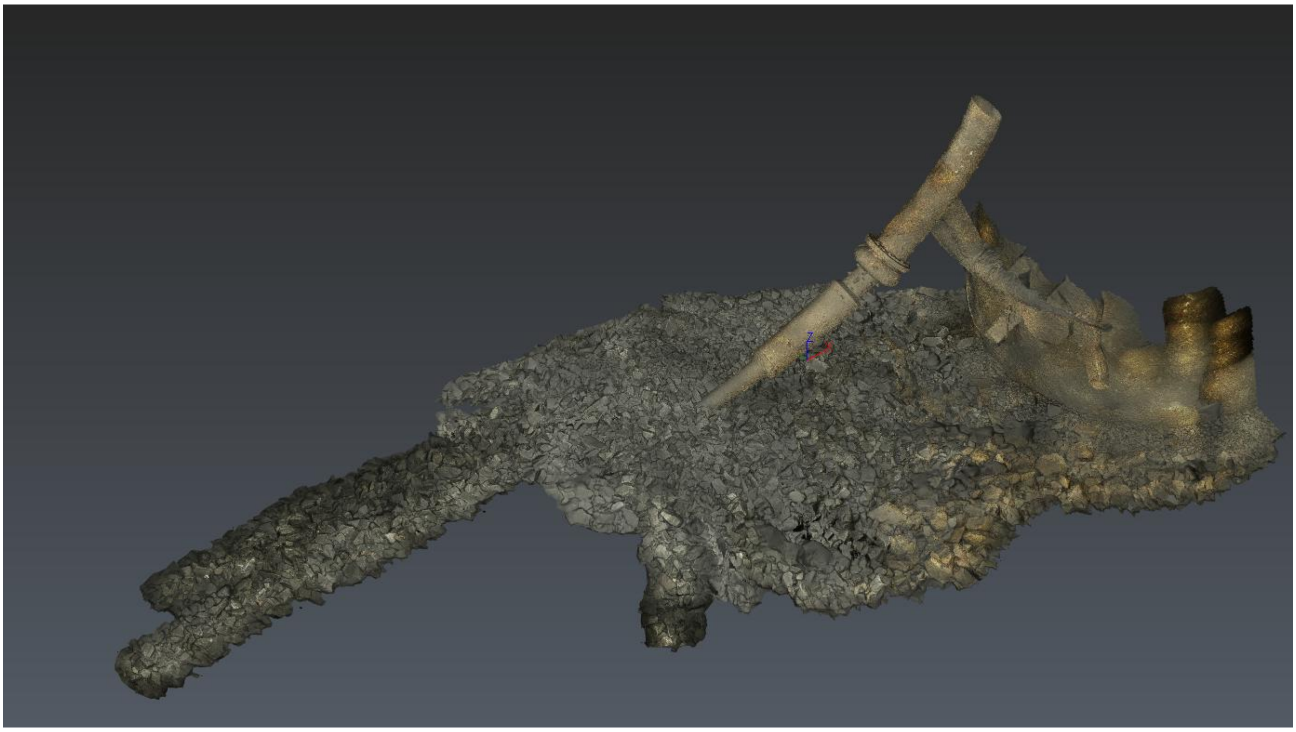

Image showing the Dense Cloud 3D Model of the OSP East CPS cable plus the surrounding rock dump area at from burial to bellmouth

Image showing the Dense Cloud 3D model of the anomaly area on the OSP East CPS cable after the rock dump operations

