Interreg North-West Europe OPIN

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WEAMEC

Research, Education & Innovation in Pays de la Loire FOR MARINE ENERGY

OPIN Workshop

Advanced Materials and Manufacturing (Composite focus)

12/11/19, Nantes

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WEAMEC
Research, Education & Innovation in Pays de la Loire FOR MARINE ENERGY

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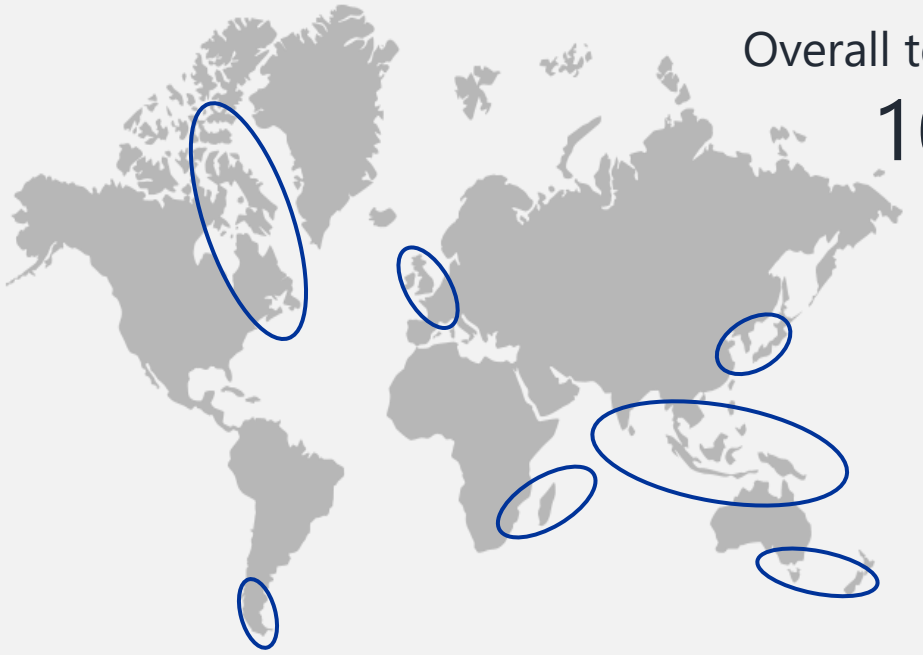
Application and needs from the industrial sector

I. Marine Current Energy

A predictable, unlimited and reliable resource

Tidal turbines harness the energy of marine currents, generated by the gravitational attraction of the Moon and the Sun. As a result, numerous advantages can be bestowed on tidal stream power.

- Unlimited and permanent source of clean energy
- Reliable and predictable energy, allowing a precise estimation of the power production
- A worldwide distribution of the resource

