

ROBUST
COST EFFICIENT
ADAPTABLE



XCF

**X-SHAPED CONCRETE FLOATER
FOR UP TO 12-MW WIND TURBINES**

**Answers to fatigue, large scaled and local production
Easy and safe O&M for the harshest seas
Robustness and cost efficiency**



As wind cannot be directed, one has to know how to adjust the sails



To be able to adjust the design to the wave, the current, the wind and the turbine capacity, we have selected proven technologies: semi-submersible floater, concrete, catenary mooring.



PROVEN TECHNOLOGY

X-SHAPED CONCRETE FLOATER



A simple and innovative device

XCF is made of and optimised for REINFORCED CONCRETE. Concrete Semi-Submersible selected as best technological and economical fit for many sites.

STABLE

- Two axes of symmetry, 4 columns, turbine at the center, to accommodate cyclonic and multi-directional wind sites
- Circular shapes to circumvent high current velocities

ROBUST

- Resistant to fatigue
- Designed for most severe conditions
 - proven technologies: semi-submersible floater, concrete, catenary mooring [but also compatible with tensioned line mooring]

COMPACT

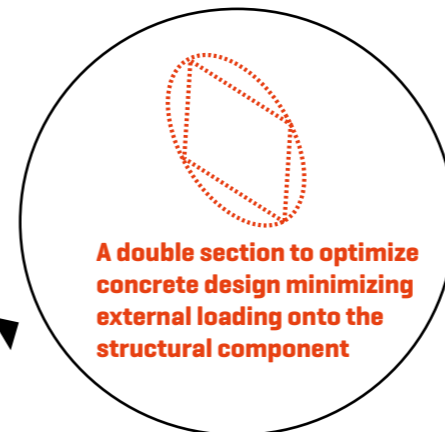
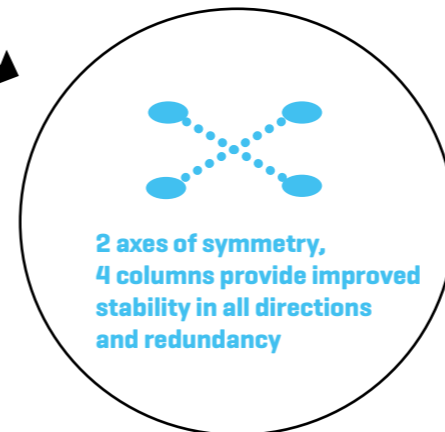
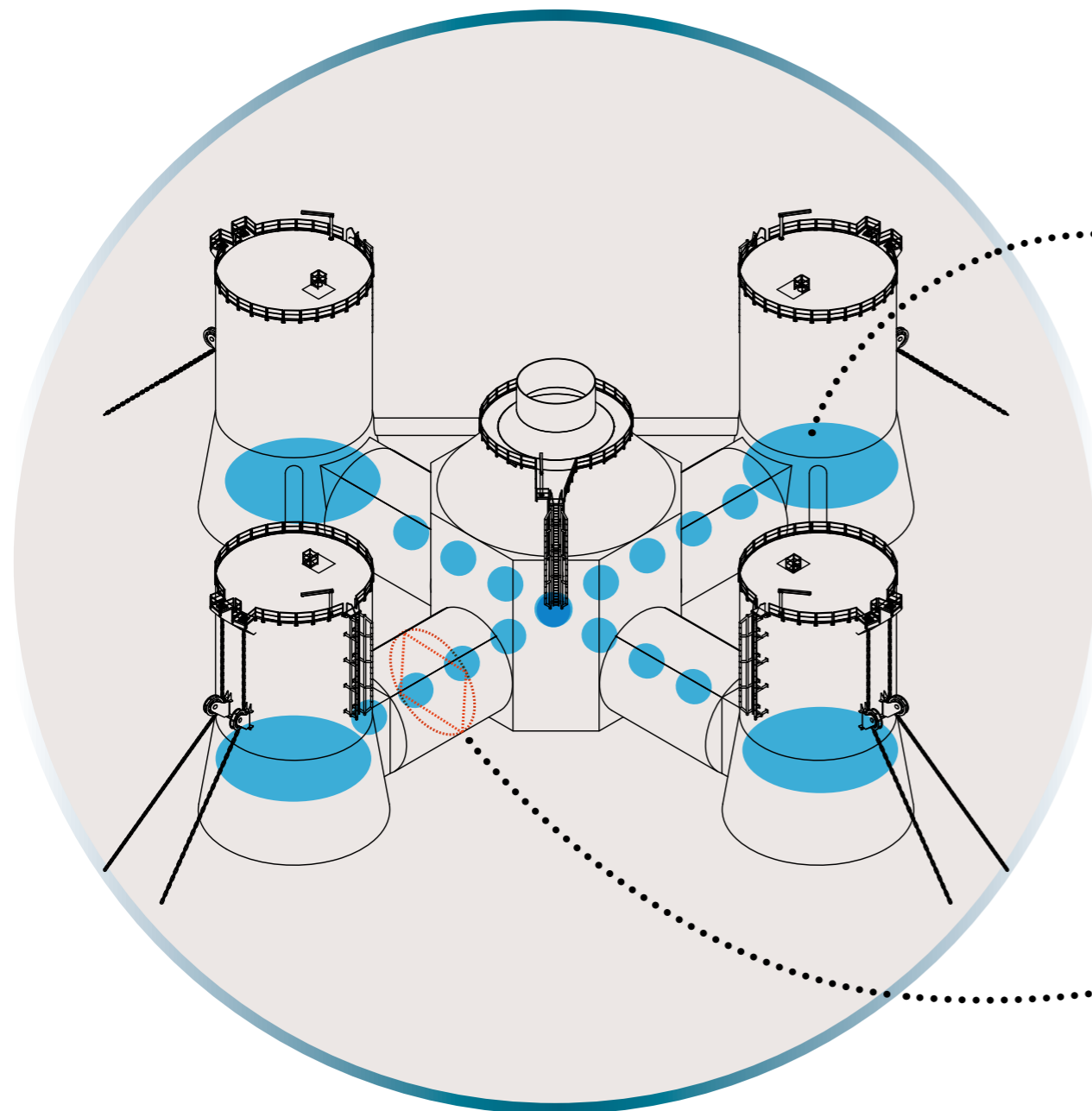
- Compact dimensions for less construction footprint
- Controlled draft to adapt to harbour restrictions and requirements

