



EUROPEWAVE

ARRECIFE- TRIMARAN

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Technology Overview



PRODUCTION

Inspired in behavior of coral reefs
Induced 'shoaling-like' effect:
energy from both potential and
kinetic energy of the waves

EFFICIENCY

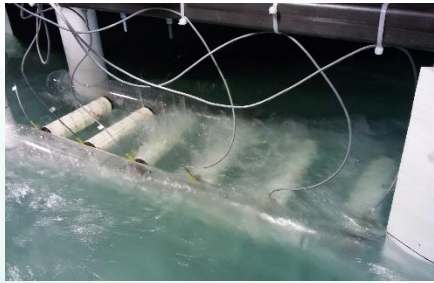
Direct turbine-generator system

INSTALLATION COSTS

One mooring line self oriented

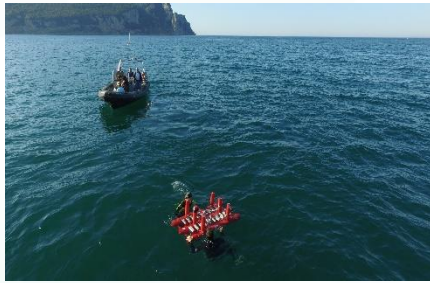
Technology Overview

2015



1:10-Scale
Laboratory Tests with
fixed system

2017



1:10-Scale
Sea Tests

2019



75 kW Sea Tests
(BIMEP)