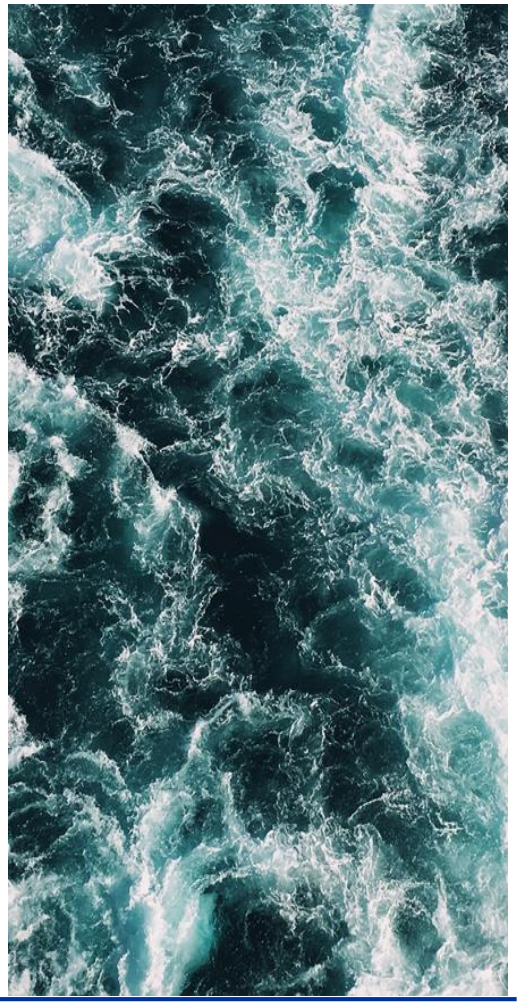


Overall technical potential

100 GW

Site selection criteria:
- Water in motion
- Acceleration sites

Minimum speed during mean spring tide: 2 m/s or 4 knots

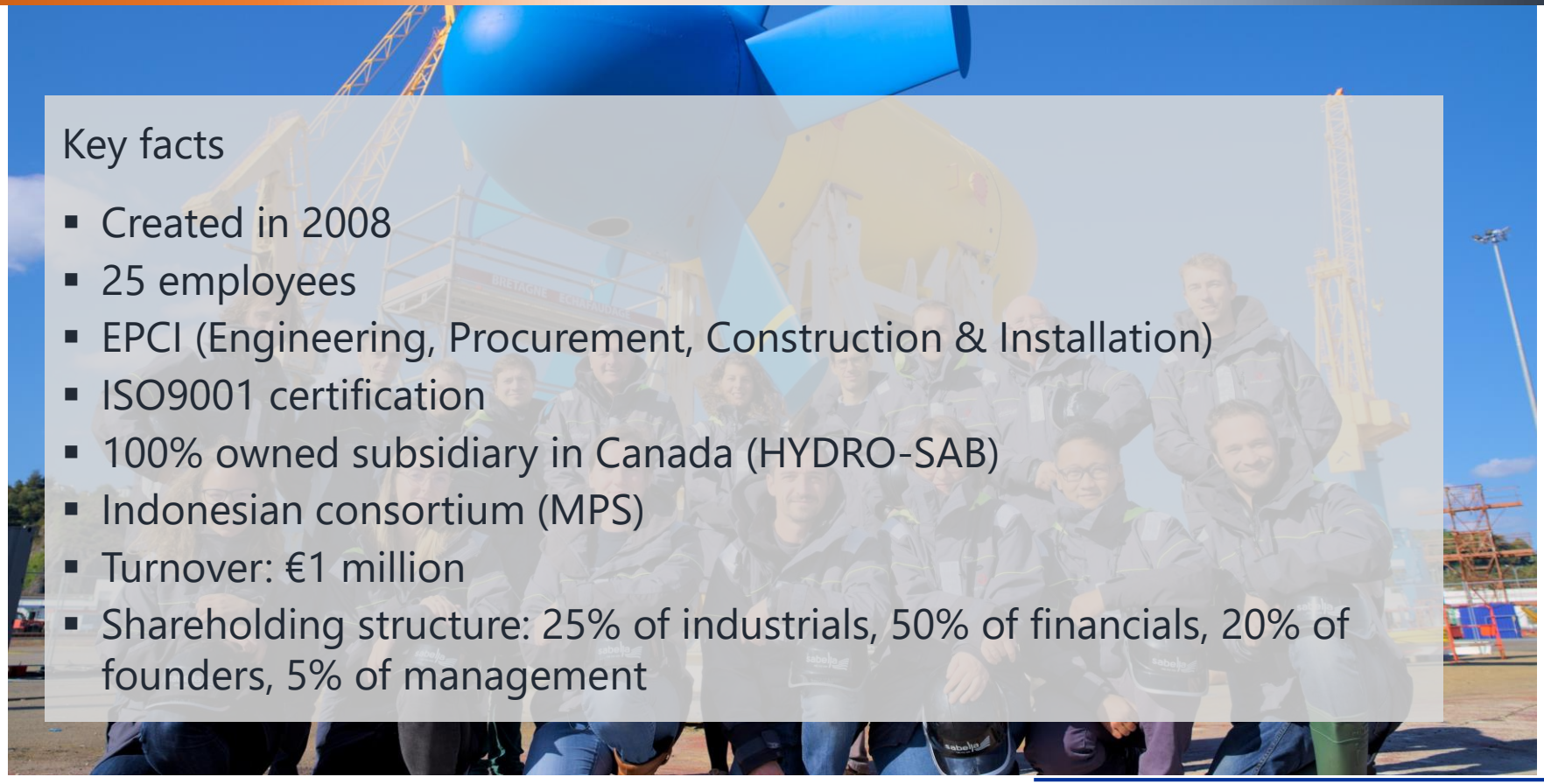


II. The company

Driving force of the energy transition, 10 years of experience in ocean energy

2008 | D03-30
1st tidal turbine installed in France during 12 months

2015 | D10-1000
1st tidal turbine to supply electricity to the French grid



Key facts

- Created in 2008
- 25 employees
- EPCI (Engineering, Procurement, Construction & Installation)
- ISO9001 certification
- 100% owned subsidiary in Canada (HYDRO-SAB)
- Indonesian consortium (MPS)
- Turnover: €1 million
- Shareholding structure: 25% of industrials, 50% of financials, 20% of founders, 5% of management

III. SABELLA tidal stream technology

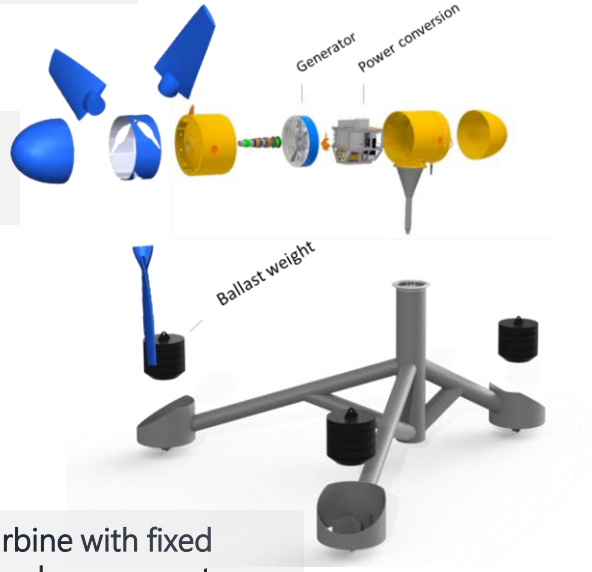
