All Electrical Drive for Marine Energy Converters
EDRIVE-MEC

Industrial Advisory Board 2018 meeting
MINUTES

ICOE 2018 Conference, Cherbourg, France
1145-1245 Thursday 14th June 2018 (Day 3 at ICOE)

Attendees (In person)	Steven Nauwelaerts – Laminaria Jack Jorgensen – Carnegie Simon Cheeseman – ORE Catapult Nick Baker, Richard Crozier, Simon Robertson, Miguel Santos-Herran – edrive team
Attendees (skype)	Marc Brand, Craig Britton – Supply Design Henk Polinder – TU Delft Steven Nauwelaerts - Laminaria Markus Muller, Steve MacDonald – edrive team
Apologies	Ainhoa Pujana Goitia, Pablo Ruiz Minguela, David Bould, Nigel Jakeman, Simon Grey, Paul Brewster

Meeting Objective: to engage with industrial partners to review progress and onward plans for the final year of the project to ensure outcomes are well aligned to the needs of the marine energy industry.

Topics of discussion:

- Welcome & Introductions (Simon)
- Work-package updates
  - Electromechanical Development, Magnetic Gearing Systems, Power Converters and Control (Nick)
  - Wave to Wire Modelling (Richard)
  - Technology Roadmap (Simon)
- Future development discussion (All)

Notes from meeting:

Welcome & Introductions (Simon)

- Meeting objectives, project objectives and WP overview given.

Electromechanical Development

- Five device architectures under investigation were described.
- A desirable outcome of the project would be the determination of the suitability of different direct drive configurations to specific WEC devices applications, akin to hydro turbine charts as a function of head and flow. May end up having different topologies for different applications.
- Perm Magnet cost has minimal effect on LCOE, as other cost and performance items dominate. Confirmed by Supply Design and U Strathclyde paper.

Magnetic Gearing Systems

- Linear arrangement unlikely to be effective as increased stroke on high-speed side can lead to large strokes and additional materials needed, offsetting other potential reductions.
- Single and Multi stage rotary arrangements look promising. Single stage has 1:8-10 ratio but can be increased through multi stage.
- Rotary gears have been modelled with interesting characteristics, including slip in extreme events as a failsafe. These will be validated in physical testing planned with a flap device in Flowave.
- Magnomatics have similar gears and worth investigating what information that have made available for comparison.

Power Converters and Control

- Voltage source is standard but with advances in power electronic technology high frequency switching, current source architectures are under investigation and may offer significant advantages. Physical testing in being undertaken to validate computer modelling to confirm this.

Wave to Wire Modelling

- Dr Richard Crozier released the Edinburgh Wave Systems Simulation Toolbox on 14.6.2018. This included a launch workshop at ICOE on 14.6.2018 to an audience of 20 people.
- The Edinburgh Wave Systems Simulation Toolbox is a new toolbox primarily designed for the simulation of wave energy converters. The toolbox also contains more general purpose components useful for simulating a wide range of systems, including electrical machines, hydraulics, advanced multibody dynamics, and, naturally, wave interaction. The simulation system is also optimised for batch processing and optimisation tasks run on servers.
- Software and documentation available: https://sourceforge.net/projects/rnfoundry/
- Will be applied to Carnegie and Laminaria desives

Technology Roadmap

- This will pull together the key technical findings of the project and prepare a commercialisation strategy. Due for release in October 2018.

Future development discussion

- Recommendations from board
    - Carnegie

        - Undertaking more testing in representative environments, eg wet testing, and dynamic events is needed to build confidence in the offshore applications and to really prove out performance. This relates to the sister Project NEPTUNE, WES C-GEN project.
        - Side loading is an important consideration as the mechanical design may not be able to fully isolate these loads and off axis loads can cause significant issues – investigation and demonstration of capability regarding this is needed.
        - Open to supporting tank testing, methods and scale models, 1:25th scale model available at Flowave.
    - ORE Catapult
        - Better characterisation of the solutions and their application in the market needed, i.e which Direct drive architecture is best applied where.
        - The TRL and status of the tech needs to be clearly communicated
        - A commercialisation pathway should be mapped out including LCOE sensitivity analysis would be good to show effectiveness of the solutions.
        - Interested in test rigs and related infrastructure.
    - Laminaria
        - Design tool needed so as a developer they can understand the solutions available and select which best suits their needs.
        - Open to supporting tank testing, methods and scale models incl 1:30th model.
- All project results will be shared widely and with TAB members. https://www.edrive.eng.ed.ac.uk

Arising Actions

1. Confirm tank capabilities with Flowave regarding a gantry held test machine. **NB, RC**
2. Carnegie to share details of the gantry based tank testing undertaken with edrive team. **JJ**
3. Carnegie to provide technical data for integration studies. **JJ**
4. Laminaria to provide technical data for integration studies. **SN**
5. Edrive team to review details of Carnegie and Laminaria existing scale devices for prime mover in tank tests for the PTOs/gears. **RC, NB**
6. Edrive team to consider the characterisation of typologies for different applications. **NB, MM**

Photo from the IAB, June 14th 2018.