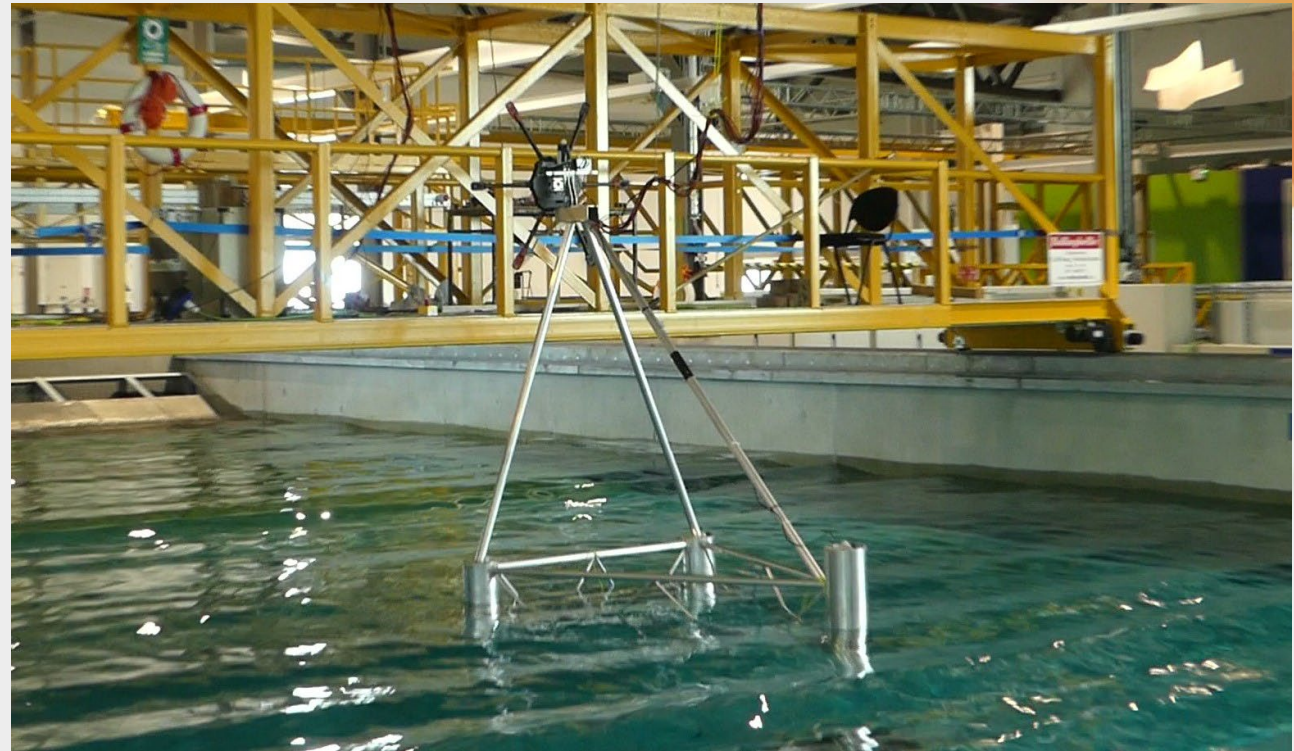


# Hybrid testing system development for single point mooring lines FOWTs

EERA DeepWind conference, 17-19 January 2024

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Ignacio Castelló	X1WIND





**01 SIL OVERVIEW**

**02 X1WIND X90 CONCEPT**

**03 SIL APPLICATION TO A SPM FOWT**

**04 RESULTS**

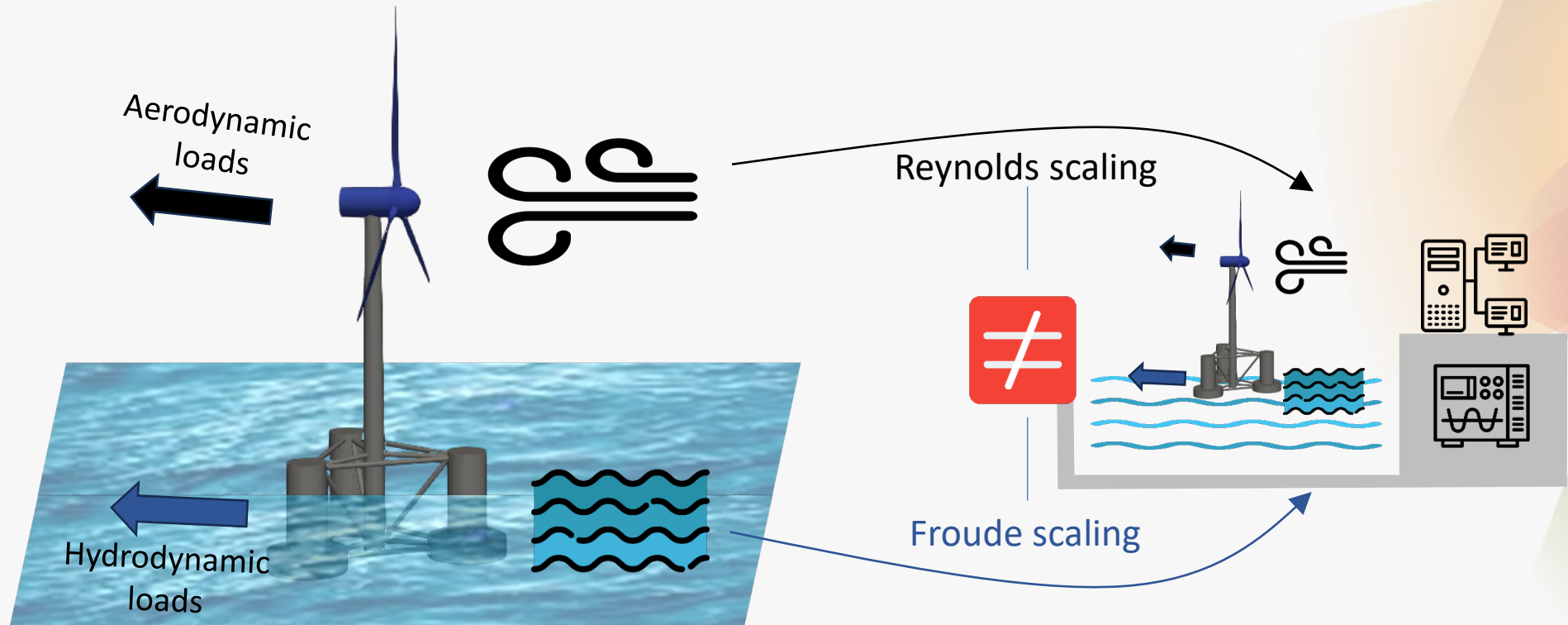