ADAPTABLE

- Separating functions, easing the design

... and SUSTAINABLE

- With concrete, it is possible to extend the lifetime to 40 years with minimum cost and design impact
- Volumes are available for energy storage technologies
- The use of concrete minimizes painting and cathodic protection, limiting spreading plastic micro parts and aluminium in the ocean





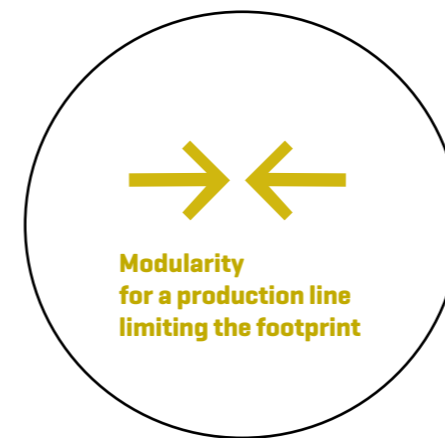
The best way to deal with a problem is to avoid it



The XCF concept is an upstream design, aiming to take into account all the challenges of the marine environment from the start. From the early stages of the project, we identified the risks and areas of concern in order to define requirements and options that would keep them from generating a problem on the ground of our experience of 18 years in the offshore industry.

CONCERN	CONSTRUCTION	INSTALLATION	O&M	CRITERION
Fatigue			X	25 years
Dynamics			X	Large period
Stability		X	X	Inclination < 10°
Size	X	X		Optimum (<60m)
Ballasting		X	X	Robust
Draft	X	X		Harbours
Flexibility	X			Simple technology Worldwide
Mooring		X	X	6 to 10 MW or more

SOLUTION
Concrete structure
X-shape layout: wind turbine at center 4 columns
Static ballast
Maximum light draft of 8 m
No prestressing
Catenary mooring



CONSTRUCTION AND INSTALLATION



An optimised process

Construction of supports for a wind farm requires mass production. XCF is thought to provide solutions to deliver one support per week, with prefabrication of the components for a final assembly over a limited footprint.