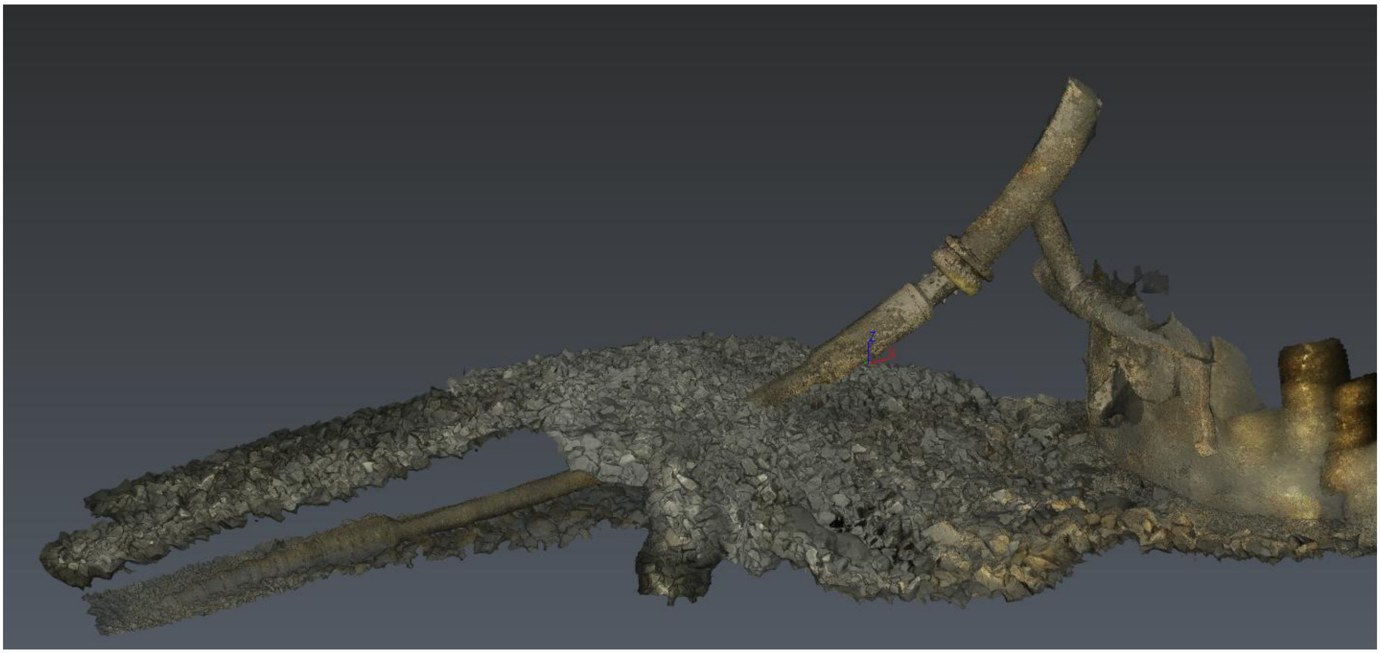

Image showing the overlay of both Mesh 3D models from phase I and phase II of the OSP East CPS cable at from touchdown to bellmouth

