

“How to install a TLP Substructure for offshore Wind? TLPWIND® Case Study”

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Abstract

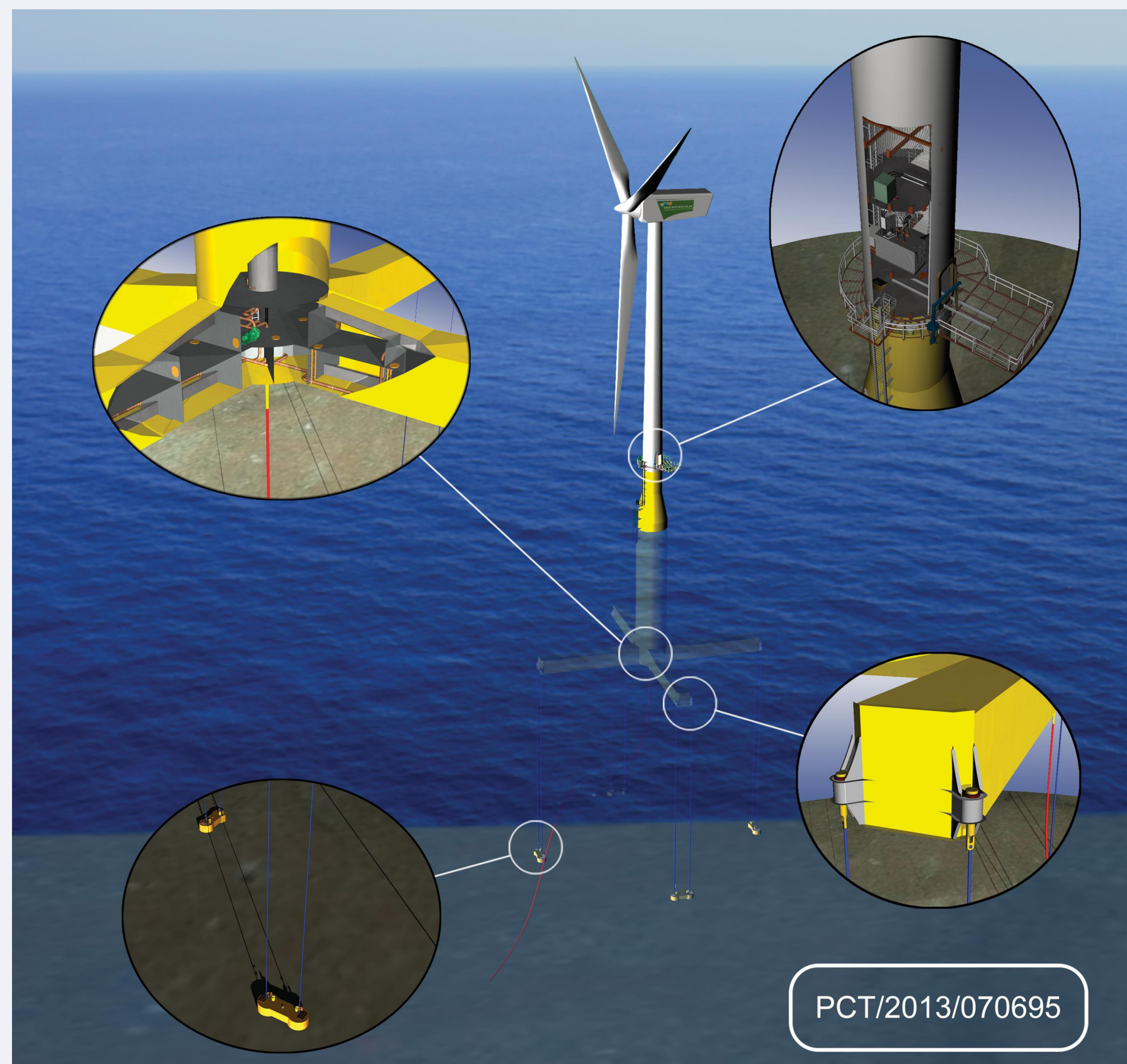


Fig 1. TLPWIND® concept description

Iberdrola Ingeniería y Construcción (IIC) has been developing since 2008 an innovative Tension Leg Platform (TLP) for Offshore Wind application, so called TLPWIND®¹, that has been designed specifically to optimize LCOE, mainly due to its lightweight design and through the development of a re-usable “ad hoc” Transportation & Installation (T&I) system and methodology.

