

Improving and Condition monitoring of an Oscillating Water Column Power Take-off to maximize the power production

Joseba Lopez Mendia ([Orcid](#) , [Scopus](#))

Director@s: Eider Robles (UPV-EHU), Salvador Ceballos (Tecnalia)

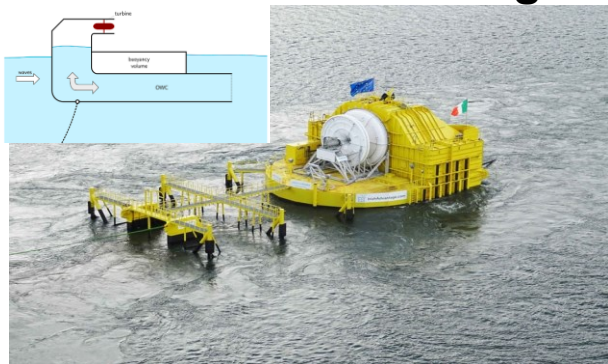
Index

- 1) Introduction about Oscillating Water Column Wave Energy Converter
- 2) Objective of PhD
- 3) Increase the OWC production by modifying the operational limits of the generator and the valve

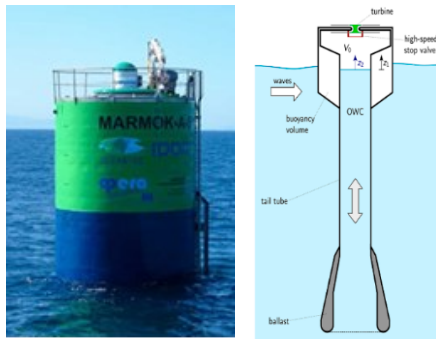
1. Introduction

1. INTRODUCTION . WAVE ENERGY CONVERTER TYPE OWC

Floating OWC

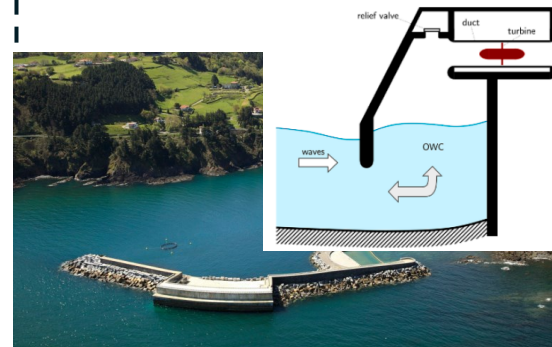


OE BUOY



MARMOK-A5
IDOM

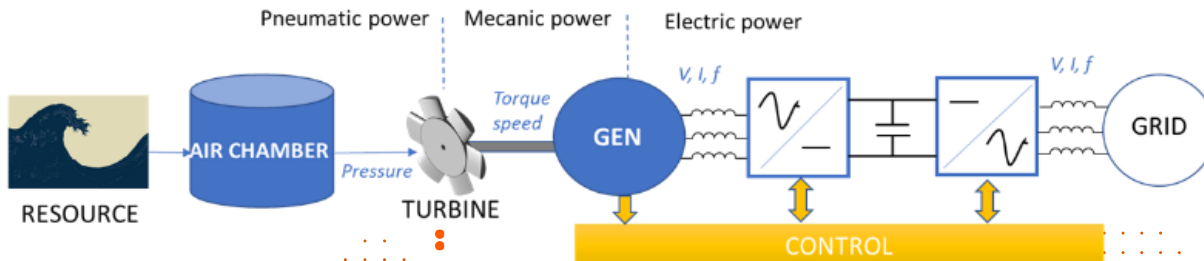
Fixed OWC



MUTRIKU



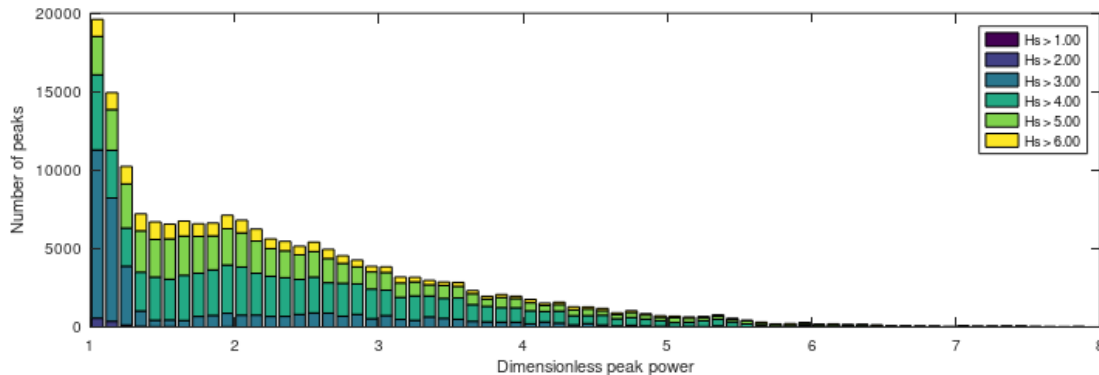
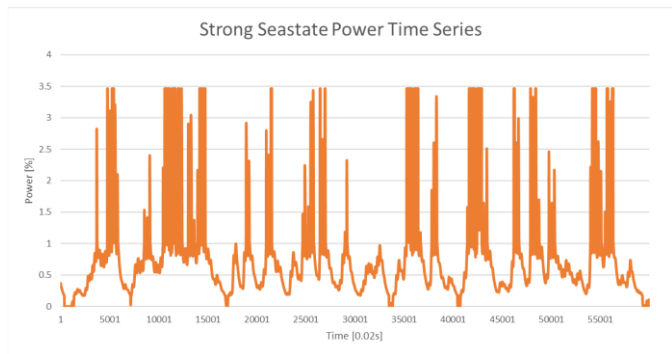
© 2008 AQUARET



1. INTRODUCTION . WAVE ENERGY CONVERTER TYPE OWC

Problem to Be Solved

- ❖ The wave energy resource is highly variable
- ❖ If the generator is sized for maximum power, the system is oversized most of the time, resulting in lower efficiency.
- ❖ If it is sized for a lower nominal power, it will operate at a higher load and greater efficiency, but there is a risk of generator failure or overheating.



2. Objective of the PhD

