ELISA:

FROM NUMERICAL MODELLING TO OFFSHORE INSTALLATION

ESTEYCO

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WESE 2019. Pamplona. (Spain)

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ESTEYCO

WHO WE ARE

ESTEYCO ENERGIA

8 years of offshore wind technologies development

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- **ELISA FUNDAMENTALS**
- NUMERICAL MODELLING
- OFFSHORE INSTALLATION

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ELISA FUNDAMENTALS

CONCRETE GBS FOUNDATION:

- GRAVITY-BASED FOUNDATION → FOUNDATION THAT RESTS ON THE SEABED ONCE DEPLOYED AND IS STABLE BECAUSE OF ITS OWN WEIGHT.
- MADE OF CONCRETE → DURABILITY IN MARINE ENVIRONMENT, LOW COST WHEN COMPARED TO STEEL
- DESIGNED IN COMBINATION WITH THE ESTEYCO'S TELESCOPIC TOWER

H2020 ELISA/ELICAN PROJECTS:

Open water full scale foundation demonstrator

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

ELISA FUNDAMENTALS

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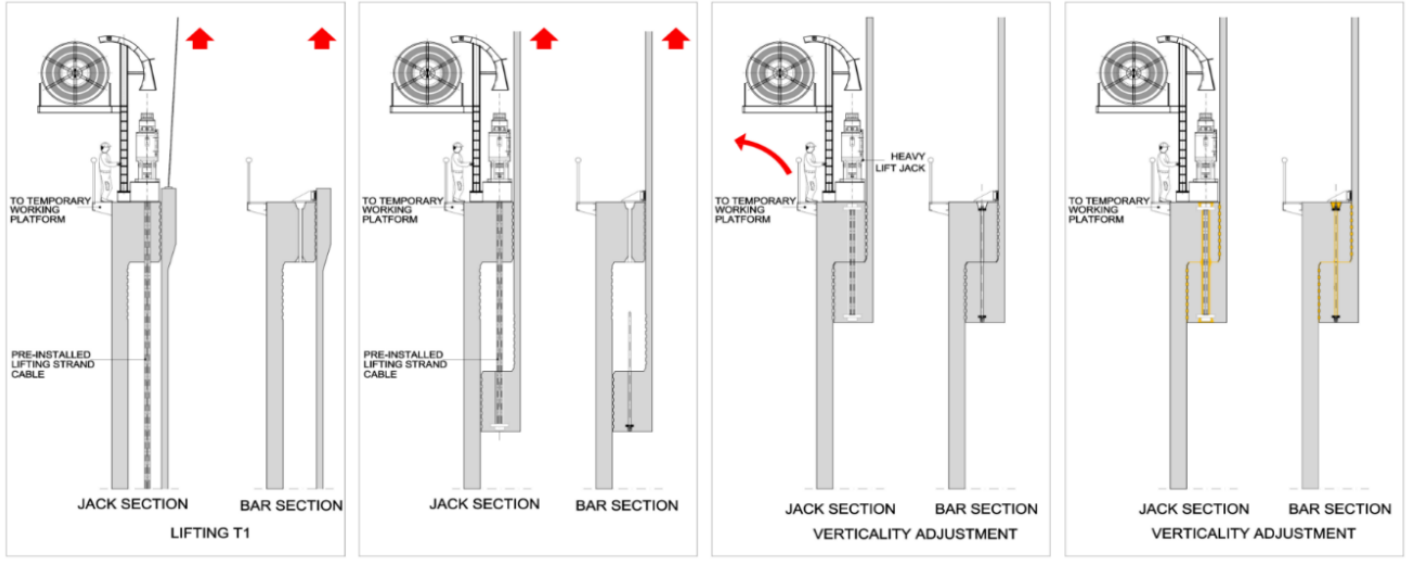
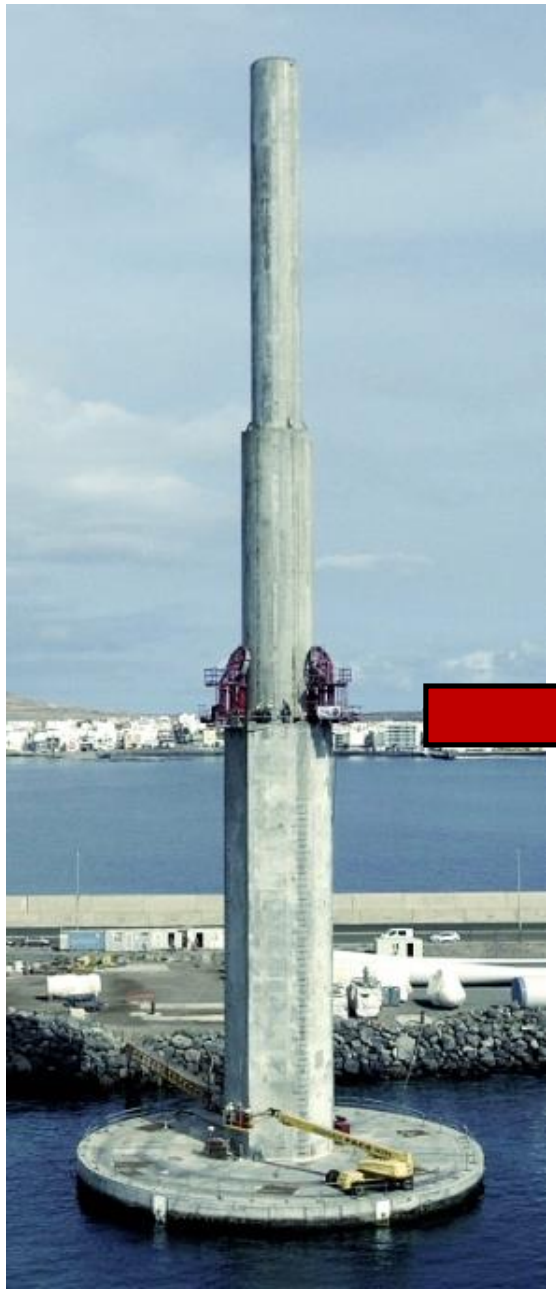
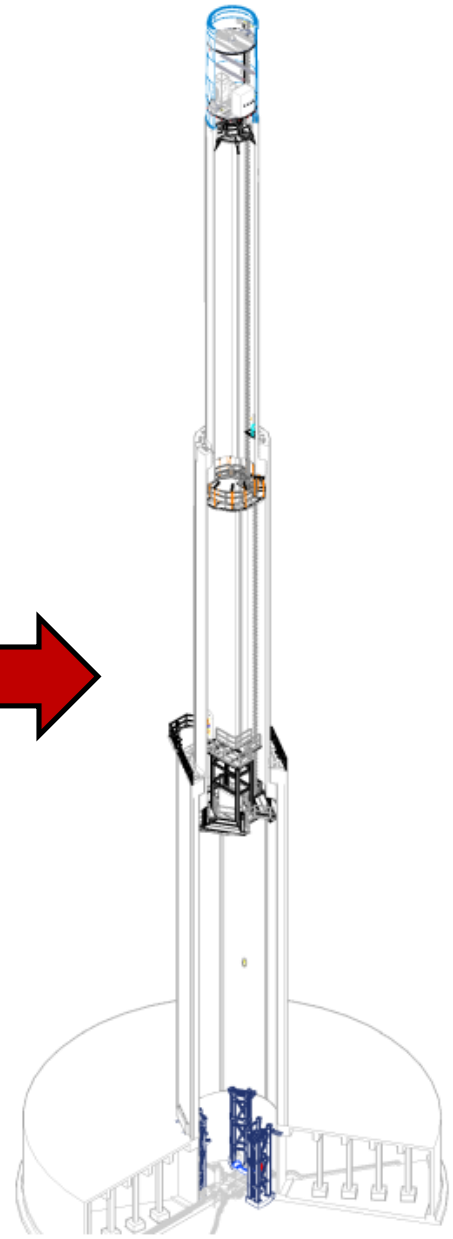
TELESCOPIC TOWER:

