

XCF Concept

March 18th 2019 FAID Boston

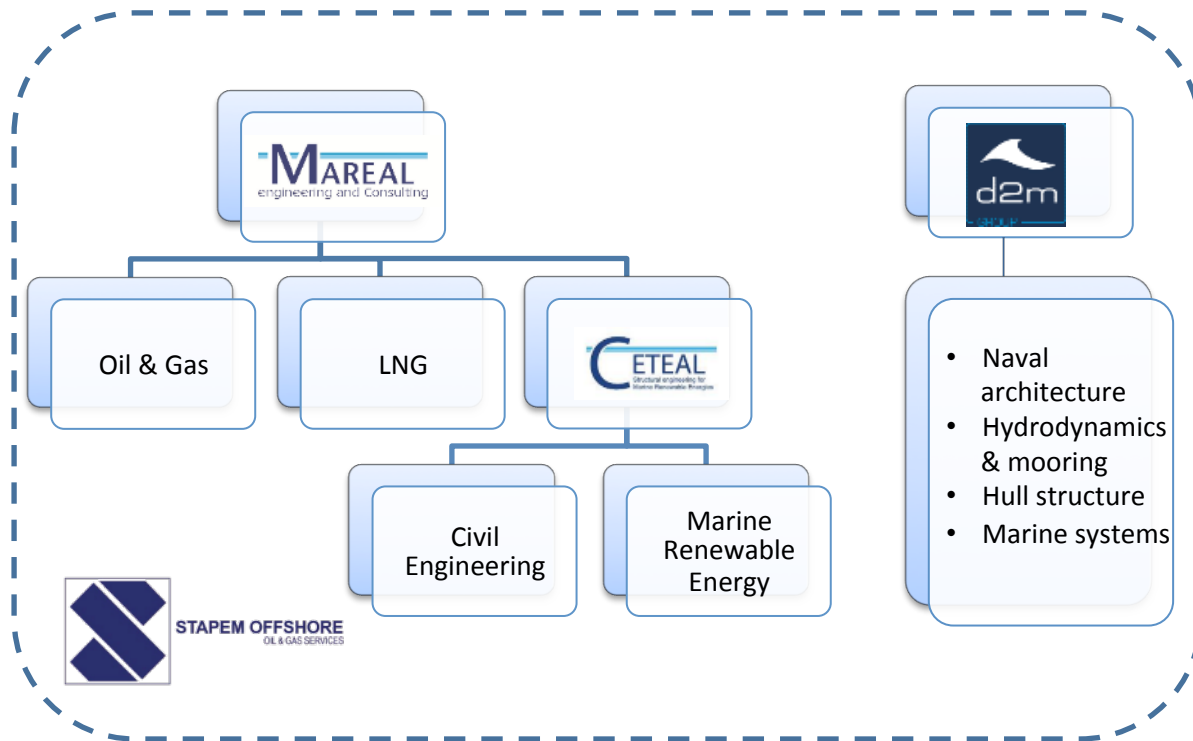
ConcreteConcept

by CETEAL

- CETEAL: Mareal's sister created in 2011, dedicated to Marine Renewable Energy
- MAREAL is involved on the Oil & Gas and LNG sectors since 2002
- CETEAL is focused on designs for offshore wind and tidal energy projects
- MAREAL is part of the STAPEM OFFSHORE group since October 2016

Let's talk numbers

- 23 engineers & draftmen
- 40,000 manhours/year
- International team with 10 possible working languages
French, English, Spanish, Arabic, Vietnamese, Polish, Portuguese, Flamish