TLPWIND® has been precisely designed to withstand very aggressive conditions in deep waters with an unbeatable dynamic behaviour. Its simplified geometry seeks to lower weight and construction costs, as well as enabling a full onshore assembly of the unit including the Offshore Wind Turbine Generator (OWTG), de-risking offshore T&I operations.

Two successful basin test campaigns proved that TLPWIND® behaviour is extremely good under the most severe conditions ever basin tested (**31m waves**) and water depths ranging from **80 to 100m**. The 5MW TLPWIND® concept design has a total weight range from **825 to 1.050 tons** (depending on site's conditions), with an overall cost of **1,0 – 1,2 million €/MW**. TLPWIND technology has proven its lower dependence on WTG loads, therefore these costs would be seriously improved when using larger OWTGs.

One of the biggest challenges to introduce TLP technology in Offshore Wind market is T&I stages, since TLPs are not inherently stable as SEMIs or SPAR technologies. Traditional T&I procedures developed at Oil & Gas industry are not applicable since they rely on the use of expensive HLVs. It is clear that to obtain a cost-effective solution for the Offshore Wind market this big challenge must be solved.

TLPWIND® Transportation & Installation solutions

IIC has been developing several “ad hoc” T&I systems as part of the TLPWIND® technology with the aim of driving LCOE down. Two solutions have been designed and tested parallel to the TLP itself, with very interesting correlated results:

