SEMC

Subsea Electrical & Mooring Connection

WES Quick Connection Systems Stage 1
Public Report

Ditrel Industrial S.L.

This project has been supported by Wave Energy Scotland

1 Project Introduction

The SEMC project (Subsea Electrical & Mooring Connection) will assess the feasibility of a submarine connector, capable of housing the electrical terminals necessary to carry out an electrical connection between an underwater electrical cable and a floating structure, e.g. a WEC, and furthermore having the function of mooring the device to the seabed through the mooring line(s).

Stage 1 of the project will be focused on the technical description of the concept with a review of the current developed solutions for electrical and mechanical connections and an assessment of risks associated with the design, development and implementation of the system. For Stage 2 a preliminary design of the connection system and operational simulation work will be carried out.

2 Description of Project Technology

Our proposed solution consists of a Submarine Connector, called SEMC (Submarine Electrical & Mechanical Connector). This consists of two separate parts, the connector head (which attaches to the dynamic cable and mooring lines) and the WEC interface (which incorporates a winch, clamping mechanism and interfacing steelwork).

The connector head is composed of a watertight device, capable of housing the electrical terminals necessary to carry out an electrical connection (including, optionally, the optical fibres) between an underwater electrical cable and a floating structure, e.g. a WEC, and furthermore having the function of mooring the device to the seabed through the mooring line(s). The connector is capable of withstanding the typical loads of a WEC mooring system.

The submarine connector is based on a double clamp hang-off and cover system which will prevent the electrical terminals protected inside from coming into contact with the marine environment at any time. Consequently, such terminals will be those usually used in the onshore industry, lowering their costs.

The described system is based on the “Konekta2” solution that has been developed by DITREL Industrials and protected by a Patent number EP2784364 (B1) and the turret arrangements of a Single Point Mooring (SPM) buoy technology.

3 Scope of Work

The Stage 1 project included 5 work packages:

- **WP01 Concept engineering**, with the objective:

  To create a thorough concept design of a QCS suitable for current and future WEC testing programmes. Refine and develop the concept to reduce risks, minimise/remove uncertainties and technical challenges

- **WP02 QCS Feasibility & Application**, with the objective:

  To assess the feasibility of the concept QCS, ascertaining its suitability for Marine Operations, considering its performance against baseline solutions, and appraising its benefits and novelty.

- **WP03 Impact & commercialisation**, with the objective:

To advance future commercial readiness by identifying potential market, both in field of WECs / WEC testing and reviewing the opportunities for optimising the device cost (use of Off the Shelf components)

- **WP04 Future Stages Planning**, with the objective:

  To create a thorough plan of future design, modelling and testing requirements of the concept QCS. The main focus on the identifying the requirements and outputs that are needed from Stage 2, but as Stage 2 should ideally lead into Stage 3, consideration of a Stage 3 physical testing programme is required at this point.

- **WP05 Project management**, with the objective:

  To ensure the smooth running of the project to time and budget and to ensure clear communication with WES regarding progress of the project. Also includes the final reporting to meet WES requirements.

The work involved in stage 1 was primarily desk-based studies and report writing however, it did include some static analysis, storyboarding, third party review, along with some customer identification and relationship building. A technology risk register, project risk register and a lessons learned register were maintained throughout the project.

4 Project Achievements

Basis of Design
A detailed basis of design was produced which acts as a foundation for future development. It identifies the standards to be used and the approach to be taken in future design work.

Concept Design
Following on from the basis of design, and a marine operations review, the design was developed with further calculations being carried out. A revised concept design was then produced reflecting the learning gained during Stage 1.

Marine Operations review
Following on from the development of marine operations storyboards of both the SEMC QCS and a baseline case, a robust review of the proposed marine operations was carried out with the input from an experienced marine operations contractor. This review allowed the concept design to be refined with the outcomes used to shape further development.

Future stages – tests & approach defined; partners identified
A clear programme for further testing and risk mitigation has been prepared which identifies the activities required to move the SEMC QCS to commercial readiness. Relationships with potential customers have been created or improved and partner companies identified to guide the requirements of the QCS.

