ETIP Ocean & EERA Ocean Energy JP Webinar:

DEMONSTRATION OF WAVE ENERGY DEVICES AND PTO

David Langston & Peter Dennis

Wave Energy Scotland

11 June 2020
Contents

• WES Background

• WES Programmes

• Wave Energy Converters

• Power Take Off Programme
WES Background
WES Background

- Developing cost competitive wave technology
- Project collaboration across Europe and globally
- A subsidiary of
- Research, development & innovation programme funded by the Scottish Government
- £39.6 million committed expenditure
- 13 Countries
- 5 Programmes
- 230 Organisations
- 96 Projects
WES Programmes
WES Stage Gate Process

Stage 0: Concept Creation
Stage 1: Concept development
Stage 2: Design Optimisation
Stage 3: Scaled demonstration
Stage 4: Full scale demonstration
Stage 5: Full scale array demonstration
Metric Topic Areas

- Controllability
- Acceptability
- Reliability
- Installability
- Manufacturability
- Affordability
- Survivability
- Maintainability
- Energy Capture
- Energy Conversion
WES Programmes

Stage 0
Concept Creation

Open Call

Stage 1
Concept development

Technology A
Technology B
Technology C
Technology D
Technology E
Technology F
Technology G

Stage 2
Design Optimisation

Technology A
Technology C
Technology D
Technology F
Technology G

Stage 3
Scaled demonstration

Technology D
Technology F
WES Programmes

- Power Take-Offs
- Novel Wave Energy Converters
- Structural Materials
- Control Systems
- Quick Connection Systems
# WES Programmes

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<td>Novel Wave Energy Converters</td>
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<td>Structural Materials</td>
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<td>Control Systems</td>
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<td>Quick Connection Systems</td>
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WES Programmes


Power Take-Offs
- Call
- PTO 1
- PTO 2
- PTO 3

Novel Wave Energy Converters
- Call
- NWEC 1
- NWEC 2
- NWEC 3

Structural Materials
- Call
- Materials 1
- Materials 2
- Materials 3

Control Systems
- Call
- CS 1
- CS 2
- CS 3

Quick Connection Systems
- Call
- QC 1
- QC 2
Wave Energy Converters Programme
WECs Phase 1

Stage 1 Award
Dec 2015

Open Call Issued
Jun 2015

Stage 1 Complete
Jan 2017


4CE
Stage 1

ALB
Stage 1

AWS
Stage 1

CHK
Stage 1

JOU
Stage 1

MOE
Stage 1

QUO
Stage 1

ZYB
Stage 1

WECs Phase 1

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Stage 1

MOE
Stage 1

QUO
Stage 1

ZYB
Stage 1
WECs Phase 2

Open Call Issued: Jun 2015
Stage 1 Award: Dec 2015
Stage 2 Start: May 2017
Stage 1 Complete: Jan 2017
Stage 2 Complete: Sep 2018
Today: 

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## WECs Phase 3

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### Stage 1
- 4CE
- ALB
- AWS
- CHK
- JOU
- MOE
- QUO
- ZYB

### Stage 2
- AWS
- MOE

### Stage 3
- 4CE
- ALB
- AWS
- CHK
- MOE
- ZYB
# Wave Energy Converter Programme

## Stage 0
**Concept Creation**

- Performance testing, optimisation and verification
- Initial concept engineering of the full scale system

## Stage 1
**Concept development**

- Engineering Development: Full scale concept and small sea-going prototype FEED
- Scale Model Testing and Simulation: Characterisation, validation and Stage 3 planning

## Stage 2
**Design Optimisation**

- Detailed design and engineering development of the sea-going prototype
- Manufacturing of a sea-going prototype
- Physical testing of a sea-going prototype
- LCOE and commercial impact investigation
- Identification of opportunities and planning for onward development

## Stage 3
**Scaled demonstration**

- Detailed design and engineering development of the sea-going prototype
- Manufacturing of a sea-going prototype
- Physical testing of a sea-going prototype
- LCOE and commercial impact investigation
- Identification of opportunities and planning for onward development
Selection Criteria

• Technology Development
• Future Commercial Offering
• Scope of Work for Stage
• Project Management
WEC Stage 1

Floating
- Oscillating Wave Surge Converter
- Bulge
  - CHK: Bulge Wave

Submerged
- Submerged Pressure Differential
  - AWS: Submerged Heaving Point
- Multi body
- Oscillating Water Column
  - JOU: Floating connected OWCs
- Articulated raft
  - MOE
  - QUO: Variable buoyancy
  - 4CE: Articulated raft
- Point Absorber
  - ALB: Part attenuator, part coupled point absorber
WEC Programme
Blue Horizon - Tank Testing
Blue Horizon - Device
Blue Horizon - Back to Back Testing
Blue Horizon - Fabrication
Archimedes Waveswing - Tank Testing
Archimedes Waveswing - Device
Archimedes Waveswing - Fabrication
CorPower PTO Testing
Power Take-Off Programme
Power Take-Off Programme

**Project**
HiDrive Cascade Drive

**Project**
Neptune Linear Generator
Power Take-Off Programme

**Project**
Quantor (Advanced Hydraulics)

**Project**
Power Electronic Controlled Magnet Gear (PECMAG)
PTO Project Example

Reciprocating linear drive
recirculating ball screw technology
PTO Project Example

EMERGE (Electro-MEchanical Reciprocating GEnerator) project
PTO Testing in Wave Tank
PTO Laboratory Testing
PTO Testing in Orkney
PTO Testing in Orkney
PTO Project Example
Knowledge Library

Wave Energy Scotland is managing the most extensive technology programme of its kind in the wave energy sector. The Knowledge Library provides access to key information and documents generated through this world leading commercial and academic research & development.

Access world leading R&D in wave energy technology

- Discover the projects supported through the Wave Energy Scotland Programme
- Find Potential collaborators in your own or other fields
- Search project reports on work completed through Wave Energy Scotland Programme
- Find information on previous wave energy technology development in Scotland