TELWIND: Evolved Spar combined with telescopic tower

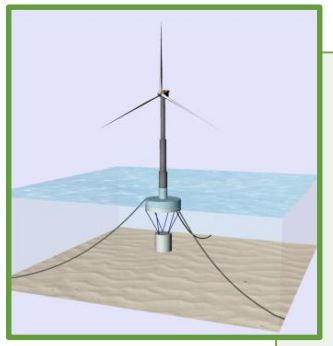
TELWIND PROJECT

ESTEYCO

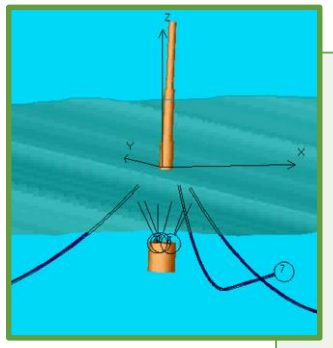
TELWIND: funded by the European Union´s Horizon 2020 research and innovation programme under grant agreement No 654634

Main Objectives

TELWIND BACKGROUND: THE TELESCOPIC TOWER



TELWIND TECHNOLOGY



MAJOR FINDINGS

INDEX

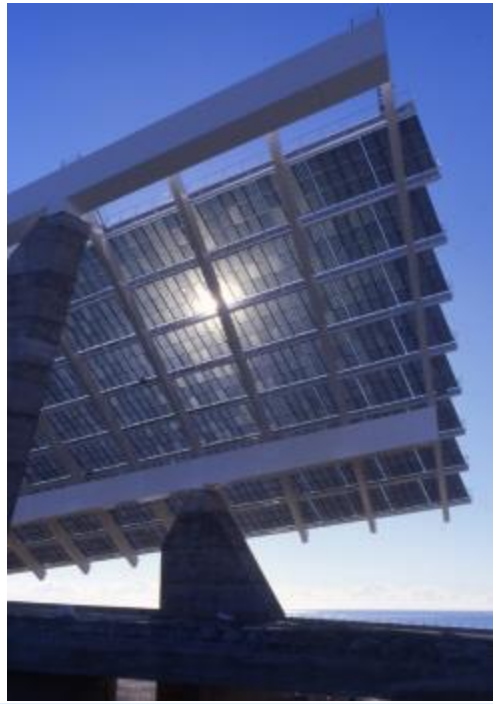
TELWIND PROJECT

ESTEYCO

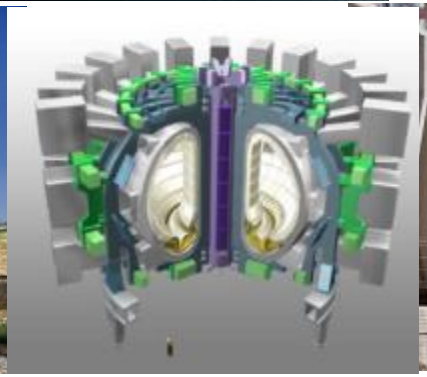
ESTEYCO:WHO WE ARE

ESTEYCO: 46 years consulting engineering experience










ESTEYCO:WHO WE ARE

Evolution to Renewable Energy

Leaders in civil works in wind energy sector

ESTEYCO:WHO WE ARE

Pioneers in precast concrete towers

IMPSA

acciona

WEG

Gamesa

SIEMENS

ALSTOM

More than 10 years experience at wind turbine concrete towers

+400 WTG towers designed and built, in 6 countries

Designs from 80m up to 160m both for conventional and the disruptive self-lifting tower. Some of our designs WF:

WF AGUA DOCE – IMPSA. Brasil
52 WTG 1,5MW HH100m

WF LES FORQUES – GAMESA. Spain
2 WTG 2MW HH100m

WF TRAIRÍ – SIEMENS. Brasil
50 WTG 2,3MW HH80m

WF COL DE PANISOT – ALSTOM. Spain
3 WTG 3MW HH100m

WF GOSTYN – ACCIONA. Poland
11 WTG 3MW HH120m

WF PEDRA GRANDE – WEG. Brasil
180 WTG 2,1MW HH120m

INDEX

TELWIND PROJECT

ESTEYCO ENERGIA

THE TELESCOPIC TOWER

VIDEO- CONSTRUCTIVE PROCESS FULL SCALE PROTOTYPE. MADRID. SPAIN. Mar – Oct 2014

THE TELESCOPIC TOWER

ONSHORE-FULL SCALE PROTOTYPE OF THE TELESCOPIC TOWER

Sections ready to be installed

CONSTRUCTIVE PROCESS FULL SCALE PROTOTYPE. DAGANZO. SPAIN. Mar – Oct 2014

THE TELESCOPIC TOWER

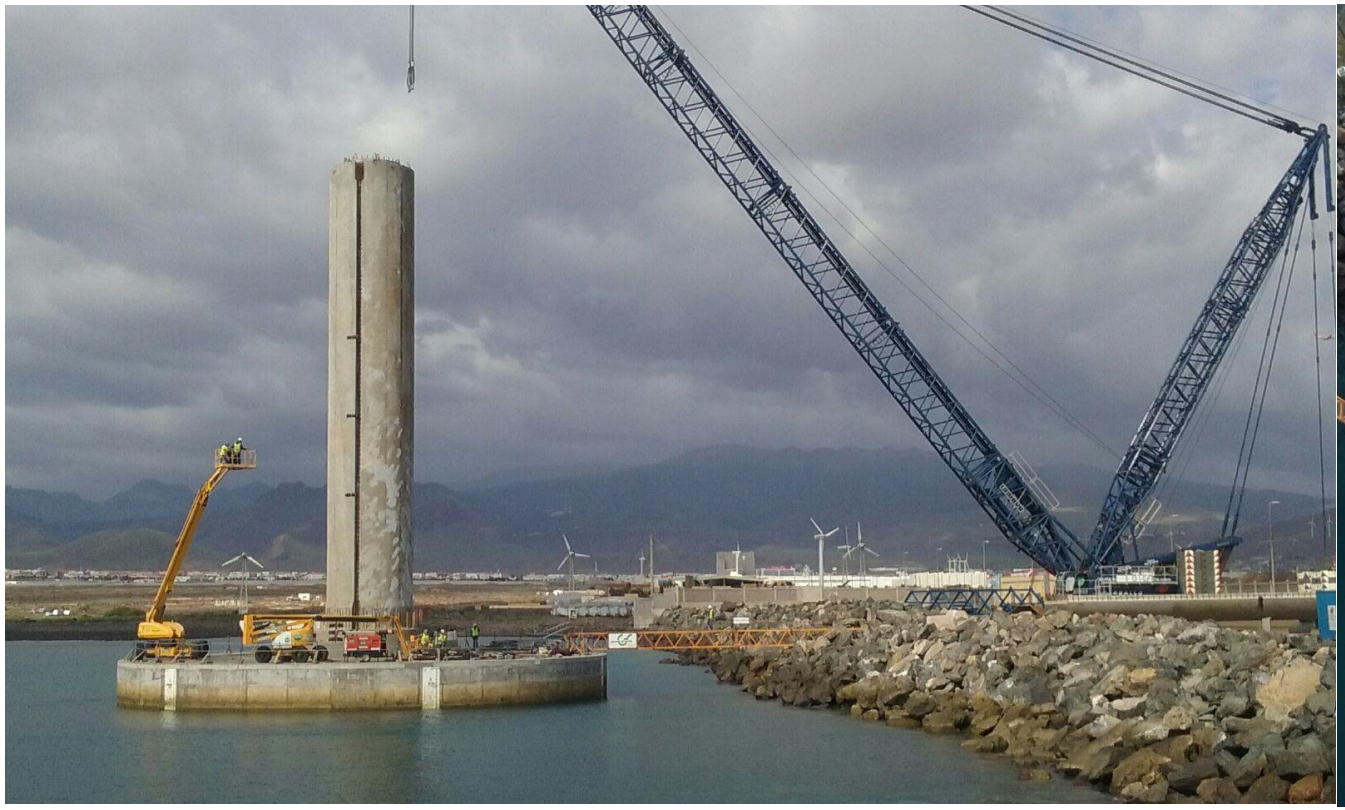
VIDEO-H2020 ELISA/ELICAN- 5MW GBS-TOWER ASSEMBLY JANUARY 2017

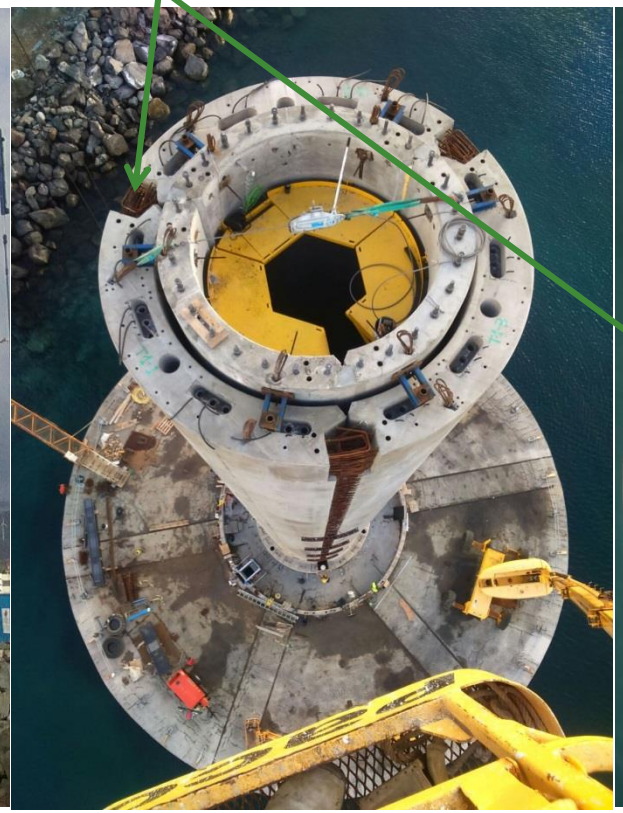
THE TELESCOPIC TOWER

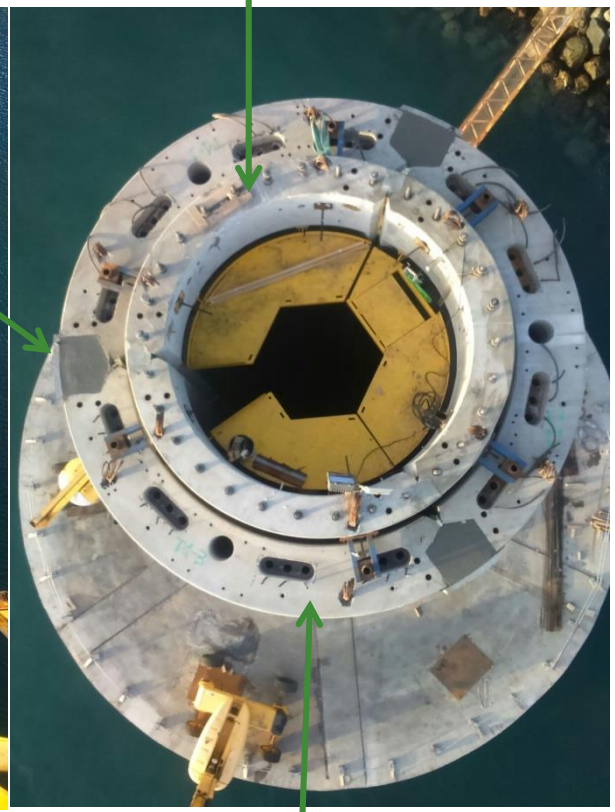
ELISA/ELICAN 5MW GBS + TELESCOPIC TOWER

Vertical joints before and after grouting

Section Tower T2







Section Tower T1

DEMONSTRATION PROJECT IN PLOCAN. GRAN CANARIA. SPAIN. Sept15– May17 (Expected)