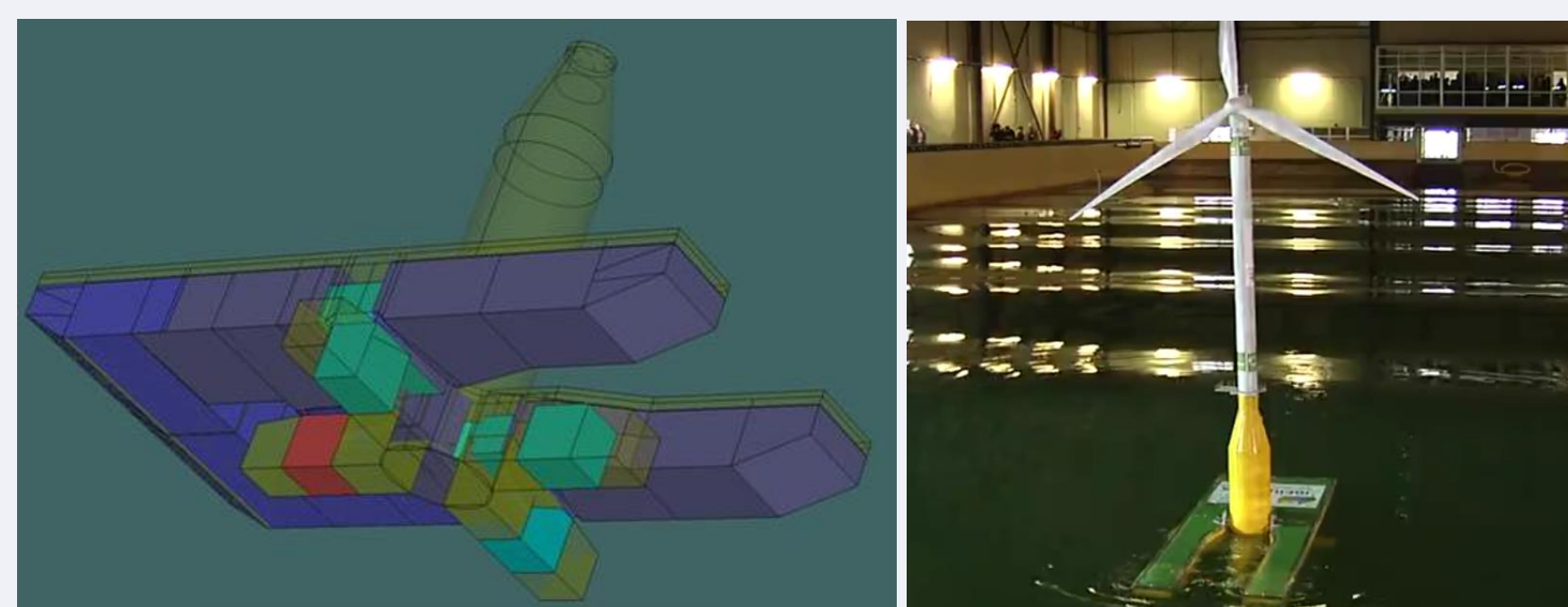


Fig 2. TLPWIND® U-shaped barge

U-shaped Barge (A). An “ad-hoc installation barge” with a footprint on the bottom that matches perfectly with the platform shapes. Fixation between platform & barge is achieved hydrodynamically. It has a very good behaviour during transportation phase (towed at 5 knots with 5m waves) with a very low water resistance but TLPWIND® installation operations are still a big challenge.