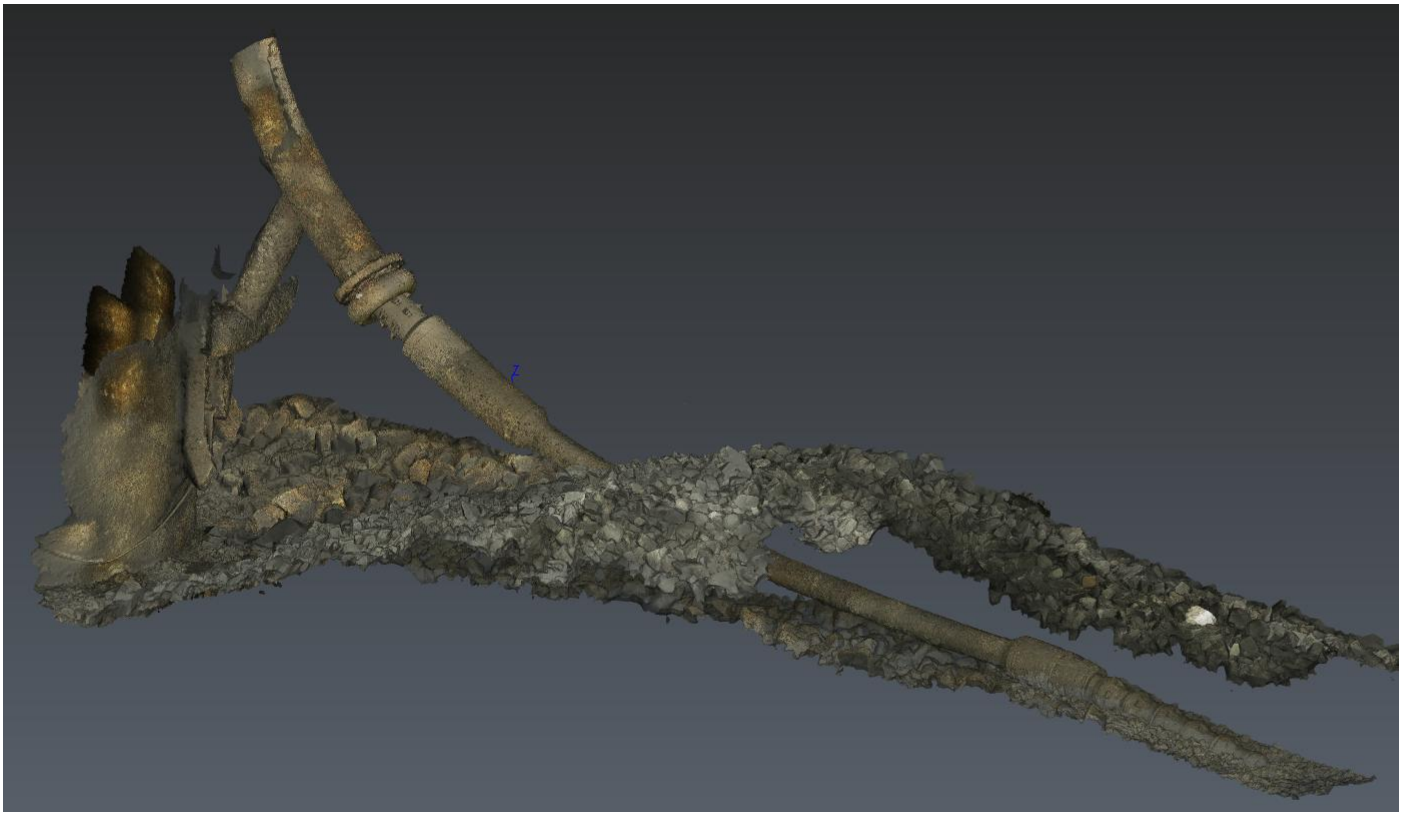

Image showing the overlay of both Mesh 3D models from phase I and phase II of the OSP East CPS cable at from touchdown to bellmouth

Dimensional Control

Accurate engineering drawings were supplied by IVM with sub millimetric precision. Measurements were taken in the form of Dimensional Control Drawings showing the distances around the latch area from the collar of the CPS to bellmouth section before and after the rock dump operations.

IVM Technologies

METROLOGY - DIMENSIONAL CONTROL RESULTS
[redacted]_OSP_East-Bellmouth

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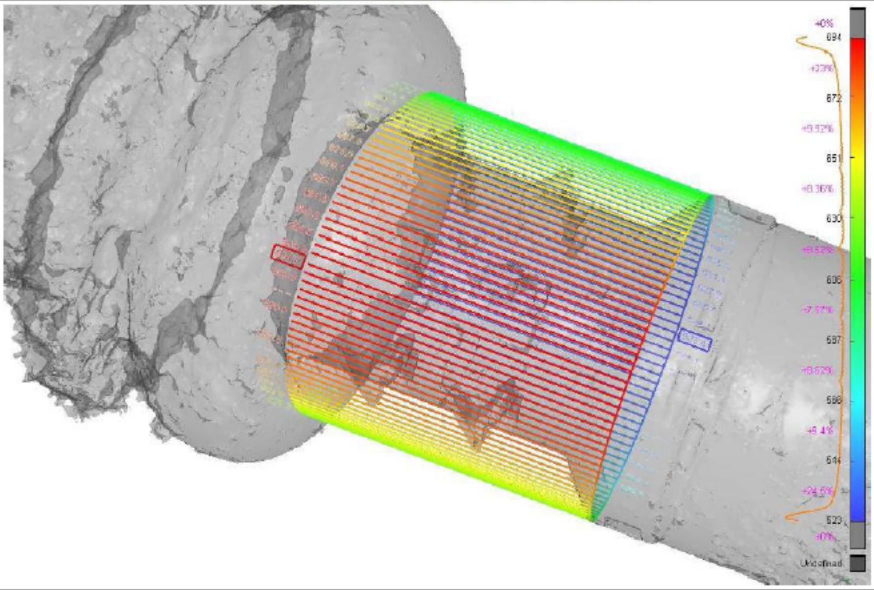
Placement of the cable inside the bellmouth