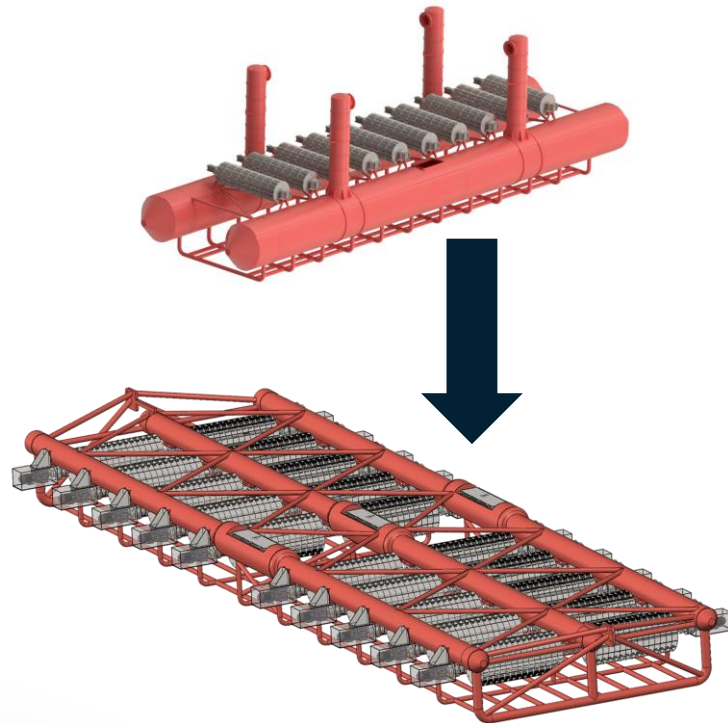
2021



1kW Sea Tests

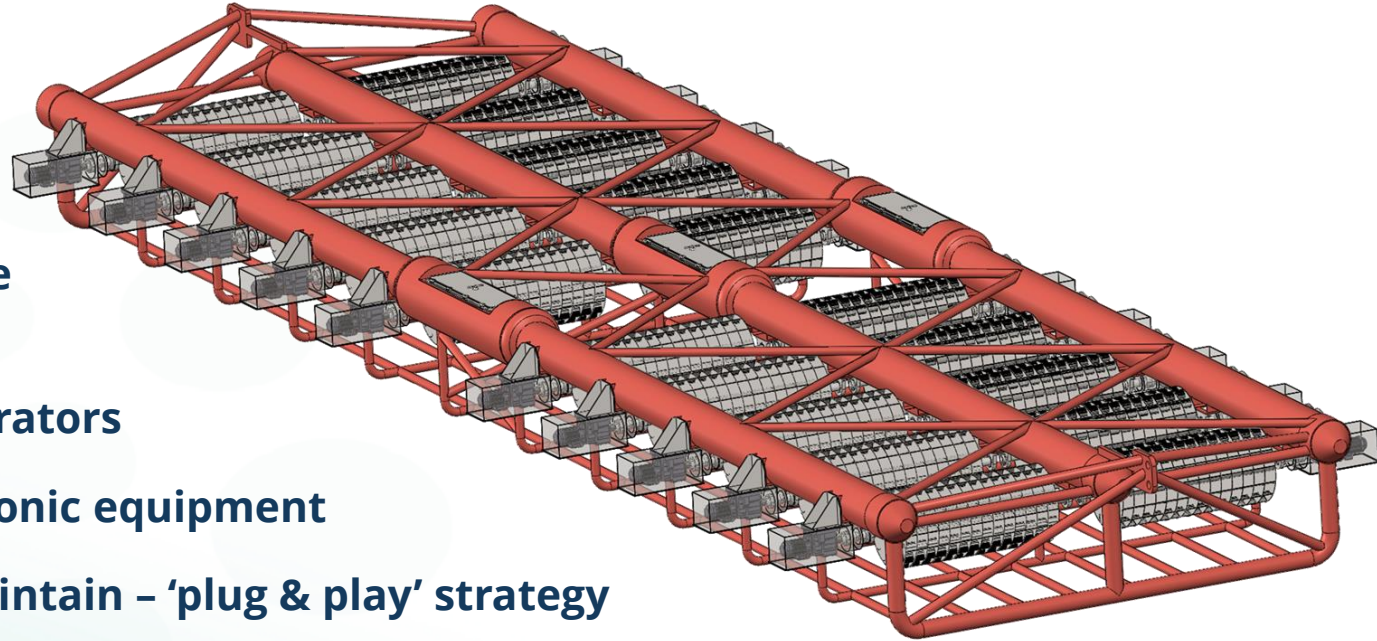
Why EuropeWave? Phase 1: Proposal

- Immersion system cancellation
- Fixed position of the turbines
- Convert from catamaran to trimaran shape
 - Increase production
 - Increase stability
- Tank tests: IH Cantabria Laboratory
 - Regular & irregular waves
 - Extreme waves tests
 - Self orientation



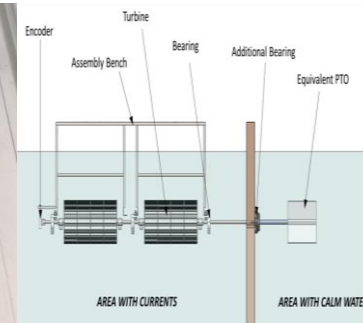
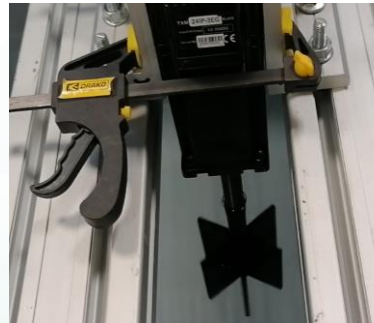
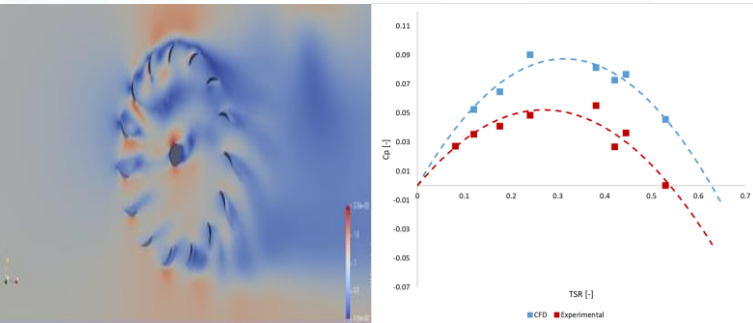
Phase 1: Proposal – System Overview

- 70 tonnes
- 1 mooring line
- 40m long, 10 m wide
- 20 turbines & asynchronous generators
- 3 hatches for electronic equipment
- Easy to install & maintain – ‘plug & play’ strategy