Project Management
The onset of the COVID-19 pandemic provided challenges to the completion of the project as normal working practices were disrupted. The way in which the project had been designed insulated us from the worst possible effects, small groups working co-operatively across a large distance had always been the plan, however getting up to speed with new systems did provide challenges. The project has been completed within the revised timetable proposed by WES to all participants of the QCS programme.

5 Recommendations for Further Work

The key activities required to take the SEMC QCS towards commercial readiness have been identified through development of the stage 1 project and written up to form the stage 2 project application pack. They are:

Listen
To develop the SEMC in line with the requirements of industry, the development team should continue to engage with and listen to the relevant stakeholders, including potential suppliers, customers and end users.

Develop
The stage 1 project has resulted in a strong concept design with a robust basis of design. For the next stage of work this must be developed further, adding more detail and realism. The design must be developed to a stage where its performance against key criteria can be critically assessed.

Assess
With the design developed to an appropriate level, the SEMC QCS must be analysed in detail for a number of representative test cases. The full cycle of preparation, connection, service, disconnection and securing work should be simulated and compared with a baseline case to identify and characterise the improvements or indeed any disadvantages which may arise through the use of the SEMC QCS. As well as considering operational performance through marine dynamic software such as Orcaflex, the simulations should consider survivability of the connection system in extreme loads. This data will be required to demonstrate suitability to customers and to qualify the system at a later date.

Refine
With results from the test simulations available, the iterative design process should continue, making improvements which will decrease risk and/or maximise the benefits of the connection system. The design should move forward to a detail design ready for practical testing and demonstrations of the system in action.

Demonstrate
A package of physical testing will be required to demonstrate the functionality and capabilities of the SEMC QCS as it moves from theoretical design, through simulation and into real world use. As a minimum, a demonstration of the connection and disconnection should be carried out alongside tests on the strength and loading capacity of the connector and associated subsystems. Tests at an appropriate scale in a representative environment will be required to prove out design features. Specific tests will be guided by the requirements to achieve approval from a classification body.

Qualify
From the next stage in the design process, a classification body such as Bureau Veritas will be engaged to identify the required steps to achieve a type classification. Following on from physical demonstrations and development of a strong technical design file, type certification should be achieved to give potential customers additional confidence that the SEMC has been designed responsibly and in-line with the expected best practices

6 Communications and Publicity Activity

At the announcement of the award of the QCS contracts, press releases were sent to a wide range of news outlets. The news story was picked up by:

Energy Voice

https://www.energyvoice.com/otherenergy/213582/highland-firm-to-develop-marine-energy-subsea-connection-after-70k-award/?utm_source=twitter

The SEMC project was also featured by a number of sites who reported the announcement of all the projects by Wave Energy Scotland.

At the same time, Ditrel and 4c Engineering both posted news stories on their company websites:
https://www.ditrel.es/noticia/18/ditrel-lidera-el-desarrollo-de-un-conector-eleacutectrico-y-mecaacutenico#
https://www.4cengineering.co.uk/renewables/4c-engineering-go-international-to-develop-subsea-connector/

A follow up story highlighting international collaboration was reported in both Executive Magazine and the Press and Journal.

7 Useful References and Additional Data

Reports:

D02 SEMC Basis of Design Rev A [Confidential]

D03 SEMC Concept Design Pack Rev A [Confidential]

D17 Stage 2 application pack [Confidential]

D24 Final Report [Confidential]

Webpages:
News page on Ditrel website [publicly available]
https://www.ditrel.es/noticia/18/ditrel-lidera-el-desarrollo-de-un-conector-eleacutectrico-y-mecaacutenico#
Blog page on 4c Engineering website [publicly available]
https://www.4cengineering.co.uk/renewables/4c-engineering-go-international-to-develop-subsea-connector/

Publicity Material

Filename	Media Type	Description
LOGO DITREL.jpg	Logo	Ditrel logo
4cE Logo 2020 colours 5500x2100.png	Logo	4c Engineering logo
TECNALIA_COLOR_GR.png	Logo	Tecnalia logo
SEMC concept image.jpg	Image	Concept image of SEMC
SEMC team at DITREL.jpg	Image	Photo of project team next to the KONEKTA2 connector prototype at the project kick off meeting