A wide range of knowledge

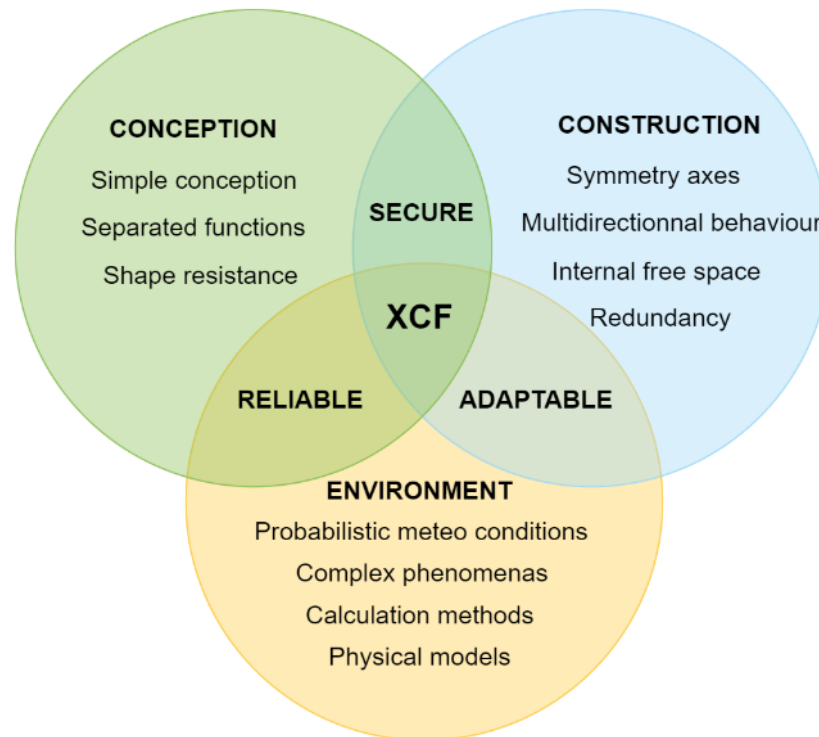
- Missions:
 - conceptual,
 - feed,
 - detailed design,
- Projects:
 - tidal machines,
 - fixed and floating wind,
 - oil&gas platforms,
- Materials:
 - steel,
 - concrete,
 - combinations of steel and concrete,

➔ **Experience means reliability**

A worldwide experience



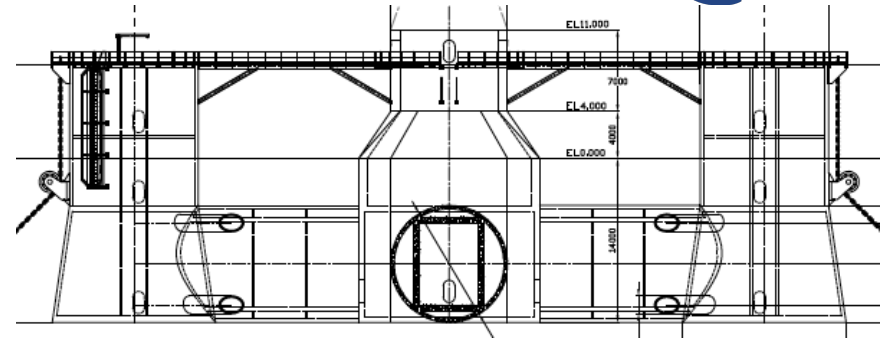
Over 15 years of offshore activity



→ **XCF another offshore project by CETEAL**

Security means cheaper money cost

- Floater security,
 - redundancy,
 - double hull effect on pontoons,
 - only proven solutions,
- People security:
 - internal circulation,
 - possible ballast modification to increase stability for maintenance in progress,
 - access to the tower from the inside,
- Production security:
 - maintenance through complete continuous monitoring,
 - meteo prediction,
 - fatigue assessment,
 - Repowering available.

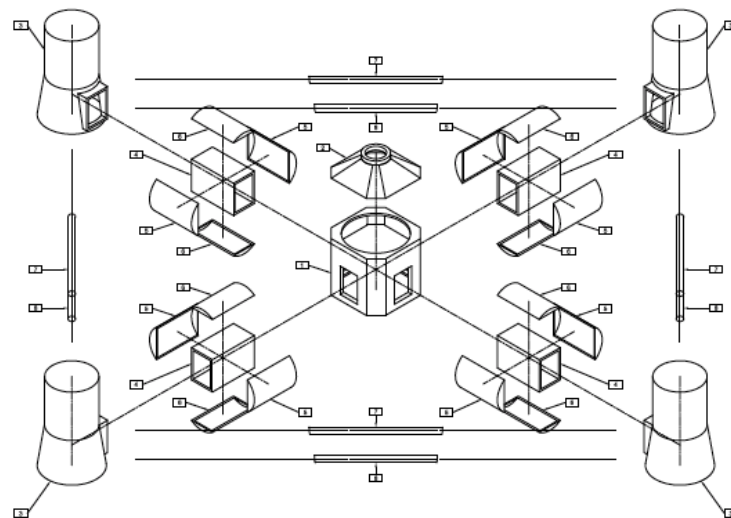


➔ Cheaper money means easier to finance projects

XCF designed for being adaptable and ready for mass production

- Designed from start for high power turbines, up to 10 MW and above,
- Compact dimensions for less harbour needs,
- Symetrical design for multi-directional environment,
- Modular design,
- Design optimised for concrete to reduce cost,
- Low maintenance through extensive monitoring,
- Can be inspected fully from the internal,
- Shaped for low drag and less tug requirements,
- Standard connections,
- No prestressing required,
- Moderate concrete grade only required,
- Low reinforcement ratios.