MODULARITY

→ Using regular concrete allows modularity for a production line limiting the footprint and optimizing project planning

EASY COMMISSIONING

→ The draft can be adjusted to comply with water depth at quay side during commissioning

LOCAL CONTENT

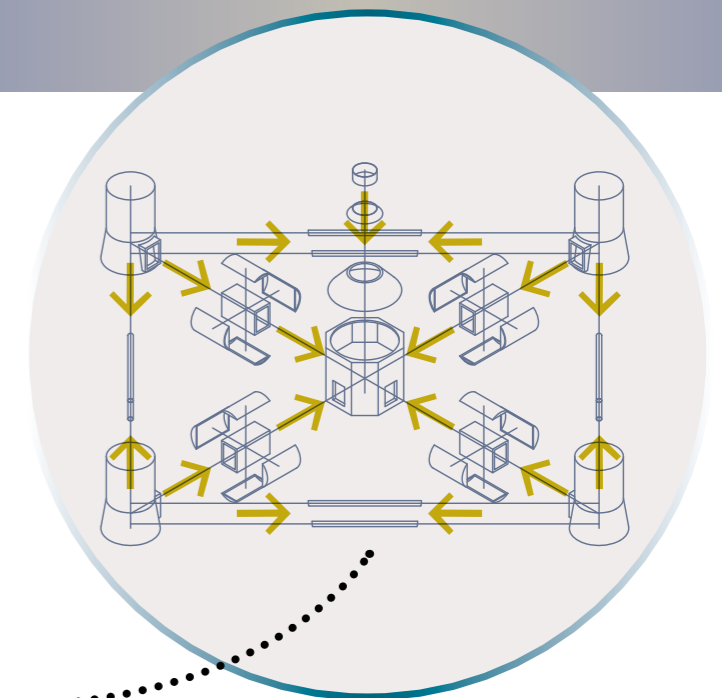
→ Concrete fabrication technology is globally well-known, and material can be supplied everywhere