**05 CONCLUSIONS**

## SIL OVERVIEW

**Scaled wave tank testing** is an efficient approach to validate concepts and design tools

The dynamic characterization of a FOWT requires an **accurate scaling of the loads**

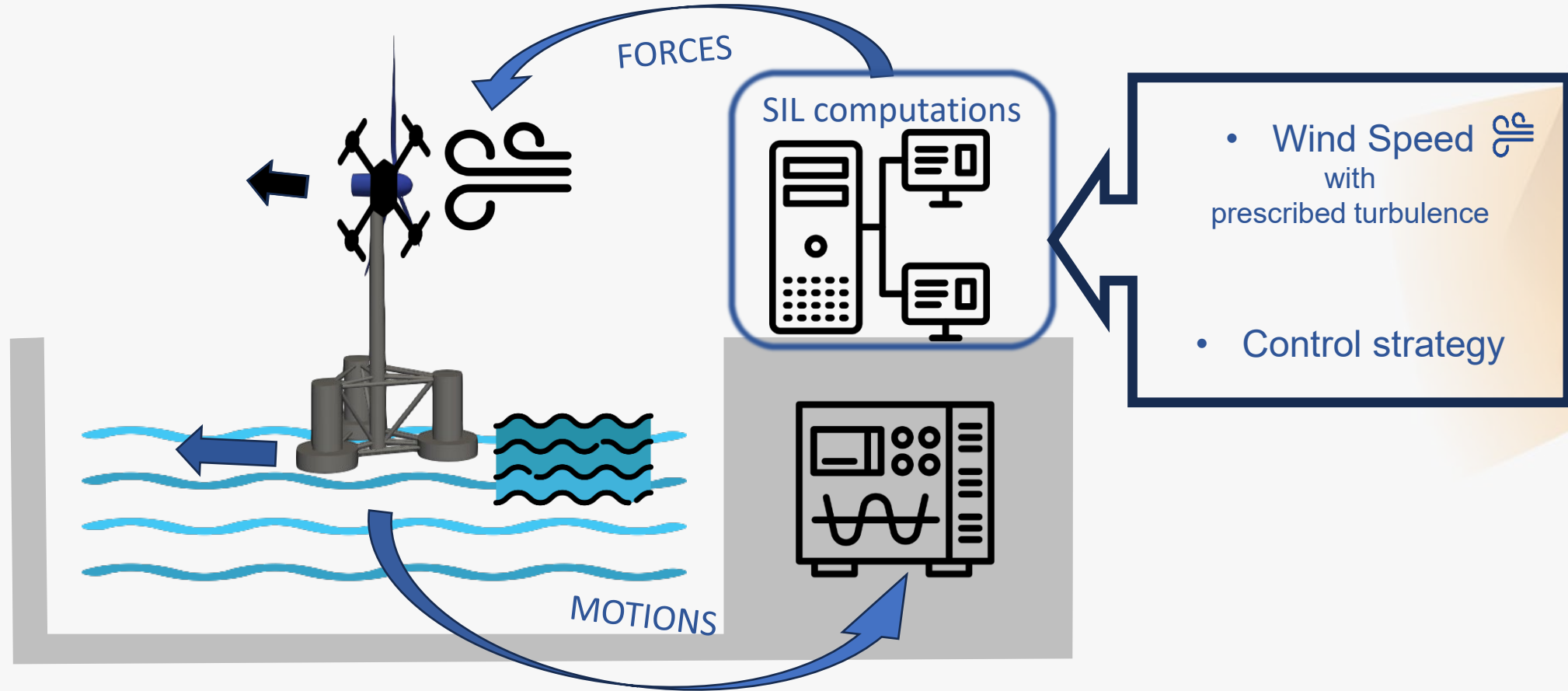
In wave tank testing of FOWT a **conflict in the scaling** of aerodynamic and hydrodynamic loads arise