- ESTEYCO PATENTED SYSTEM
- LOW-MEDIUM HEIGHT FOR WTG ASSEMBLY
- LOWERING THE CENTRE OF GRAVITY DURING TRANSPORT AND INSTALLATION CONDITIONS → TURBINE INSTALLED AT HARBOUR
- INDEPENDENT OF HEAVY-LIFT CRANES
- COMPLETELY COMPATIBLE WITH OEM INTERNALS



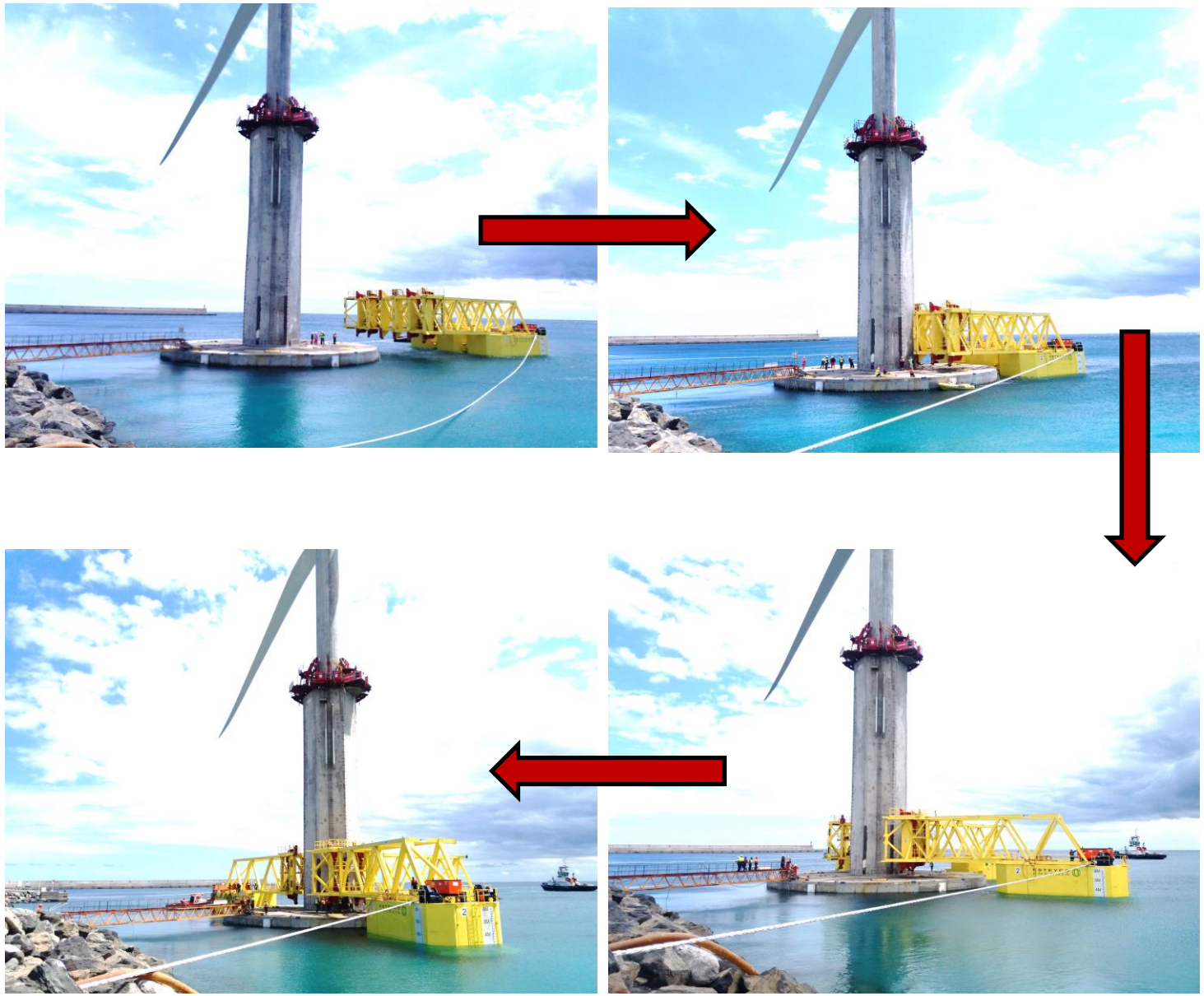




ELISA FUNDAMENTALS

TIM PLATFORM:

- AUXILIARY FLOATING SYSTEM REQUIRED FOR BALLASTING OPERATION
- TIM STRUCTURE IMPROVES THE ELISA BEHAVIOUR DURING TRANSPORT
- LOW COST SYSTEM. UNMANNED, NON-PROPELLED. SMALL TUGS USED FOR TRANSPORT AND COUPLING
- DESIGNED TO BE RETROFITTED FOR MAINTENANCE OPERATIONS