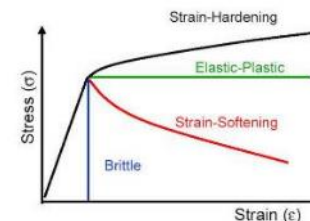
➔ **Mass production is key factor for cost reduction**



Offshore means high costs against failure. Stay simple.

- Simple design are less prone to failure,
- Separating functions eases the design:
 - draft,
 - overturning moment,
 - dynamical behaviour,
 - horizontal offset,
- A number of phenomena are not precisely known:
 - slamming,
 - green water,
 - dynamical water pressure,
 - cracking of concrete.
- Necessity to use models that are only approximate,
- Forces can be resisted by shapes,
- Waves, wind and current speed are probabilistic in nature, not absolute truth,
- Deal with the cause better than with the effect.

➔ **The best way to deal with a problem is to avoid it**



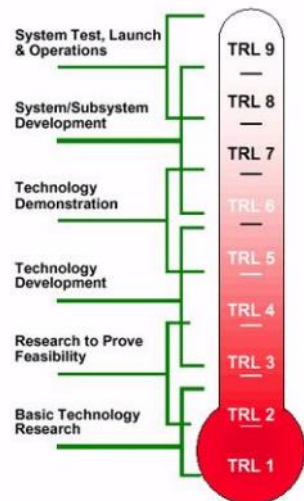
Concrete Semi-Submersible selected as best technological and economical fit for many sites

The floater's main criteria

- Simple technology,
- Cost effective solution,
- Very adaptable floater,
- Designed for most severe conditions,
- Dimensions and material allow to use local supply-chain.

CONCERN	CONSTRUCTION	INSTALLATION	M&Op	CRITERION	SOLUTION
Fatigue			X	25 years	Concrete structure
Dynamics			X	Large period	X-shape layout: <ul style="list-style-type: none"> - Wind turbine at center - Floaters - Qty = 4
Stability		X	X	Inclination < 10°	
Size	X	X		Optimum (< 60 m)	
Ballasting		X	X	robust	Static ballast
Draft	X	X		Harbours	Maximum light draft of 8 m
Flexibility	X			<ul style="list-style-type: none"> ▪ Simple technology ▪ Worldwide ▪ 6 to 10 MW or more 	No prestressing
Mooring		X	X		Catenary mooring
Standards	DNV-OS-J103 ; DNV-OS-C502 ; EUROCODE 2 and 3 ; IEC 61400-2 and -3				

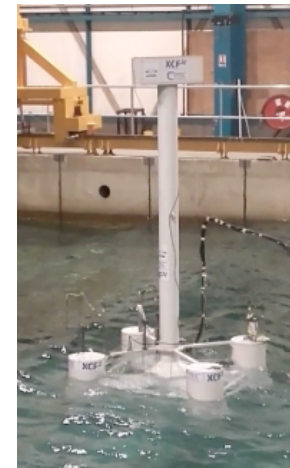
Note: dynamic cable is not covered by the concept and our studies, this challenge is not our know-how and not differentiating



We are going here

We are here

Technology Readiness Levels in the European Commission



Technology Readiness Level	Description
TRL 1.	basic principles observed
TRL 2.	technology concept formulated
TRL 3.	experimental proof of concept
TRL 4.	technology validated in lab
TRL 5.	technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 6.	technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 7.	system prototype demonstration in operational environment
TRL 8.	system complete and qualified
TRL 9.	actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)



CETEAL is involved in several RFIs in the world for Floating Offshore Wind Projects



CETEAL is meeting with several investors to support the development of XCF



CETEAL keeps on working on the concept to adapt it to new technologies and make it as cost efficient as possible

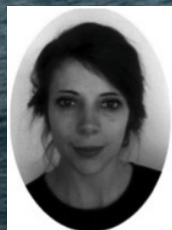
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Thank you for your attention