## SIL OVERVIEW

SIL (Software-in-the-Loop) is a hybrid testing method to overcome this conflict

Aerodynamic forces applied by a force actuator fed by real time computations





# SIL OVERVIEW

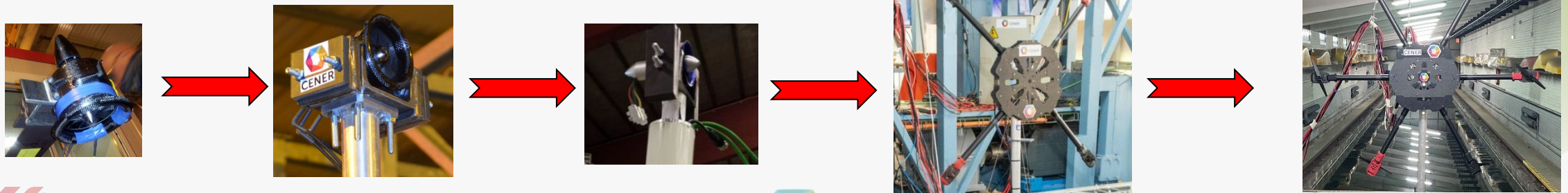
SIL system developed by CENER in 2011

Widely used at several test facilities and on different FOWT concepts

Semisubmersible, Spar, TLP, Spread, SPM



Upgraded to include out of plane forces and higher scaled tests



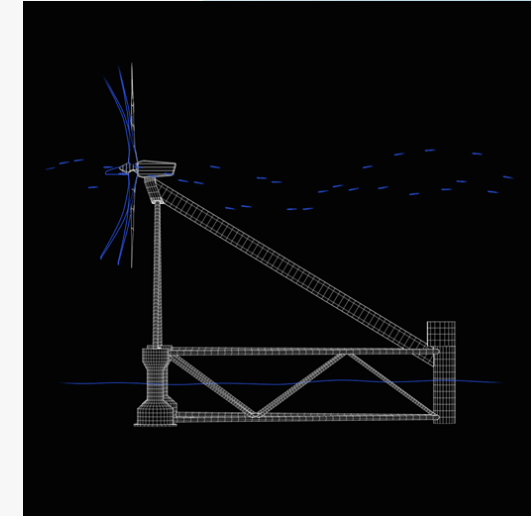
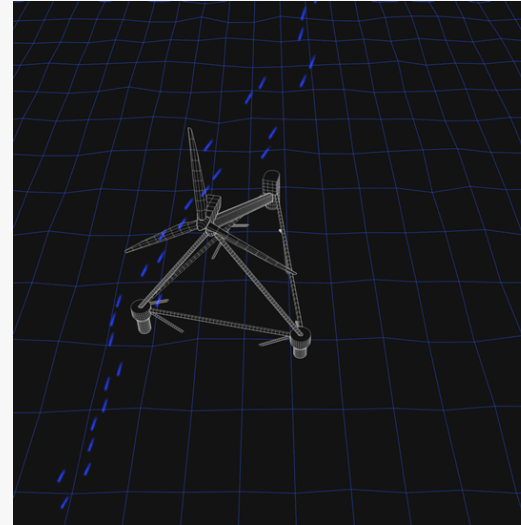
# X1WIND X90