INDEX

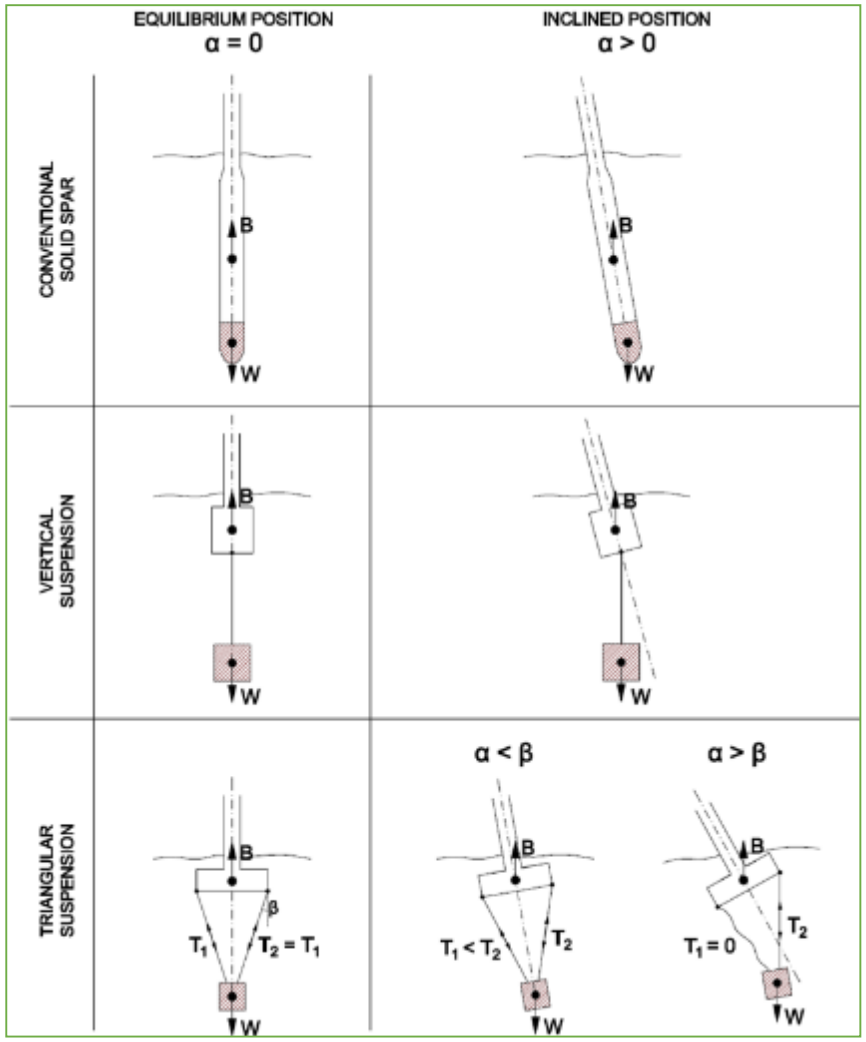
1. ESTEYCO WHO WE ARE
2. **BACKGROUND: THE TELESCOPIC TOWER TECHNOLOGY**
3. **TELWIND FUNDAMENTALS**
4. SEAKEEPING & TANK TESTING
5. CHALLENGES & NEXT STEPS

TELWIND PROJECT

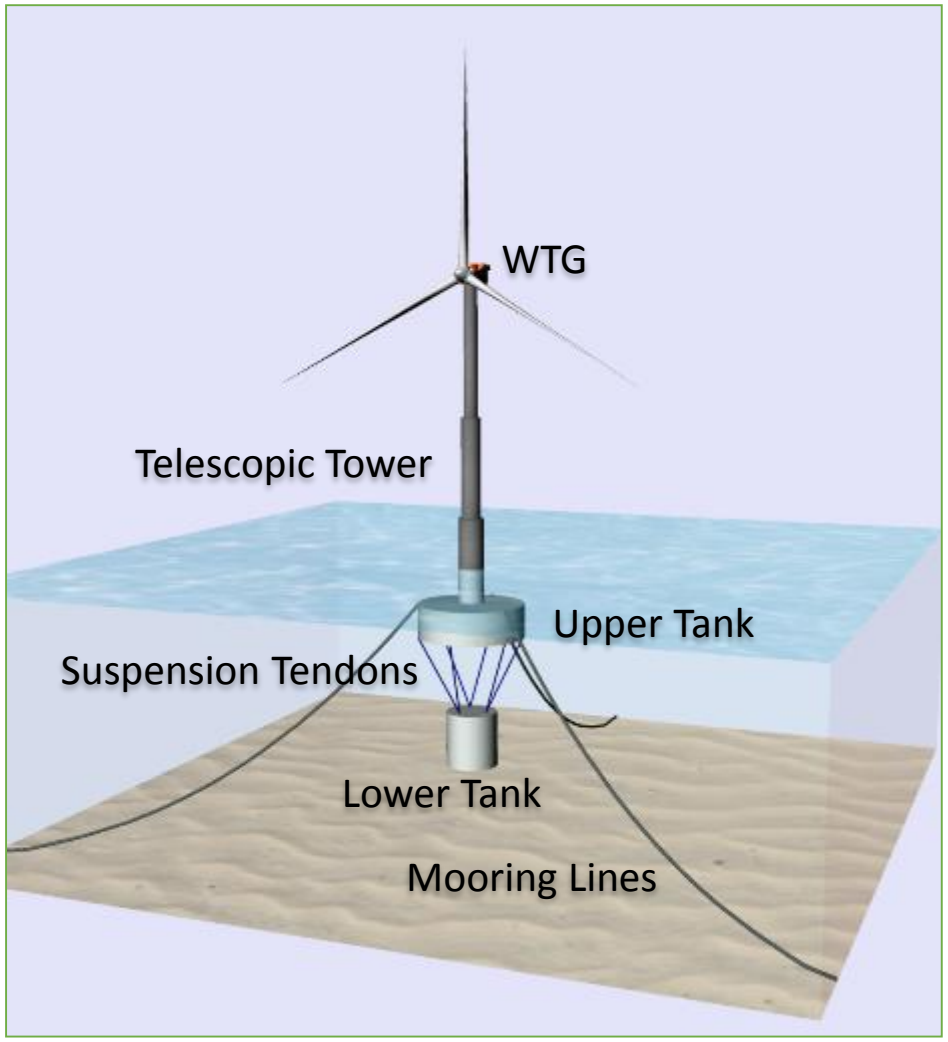
ESTEYCO ENERGIA

TELWIND FUNDAMENTALS

FUNDAMENTALS



MAIN COMPONENTS



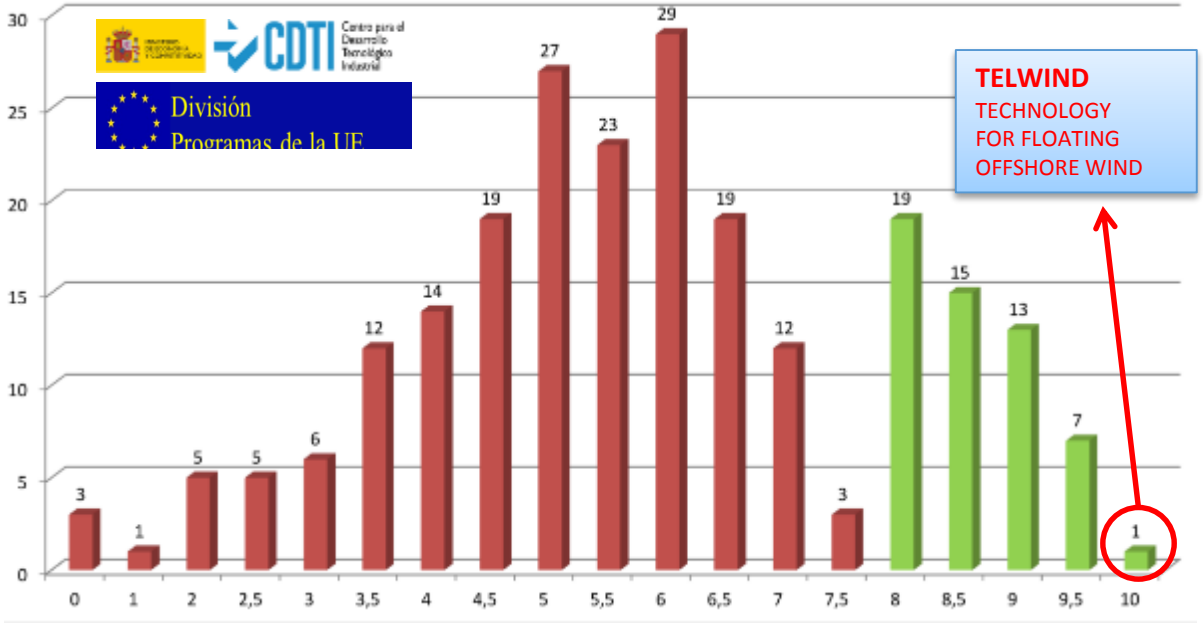
TECHNOLOGY DEVELOPMENT & DEMONSTRATION

H2020 TELWIND PROJECT: Integrated telescopic tower and evolved spar floating substructure for low-cost deep offshore wind and next generation of 10MW+ turbines

EU Contribution: **3,498,530.00** €

Consortium: **Esteyco**, ALE Heavylift R&D, ACS-Cobra, CEDEX, Dywidag Systems International, Mecal WTD, TUM, UC-IHC.

