EPSRC Marine Wave Energy Programme
Mooring analysis and design for offshore WEC survivability and fatigue (MoorWEC)

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Research motivations

- Wave energy globally has potential average power slightly less than wind

- Aim is for multi-float M4 to have similar capacity as offshore wind

- The mooring is the most vulnerable structural component of an offshore wave energy converter (WEC). Snap loads are a particular problem in extreme waves, and also in intermediate waves affecting fatigue. *There is a widespread consensus in the wave energy community that mooring system design and modelling is a major challenge that needs to be overcome*

- Best mooring configuration: catenary, elastic synthetic, with buoys ?

- How to minimise loads ?

- Efficient hydrodynamic load prediction

Testing 132 configuration at MaREI, Cork, 2018
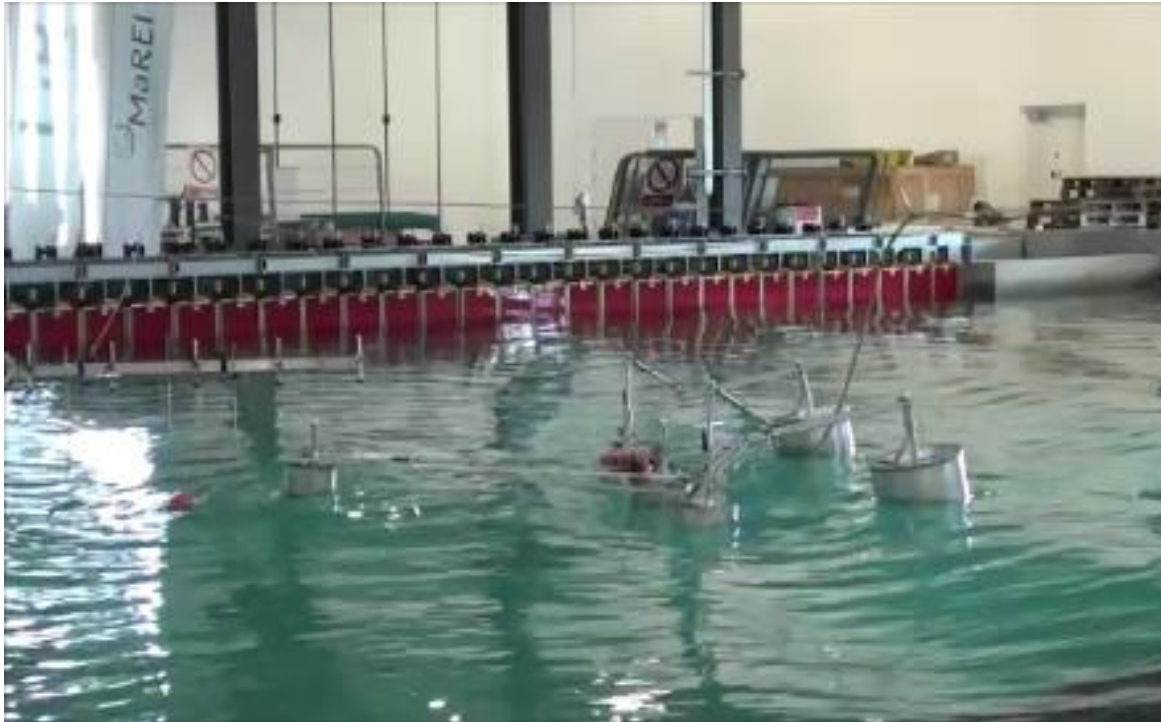
Proposed 134 configuration with 4 PTOs

Related programmes

- Marinet2: M4 elastic mooring data from July – MaREI, Cork

- HydroMore for floating wind - Norway with two PhDs (David Lande-Sudall, Bergen)

- Blue Economy CRC: Seeding marine innovation in SW WA with a WEC deployment in Albany (¼ scale M4 ocean test project with UWA)