ELISA FUNDAMENTALS

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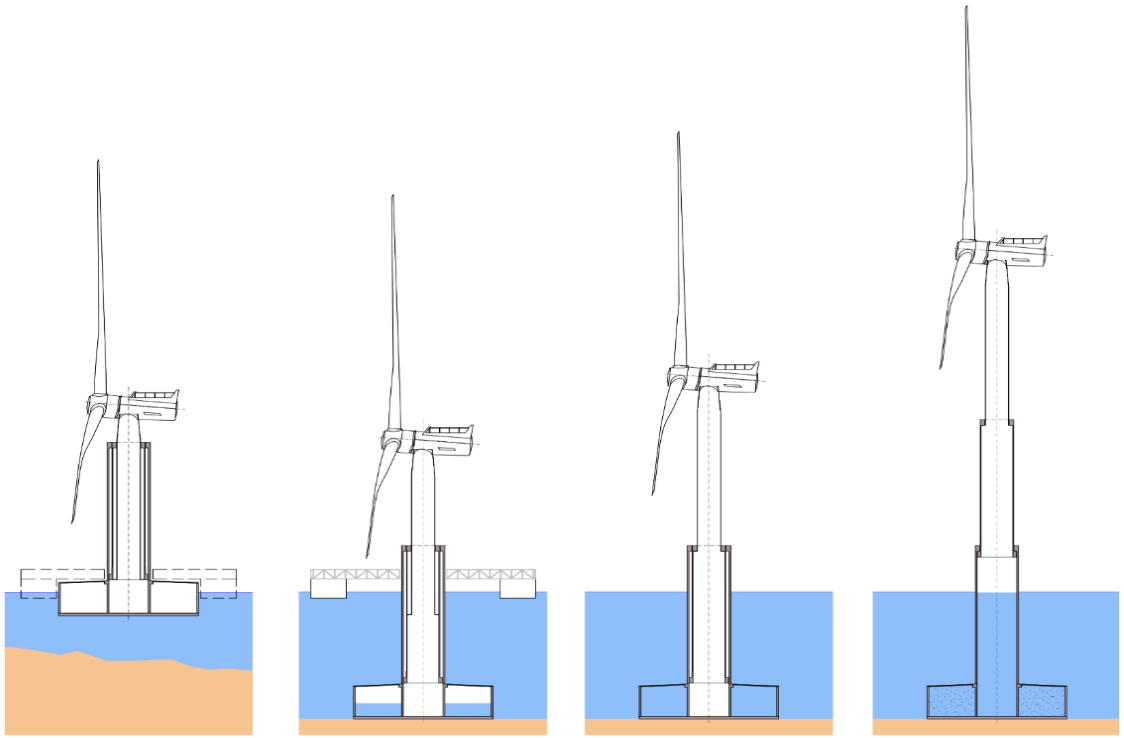
BALLASTING / INSTALLATION

- INSTALLATION BY BALLASTING THE ELISA WITH 3 TUGBOATS KEEPING IT ON POSITION.
- TIM PROVIDES STABILITY ALONG THE PROCESS
- BALLASTING + TOWER LIFTING → ITERATIVE PROCESS TO KEEP THE BLADES WITH ENOUGH AIRGAP TO SEA LEVEL



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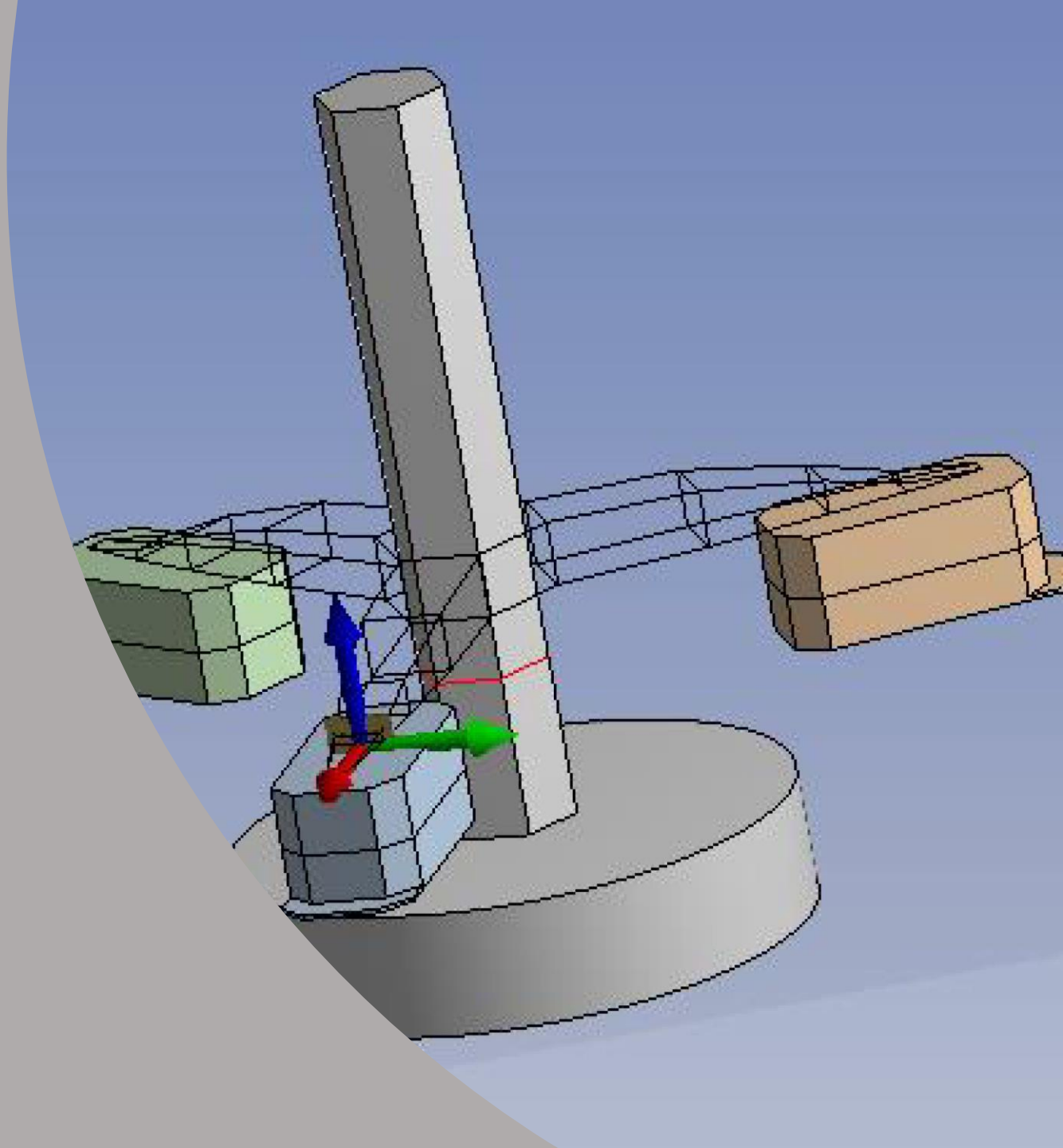

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AQWA MODEL & TANK TESTING

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HYDRODYNAMICS ANALYZED IN ANSYS AQWA.