A cutting-edge technology for a differentiated solution

Direct drive generator with permanent magnets

No wearing parts

Onboard conversion chain and transformation with complete redundancy

Increased reliability in case of component failure



Low rotation speed

Marine life friendly

Modular architecture

Installation and O&M costs reduction

Horizontal axis turbine with fixed symmetrical blades and no yaw system

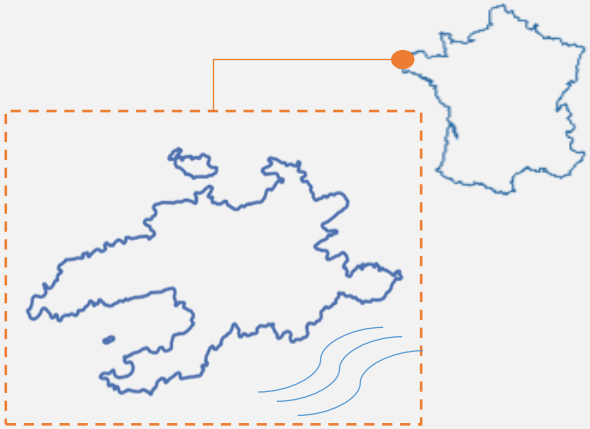
Improve yield, proven design and ruggedness

Gravity-based support structure with ballast weight

Environmental impact

IV. Main projects

Ushant: insular, off-grid and autonomous



Ushant island
900 inhabitants – 4 Diesel power gensets,
Peak consumption 2 MW
7,000 MWh/year – 2 millions litres of fuel per year

SABELLA's projects on this island
3 steps from a first deployment in 2015 to the establishment of a tidal turbines array in the Fromveur Passage:

