15th 2023 EWTEC
European Wave and Tidal Energy Conference Series

BILBAO
3rd -7th SEPTEMBER 2023

NEMMO
MAKING BETTER BLADES

Final Event:
On the Cutting Edge of Tidal Blade Design and Materials

5 September, 2023 - 16:00 - 17:30

Bilbao, Spain

Programme

Time	Topic	Speaker
16:00	Welcome & introduction	Pablo Benguria Uribe, Tecnalia
16:10	Novel testing procedures for tidal composite blades	Jean Baptiste Jorcin, Tecnalia
16:20	Increase of blades strength by means of adding carbon nanoparticles included in composite formulation	Célia Mercader, Canoe
16:30	Design and testing of novel antifouling strategies for turbine blades	Yan Delaure, Dublin City University (DCU)
16:50	Accelerated ageing test to reproduce the degradation of composite material in sea water	Jean Baptiste Jorcin, Tecnalia
17:00	Environmental and socio-economic assessment of a 34 MW tidal energy farm based on the NEMMO project	Marco Bianchi, Tecnalia
17:15	Mechanical testing of large-scale prototype and demo installation	Javier Grande, Magallanes Renewables
17:25	Final remarks // End of event	Pablo Benguria Uribe, Tecnalia

NEMMO Project
Final event
Welcome and introduction

15th ewtec 2023
European Wave and Tidal Energy Conference Series

September 4th 2023, Bilbao

NEMMO
MAKING BLADES BETTER

Next Evolution in Materials and Models for Ocean energy

Starting date: April 1st 2019
Ending date: September 30th 2023

Participant No./Status	Participant Organisation Name/[Short Name]	Country
1 (Coordinator) / RTO	Tecnalia Research & Innovation [TECNALIA]	Spain
2.SME	Grupo INPRE Composites [INPRE]	Spain
3.RTO	Israel Institute of Technology Technion [TECHNION]	Israel
4.RTO	Dublin City University [DCU]	Ireland
5.RTO	Association Pour Le Developpement De L'enseignement Et Des Recherches Aupres Des Universites, Des Centres De Recherche Et Des Entreprises D'aquitaine [ADERA]	France
6.RTO	Fundación para el Desarrollo y la Innovación Tecnológica [FUNDITEC]	Spain
7.SME	Sagres SL [SAGRES] / Magallanes Renovables [MAG]	Spain
8.RTO	SSPA Sweden AB [SSPA]	Sweden
9.RTO	Instituto Tecnológico de Aragón [ITA]	Spain
10.SME	SP Nano Ltd. [SPNano]	Israel
11. IAG	Ocean Energy Europe [OEE]	Belgium
12. RTO	Blade Test Centre A/S [BLAEST]	Denmark

- NEMMO gathers **the entire value chain**:
  - **2 industrial partners** that will directly commercialise NEMMO results :
    - **SPNano**: Their SP1/CNT technology is being forecasted to impact, wind energy and EV market
    - **INPRE**: composite blade manufacturer, having manufactured six 9m-long-blades for MAG.
  - **8 RTD partners** to provide leading edge technological advances
  - The largest **global network of ocean energy professionals (OEE)** will promote NEMMO results to their members and to potential investors and stakeholders in their European links.
  - An **end user (MAGALLANES)** within the consortium facilitates early assimilation of results by industry while generating the credibility essential for market success