EU Horizon 2020 – Low Carbon Energy Call LCE-2015
Number of Proposals vs. Evaluation (Phase 1)



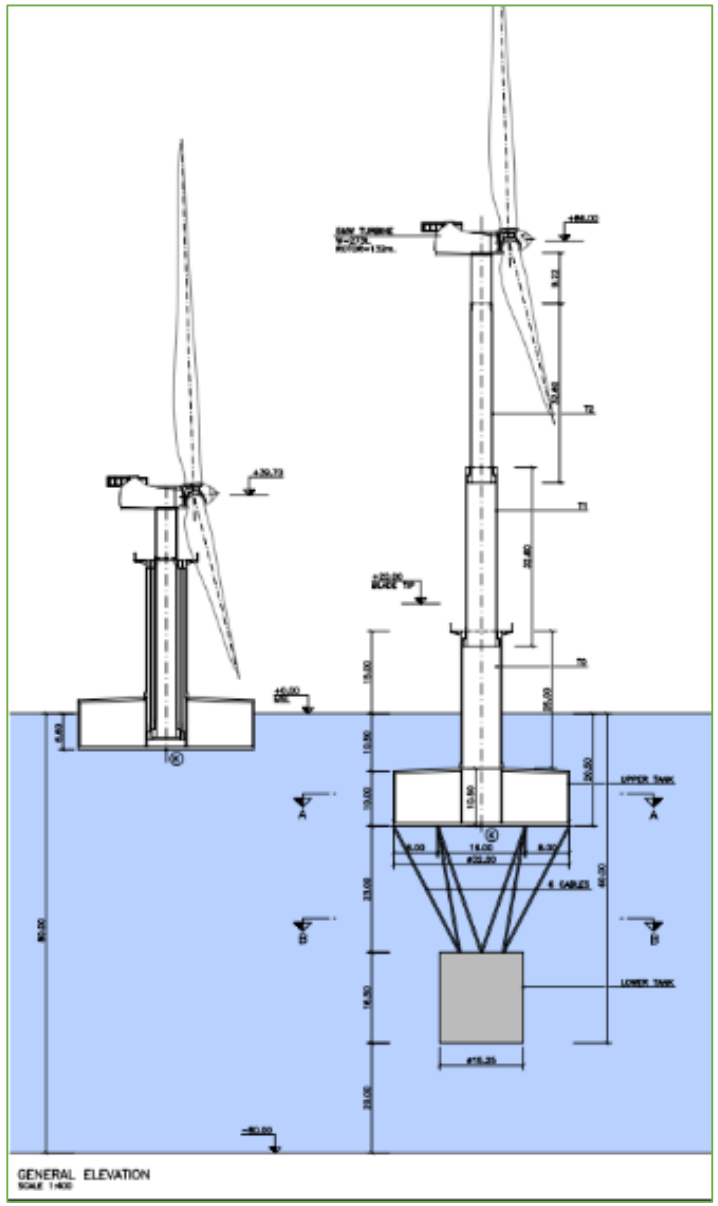
ESTEYCO is also currently collaborating with DNVGL in the project:

DNV·GL JOINT INDUSTRY PROJECT (JIP)
COUPLED ANALYSIS OF FLOATING WIND TURBINES

MAIN OBJECTIVES

- Design a 5MW WTG from conceptual to detail-constructive engineering.
- Study the concept **scalability** for a 12 MW WTG.
- Build a **fully coupled aero-hydro-servo-elastic** Floating Wind Turbine model and investigate coupling effects in the overall wind turbine performance
- **Model Basin Tests** in operating, extreme and installation conditions
- Perform **laboratory tests** to study the performance of the suspension **tendons**
- **CapEx and OpEx** estimate. **Viability** analysis of a single installation and integration in a multi-megawatt floating wind farm
- Obtain the **Certification** of the design
- Project **dissemination** in general and technical forums and conferences

PRELIMINARY DESIGN

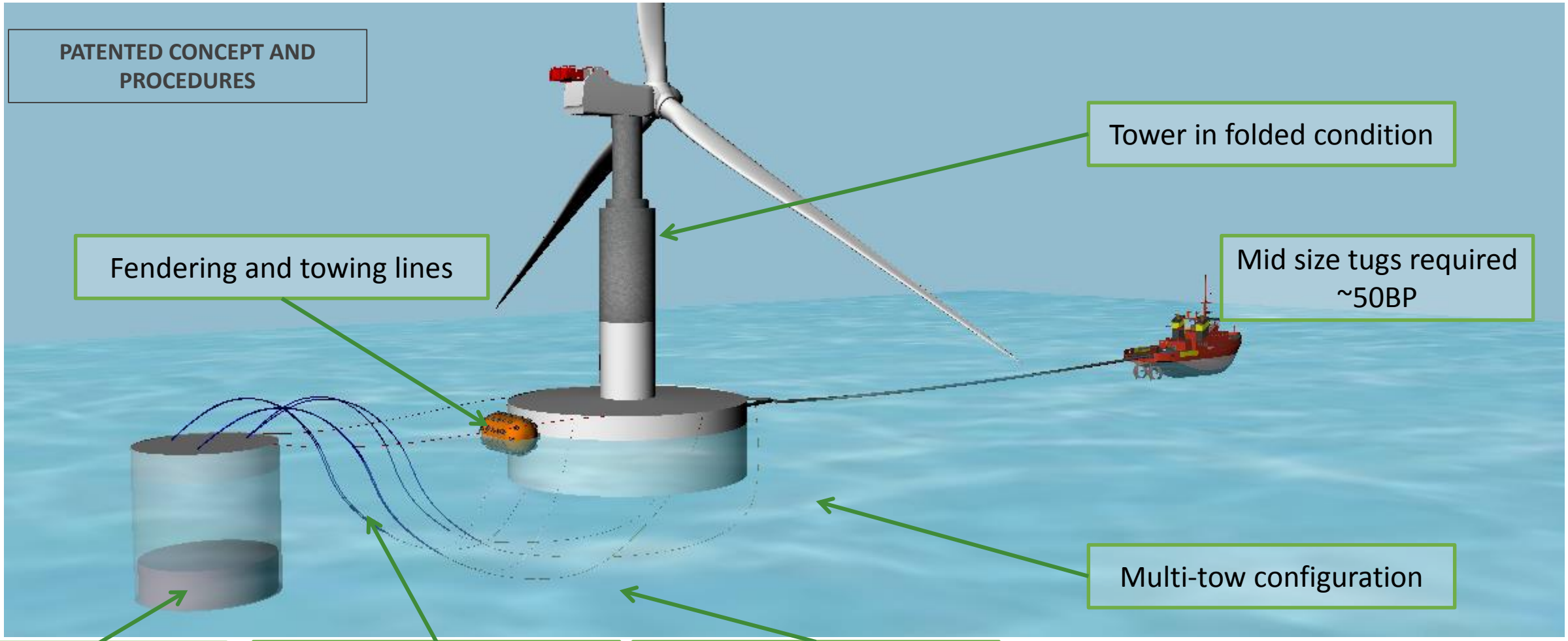


Parameter	Value	
Wind Turbine	5	MW
Water depth	80	m
Hub Height above MSL	86	m
Nacelle Weight	273	t

Parameter	Value	
Overall Draft	60	m
Upper Tank draft	20.50	m
Upper Tank diameter	32.00	m
Lower Tank diameter	15.35	m
Metacentric height inplace (GM)	>3m	m
Metacentric height transport (GM)	>2m	m
Tilt static angle (θ_{STA})	<10º	º
Overall heave period (T3)	>30s	s
Overall pitch period (T5)	>35s	s

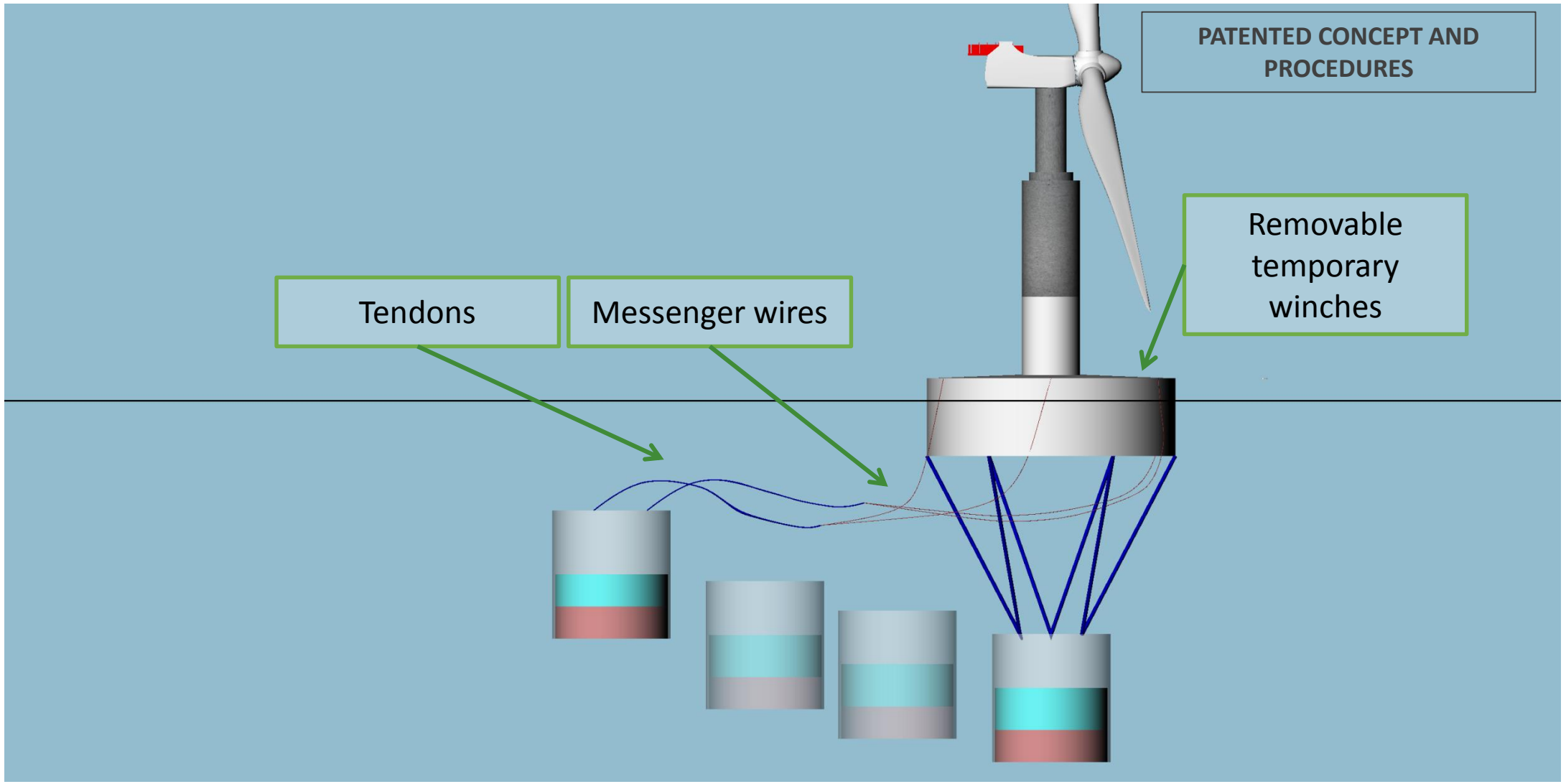
INSTALLATION STORYBOARD

Transport configuration. Preferred alternative-Multi tow configuration (work in progress)



