



Q-Connect

WES Quick Connection Systems Stage 1 Public Report

Quoceant



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1 Project Introduction

The Q-Connect system is a modular and adaptable Quick Connection System (QCS) for rapid and safe connection of moorings and electrical cables. It is being developed to serve a wide range of WEC types and has the potential for wider application in the marine industry. Stage 1 of this project considered the design feasibility, impact, and applicability of the Q-Connect.

Stage 1 of the project has been delivered by a team including project lead Quocean and two sub-contractors, Inyanga Marine and the European Marine Energy Centre (EMEC). The project team and their roles in stage 1 is briefly outlined below:

Quocean, Project Lead – A Scottish based engineering consultancy specialising in marine energy and technology, its staff have a wealth of experience the wave energy sector. Quocean’s independent consultancy has benefitted a wide range of companies in the wave, tidal, offshore wind, and maritime sectors. The company also seeks to directly innovate enabling technology for the blue economy.



Inyanga Maritime, Marine Operations – Inyanga Marine provide cost-effective and reliable offshore operations and engineering consultancy for developers specialised in the marine renewables sector. The team have contributed to almost every marine renewable device installation in the UK over the past 5 years, including over 50 connection / release operations, 28 of which used quick connect systems.



EMEC, Market Review - The European Marine Energy Centre (EMEC) Ltd is the first and only centre of its kind in the world to provide developers of both wave and tidal energy converters with purpose-built, accredited open-sea testing facilities. With 13 grid-connected test berths, there have been more marine energy converters deployed at EMEC than at any other single site in the world, with developers attracted from around the globe to prove what is achievable in some of the harshest marine environments.



2 Description of Project Technology

The Q-Connect is a modular and adaptable Quick Connection System (QCS) being developed to provide mechanical and electrical connection in a single operation. The Q-Connect system provides ‘Hands free’ remote connection and disconnection of a wide range of different WEC types, to both moorings and electrical systems, with no person access to the WEC and no taut lines on deck. This allows WECs to be installed in short weather windows in conditions available year-round at typical exposed wave energy sites and removed in conditions up to the WEC towing limits. Crucially for both early demonstration and long-term economics, small and relatively inexpensive vessels may be used to carry out installation and removal operations with minimal crew.

A single compact package combines mechanical latching and release with well-proven wet-mate power and data connection in a robust staged and self-aligning mating arrangement. The system will achieve high reliability by building on proven design elements from previous quick connect systems. The Q-Connect’s wet mate connector carriage maintains reliable electrical connection under this highly dynamic application, and over many expected install/removal cycles.

The design comprises a set of modular subsystems and components that may be combined in different configurations to provide quick, safe, and low-cost connection for a wide range of WEC types and applications. These configurations share the same alignment, electrical connection, and mechanical latching systems and allow similar operating procedures, despite major differences in the WEC type and mooring arrangements. In this way, the same Q-Connect system can cater for slack and taut moored devices, either on the surface or sub-sea.

This modular approach allows a common framework of equipment and operational procedures to be made available to the whole sector, with associated benefits in reliability, shared equipment and skills, and reduced costs. Feedback from different operations using common equipment then provides for ongoing iterative improvements in reliability and function for all applications, and improvements may be rolled out to serve the sector. The male (mooring) side of the Q-Connect for one configuration is shown in Figure 1.

The Q-connect provides a solution that is technically and operationally sound, built on the experience of creating and operating the previous state of the art WEC quick connection systems. The direct involvement of both EMEC and leading WEC developers will continue to focus this new and improved design on the industry's needs.

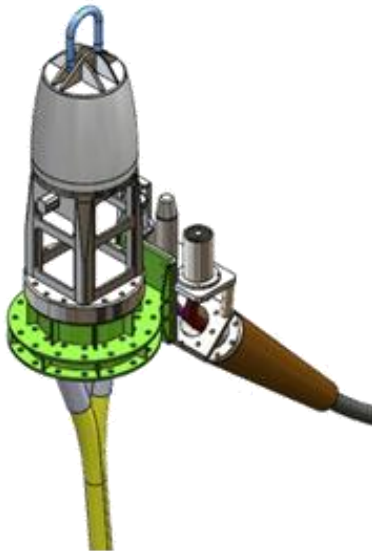


Figure 1: The male (mooring) side of the Q-connect in 'pull-up configuration with a single mooring tether. (latching mechanism not shown)

3 Scope of Work

The aim of the stage 1 work was to complete a concept design and confirm the feasibility of the technology, establish the extent of its applicability, and quantify the expected impacts of the technology on the wave sector.