## X1WIND concept

A disruptive a self-orientating floating design that reduces the weight and minimizes the costs of installation and maintenance

As light as TLP platforms and fixed offshore wind foundations, but can be easily installed with local vessels

SPM Weathervaning Downwind Configuration

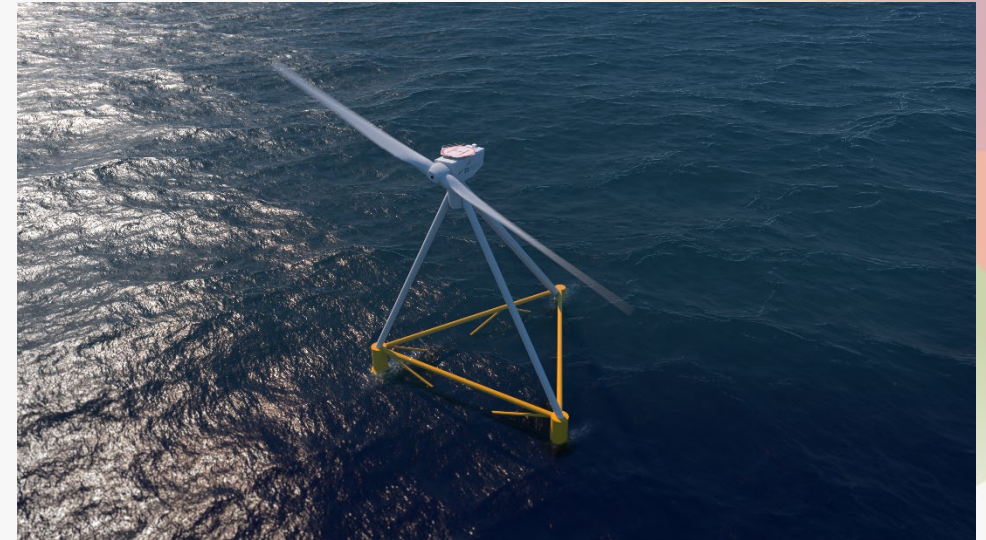


Experimental test campaign at wave basin



