PORTOS Project

Test Facility Specifications

Contact the test facility manager immediately to show your interest.

Wave flume at the Universidade de Santiago de Compostela

Project Details	
Project acronym	PORTOS
Project title	Test Facility Specifications

Introduction

Sea ports have high-energy requirements which are normally catered for by fossil fuels and are a source of air pollution, two environmental problems that can be minimised by using renewable energy. Considering the convergence of resources, infrastructures and facilities in ports, marine renewable energy (MRE) has the potential to be a promising alternative.

PORTOS aims to assess, develop and promote the integrated use of renewable energy resources in Atlantic Area ports and increase their energy efficiency, establishing a roadmap to a more competitive and sustainable sector. Although there are proven technologies to harness MRE, new concepts are continuously being invented by academic, non-academic and industry inventors and entrepreneurs, who may not have enough resources and expertise to develop their ideas further.

In that regard applicants are invited to submit an application for the testing of their MRE device or technology to an independent Selection Panel (SP) comprising of experts in this sector. The SP positively appreciates solutions that can be integrated into ports.

Successful applicants will have access to one of the following facilities for two weeks;

- Universidade do Porto – UPORTO (PT) multidirectional wave basin or wave-current flume;
- Universidade de Santiago de Compostela – USC (ES) wave/current flume;
- Ecole d'Ingenieurs en Genie des Systemes Industriels – EIGSI (FR) technical assessment of novel technologies;
- Universidad de Oviedo – UNIOVI (ES) – numerical modelling of novel technologies.

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The institutions have various facilities. The maximum access that will be granted is two weeks. The researchers at each facility have vast experience and knowledge on MRE which will prove invaluable during the test. Applicants are required to contact the test facility prior to applying to ensure they can facilitate the campaign.

Contents

1. UNIVERSIDADE DO PORTO – UPORTO (PT) - MULTIDIRECTIONAL WAVE BASIN

DETAIL OF SERVICE BEING OFFERED

Access to the wave basin of the Faculty of Engineering of the University of Porto, Portugal. 2D/3D tests of a novel wave energy conversion technology at a small to intermediate scale.

DESCRIPTION OF FACILITY/TANK/MODEL THAT WILL BE USED

The Hydraulics Laboratory of FEUP has a multidirectional wave basin that is 28.0 m long, 12.0 m wide and 1.2 m depth, and includes a central pit (4.5 x 2.0 x 1.4 m^3), Figure 1. This facility is prepared for a wide variety of studies in the domains of marine renewable energies, offshore and coastal engineering, allowing the simulation of regular and irregular waves, either long or short crested.

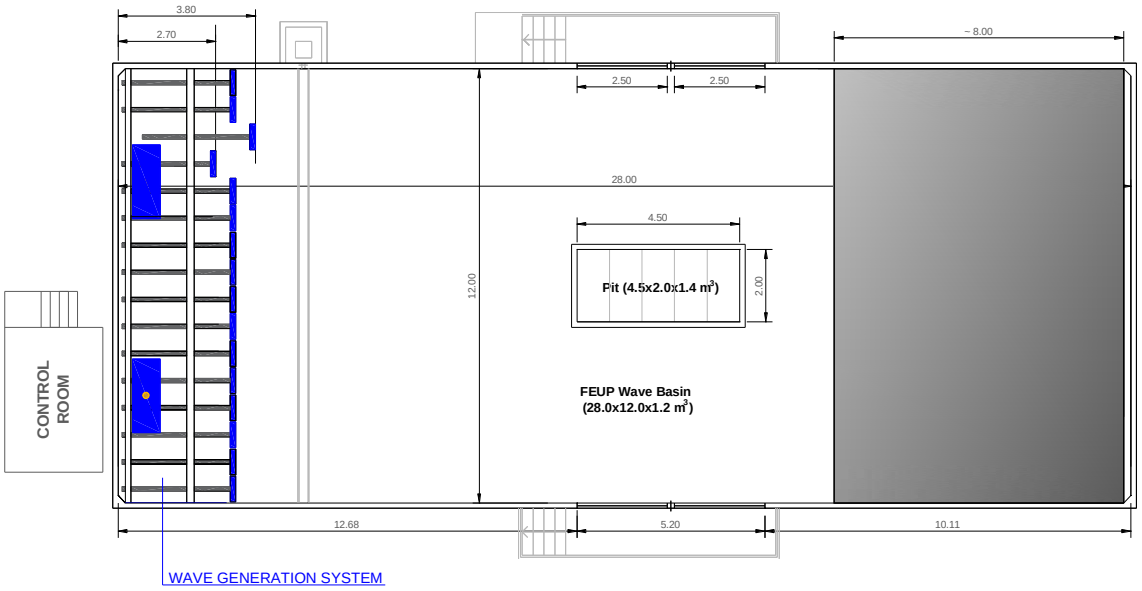

Figure 1. Wave basin of the Faculty of Engineering of the University of Porto, Portugal.