- 55 meters deep
- 2 km off the shore
- Up to 4.5 m/s (9 knots) current velocity

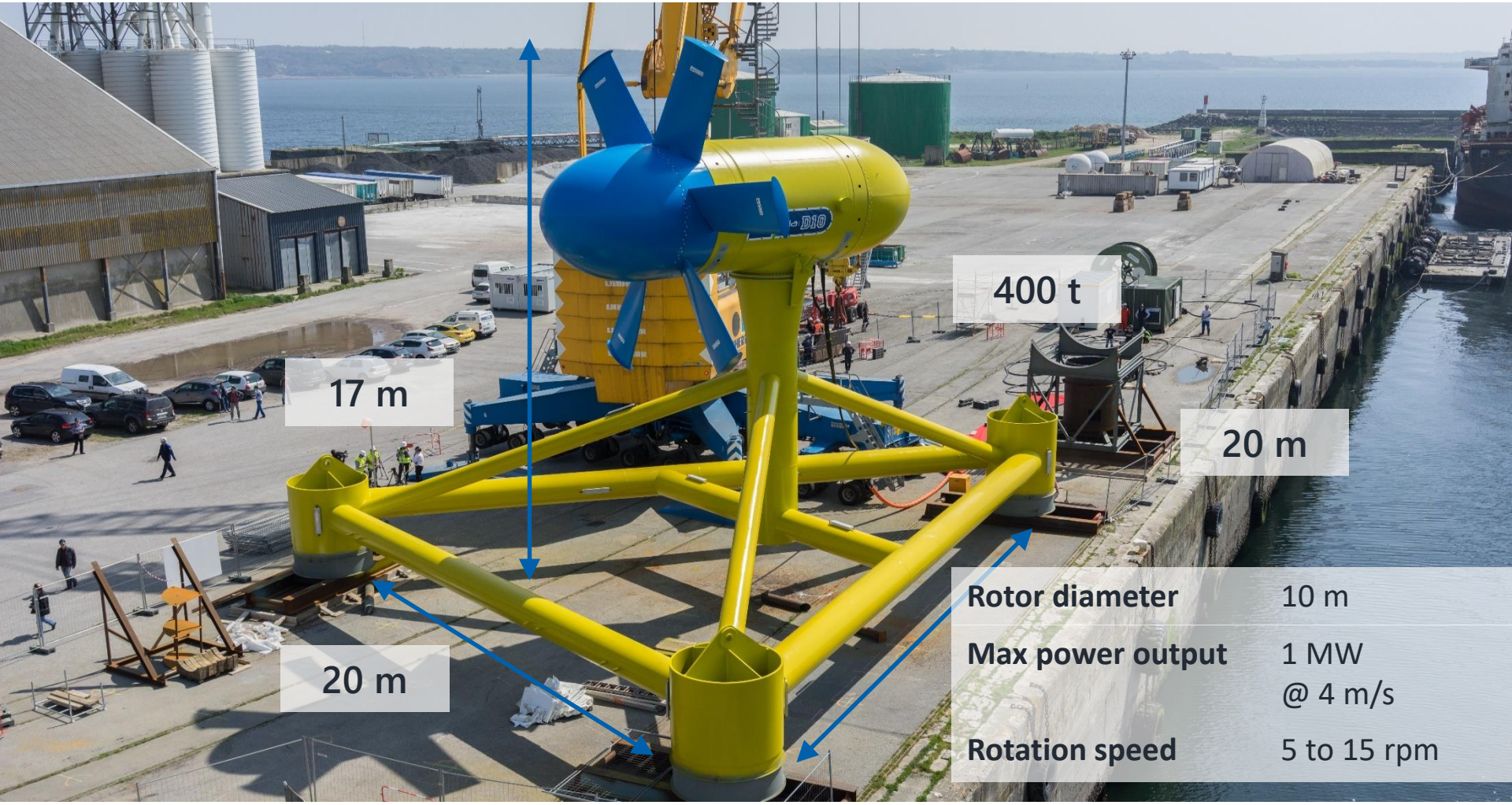
Step 1: D10-1000 mechanical and grid integrity and environmental compatibility ✓

- Supported by the French government and Brittany region
- 1 MW device of 10-meter rotor diameter
- 2015: deployment in the Fromveur Passage and **connection to the electrical network of Ushant Island,** a weak and fragile off-grid network
- **Operation and monitoring** of the turbine during the 12-month authorized period