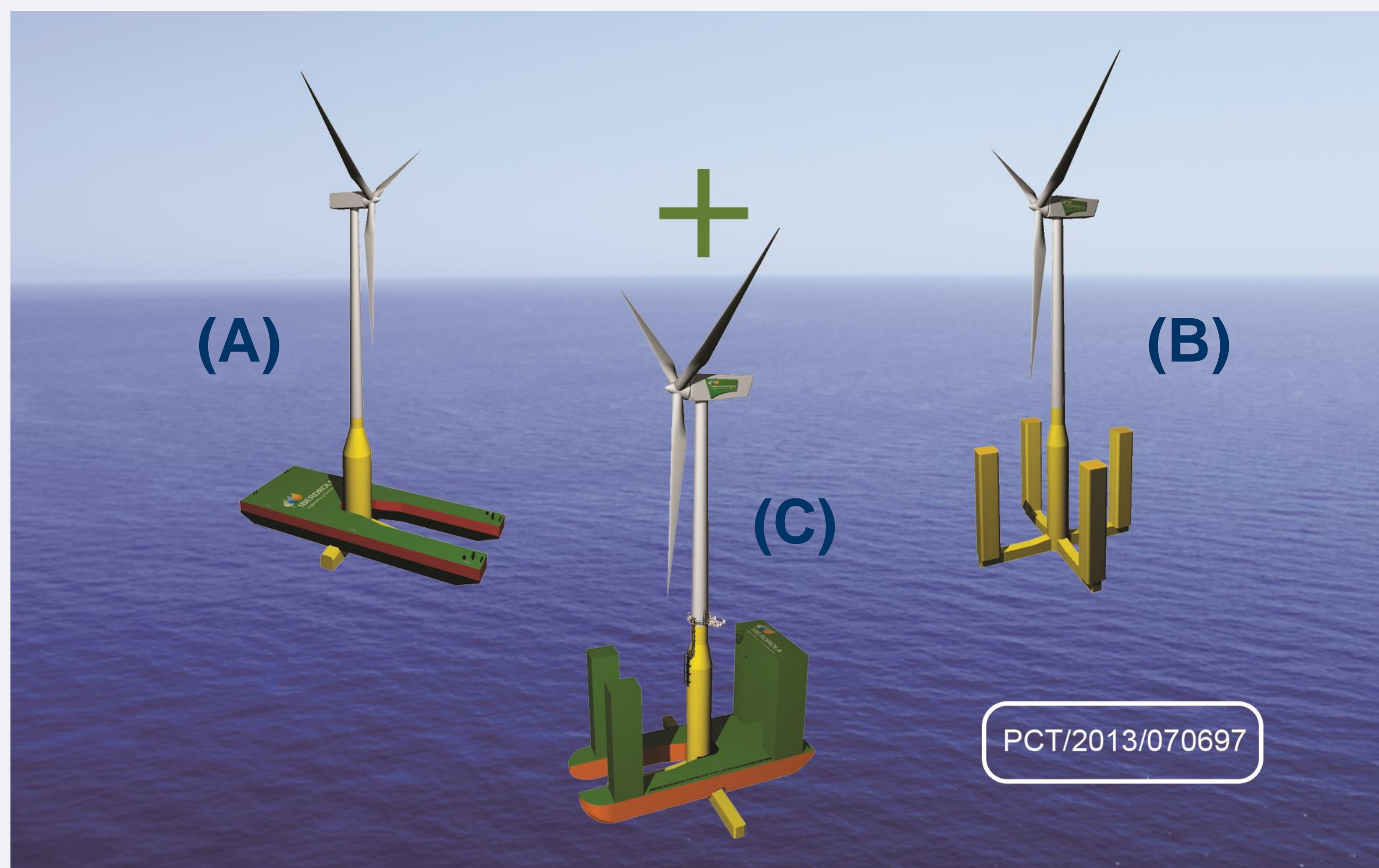


Fig 4. TLPWIND® T&I solutions

U-shaped Semisubmersible barge² (C). A new system has been recently designed for maximizing overall weather windows and minimising overall cost and risks, specially at offshore operations. The idea of a semisubmersible barge grows up as a synergy between the two previous T&I systems, making an optimal use of their advantages, as well as trying to simplify offshore operations and subsequently reducing overall risks, by offering an stable working platform at several draught conditions. This innovative concept design will be thoroughly tested this summer at Strathclyde's Univ. basin test facility.