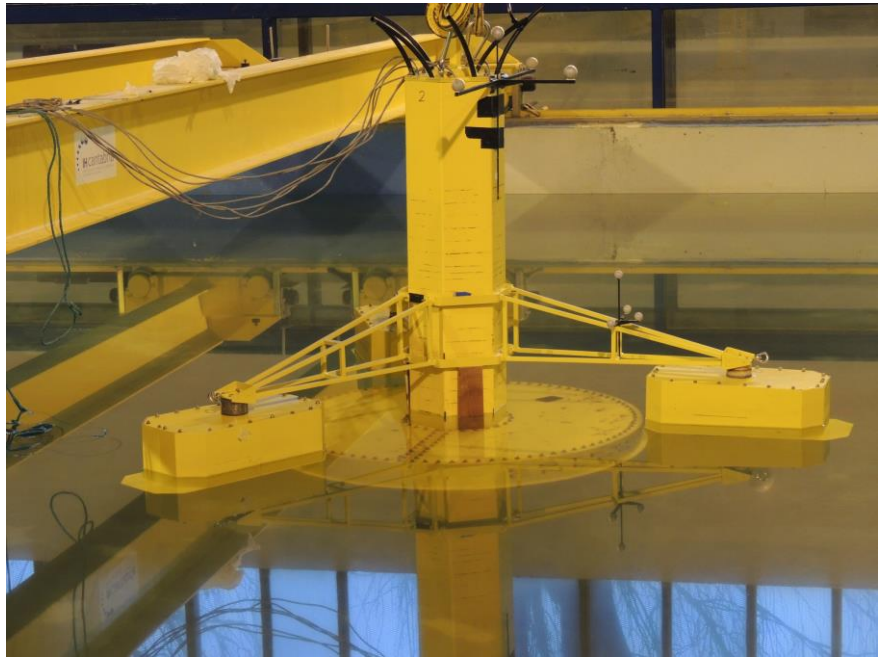
THREE TANK TESTING CAMPAIGNS TO VALIDATE RESULTS AND CALIBRATE MODELS:

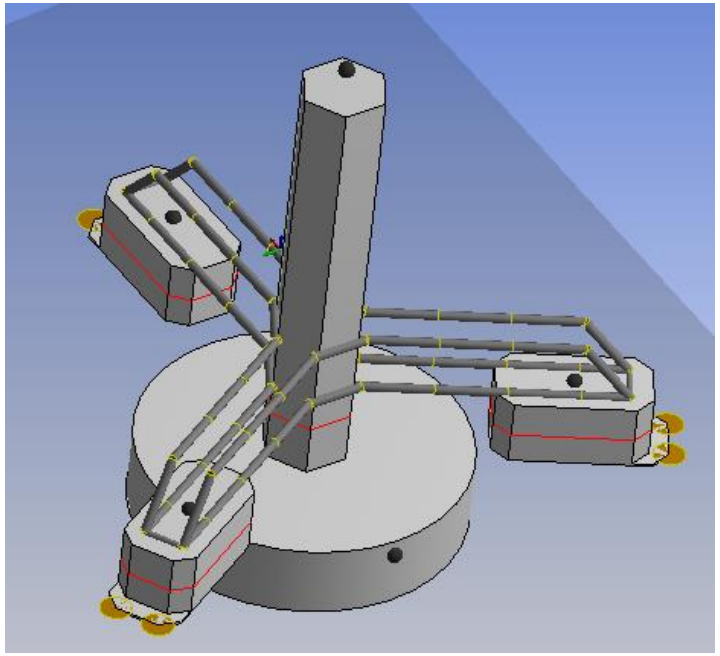
- PROOF OF CONCEPT IN CEDEX (2014)
- TRANSPORT TESTS IN CEHIPAR (2016)
- TRANSPORT & INSTALLATION TESTS IN IHC (2017)

* + 1 EXTRA CAMPAIGN → TIM TOWING TESTS IN CEHINAV (2018)

MAIN OUTCOMES:

- MOTIONS & ACCELERATIONS
- TIM / TOWER FORCES





AQWA MODEL & STAAD ANALYSIS

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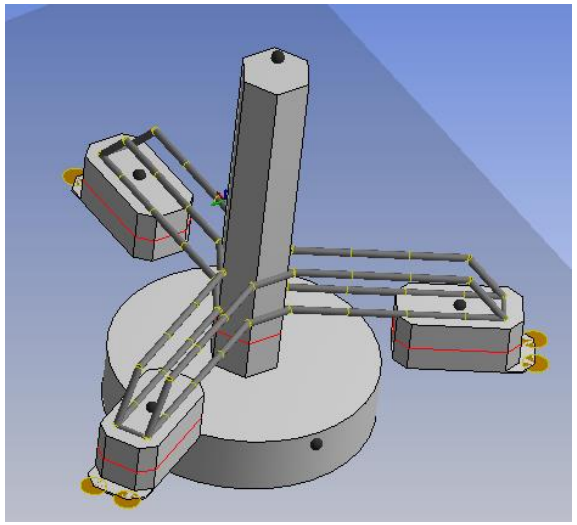
SPECIAL CONCERN → INTERACTION TOWER – TIM GUIDING SYSTEM

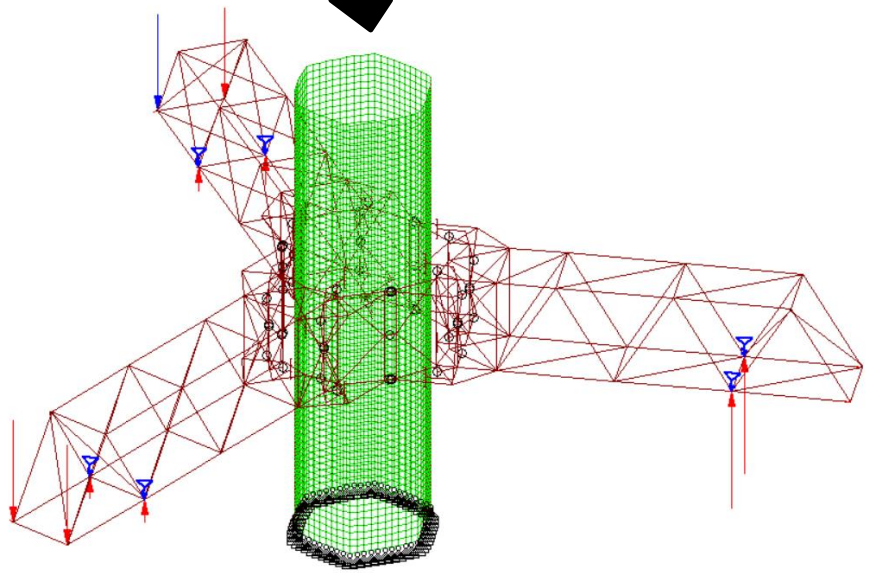
HYDRODYNAMIC MODELS CALIBRATED AND VALIDATED AGAINST TANK TESTS USED TO GET FORCES IN THE STRUCTURE IN A FULL SET OF LOAD CASES, IDENTIFYING THE MAXIMUM FORCES / MOMENTS AND CONCOMITANTS.