INSTALLATION STORYBOARD

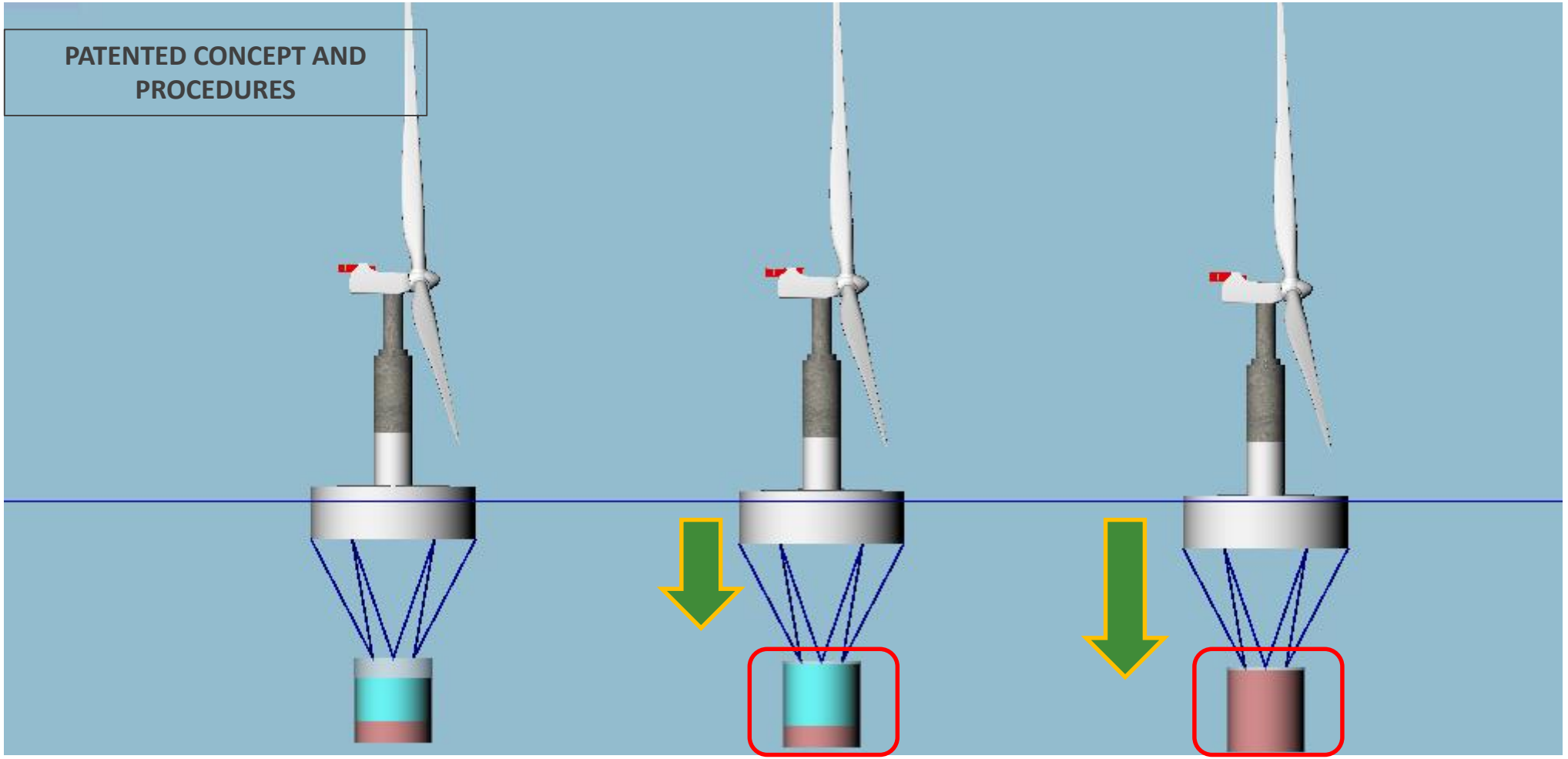
Offshore Installation



LT CONTROLLED BALLASTING & SINKING

INSTALLATION STORYBOARD

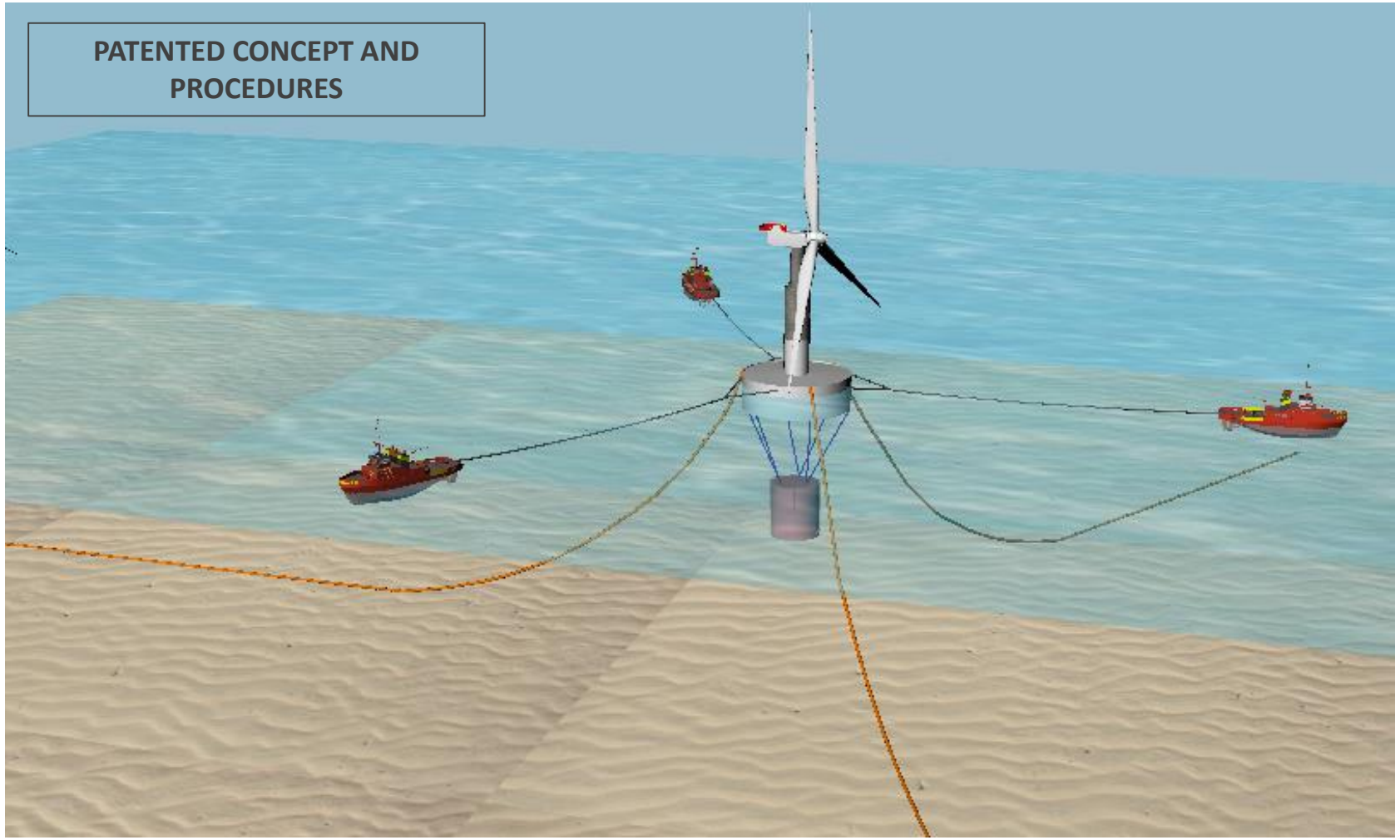
Offshore Installation



Final Pull in and fine adjustment of tendons Progressive ballasting of LT internals	LT Fully flooded. Tendons in position	Solid Ballast Installation