The wave basin is equipped with a multi-element piston-type wave generation system, controlled by a HR Wallingford wave synthesiser, which integrates a dynamic wave absorption system. The following key equipment is available: 12 resistive wave gauges, an infrared motion capture system composed of 3 cameras (Qualisys) to measure the motions of floating bodies in 6 DoF (Figure 2), FUTEK load cells (10 lbs and 25 lbs), pressure sensors, among others.

Figure 2. Qualisys System.

For a water depth of 0.80 m, the theoretical generation capabilities of the HR Wallingford wave maker are presented in Figure 3. Testing programme has to be discussed with the technical staff from the FEUP experimental facility.

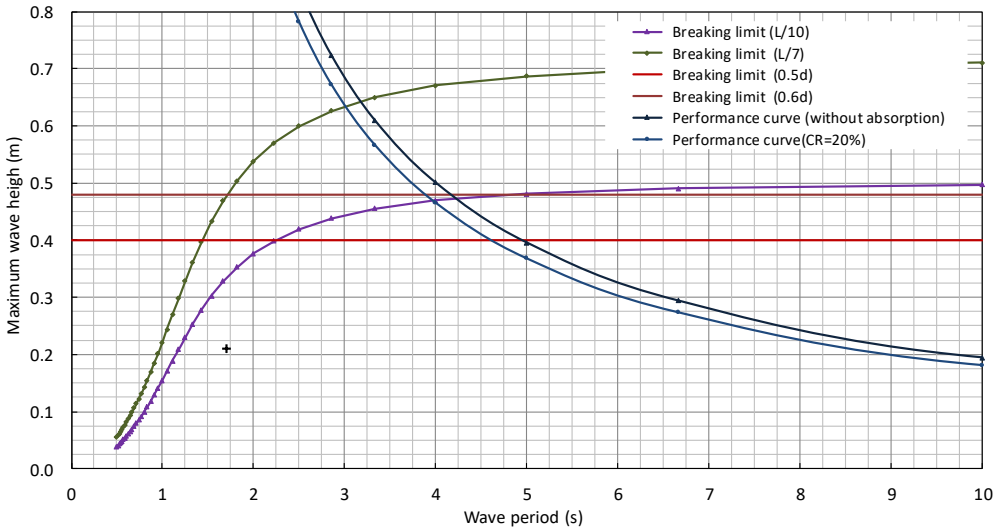

Figure 3. Generation capabilities of the wave maker for a water depth in the wave basin of 0.80 m.

TIME AVAILABLE FOR ACCESS

Access to the experimental facility of FEUP/UPORTO during 1 month. The period of access should be agreed with FEUP/UPORTO staff after the selection procedure and fit in the time window from September 2020 to March 2021.

OTHER RESOURCES AVAILABLE

Support of one technician (general expertise) for small adjustments of the physical model to be tested and the preparation of the experimental setup in the wave basin. Support of the technical staff from the laboratory to run the tests and use the equipment available.

Basic data processing of the experimental data measured during the testing campaign. Report covering the description of the technology tested, the experimental campaign carried out (characteristics of the model, set-ups, testing conditions, etc.) and some general conclusions of the proof of concept.

Support can be provided to the construction of the physical models up to the amount of €5000.

The Hydraulics Laboratory of FEUP/UPORTO has also a wave-current flume, 32.0 m long, 1.0 m wide and 1.0 m deep. This experimental facility is also available as alternative to the wave basin if, for the characteristics of the study to be performed, is found to be more suitable.

CONTACT

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2. UNIVERSIDADE DE SANTIAGO DE COMPOSTELA – USC (ES) - WAVE/CURRENT FLUME

DETAIL OF SERVICE BEING OFFERED

Testing and analysis of a MRE converter of one of the following types:

-Wave energy converters (WECs): 2D tests of fixed models
-Stream energy converters (SECs): fixed models, preferably 2D
The size and scale are limited according to the dimensions of the wave-current flume (20 m long*0.65 m wide*0.95 m high).

DESCRIPTION OF FACILITY/TANK/MODEL THAT WILL BE USED

- Description: wave-current flume (20 m long*0.65 m wide*0.95 m high) equipped with piston-type wave generation paddle and active wave absorption system.