EACH LOAD SCENARIO IS TRANSFERED TO STAAD TO CHECK TIM & TOWER INTEGRITY → ITERATIVE PROCESS TO OPTIMIZE THE STRUCTURE.



LOAD SCENARIO MATRIX EXAMPLE

LOAD MATRICES



NEMOH & ABAQUS CHECK

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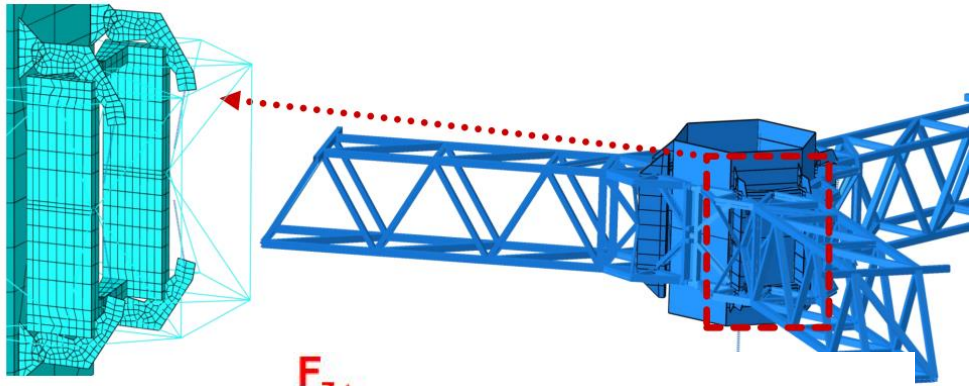
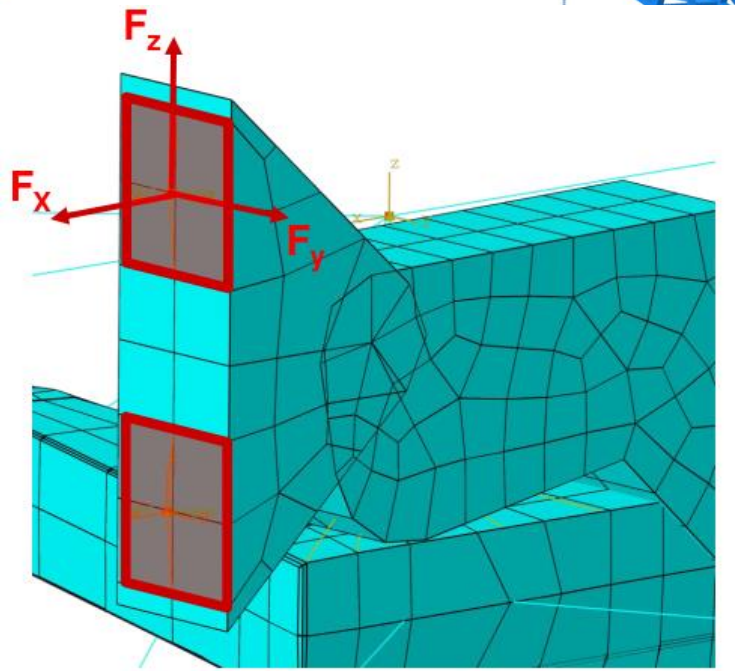
SPECIAL CONCERN → INTERACTION TOWER – TIM GUIDING SYSTEM

A CROSS-CHECK ANALYSIS CARRIED OUT, LOOKING SPECIFICALLY AT THE GUIDING SYSTEM AND THEIR CONTACT WITH THE TOWER.

RESULTS SIMILAR TO THOSE FROM AQWA-STAAD.