Environmental compatibility and operability assessed during the operations

IV. Main projects

Ushant: insular, off-grid and autonomous



Rotor diameter	10 m
Max power output	1 MW @ 4 m/s
Rotation speed	5 to 15 rpm

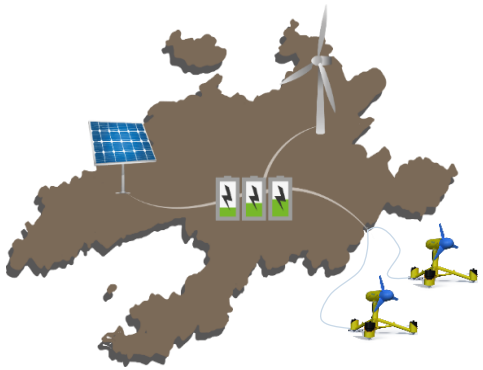
IV. Main projects

Ushant: insular, off-grid and autonomous

Step 2: PHARES – 2 tidal turbines – Commercial phase ✓

- Showcase for the "Fuel Free Island" energy model
- Led by AKUO Energy, final step of Ushant's energy transition toward a green energy mix
- **Deployment of two tidal turbines, one wind turbine, solar panels and energy storage capacity**
- **Fuel saving** of 1,500,000 liters/year (75% of Ushant energy needs)
- Commissioning in **2022**, 20-year period operation
- **Overall cost of the hybrid solution cheaper than Diesel generators (€450 per MWh)**

The first commercial turbines array in France

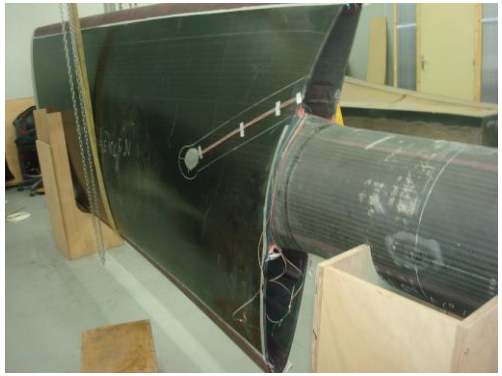


Two tidal turbines of 500 kW each, one wind turbine of 900 kW, 500 kW of innovative solar panels solutions and an energy storage (Li-Ion) of 2 MWh.

Total power: 2.4 MW

V. Next generation composite blades

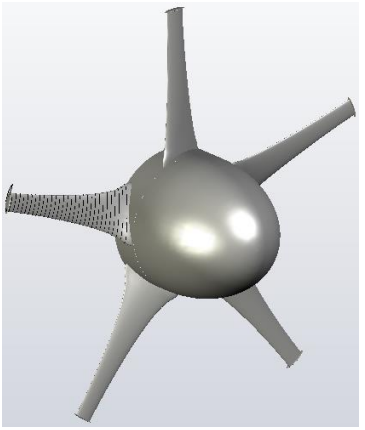
- **D10 blades design**
  - Validation of performances with CFD and tank tests
  - monolithic carbon fiber composite
  - 3 main éléments : spar, blade shape, winglet
  - Fixed to the hub with steel flange
  - 2 process used : pre-preg for spar, infusion for balde shape
  - Monitoring : strain gauges linked to data loggers installed by IFREMER
  - Lack of knowledge on real environmental conditions
  - Lack of knowledge on the behaviour of composites in underwater environments
  - Absence of design standards dedicated to tidal devices