INSTALLATION STORYBOARD

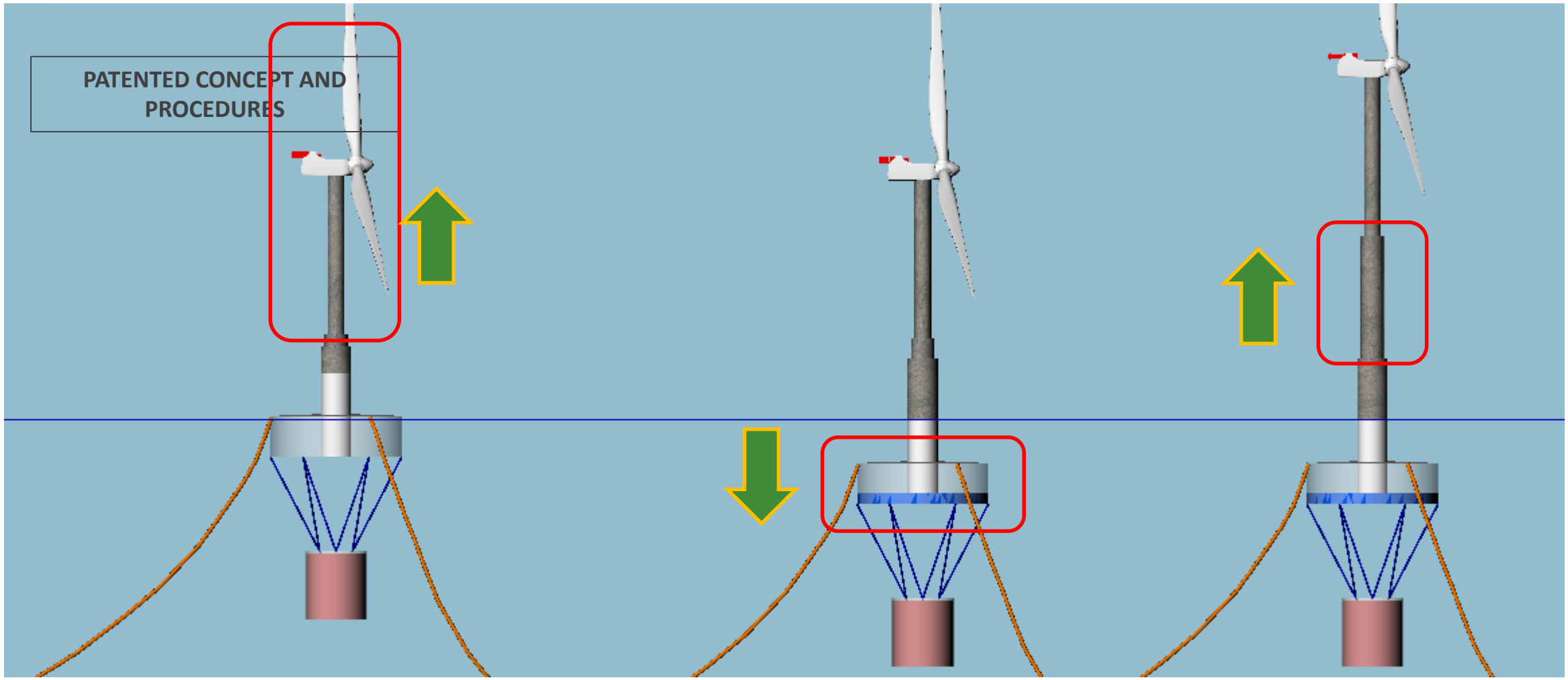
Offshore Installation



Mooring Installation

INSTALLATION STORYBOARD

Offshore Installation



Jacking up tower first section (T2)

UT ballasting until targeted position

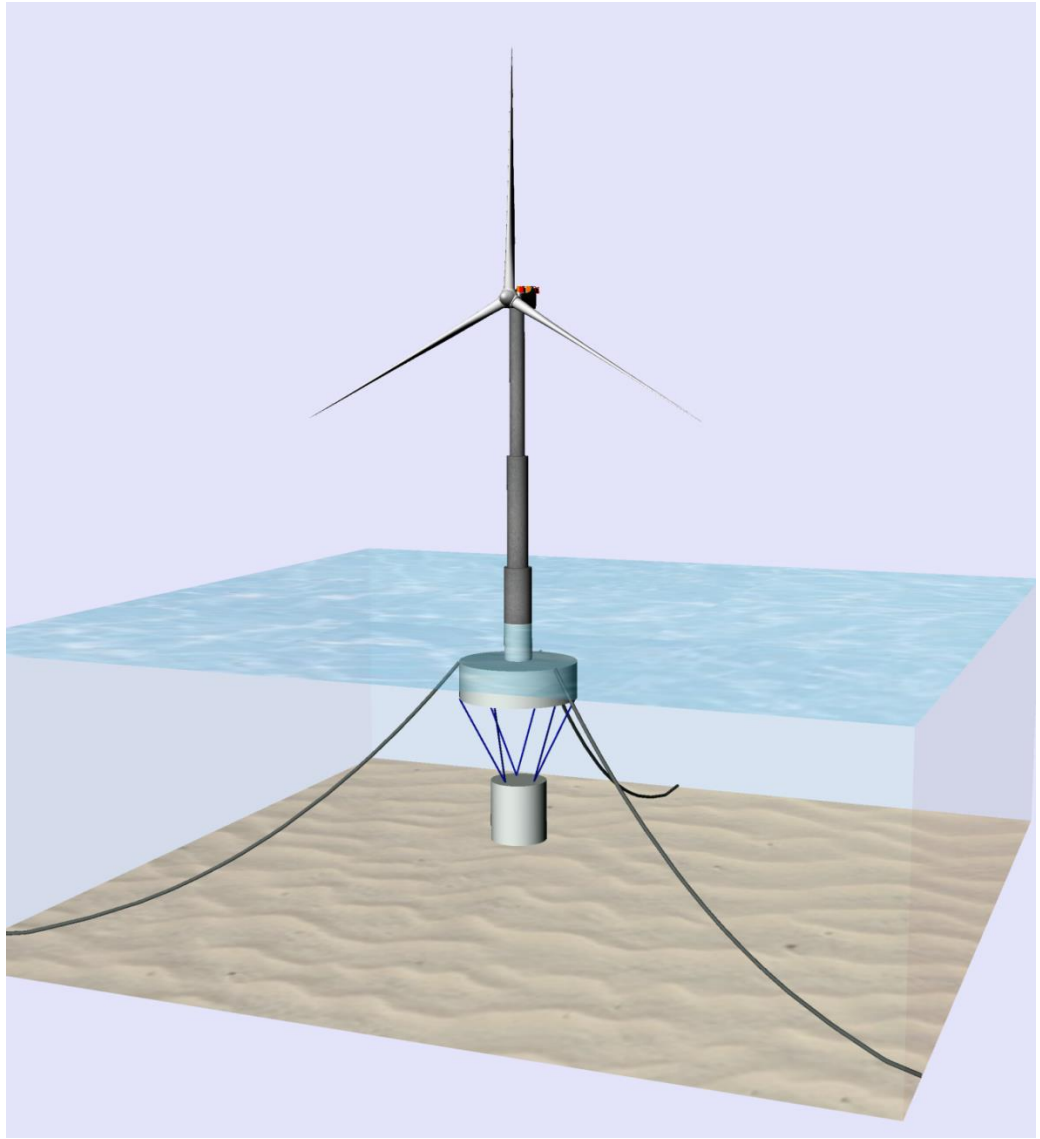
Jacking up tower second section (T1)

INSTALLATION STORYBOARD

Offshore Installation

PATENTED CONCEPT AND PROCEDURES

JOINTS termination. Removal of equipment (strand jacks, generators, power packs etc)
WTG Comissioning.
Platform inplace