2. Objective of the PhD

Main Objective: Increase the production of an OWC (Oscillating Water Column)

- ❖ **Improvement of the efficiency** of an OWC transformation system by considering the generator's efficiency in the control strategy.

- ❖ <https://www.mdpi.com/1996-1073/17/5/1146>

- ❖ **Increase the OWC production** by modifying the operational limits of the generator and the valve.

- ❖ <https://www.sciencedirect.com/science/article/pii/S0029801824032554>

- ❖ **Study of monitoring alternatives** for a generator in an OWC system.

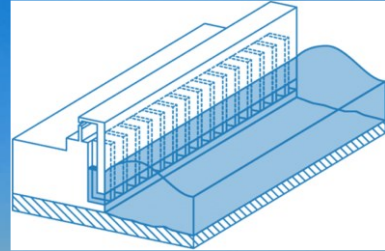
- ❖ <https://www.sciencedirect.com/science/article/pii/S2590174525000017>



3. Increase the OWC production by modifying the operational limits of the generator and the valve

3 Increase the OWC production by modifying the operational limits of the generator and the valve

Case study Mutriku Wave Power Plant



3.2 Increase the OWC production by modifying the operational limits of the generator and the valve

- ❖ The objective is to increase the production of the Mutriku Wave Power Plant (MWPP).
- ❖ To achieve this, it is proposed to increase the operational limits of the generator and the valve.
- ❖ Several steps have been followed to reach this objective.

