



BLACKFISH

ENGINEERING DESIGN AND PRODUCT DEVELOPMENT

**C-DART Mechanical and Electrical
Quick Connection System**

***WES Quick Connection Systems Stage 1
Public Report***

Blackfish Engineering Design Ltd



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1 Project Introduction

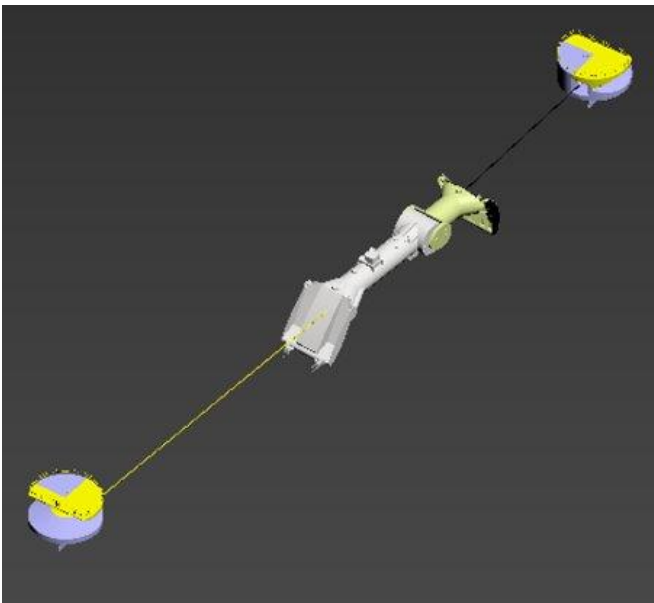
This report gives an overview of the feasibility study conducted by Blackfish Engineering and Skua Marine for a Quick Connection System (QCS) to safely, reliably and cost effectively connect a Wave Energy Converter (WEC) to a mooring and electrical cable offshore. This is for Stage 1 of the Wave Energy Scotland QCS project. The concept which has been developed is called C-DART.

In order to assess the merits of C-DART the Pelamis system was selected as a baseline to assess against. Although the Pelamis Tether Latch Assembly (TLA) deployment and retrieval system achieved impressive performance through the course of its development the C-DART system offers significant improvements.

2 Description of Project Technology

C-DART is a means to mechanically (or mechanically and electrically) connect a mooring system (or other similar mechanical system) and high voltage electrical connections at sea without the need for divers, ROVs, human contact or vessel interaction. In the context of wave energy this allows inexpensive, safe and effective means to connect and disconnect WECs in high sea-states using conventional workboats. This overcomes many issues of connection and disconnection offshore, namely poor weather, ensuring safety whilst reducing complexity and reliability of the connection / disconnection systems and methods. This system also has the potential to have similar utilisation and benefits in other sectors including wave, tidal, offshore wind and ROV operations. The design of the connection is very simple, robust and reliable, having minimal moving parts and no powered actuators. It is a cost-effective remote connection / disconnection method. This sets the C-DART apart from other devices currently on the market.

C-DART connects (and disconnects) WECs to a pre-installed mooring spread and dynamic export cable by making a remote connection of a mechanical / electrical connection to a surface buoy using only the installation vessels' towing and manoeuvring capabilities.



3 Scope of Work

The work completed in Stage 1 includes:

- A detailed set of requirements for the C-DART, along with preliminary Means of Compliance
- Initial concept ideas creation, based on new ideas, existing technology and combinations of solutions
- An agreed basis for the concept of the C-DART including design and methods
- Assessment of all key features and characteristics, and in conjunction with the marine operations an assessment to demonstrate feasibility of the solution
- Assessment of technical risk and failure modes
- Comparison of the technical solution to the baseline scenario, Pelamis TLA.
- Assessment of marine operations weather tolerance and comparison against Pelamis
- Assessment of operational durations and comparison against Pelamis
- Assessment of operational risks and comparison against Pelamis
- Assessment of key benefits, limitations, impacts and interdependencies
- Identifying market opportunities within the wave industry as well as many other opportunities
- Creation of a technical roadmap, to determine how to prove the technology and progress to TRL8+
- Creation of a commercial roadmap, identifying route to market, assessing scalability, identifying customers, a competitor assessment, SWOT and PESTLE analyses.
- Identifying IP that can be protected
- Cost analysis of OPEX and CAPEX and comparison against Pelamis

4 Project Achievements

Overall, it is believed that this totally novel concept is feasible and can provide significant advantages over other connection systems, namely:

- Only standard workboats, multicat or tug vessels required for marine operations
- No ROVS required
- No diver operations
- No over the side deck operations
- Increased weather window of operations
- Reduced time to deploy
- Scalable to suit small and large WEC devices and other markets
- Simple, passive design of connection and disconnection that improves reliability
- Standard COTS parts can be integrated into the design, including wetmate connectors, cables, bend restrictors, instrumentation, hawsers, and release shackles.

Through this Stage 1 study, C-DART has been proven feasible and offers significant advantages in terms of marine operations in reducing technical risk, reducing cost, reducing time required and improving safety. Whilst there are many areas to develop in more detail to increase the TRL level of this system, this feasibility study concludes that the concept is worthy of further development and detailed design.

If successful in Stage 2, the concept will be assessed in far more detail for a specific Wave Energy Converter and a floating Tidal energy Converter. In both cases, detailed hydrodynamic modelling will be undertaken to assess the performance of C-DART in extreme operation and cyclic loading cases.

5 Recommendations for Further Work

Key activities in any further work involve:

- Detailed analysis of hydrodynamics to assess loads in the system and dynamic responses
- Detailed marine operations analysis in conjunction with the analysis above to determine safe sea states for all operations.
- Detailed assessment of all the business cases to determine how to exploit the technology. A large number of markets have been identified, both novel and well established.

6 Communications and Publicity Activity

None

7 Useful References and Additional Data

There is no additional published data on this technology, as it is confidential.

Publicity Material

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