Comments

Placement of the cable inside the bellmouth.
Max.: 694 mm
Min.: 523.6mm

Metrology	Vessel	Survey date	Rev	Date	Description	IVM	Page
Document number [redacted]	Unknown	07/07/2024	0	24/07/2024	First issuance	AGO	4 / 4

Dimensional control drawing before the rock dump campaign

IVM Technologies

METROLOGY - DIMENSIONAL CONTROL RESULTS
[redacted]OSP_East-Bellmouth

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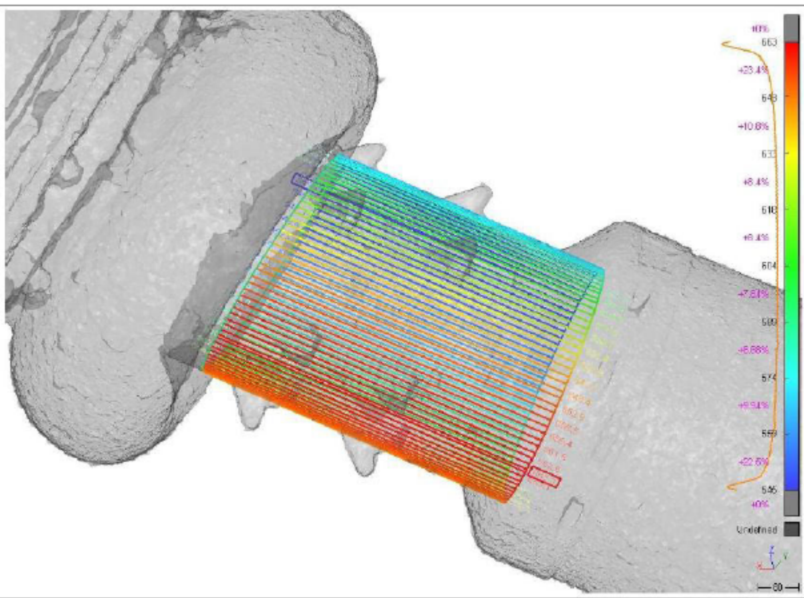
Placement of the cable inside the bellmouth



Comments

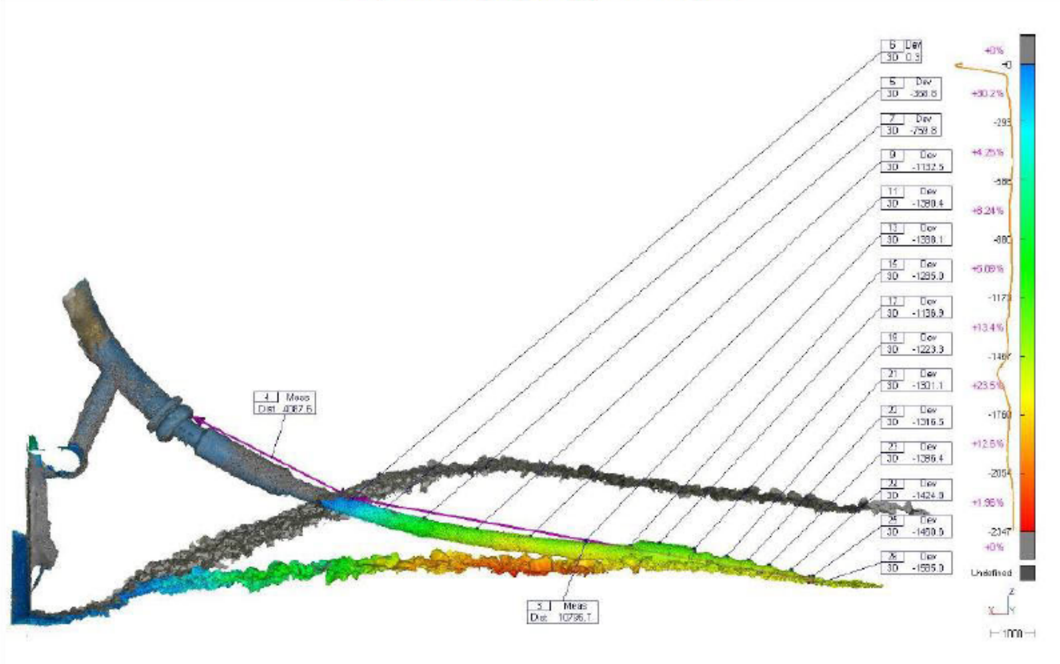
Placement of the cable inside the bellmouth.
Max.: 663mm
Min.: 545mm