3.2.1

Characterization of the
Mutriku Plant

3.2.2

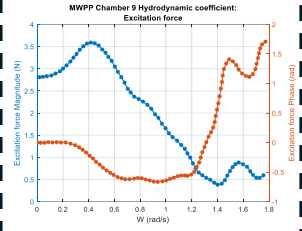
Development of the Mutriku
Model and Validation with
Real Data

3.2.3

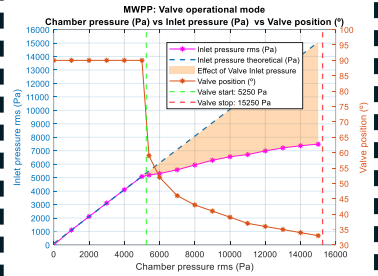
Study of Power Increase by
Expanding Generator and
Valve Limits

❖ Development of the Mutriku Model

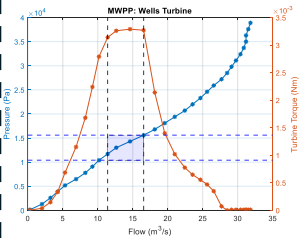
Chamber characterization



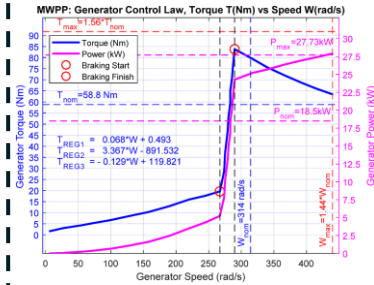
Valve Characterization



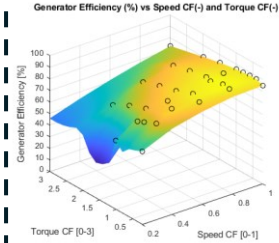
Turbine Model



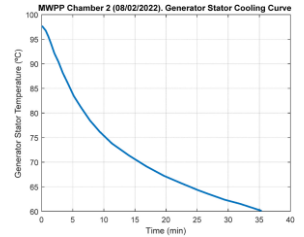
Control



Generator Efficiency



Thermal model



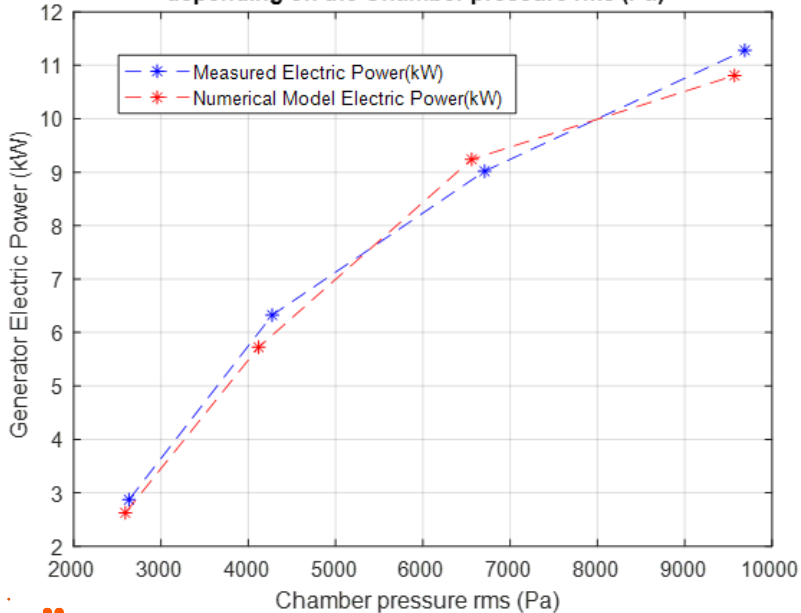
Power production

Numerical model vs Real data