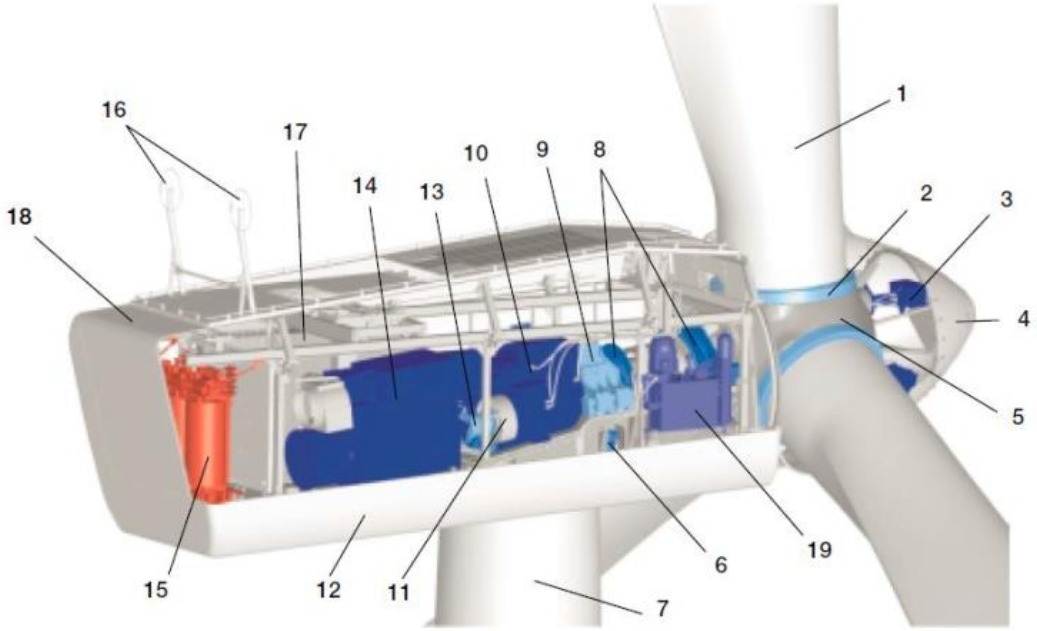
BLADED: WTG CHECK

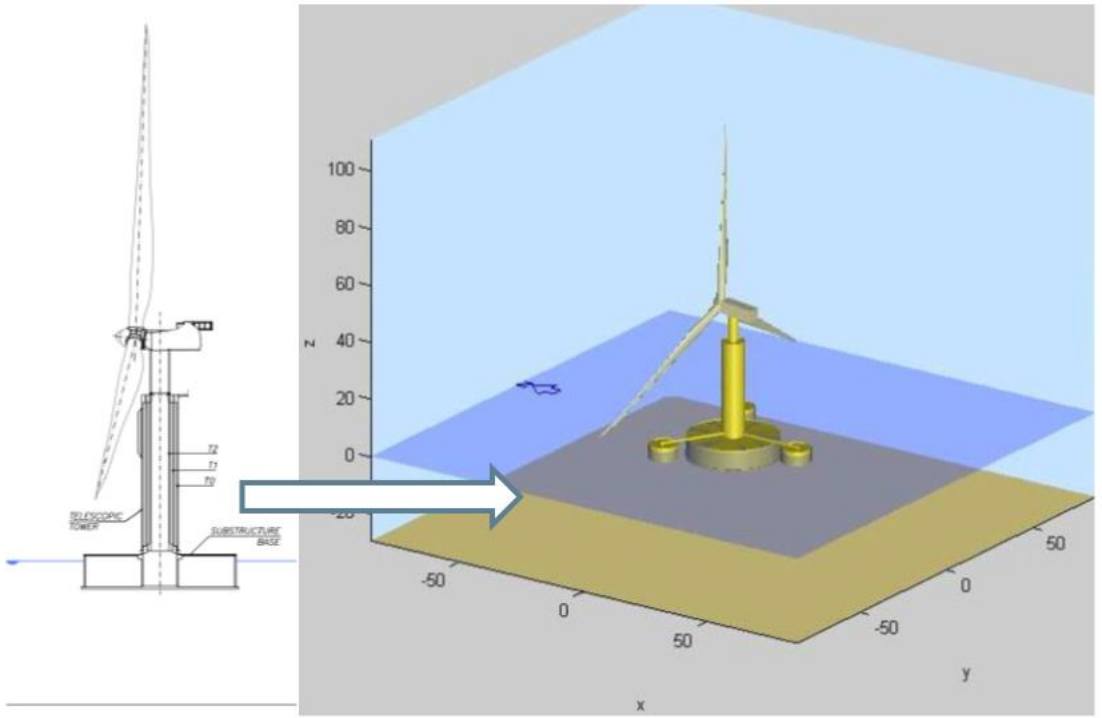
WIND TURBINE TO BE CHECKED IN TRANSPORT / INSTALLATION CONDITIONS

ALTRAN, ON BEHALF OF GAMESA, CARRIED OUT A 3RD PARTY ASSESSMENT USING BLADED FOR THE TRANSPORT CONDITION TO EVALUATE THE TURBINE INTEGRITY, MAINLY IN TERMS OF TILT ANGLE AND ACCELERATIONS.

BLADED MODEL UNDERDAMPED → CONSERVATIVE APPROACH

RESULTS ALWAYS WITHIN SECURE RANGES FOR THE TURBINE COMPONENTS INTEGRITY AS PER GAMESA THRESHOLDS





3RD PARTY CROSS-CHECK

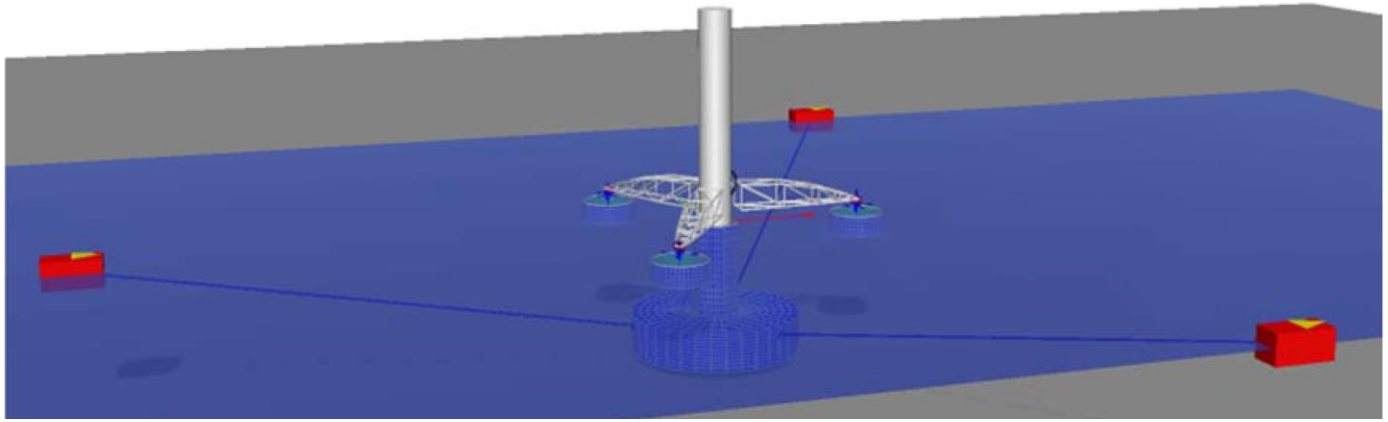
OWN ANALYSIS WERE CROSS-CHECKED WITH TWO DIFFERENT 3RD PARTY REVIEWS

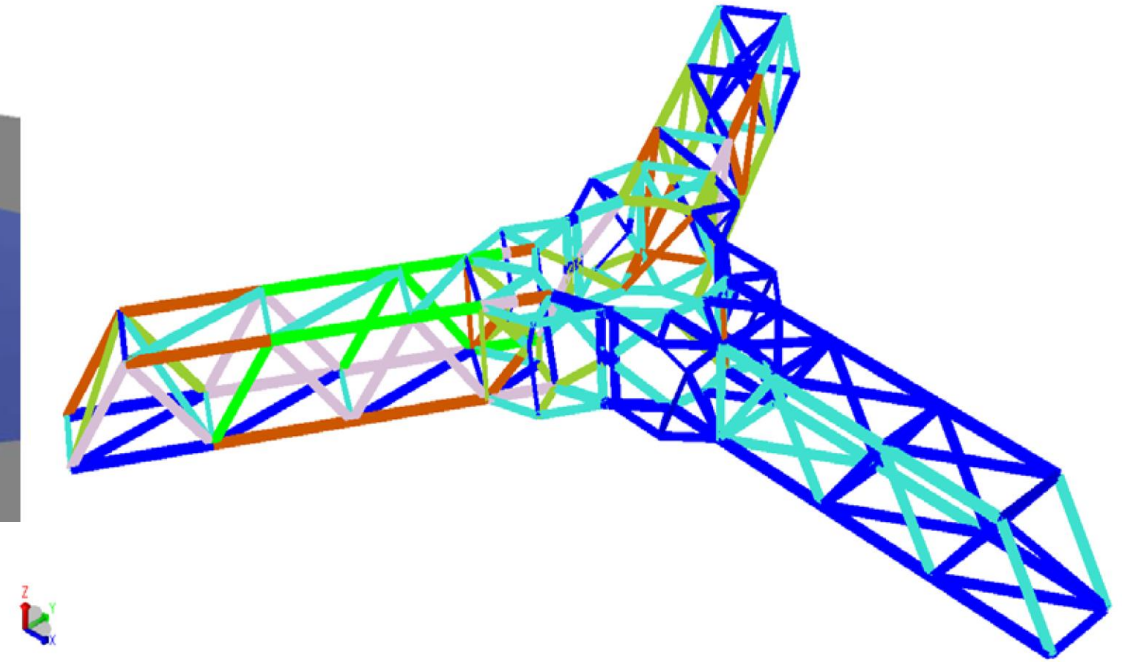
AT DIFFERENT STAGES, RESULTS FROM AQWA MODELS WERE CROSS-CHECK AGAINST SESAM RESULTS.