- EPSRC marine wave energy call: System-level Co-design and Control of Large Capacity Wave Energy Converters with Multiple PTOs : M4 system (PI Guang Li, QMUL; Judith Apsley, Manchester; Mike Belmont, Exeter)
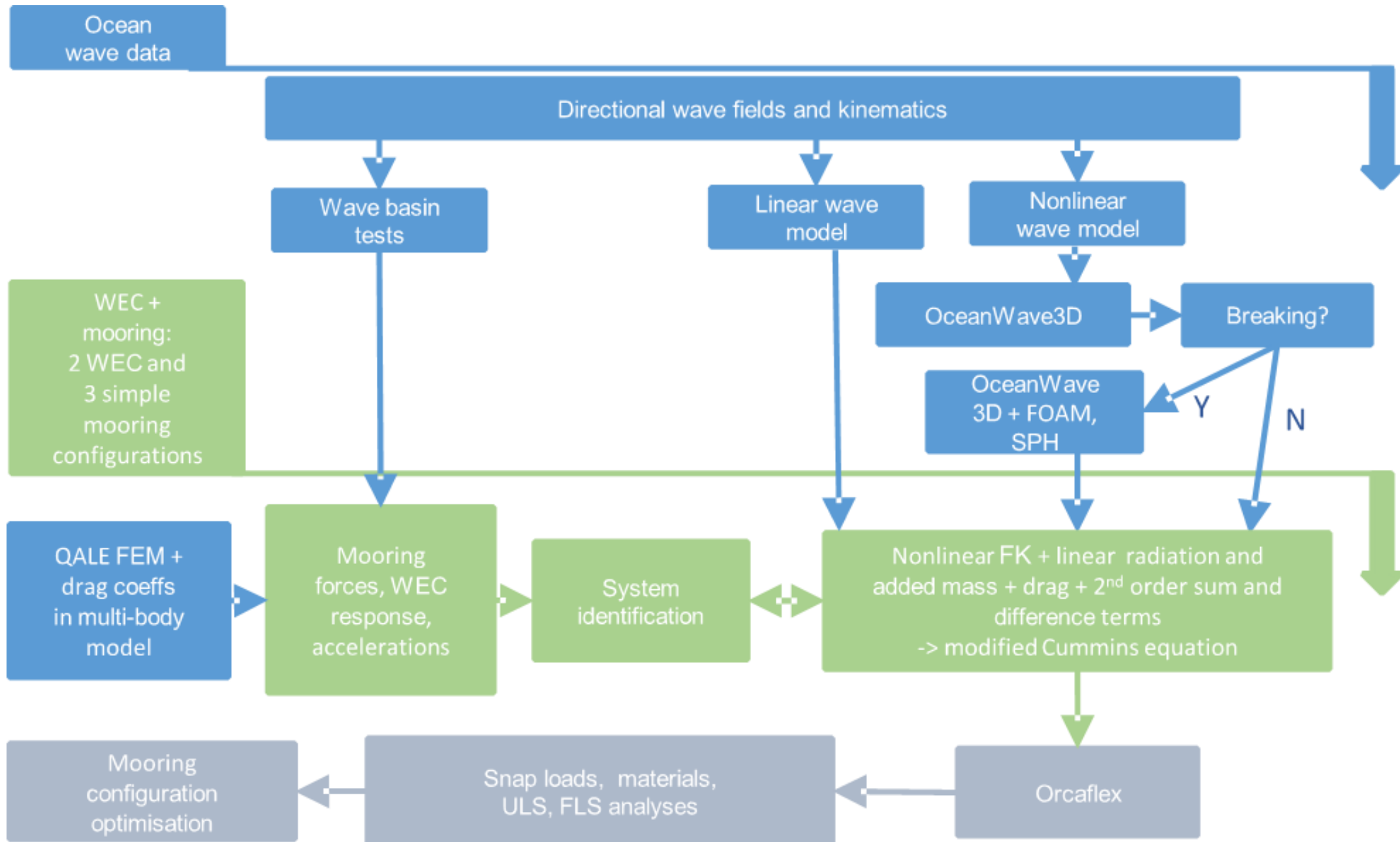
Note with the linear wave model the nonlinear FK force results from system identification of measured forces and motion

Work packages

- **WP1**: wave fields, basin testing, hydrodynamic/mooring modelling : Stansby, Draycott, Lind, RA1 (36 months)

Task 1.1 Selection of extreme wave and combined wave-current conditions

Task 1.2 Wave basin testing

Task 1.3 Non-linear sea state simulations

Task 1.4 Hydrodynamic/mooring modelling

- **WP2**: mooring design and analysis : Johanning, Pillai, RA2 (21 months)

Task 2.1 Coupling of hydrodynamic force model and mooring analysis software

Task 2.2 Integrated mooring analysis considering snap loads and fatigue

Task 2.3 Mooring system design optimization using multi-objective genetic algorithms

- **WP3**: system identification (SI) : Zhang, RA3 (12 months)
- **WP4** WEC hydrodynamics by nonlinear potential-flow modelling QALE-FEM : Yan, Ma, RA4 (12 months)
- **WP5** OpenFOAM CFD : Xiao, RA5 (10 months)
- **WP6** SPH : Fourtakas, Lind