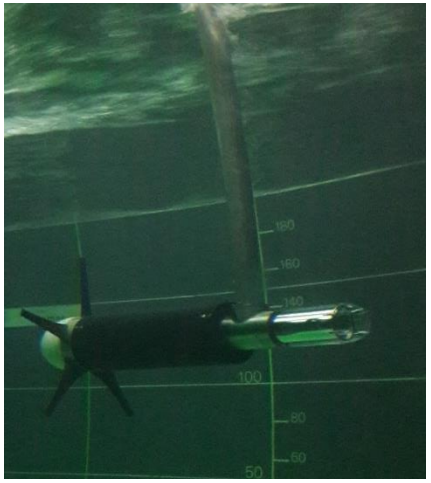


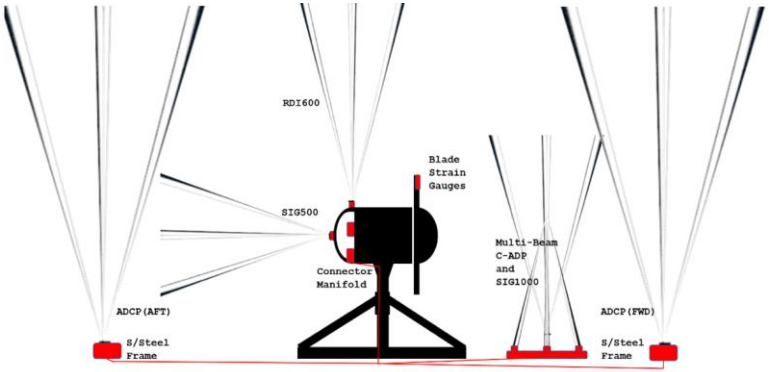
V. Next generation composite blades

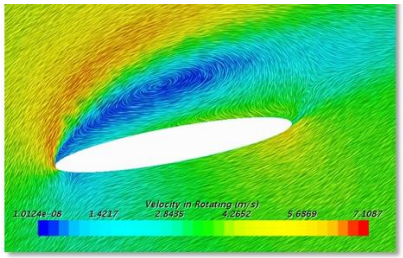
- **R&D activities for blade design improvement**

  - Blade shape optimisation using BEMT tools
  - Validation of performances with CFD and tank tests
  - Refined measurement campaign and study of environmental conditions in Fromveur Strait, including turbulences
  - Analysis of dedicated standards for load cases definition (IEC 62600, BV NI603, DNV-GL ST0164) for optimisation of safety factors







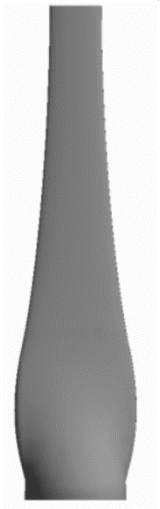


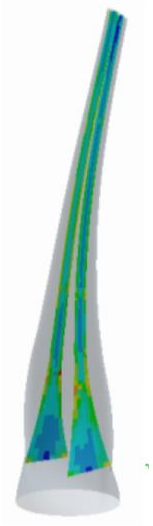
- **R&D activities for blade design improvement**

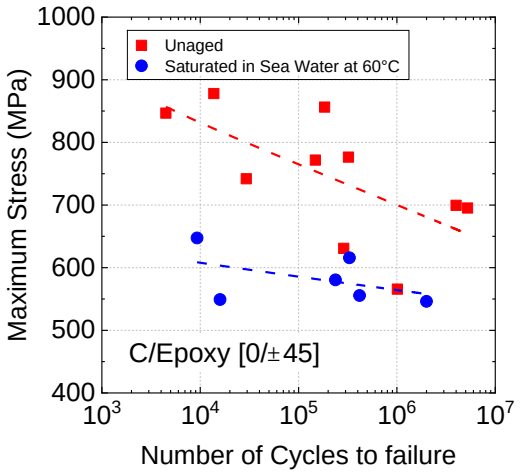
  - Characterisation of composite behaviour in underwater environment (IFREMER)

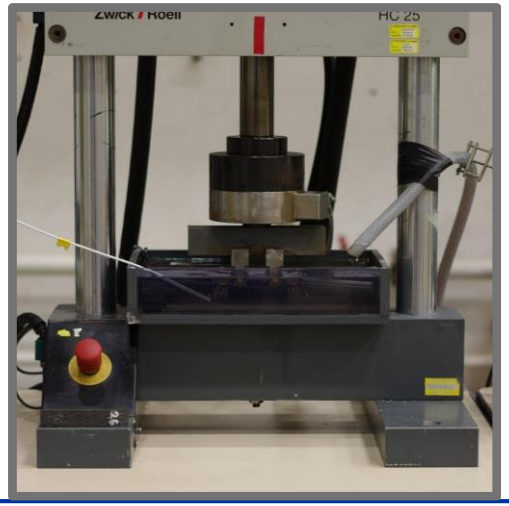
  - Integration of blade fixation in blade root (inserts in composite)

  - Works on new monitoring methods using fiber optics and cracks detection system









V. Next generation composite blades

- **Next steps**

  - Characterisation of impact of turbulences on fatigue behaviour for composite
  - Characterisation and use of new composite materials, included « eco-friendly » materials (recyclable/bio-sourced materials)
  - Industrialisation process for composite blade manufacturing
  - Integration of monitoring systems in composite

  ➢ **Reduce cost of blades for tidal turbines**

  ➢ **Improve reliability of composite blades for tidal turbines**

Q&A

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Thank you!