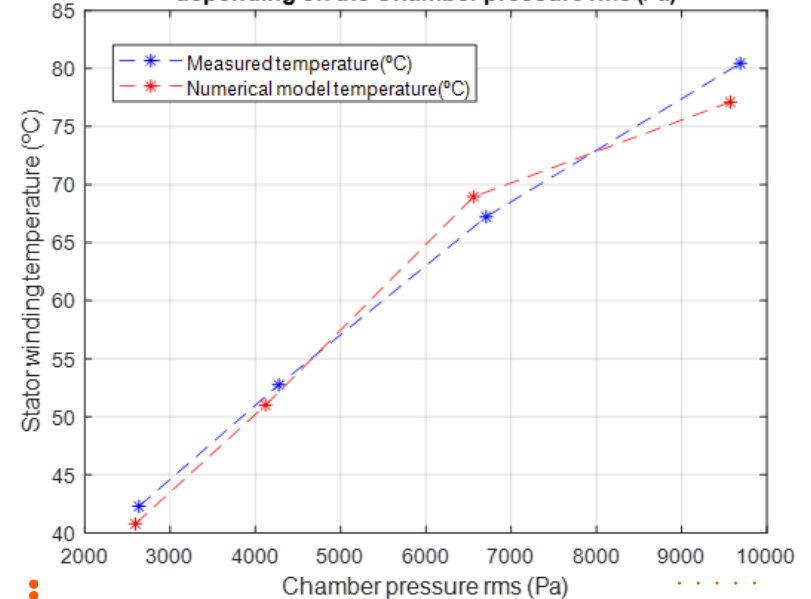
Generator Thermal behaviour

Numerical model vs Real data

MWPP Generator electric power (kW) (Chamber 2) vs Numerical model depending on the Chamber pressure rms (Pa)



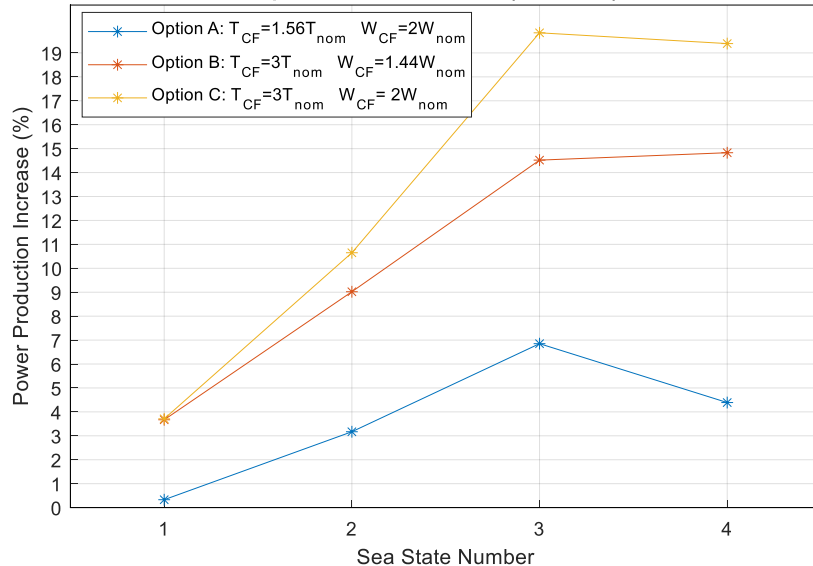
MWPP Generator stator winding temp(°C) (Chamber 2) vs Numerical model depending on the Chamber pressure rms (Pa)



❖ Study of Power Increase by Expanding the Operational Limits of the Generator

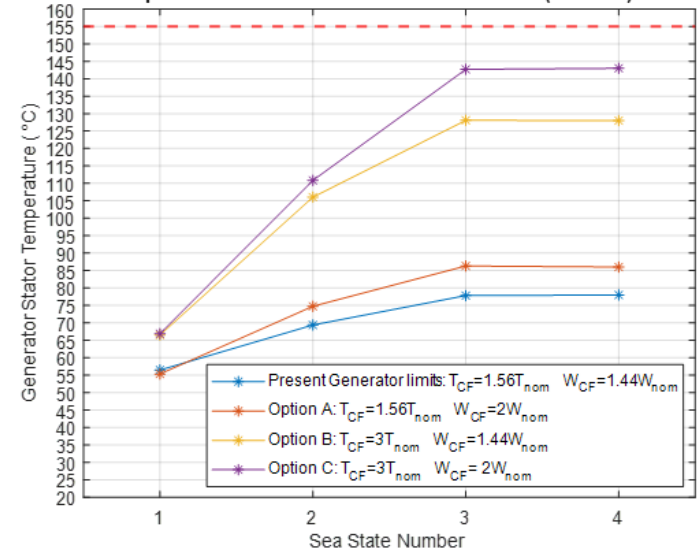
MWPP : Power production increase with respect to existing setting (with current limits $T_{CF} = 1.56 T_{nom}$ and $W_{CF} = 1.44 W_{nom}$) for several generator limits T_{max} and W_{max} , for 4 sea states