INDEX

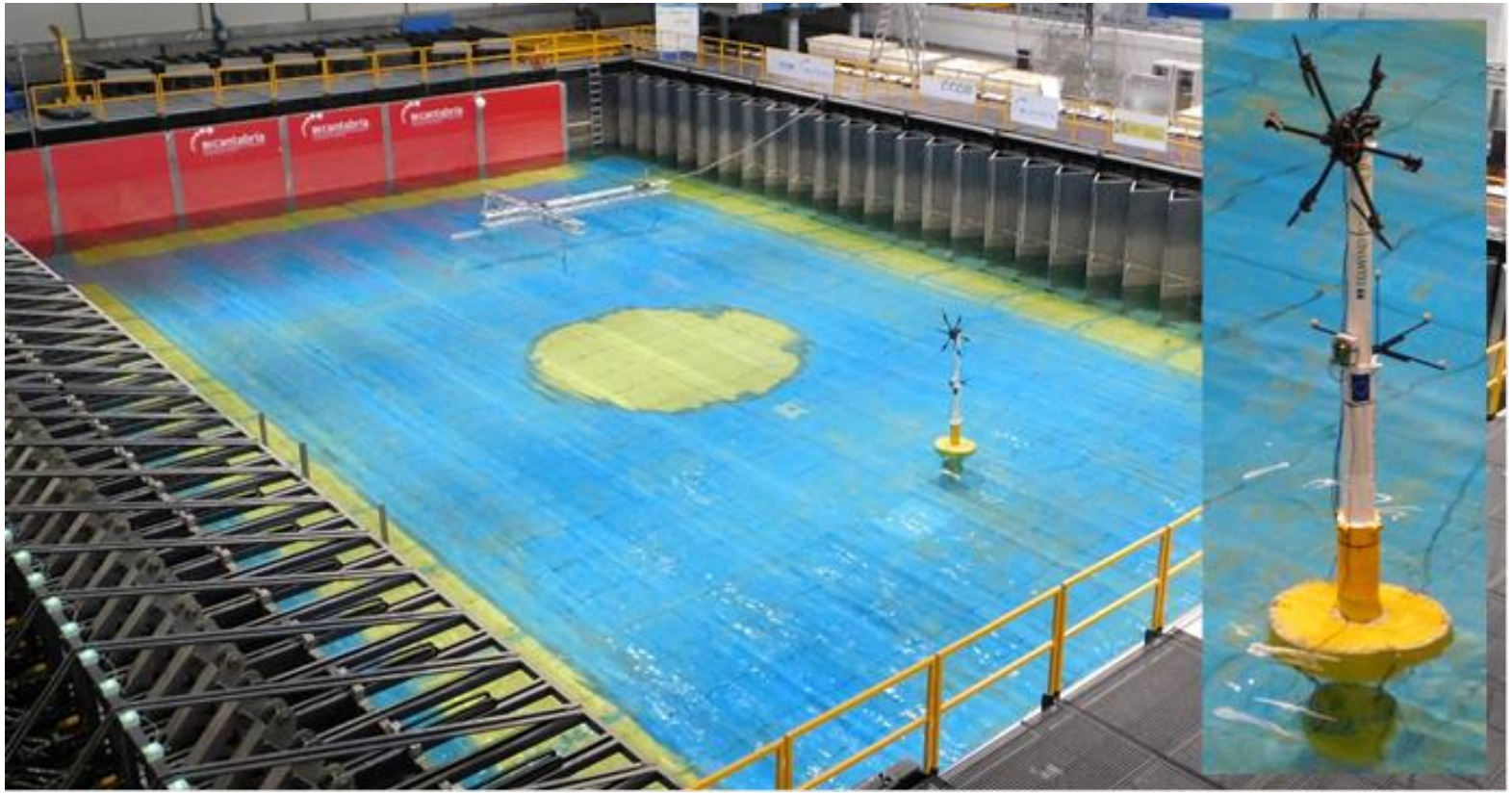
TELWIND PROJECT

ESTEYCO ENERGIA

PROJECT TODAY

IHCantabria tank testing facilities

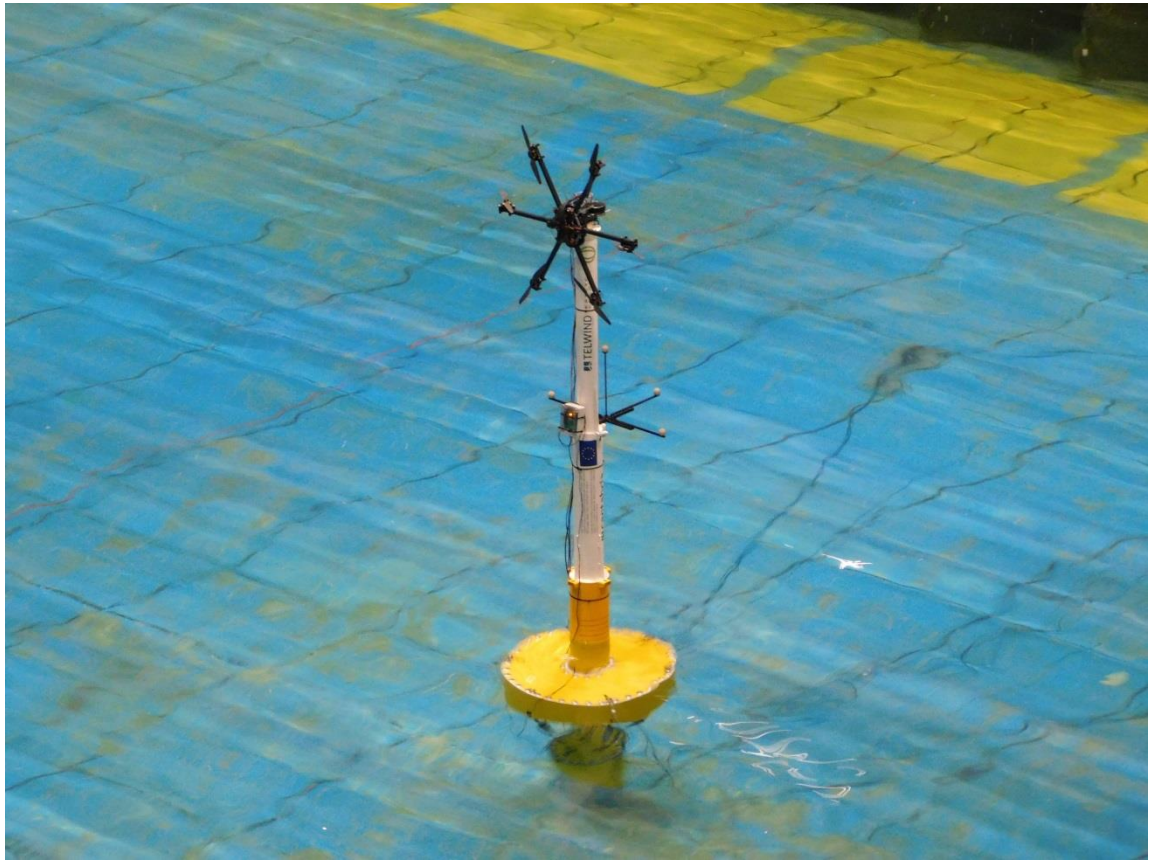
- Two tank testing campaigns expected
- IHCANTABRIA has extensive experience on floating platforms and singular floating devices
  - http://www.ihcantabria.com/es/
  - http://ccob.ihcantabria.com/
  - https://vimeo.com/183657521
- OBJECTIVES
  - Proof of TELWIND fundamentals: solidary motion between LT and UT
  - To quantify Hydrodynamic Damping
  - RAO´s
  - Response in irregular waves
  - First test for coupling wind (multifan) + waves



PROJECT TODAY
TELWIND SCALED MODEL

Basin tests performed during first campaign

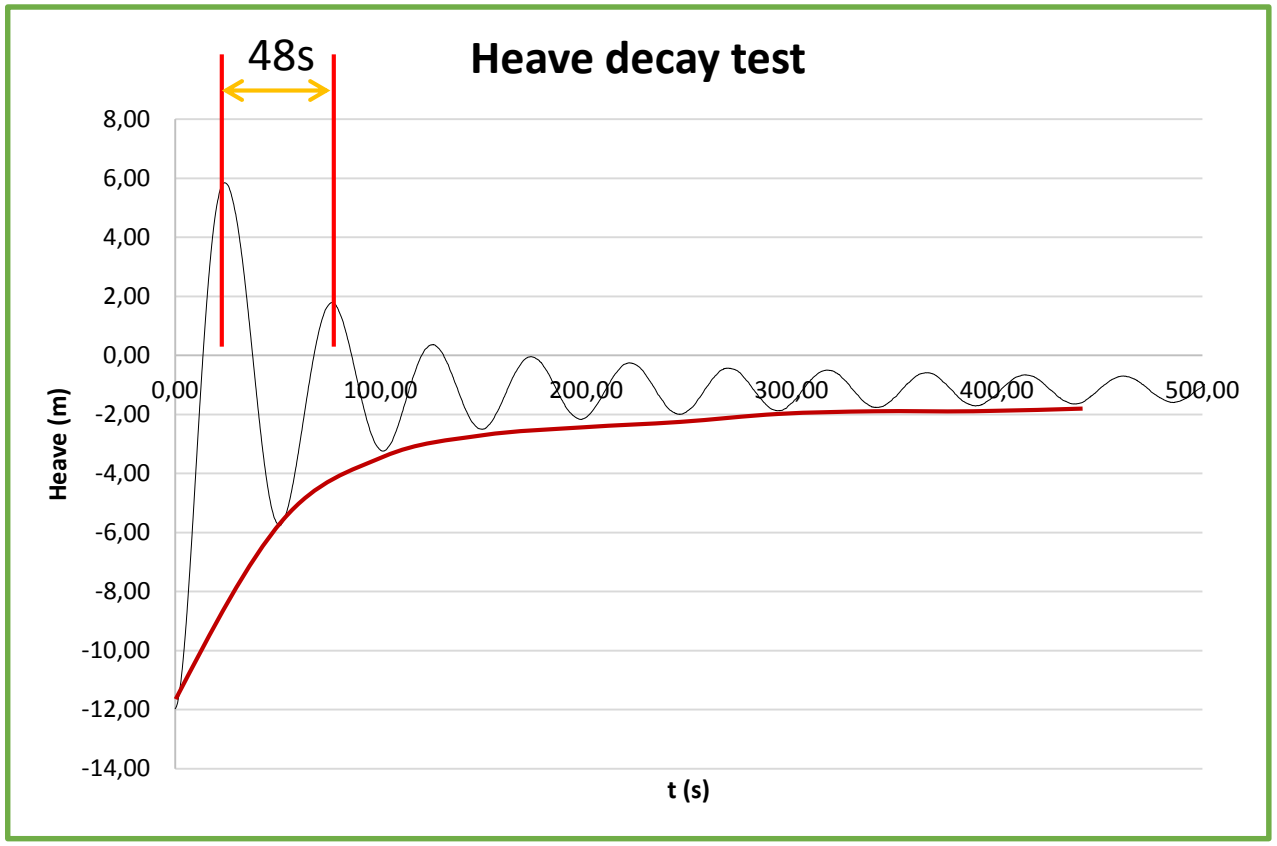
- Dry characterization tests
- Basin characterization tests
- Wave only tests
- Wind only tests
- Current only tests
- Wave + wind tests
- Wave + wind + current tests



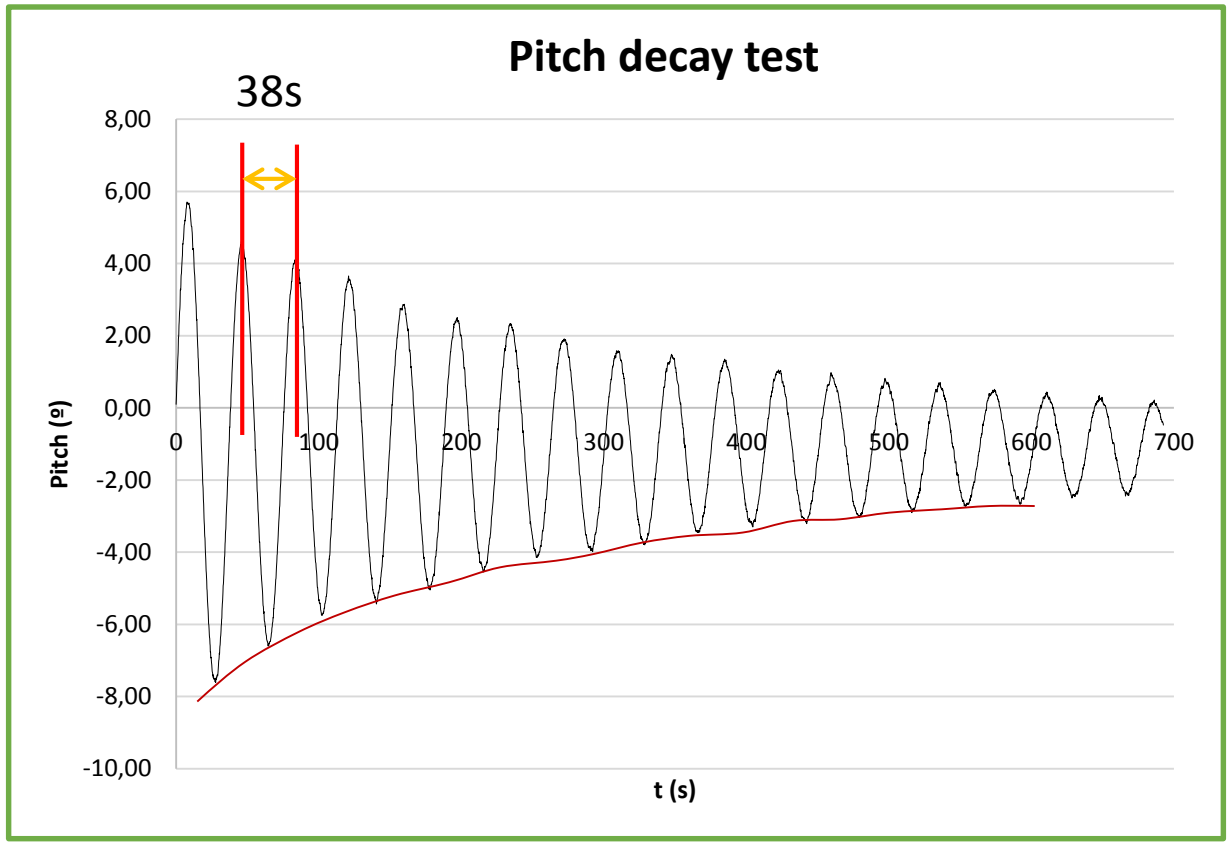
First set of results expected by end of Jan-2016