- 1ST CROSS-CHECK: COREMARINE (2017).
- 2ND CROSS-CHECK: DNVGL (2018).

} SEAKEEPING ANALYSES & LOADS ASSESSMENT

<u>RESULTS ALWAYS IN THE SAME ORDER OF MAGNITUDE ONCE MODELS WERE PROPERLY CALIBRATED</u>





MULTI-DISCIPLINARY ANALYSIS CHART

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ESTEYCO. NAVAL ARCHITECTURE TEAM

ESTEYCO. STRUCTURAL TEAM

ESTEYCO. MECHANICS TEAM

IHC, CEHIPAR, CEHINAV, CEDEX: TANK TESTING FACILITIES

DNVGL, COREMARINE, ALTRAN: 3RD PARTY ASSESSMENT

HANDS-ON CALCULATIONS + PRELIMINARY STRUCTURAL & HYDRODYNAMIC MODELS

PROOF OF CONCEPT **TANK TESTING** CAMPAIGN

AQWA **HYDRODYNAMIC** CONCEPT ANALYSIS

STAAD **STRUCTURAL** CONCEPT ANALYSIS

BLADED ANALYSIS. **WTG LIMITS** CHECK

TRANSPORT CONCEPT **TANK TESTING** CAMPAIGN

AQWA **HYDRODYNAMIC** DETAILED ANALYSIS

STAAD **STRUCTURAL** DETAILED ANALYSIS

GUIDING SYSTEM DETAILED CHECK: NEMOH+ABAQUS

TRANSPORT & INSTALLATION DETAILED **TANK TESTING**

CROSS CHECK: SESAM

AQWA HYDRODYNAMIC FINAL ANALYSIS

STAAD STRUCTURAL FINAL CHECK

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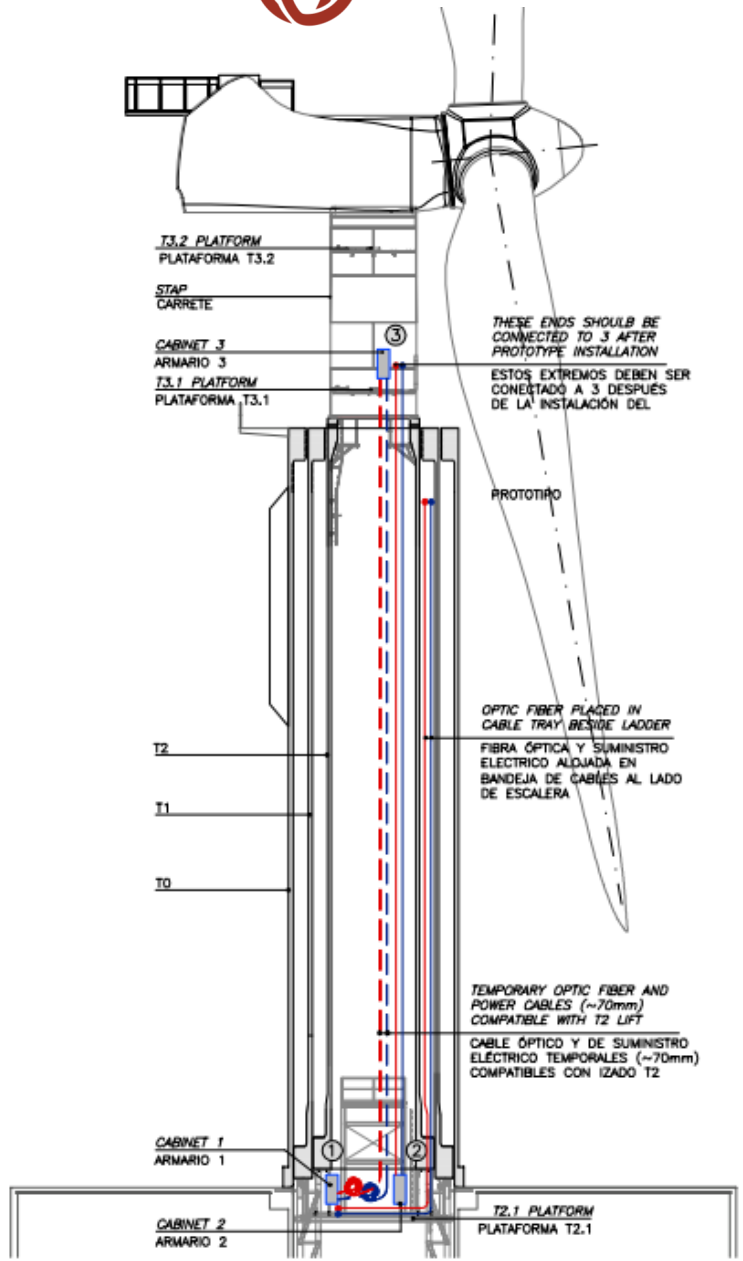
OFFSHORE INSTALLATION

ELISA SET SAIL THE 20TH OF JUNE 2018 AT 18.00 APPROXIMATELY.

- THERE WAS A TRIP OF AROUND 12-14 HOURS BEING TOWED.
- BALLASTING OPERATION STARTED AT 8.00 THE 21ST OF JUNE 2018.

ELISA WAS FULLY MONITORED WITH PLENTY OF SENSORS INSTALLED ALL ALONG THE PLATFORM. SPECIALLY ACCELEROMETERS AND CLINOMETERS WERE CONTROLLED FROM A SEAKEEPING POINT OF VIEW.