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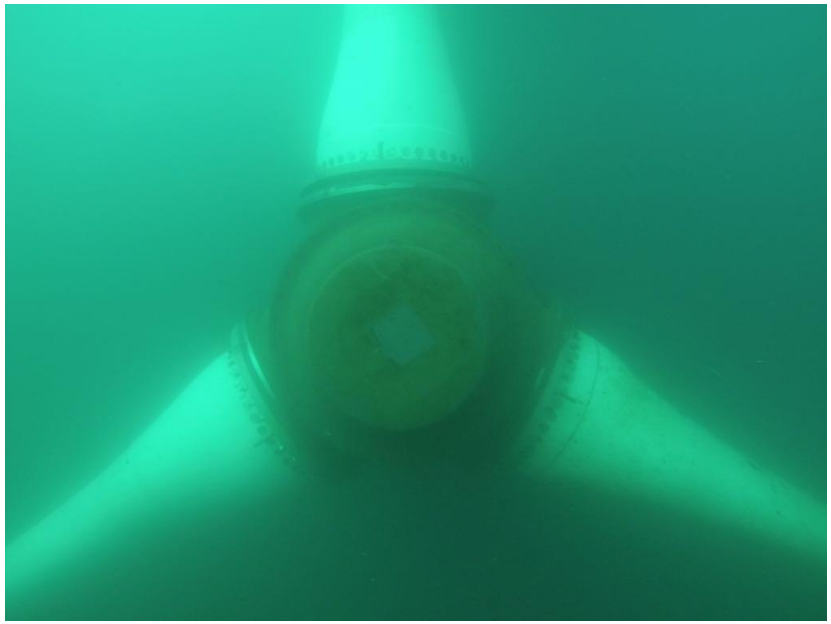
The key objective of the NEMMO project is to **design, model and test downscaled prototypes of larger, lighter and more durable composite blades for >2MW floating tidal turbines** to reduce LCoE of tidal energy to €0.15/kWh, meeting 2025 SET-Plan targets and making it competitive to competing fossil fuel sources.



NEMMO is about BLADES!

Concept

- ✓ A major share of tidal energy OPEX costs is caused by **failures, damages and fouling growth** in blades.
- ✓ Available simulation tools and testing procedures have **limited capacity to predict the behavior** of components and devices at real operational conditions.
- ✓ NEMMO project seeks to **enhance blades performance** (+20% hydrodynamic performance, -34% OPEX) for 20 years in >2MW tidal generators by means of novel:
  - ➢ Behavioral models
  - ➢ Testing procedures/methodologies
  - ➢ Materials and coatings
  - ➢ AFC strategies
- ✓ A set of **three 1:1 scale blades** including best performing solutions will be manufactured and validated in Magallanes ATIR device.

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Figure 1. One of the 1:1 blades manufactured by INPRE

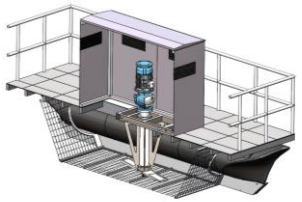

Figure 3. Tecnalia's HarshLab in the Bay of Biscay (Spain)

Figure 2. DCU's dynamic antifouling test rig (Ireland)

Results so far

- ✓ Development and validation of suitable computational fluid dynamics (CFD) workflow for **simulating tidal turbine cavitation**
- ✓ **Carbon nanoparticles** included in composite formulation to increase blades strength → good performance, but **not feasible at industrial level**
- ✓ **Active Flow Control** strategies analyzed, but implementation is not feasible in current Magallanes blades
- ✓ **First Reduced Order Modelling** of the main mechanical properties of the above-mentioned materials
- ✓ **Accelerated ageing test** to reproduce the degradation of composite material in sea water. Validation in the Bay of Biscay (HarshLab)
- ✓ 2 formulations for **antifouling coatings** developed and tested in floating jetty (Pasaia Port) and in HarshLab (Bay of Biscay)
- ✓ Best performing **biomimetic surface textures** selected
- ✓ Design and validation of a novel test platform for **biofouling testing** under realistic dynamic stress conditions at Malahide Marina (Ireland)

Ongoing

- ✓ Manufacturing of four **1:1 tidal blades** with new geometry
- ✓ Validation of fatigue **testing procedures in a 1.1 blade**
- ✓ Validation of a **set of three 1:1 scale blades** in Mag's platform at EMEC