Phase 1: Power measurement challenge

- ✓ Reynolds NR
- ✓ CFD modelling:
Cp-TSR & Cd-TSR curves from 2D
- ✓ Correlation of curves with
experimental results
- ✓ Setup of CFD-Waves model
- ✓ Calibration before tests
- ✓ Calibration of equivalent PTO
- ✓ Turbine calibration IH Cantabria tests



Phase 1: Model design and fabrication

- ✓ Successful fabrication
 - Aluminium structure
 - 3D ABS turbines
- ✓ Adequate water tightness, buoyancy and assembling



Phase 1: Tank tests

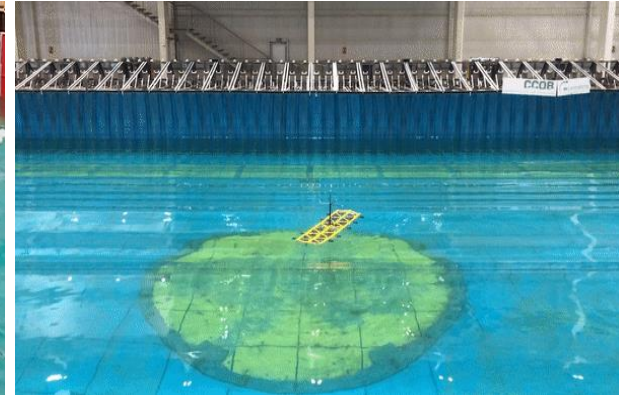
- ✓ Regular & irregular wave tests
- ✓ Extreme waves tests
- ✓ Self orientation



Tank tests



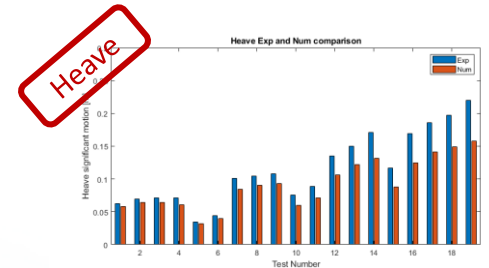
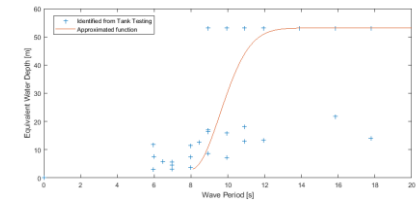
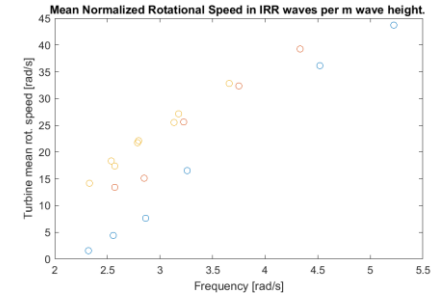
Extreme tests



Automatic orientation

Phase 1: Conclusions

- ✓ Ability to complete all the Phase 1 required tests
- ✓ Turbines show a regular rotation for a variety of sea-states
- ✓ Good survivability: No issues in any of the structural parts
- ✓ Mooring oversized: Margin for optimization
- ✓ Potential for better performance at longer periods
- ✓ Potential to maximize 'shoaling' effect generated
- ✓ Self orientation confirmation



Phase 2: Approach

tecnal**a**

MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

IHcantabria
INSTITUTO DE HIDRÁULICA AMBIENTAL
UNIVERSIDAD DE CANTABRIA

GEODIS

GRUPO JIS
Jauregui Industrial Services

iraundi
SPECIAL BEARINGS

GRUPO amper
Elinsa

- ✓ Performance simulations
 - Turbine design optimization by CFD
 - CFD-waves to optimize shoaling effect
- ✓ Lab. studies: Turbine and shoaling effect
- ✓ Operation & maintenance
 - Operational planning
 - Corrosion studies (Harshlab)
 - Turbine
 - Bearings
- ✓ Power electronics
 - Generator testing at Dry Test Bench
 - Hardware architecture



Ambition Phase 3 deployment

- Bimep installation
- Get a design as close to a final concept
- Port manufacturing - Do not depend upon shipyards
- Plug & play connector
- Reduce the number of maintenance maneuvers
- Shoaling-Coral reef effect
- Constant energy generation (>1m waves)
- Low turbine corrosion