- Available instrumentation: wave gauges for free surface measurements (11), ultrasonic level sensors (3), differential pressure sensor (1), water pressure sensors (8), ADV (1).

- Generation capacity:

Maximum significant wave height: Hs=0.14 m approx. (depending on the water depth)
Average current velocity: v=0.3 m/s approx. (depending on the water depth)

TIME AVAILABLE FOR ACCESS

-Testing: January / February 2021 (2 weeks of preparation and 2 weeks of occupation of wave flume for tests) (the wave flume will be occupied until this date)

- Data analysis and report: March 2021

OTHER RESOURCES AVAILABLE

According to our budget, we do not have money allocated to this action, so we do not have resources for model fabrication. Therefore, we can develop / give support the tests and the analysis of results of a model that should be provided to us by the applicant. We can also provide support for its construction (e.g. selection of model scale) so as to it being adapted to the characteristics of our facility.

CONTACT

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3. L'ECOLE D'INGÉNIEURS EN GÉNIE DES SYSTÉMES INDUSTRIELS – EIGSI (FR) - TEST BENCH FOR HYBRID MULTI-SOURCE ENERGIES WITH STORAGE CAPACITIES

3.2. DETAILS OF SERVICE BEING OFFERED, TIME AVAILABLE FOR ACCESS

We offer users free access to the research and test laboratory in the framework of the European PORTOS project. It is possible to carry out tests for a maximum of one month, by making a written request one month in advance. This request must be justified. Applicants (users) are asked to provide information relating to the "user" personnel, the access period. Detailed information is also required regarding the scientific project with a description of the proposed work, including a test and trial plan, the technical requirements and the expected results. Additional documents presenting the details of the project must be attached to the candidature.

All these elements must be submitted, in the form of a set of word and PDF documents.

Exchanges and discussions with users are mandatory during the application phase to ensure the adequacy of the requested infrastructure with regard to the objective of the project and the test plan. These discussions must be initiated by the candidates.

The selection process is divided into 2 main stages:

Assessment of technical feasibility: this step consists of assessing the technical feasibility of projects. If a project is not technically feasible in terms of infrastructure, it is either rejected or proposed to another partner in the European PORTOS project.

Scientific assessment: a panel of (internal) experts assesses the applications from the point of view of scientific content and the relevance of the result. Experts give marks to the application on these two criteria. The committee of experts is responsible for making a final decision, based on the comments provided by the experts as well as criteria related to the allocated / remaining access time.

The access procedure begins with an agreement between the User and our laboratory.

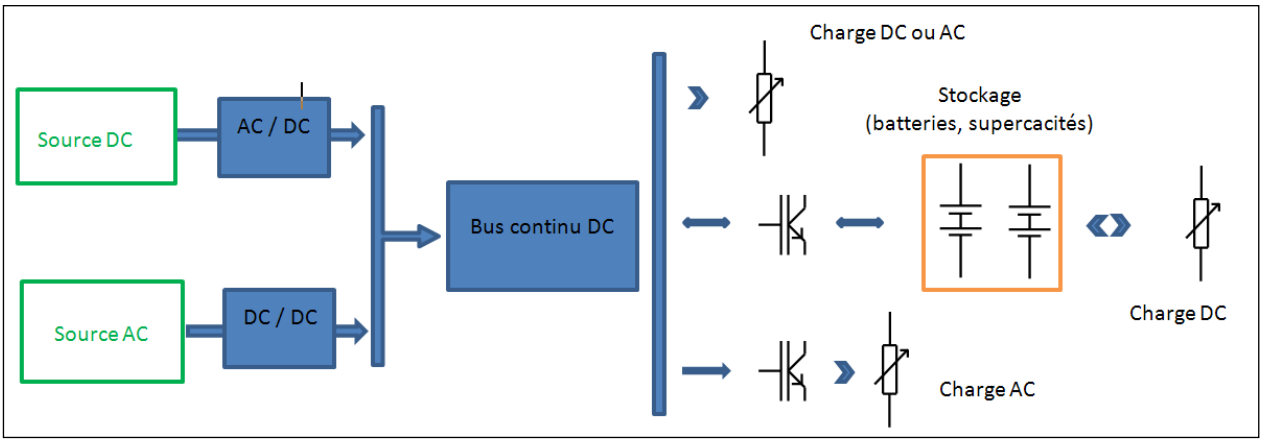
Once an agreement has been reached and the access period is open, access to the facility will be organized.

Important note: all travel and personnel costs are the responsibility of the user.