1.– TRANSPORT STAGE

NUMERICAL / TANK OUTPUTS vs ACTUAL FIGURES

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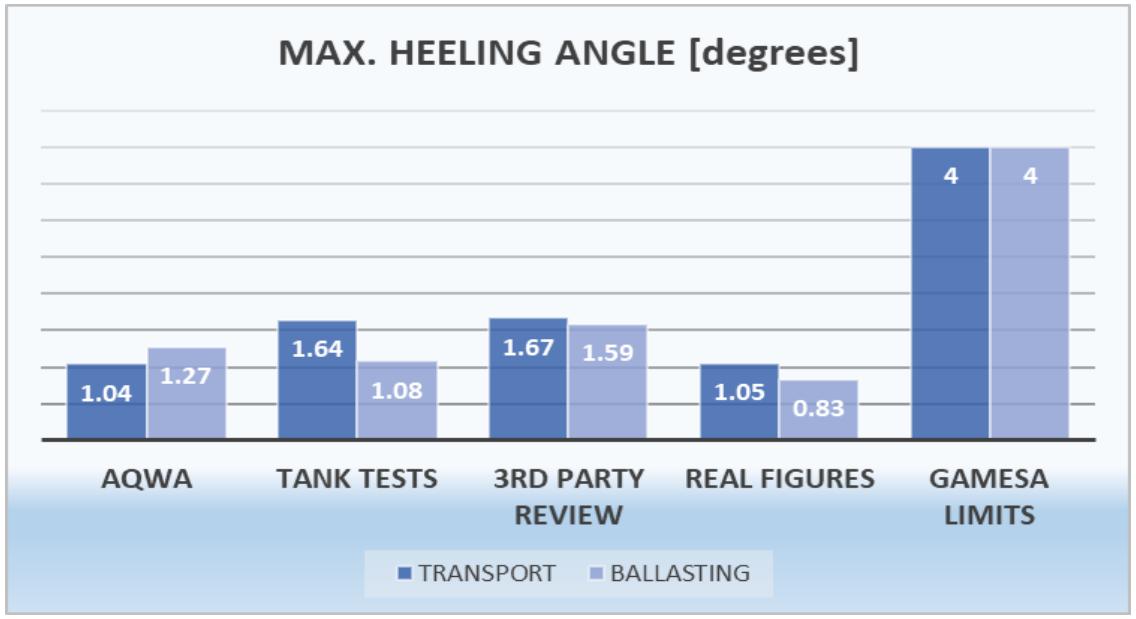

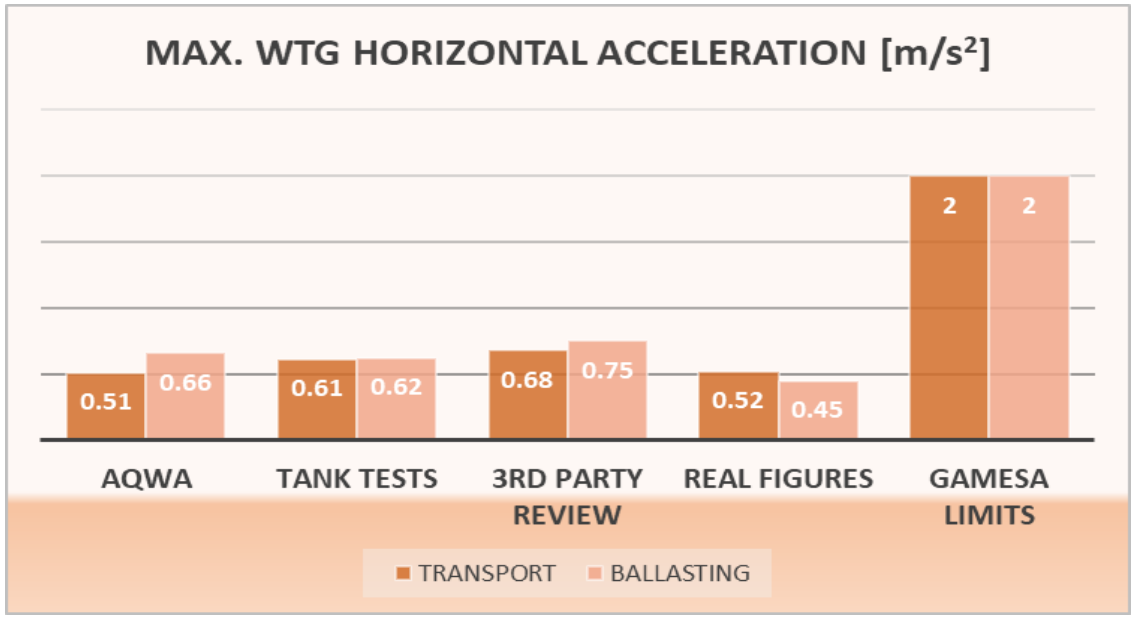

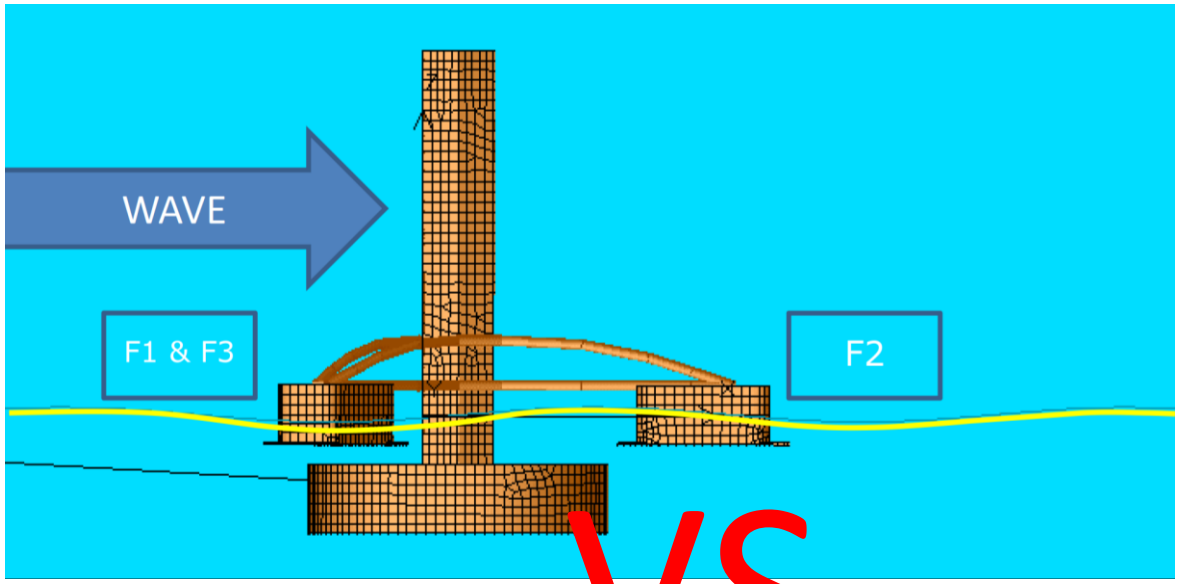

VS

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ELISA TECHNOLOGY BY ESTEYCO

Thank you

SELF BOUYANT GBS FOUNDATION AND TELESCOPIC TOWER FOR CRANELESS INSTALLATION OF COMPLETE OFFSHORE WIND TURBINES

CONSTRUCTION OF THE 5MW DEEP WATER PROTOTYPE (CANARY ISLANDS)

The ELISA project has received funding from the H2020-SMEINST-2014 under grant agreement No 674741. The ELICAN project has received funding from the H2020-LCE-2015-2 under grant agreement No 691919.

El proyecto ELISA está subvencionado por el programa H2020-SMEINST-2014 bajo acuerdo Nº 674741.
El proyecto ELICAN está subvencionado por el programa H2020-LCE-2015-2 bajo acuerdo Nº 691919.

PROJECT PARTNERS:

ALE SMARTER, SAFER, STRONGER

SIEMENS Gamesa RENEWABLE ENERGY

DEWI OCC a UL company

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