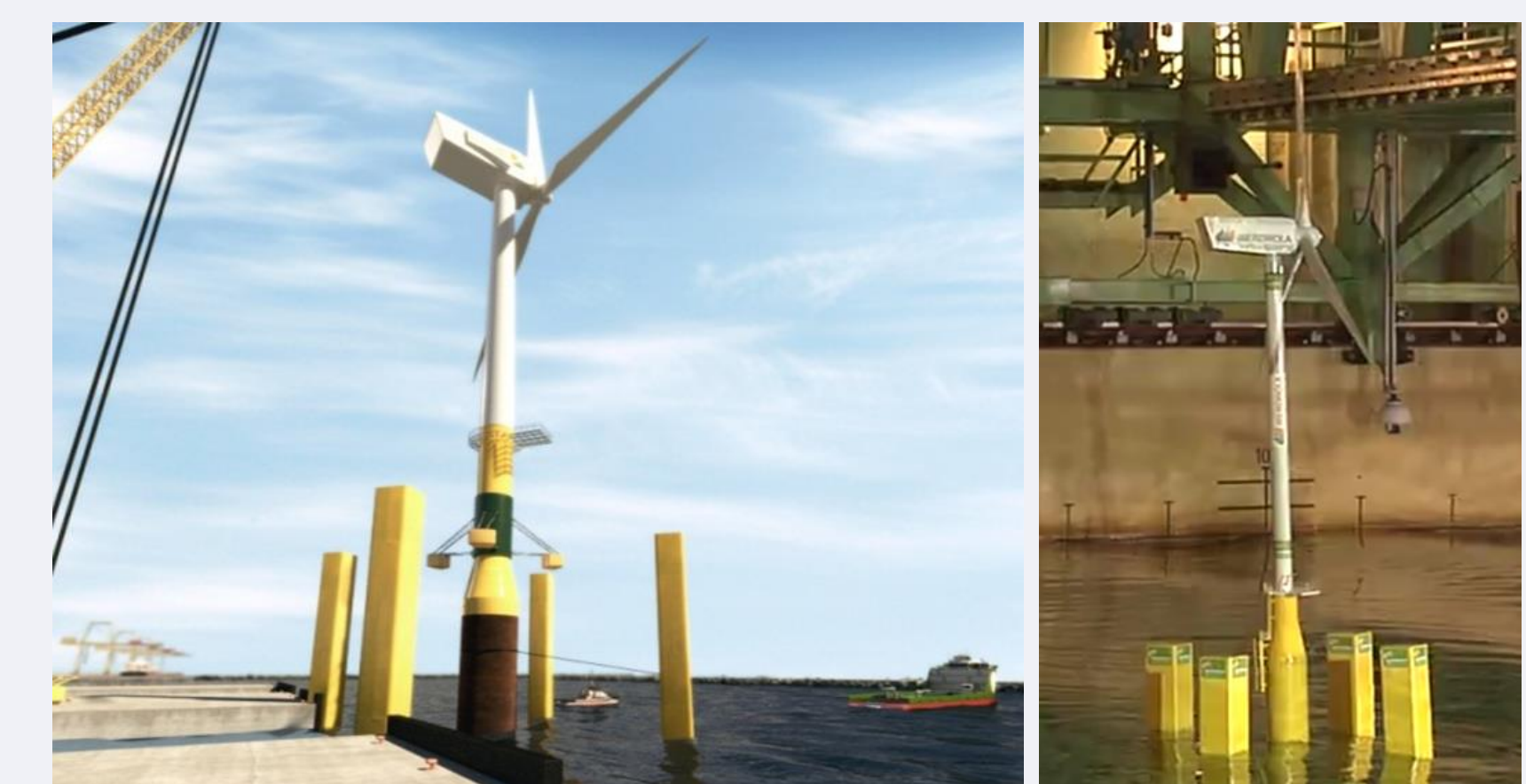


Fig 3. TLPWIND® Reusable floaters

Reusable Floaters (B). This solution allows transforming the TLPWIND® platform into a semi-submersible platform. A set of buoyancy modules are temporarily connected to the ends of the pontoons. floaters ease the installation procedure, but present an added water resistance during towing and hence larger transportation time with reduced weather windows.