3.3. DESCRIPTION OF FACILITY

Our test bench aims to replicate the behavior of a hybrid multi-source system including storage. It consists of several chains of conversion and storage capabilities (batteries and ultracapacitors to simulate continuous DC or AC source. Each source is controlled in real time by a dSPACE MicroLabBox using Matlab / Simulink™ software. Power injection on the Grid can also be performed.

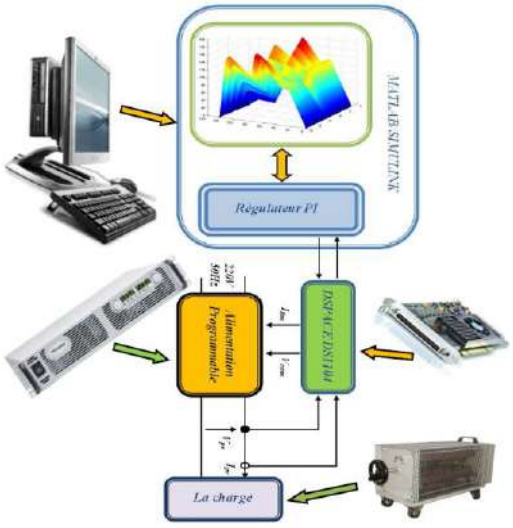
Block diagram of a typical offgrid hybrid bench



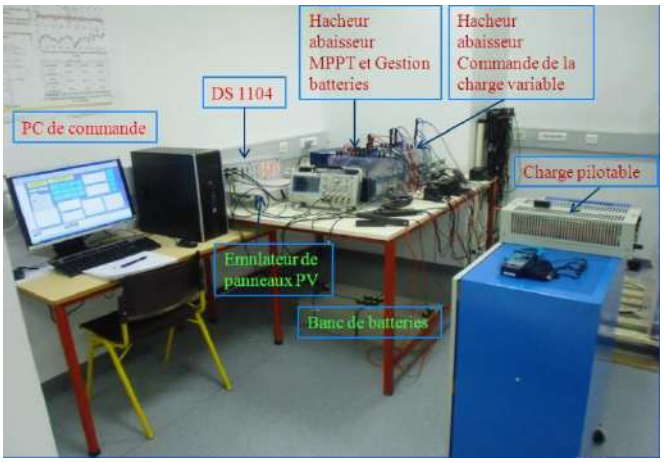
3.4. DC CONVERSION CHAIN

DC conversion circuit includes:

- A programmable power source TKD-Lambda in order to emulate the DC source (DC 3.3kW 100V-33A with RS232 / RS485 input 230VAC), A variable DC power source (6.6 kW, 300 V 23 A)
- Two DC / DC converters AN-8005 Semikron non reversible IGBT modules SKM50GB123D which can be assigned respectively to the DC source and the load (simulation of load variations)
- Six batteries Yuasa 12V 78 Ah connected in series to obtain a voltage close the DC bus, four ultracapacitor modules 500F 16,2V Maxwell
- Resistive load of 4kW.



Emulation of solar panel using a continuous DC source

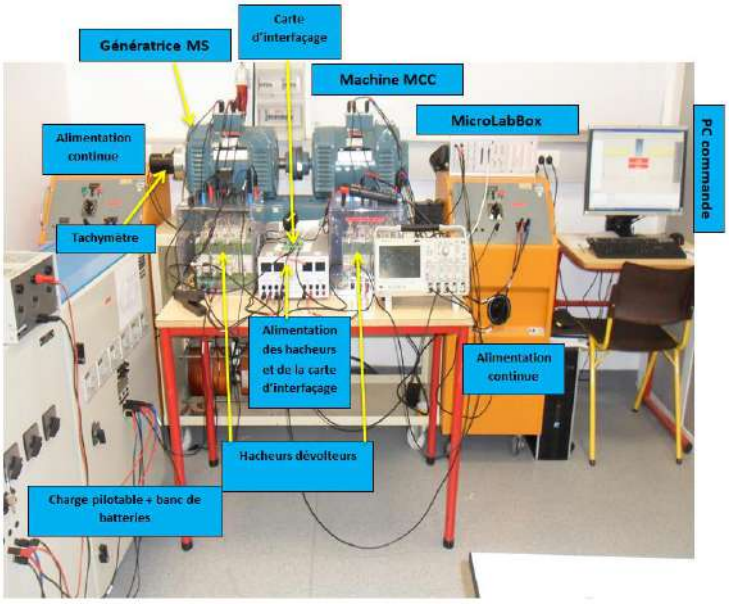


Continuous conversion chain DC

AC conversion chain:

The AC conversion circuit is simulated and consists of the following:

- Two machines: MCC(3kW) for the reproduction of the torque source induced by a wind turbine and synchronous machine to simulate the generator (3kW)
- The energy storage device (battery or ultracapacitors)
- A first step-down chopper for controlling MCC and a second for control of the generator. Both choppers can be controlled in real time via dSPACE.
- Resistive load of 4kW.