MWPP-NM: Power production increase (%) per 3 Generator Limits (T and W)



MWPP Generator stator temperature (°C) for 4 sea states and generator limits

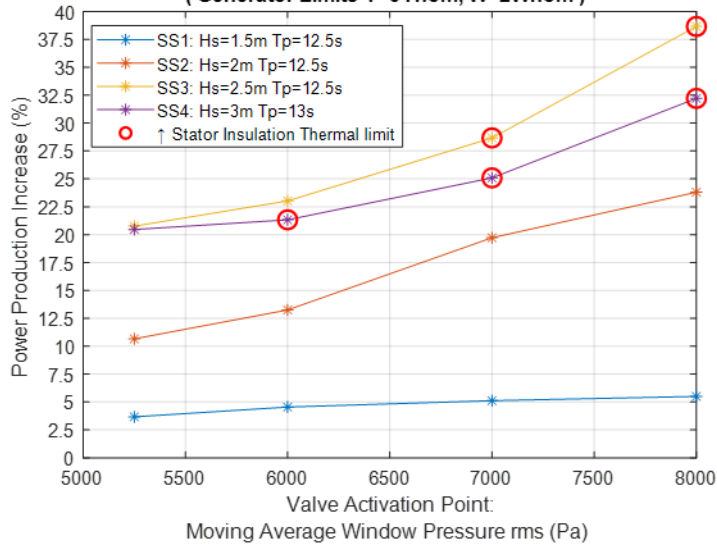
MWPP-NM: Generator Stator Temperature (°C) per several sea states and Generator limits (W and T)



❖ Study of Power Increase by Expanding the Operational Limits of the Generator and Valve

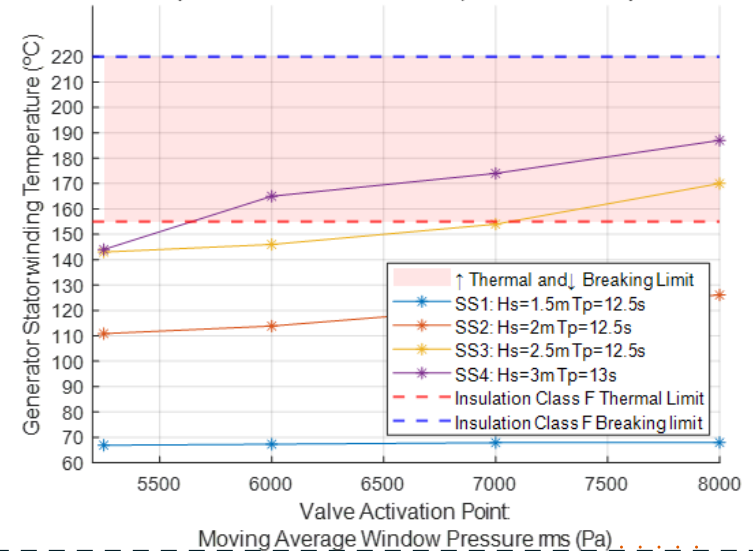
MWPP-NM: Summary of Power production increment (%) increasing generator Limits (T and W) and for several valve activation points

MWPP-NM: Power Production Increase (%) vs Valve Activation Pressure (Pa) (Generator Limits T=3Tnom, W=2Wnom)



Generator stator temperature (°C) vs Valve activation rms pressure for several sea states

MWPP-NM: Gen. Stator Temp. (°C) vs Valve activation pressure (Pa) (Generator Limits T=3Tnom, Wmax=2Wnom)



Eskerrik Asko

Joseba Lopez Mendia

joseba.lopez@tecnalia.com



tecnalia.com

tecnalia

MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE



Universidad
del País Vasco

Euskal Herriko
Unibertsitatea