Concept design – The basis of design, functional requirements, specifications, and standards against which design would be conducted and assessed were first established. A concept design for the Q-Connect system was developed through consideration of several options for the different subsystems, and the feasibility of these mechanisms and their modularity was assessed objectively. Supplier engagement was undertaken for the key commercial off-the-shelf components that are incorporated into the Q-Connect system, including wet mate connectors. Further design iteration and concept level analysis was then undertaken with input from across the project team. The concept design carefully considered common interfaces between all modular parts to serve the different Q-connect configurations.

Marine operations assessment and storyboarding – Inyanga Maritime led an exercise to storyboard the main operational steps in using the Q-Connect. This considered two WEC designs with different mooring types to demonstrate the applicability to different WEC families. These Q-connect operations were compared against the ‘baseline’ connection and disconnection process carried out using conventional technology. This allowed the reduction in marine operations time and complexity to be described and quantified.

Impact assessment – The impact of the Q-Connect on key metrics was quantified and described against base case assumptions. The Q-Connect was shown to have other major advantages over the baseline cases in terms of installability, safety, survivability, availability, performance, and reliability.

Costing – Costing of the concept design and the associated operations was undertaken. This showed the Q-Connect system has the potential to dramatically reduce the overall operating costs over a WEC’s lifetime. Further economic benefits arise from increased availability to generate.

Market review and applicability study: A thorough applicability study was undertaken to address the following key questions:

- What are the main connection considerations within each WEC and mooring family?
- Are the proposed configurations developed for the Q-Connect appropriate?
- Which classes of WEC and mooring type could use the Q-Connect system?
- What other applications beyond wave energy are potentially applicable, and what technology changes are required to expand applicability to other applications?

A market study was also completed by EMEC to identify short- and long-term market targets for the technology.

4 Project Achievements

The project delivered against its stated objectives and provided a feasible concept design with demonstrated applicability across the sector. With further development, the Q-connect can provide a solution that is technically and operationally sound, built on the experience of creating and operating the previous state of the art WEC quick connection systems. The direct involvement of both EMEC and leading WEC developers will focus this new and improved design on the industry’s needs.

The project devoted substantial effort to the partial development and assessment of multiple alternative concepts before arriving at the selected design. This led some of the preferred ideas going into the project to be replaced by more appropriate ones through the stage 1 design process, as the modular and generally applicable Q-connect concept converged. This wide-ranging and objective approach to design evolution is expected to reap benefits in any further development work to bring Q-connect to market.

The project took place under the shadow of the coronavirus pandemic lockdown, the suddenness of which posed severe challenges in delivering aspects that were highly dependent on close collaboration and fluid communication. The team were very grateful for the extension to the final submission deadline that WES granted to mitigate this unprecedented situation - this time was well used to adapt working practices and deliver a successful result. This will stand the project team in good stead for the future.

5 Recommendations for Further Work

The concept design has been shown to be feasible for a range of WECs and other systems. Further work should detail the design of the Q-Connect for use in specific WEC examples, including integration with the WEC structure and its moorings.

Stage 2 plans include extensive numerical simulation of all phases of operation, with different specific WEC types and vessels fully represented. This will demonstrate the operations virtually, characterise the operating sea limits, and quantify the associated loads and motions on the QCS and components. The numerical analysis will compare to a base case without the Q-connect system to allow impacts to be further quantified in relative terms. The early de-risking of the Q-connect would also benefit from small-scale physical modelling of key components and mating interactions.

Further development of a commercial and technology development strategy will assess opportunities for system prototyping and targeted testing. Key qualification activities will be outlined with respect to onward compliance of the system to the market's needs.

6 Communications and Publicity Activity

The Q-Connect project is described on the Quoceant website. On award a blog release was made with accompanying social media posts. Quoceant submitted an abstract, "Get Connected! A Quick Connection System for Marine Renewables" for presentation at All Energy but this has been delayed due to the coronavirus pandemic – hopefully, an opportunity will arise later in the year.

<https://www.quoceant.com/post/getting-connected>

7 Useful References and Additional Data

<https://www.quoceant.com/projects> Quoceant projects website including short article on this project

Publicity Material

Filename	Media Type	Description
Quoceant-logo	.png	Quoceant’s company logo
Q-Connect general image	.png	Public image of the Q-Connect concept