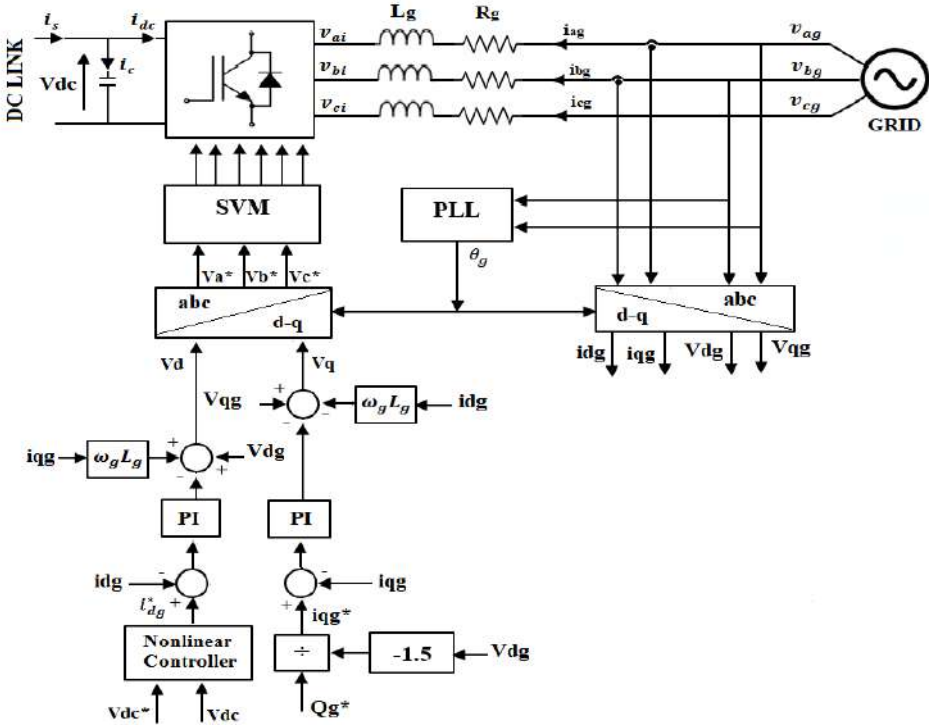


Alternative conversion chain AC

3.5. GRID CONNECTION

Power injection into the Grid is performed via an inverter controlled by the dSpace MicroLabBox. The power injected is of the order of magnitude of the powers supplied by the AC / DC sources described above (a few kW).

Different algorithms are possible to manage the stability of the system and the quality of the injected currents depending on the instantaneous power available on the DC bus.



Block diagram of the system for Grid power injection

3.6. CONTACTS

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4. UNIVERSIDAD DE OVIEDO – UNIOVI (ES) – NUMERICAL MODELLING OF NOVEL TECHNOLOGIES.

DETAIL OF SERVICE BEING OFFERED

University of Oviedo offers support for the proof of concept of a floating photovoltaic energy system that could be deployed in ports and marine environments. The technology must be in a TRL no higher than 3.

For this purpose, advanced numerical modelling techniques will be used by our research team. The basic specifications and details of the device will be provided by the external group, which will collaborate in defining the analysis.

DESCRIPTION OF FACILITY/TANK/MODEL THAT WILL BE USED

Computational facilities will be used for the proof of concept by means of a radiation/diffraction panel code (Ansys Aqwa or similar). The motion response of the device under marine environmental loads will be analysed by means of numerical modelling techniques. The mooring systems, connector and other auxiliary systems can be included and evaluated. Hydrodynamic analysis results, such as motions and pressures, can be transferred to FE models for structural analysis. The simulations can be performed either in the frequency domain or in the time domain.

TIME AVAILABLE FOR ACCESS

January - February 2021. The information regarding the concept must be received prior these dates. The report on the proof of concept and the results of the simulations will be provided to the external group no later than March 2021.

OTHER RESOURCES AVAILABLE

Realistic environmental conditions could be used for the simulations depending on availability of data. The external group can suggest the locations of interest and/or provide the required site-specific parameters.

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