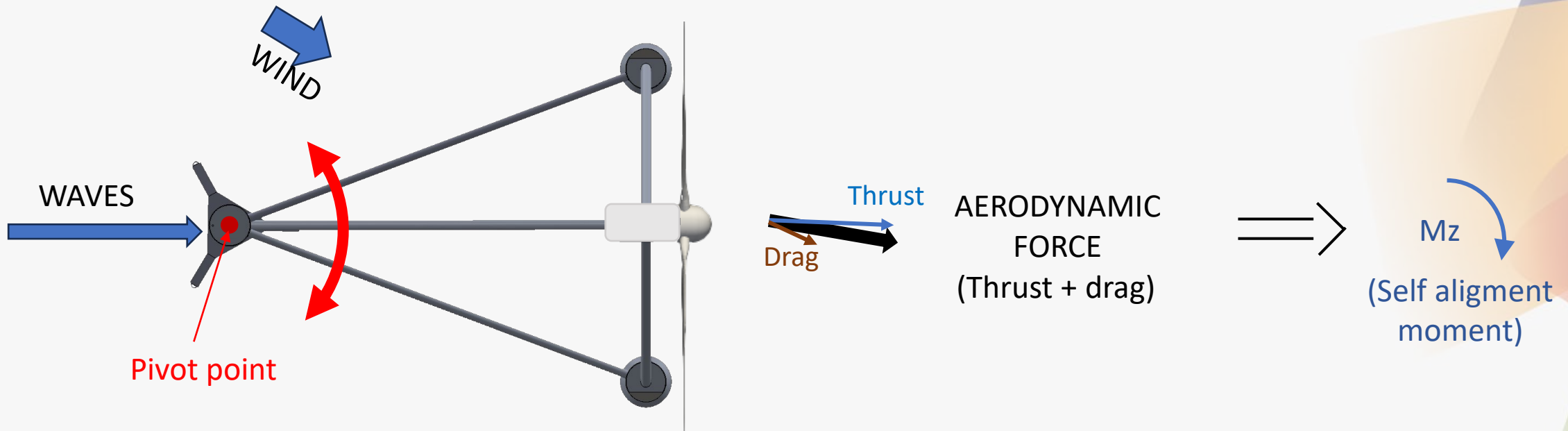
X1Wind X90 platform

Downwind  
6MW  
two-bladed  
WT





## Dynamic self-alignment of platform with the wind direction

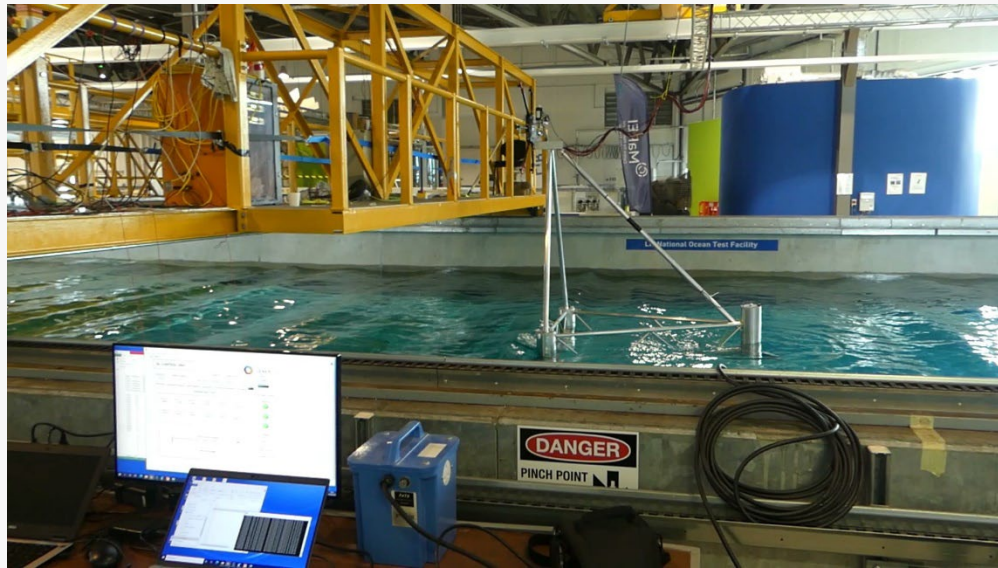


# SIL APPLICATION TO A SPM FOWT

- Main test requirements:
- Computation of force misalignment
  - Inclusion of nacelle and platform drag aerodynamic forces