FREE DECAY TESTS

Preliminary decay tests of pitch and heave DOFs with mooring



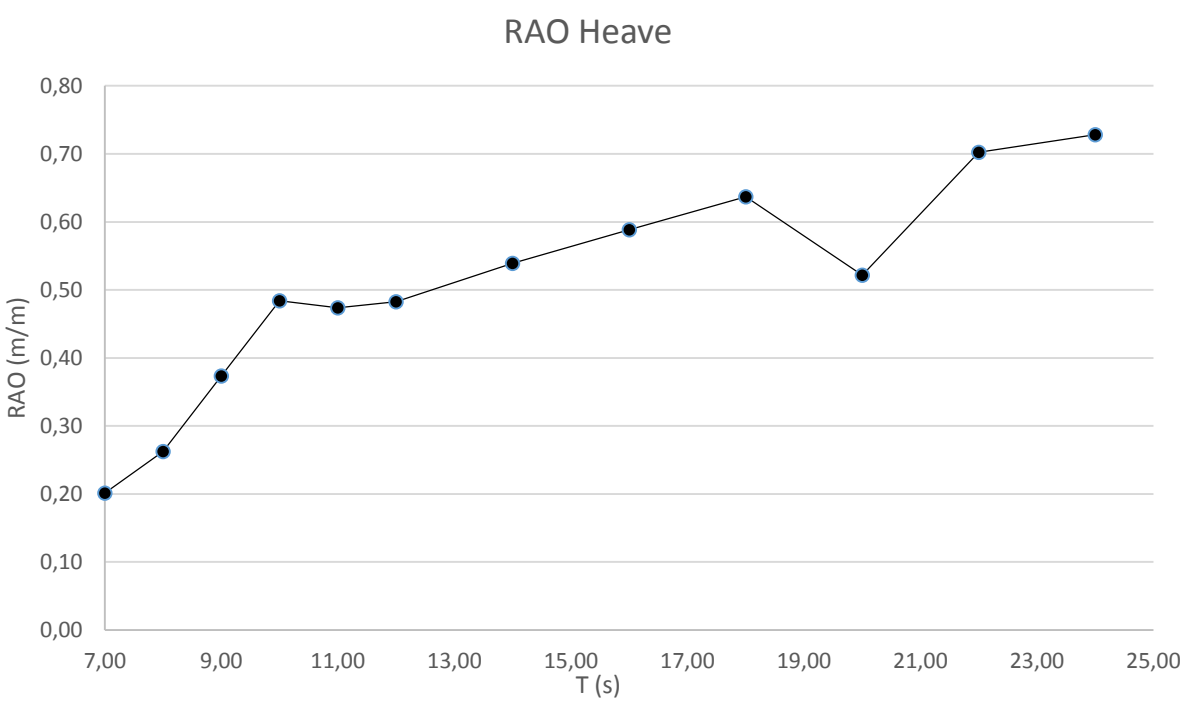
Heave



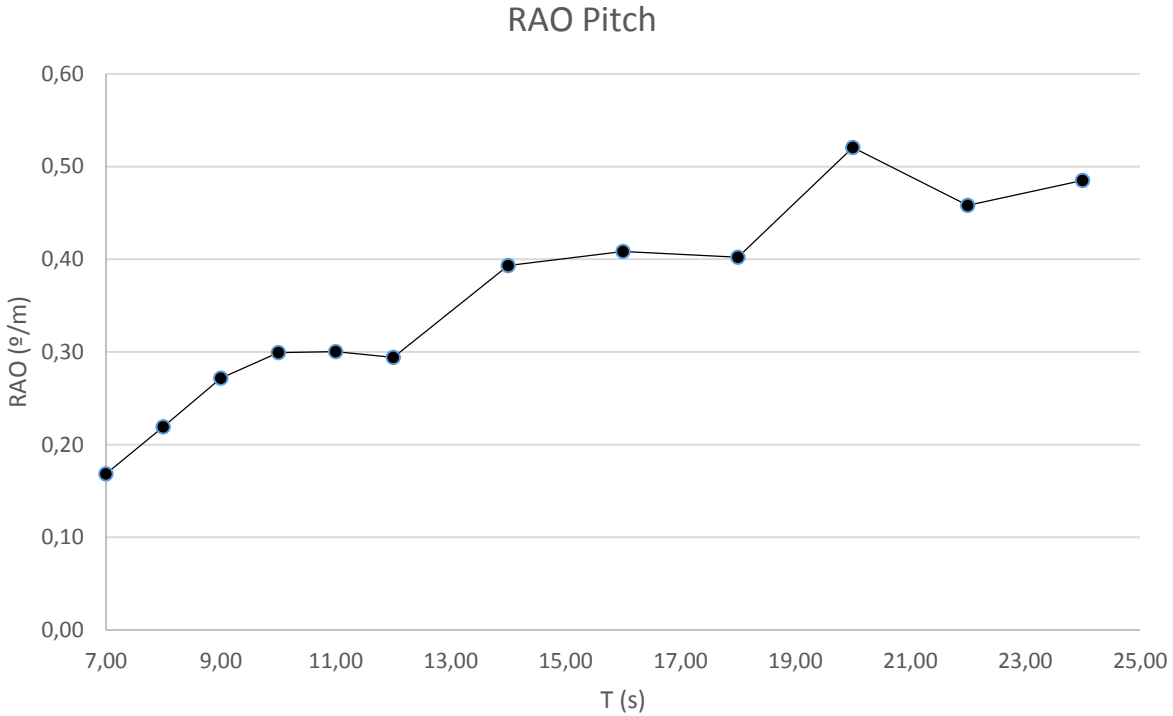
Pitch

RESPONSE AMPLITUDE OPERATORS (RAO´s)