Metrology	Vessel	Survey date	Rev	Date	Description	IVM	Page
Document number [redacted]	Unknown	25/10/2024	0	19/11/2024	First issuance	AGO	4 / 5

Dimensional control drawing after the rock dump campaign

METROLOGY - DIMENSIONAL CONTROL RESULTS

[redacted]_OSP_East-Bellmouth

Comparaison bewteen July and October	Comments
	As of October 2024, the rock blocks cover the CPS 4.1m after the bellmouth, and over a length of 10.795m compared to the previous inspection in July 2024.

Metrology	Vessel	Survey date	Rev	Date	Description	IVM	Page
			0	19/11/2024	First issuance	AGO	
Document number: [redacted]	Unknown	25/10/2024					5 / 5

Dimensional control drawing overlaying both photogrammetry phases I & II

Results

The analysis revealed from the 3D models and Dimensional Control drawings the amount coverage of the rock dumped area on and around the CPS and the amount of movement of the latch area in relation to the bellmouth.

The distance of the CPS from the bellmouth to the burial point measures 4.087 mtrs.

The maximum change in measurement for the placement of the cable inside the bellmouth is a difference of -31mm

The minimum change in measurement for the placement of the cable inside the bellmouth is a difference of +21mm

Benefits

Enhanced Accuracy: The photogrammetry campaign provided a level of detail and accuracy that surpassed traditional inspection methods. The 3D model allowed for precise measurements and identification of anomalies.

Reduced Inspection Time: The use of ROVs and Photogrammetry reduced the time required for inspection compared to manual methods, while also minimizing the risk associated with divers in a hazardous environment.

Improved Planning: The detailed model facilitated better planning for maintenance activities, allowing for more targeted and efficient repairs.

Comparison with Historical Data: The data that has been collected has ascertained any movement, strain or stresses on the cable and identified if any further corrective maintenance is needed. With frequent models taken awe can identify trends or any changes in the condition of the CPS cable.

Challenges

Weather Conditions: The coastal location of the windfarm meant that the sea conditions can be unpredictable. Operating in shallow water close to the coastline minimizes the ROVs operational time in the water due to the strong currents. Atlantas Marine will always consider the currents and plan the best operational window accordingly.

Creating the model for the rock dump area took more operational and processing time than originally anticipated due to the sheer scale of the rock dumped area that was required to be modelled. More specific areas that are being modelled needs to be confirmed in the future to scale down the operational and processing time.

Conclusion

The photogrammetry phase II campaign provided a detailed 3D Model with dimensions into the condition of the CPS cable and latch area. Both overlayed 3D models show the amount of area covered around the rock dump area around the CPS. Very slight movement of the cable was apparent after the rock dump operations indicated by the Dimensional Control drawings.

By leveraging advanced imaging and modelling techniques, the campaign enhanced the accuracy of the inspection, identifying areas that requires corrective/preventative maintenance, and improves overall efficiency. This approach represents a significant advancement in the field of infrastructure inspection and maintenance, offering a 3D Model alongside Dimensional Control Drawings that can be applied to similar projects in the future.