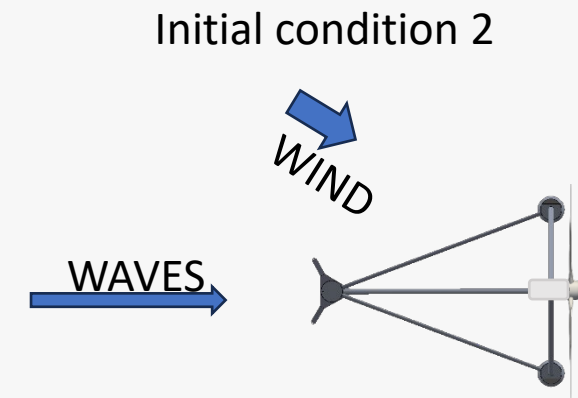
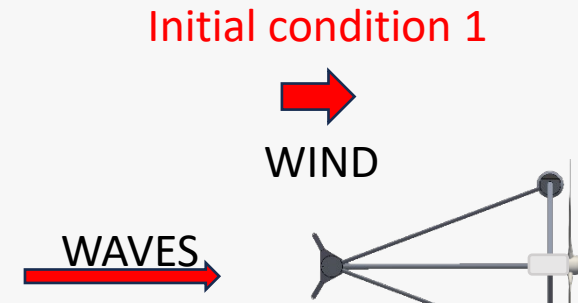
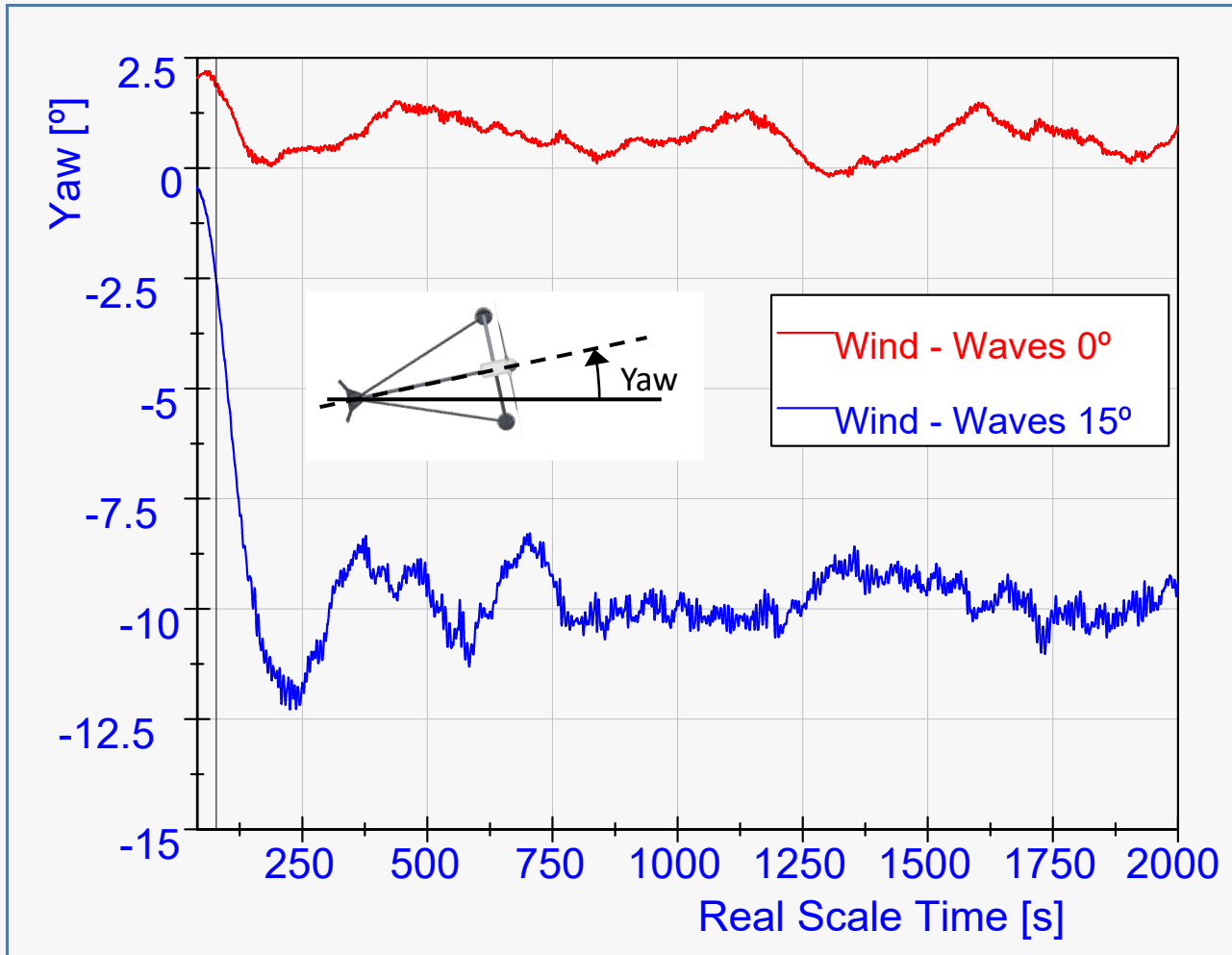
Challenges:

- Platforms with SPM experience large yaw rotations
- Higher transients (forces, moments) are generated
- Actuator propellers are more demanded in terms of amplitude and frequencies
- An accurate calibration is required as small imbalances can largely impact the system dynamics
- Cabling must be carefully allocated as an SPM system can be very sensitive





# RESULTS



Self-alignment behaviour of the plataform

## CONCLUSIONS

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New SIL upgrade allows yaw misalignment testing of SPM concepts

Aerodynamic drag of nacelle and platform 'out of water' elements help self-alignment

X1Wind X90 platform tests validate self-oriented behavior

# THANKS A LOT.

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This research has been funded by the "Ayudas a agentes del SINAI para la realización de proyectos de I+D colaborativos 2022" program of the Government of Navarre.