Preliminary RAOs of heave and pitch DOF´s



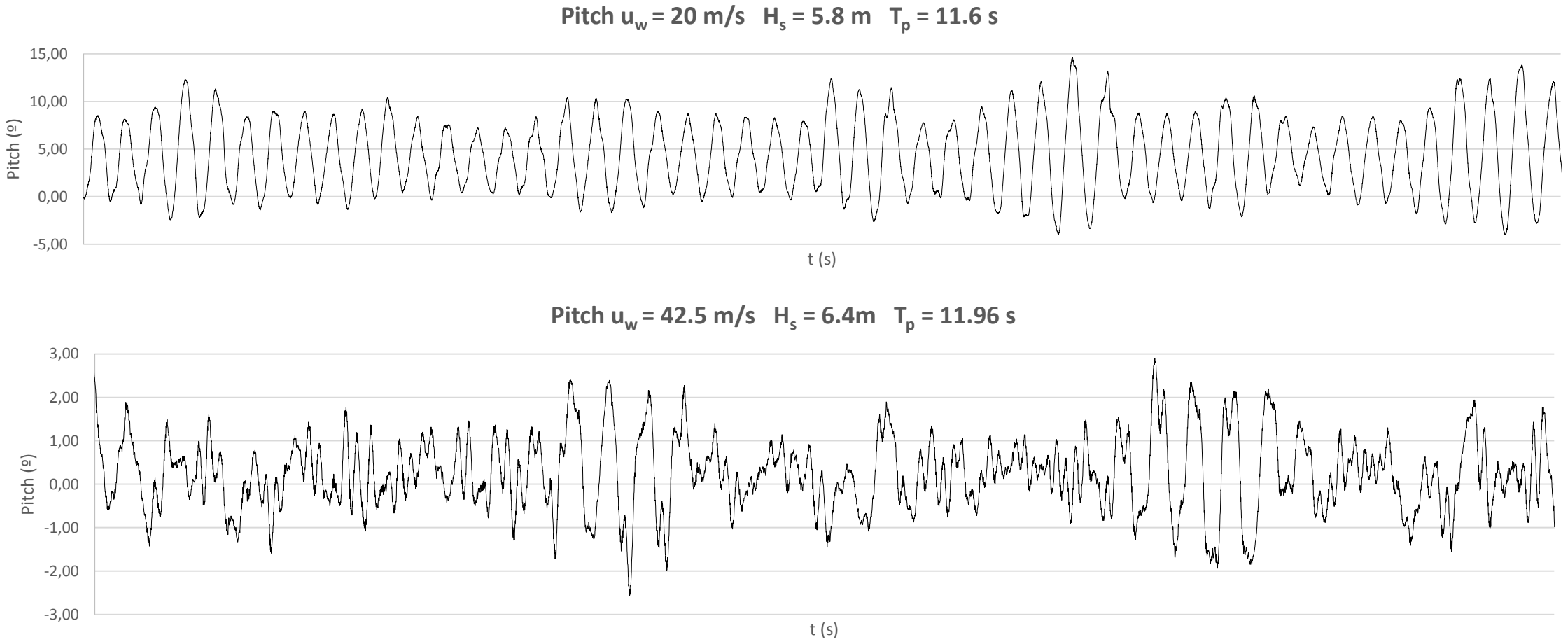
Heave



Pitch

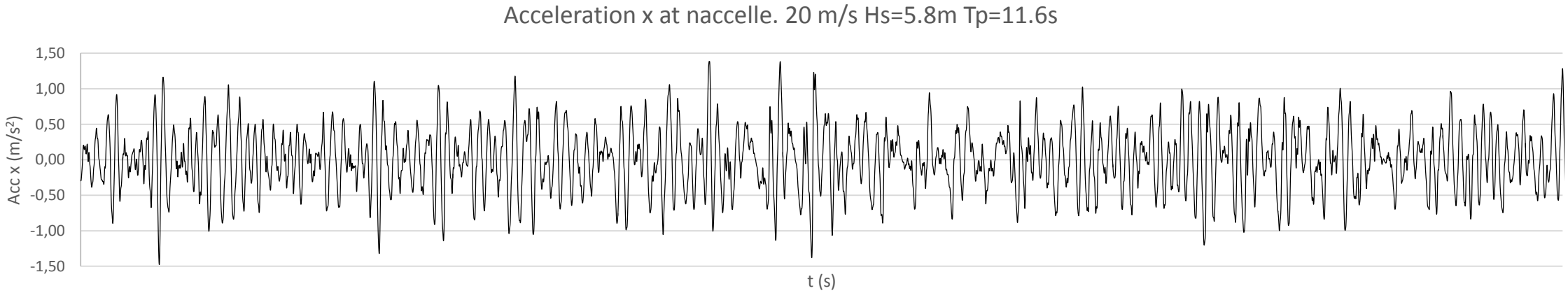
TIME DOMAIN SOLUTIONS

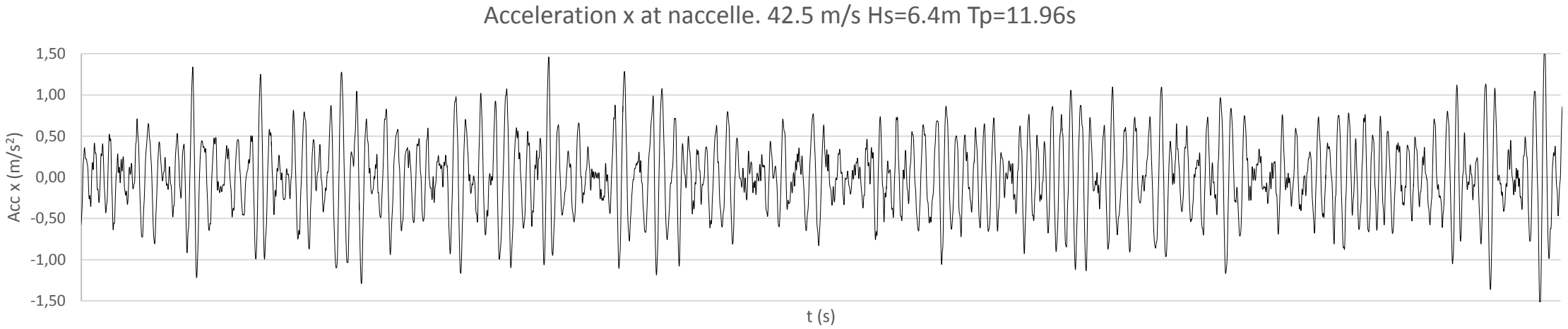
Preliminary pitch motion time series



TIME DOMAIN SOLUTIONS

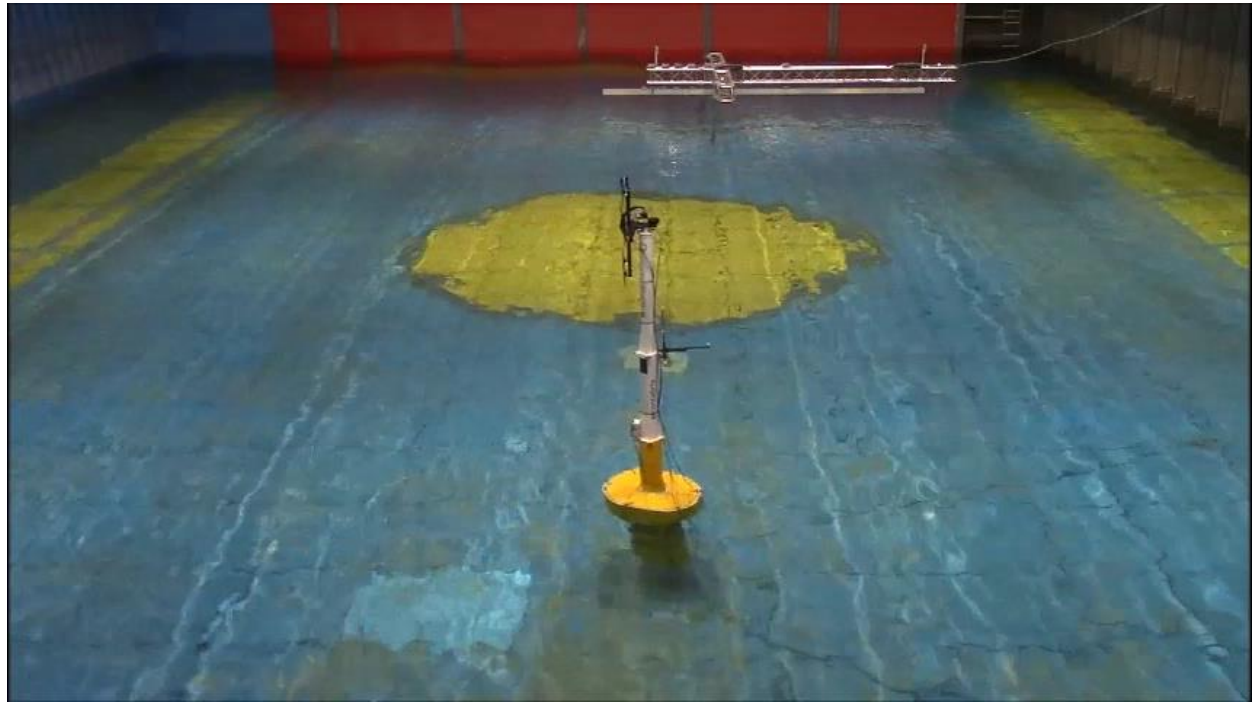
Accelerations X-direction at the naccelle





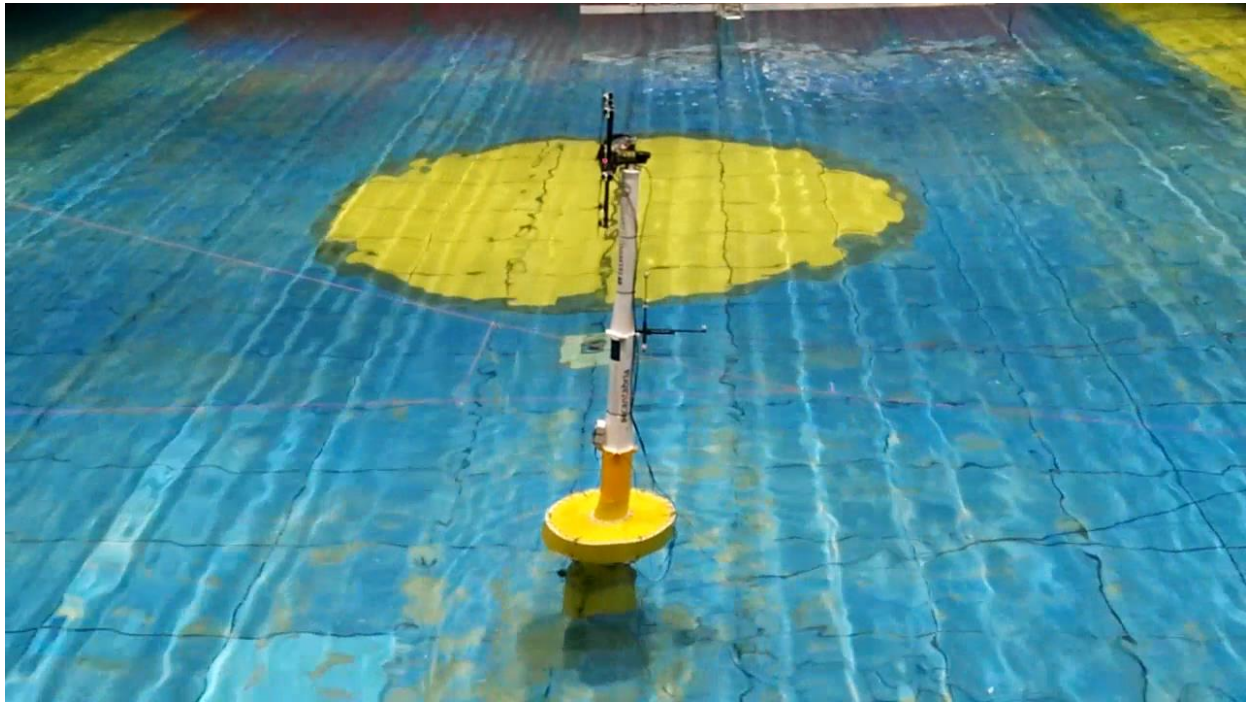
A FEW DEMONSTRATIVE VIDEOS

Videos



PARKED

PLOCAN 50 yr storm-ULS H_s = 6.4 m T_p = 11,96 m



OPERATING

PLOCAN extreme operating conditions

U_w = 20 m/s H_s = 5,8 m T_p = 11,6 s

COMING SOON…

Next remarkable steps

WP2 ESTEYCO
- Design Basis Final Version
- Design certification
- Active Ballast system design
- Scalability to 12MW WTG

WP3 MEC-IHC
- Calibration of Numerical models based on tank testing results
- Ad hoc WTG control for TELWIND floating platform

WP4 ESTEYCO-DSI
- Laboratory tests campaign
- Detailed definition of connections and guides
- Tendon Fatigue design

WP5 IHC
- Optimization of mooring system
- Selection of anchoring

WP6 ESTEYCO-CEDEX
- Installation method statements
- Installation storyboards

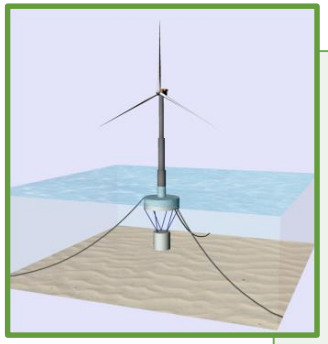
WP7 IHC-CEDEX
- Installation tank tests
- Full implementation of software in the loop (SiL) strategy during the second test campaign

WP8 COBRA-ESTEYCO
- CapEx and OpEx estimate for a large scale wind farm
- Financial Model-Feasibility Analysis
- Set up a commercial business plan based on the feasibility analysis

CONCLUSIONS

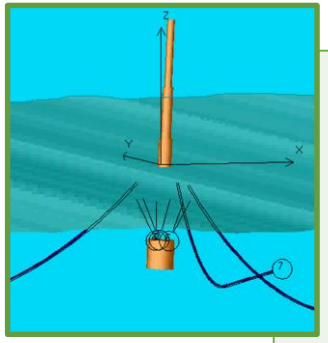
TELWIND BACKGROUND: THE TELESCOPIC TOWER

- Proven technology
- WTG fully assembled onshore
- No HLV and Jack up required



TELWIND TECHNOLOGY

- Spar type solution
- Solidary motions between LT and UT
- Cost savings: material and installation



MAIN FINDINGS

- Tank tests alligned with numerical models and telwind fundamentals
- Very good response in waves

TELWIND: funded by the European Union´s Horizon 2020 research and innovation programme under grant agreement No 654634

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