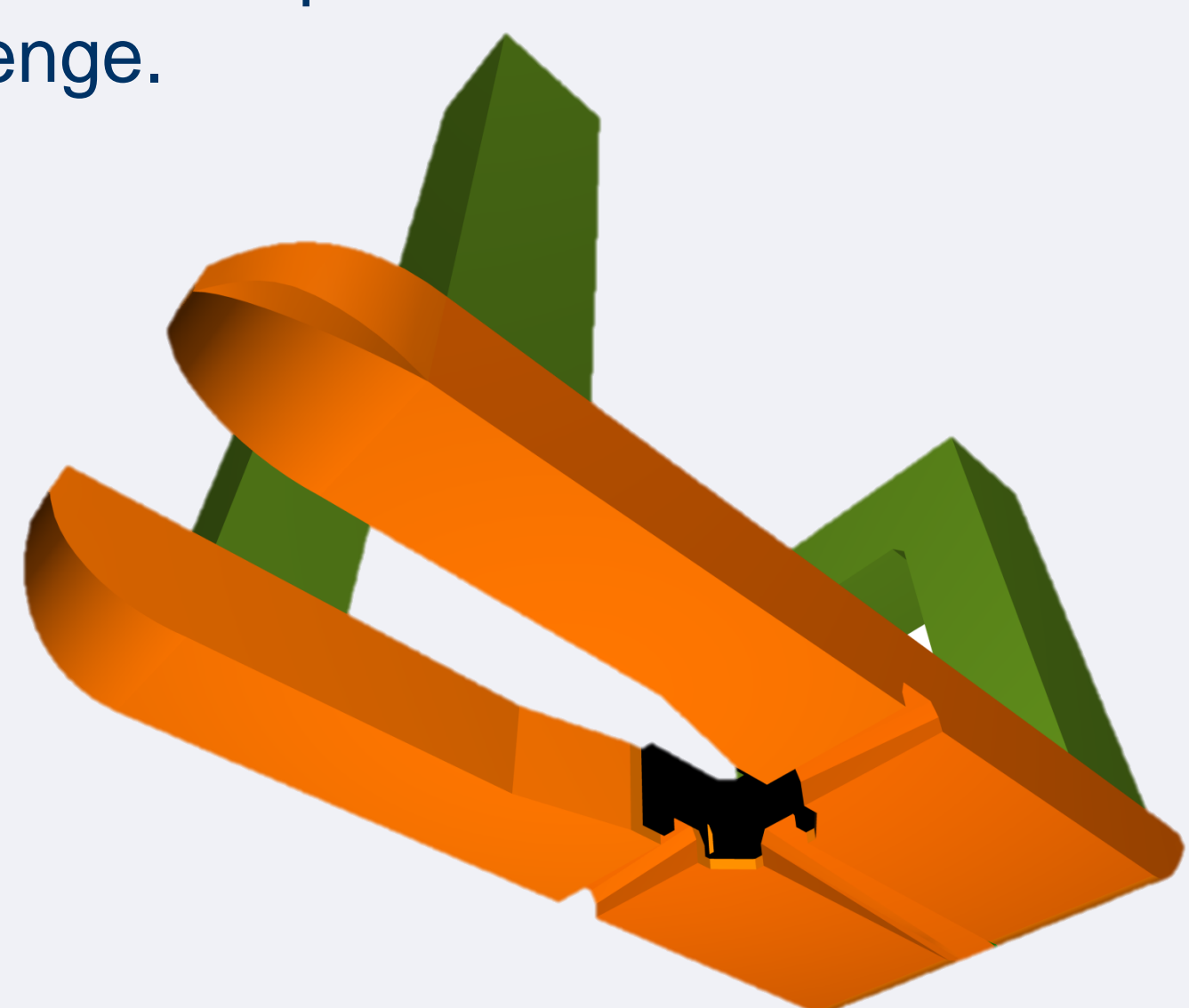


Fig 5. TLPWIND® U-Shaped Semisubmersible barge

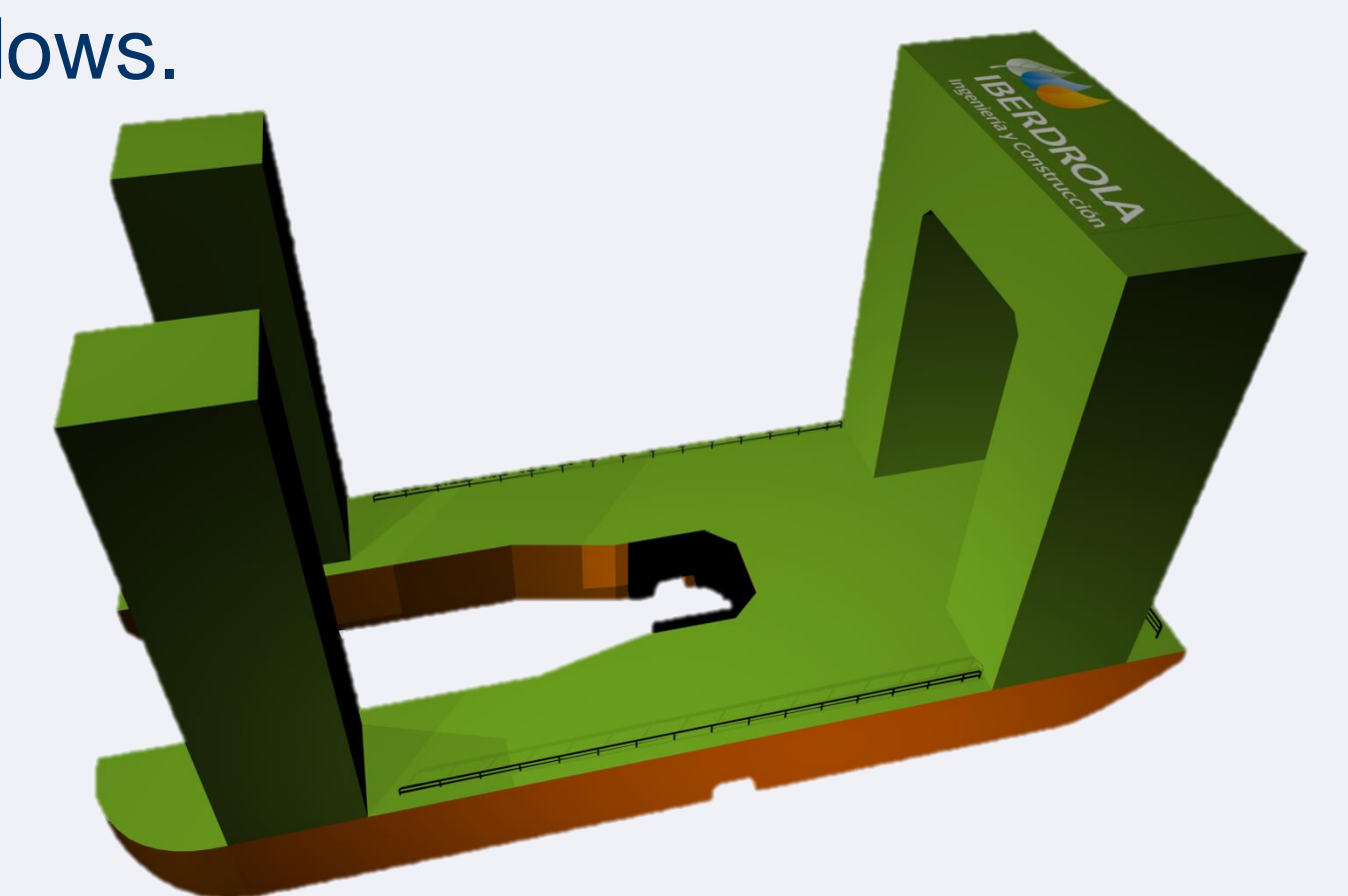


Fig 6. TLPWIND® U-Shaped Semisubmersible barge

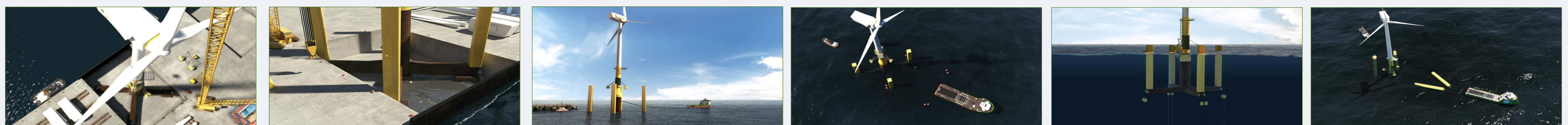


Fig 7. TLPWIND® T&I process for reusable floaters solution

Conclusions

TLP designers have to face some demanding challenges to assure stability during T&I phases, specially when self-installing these kind of platforms. IIC has designed and tested at reduced scale (1:35 & 1:40) two innovative T&I systems that showed up some outstanding performance results. A new technical and feasible solution is being developed merging the best characteristics of the two different systems: TLPWIND ® U-Shaped Semisubmersible Barge. This solution will be tested in June at the Strathclyde's Univ. Basin Test facility under the INNOVATE UK's supported project: TLPWIND UK. A significant cost reduction is achievable even enhancing the “local content” since:

- Use of local Standard tugs (5-10 k€/day) for performing towing and hook up procedures **vs** Specialized vessels/HLVs (150-500 k€/day)
- Enhancing the Operational limits at T&I operations (Hs ~ 3m) → Increasing the amount of Workable days-per-year
- Mooring System installation operation is independent from TLP installation and can be done using local AHTs (30-60 k€/day)
- Insurance & Financial costs-savings → Risk mitigation by minimising offshore operations when compared with current Offshore Wind Construction practices

1. TLPWIND floater PCT/2013/070695 2. PCT/ES2013/070697 U- shaped Semisubmersible barge