COST EFFICIENCY

→ Concrete is cost efficient for series of similar bodies

RESISTANCE

→ A better resistance against corrosion and requiring low maintenance

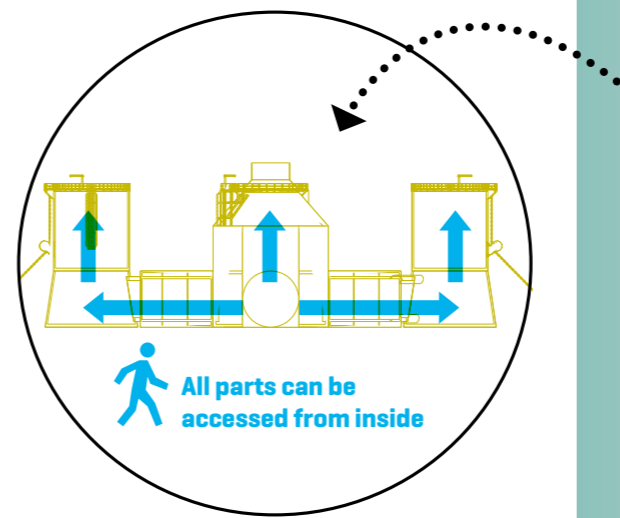
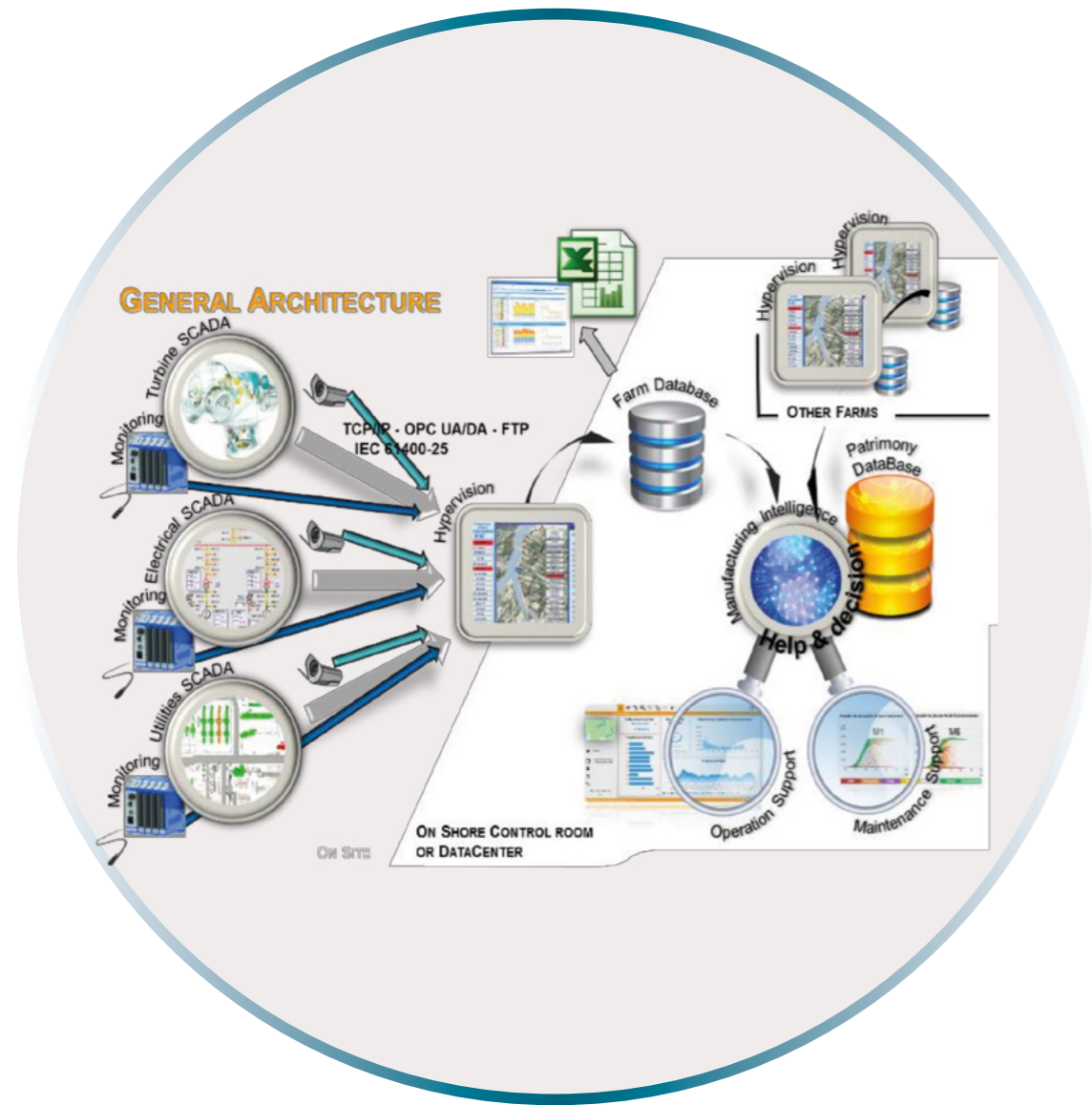




When you don't know to which port to sail, there is no good wind

Éric Tabarly

A wind turbine is made to produce power, and this is to be carried out within the best economical conditions. That's why the concept was thought from start integrating a monitoring system that collects data to exploit them, aiming at limiting site visits, anticipating issues, and also dialoguing with the turbine control command to optimize the production on a floating support.



OPERATION AND MAINTENANCE



Health & safety

O&M and HSE are part of the concept, as these are concerns not only during construction and installation, but also during the wind farm service lifetime, with significant impact on power production project profitability.

SECURITY

- All parts can be accessed from inside, whether it is for operation or maintenance
- Redundancy from the four columns and the double hull effect on pontoons

EASY MAINTENANCE

- Easy access for site visit and inspection from the inside, using walkways, stairs and ladders that are arranged inside the floater
- Possible ballast modification to increase stability for maintenance in progress and to adapt to specific environment conditions
- Access to the turbine tower from the inside

MONITORING SYSTEM

- A monitoring system designed to collect proper data for an efficient control limiting site visits and managing efficiently power production

THREE-FOLD SECURITY

- For the personnel who can circulate inside the floater
- For the floater that can survive flooding of two columns
- For the production, that is assisted by monitoring and coupled to the floater motion parameters

OUR PARTNERSHIPS FOR SECURITY

- Our partners for HSE and O&M are fully involved in the development of the project

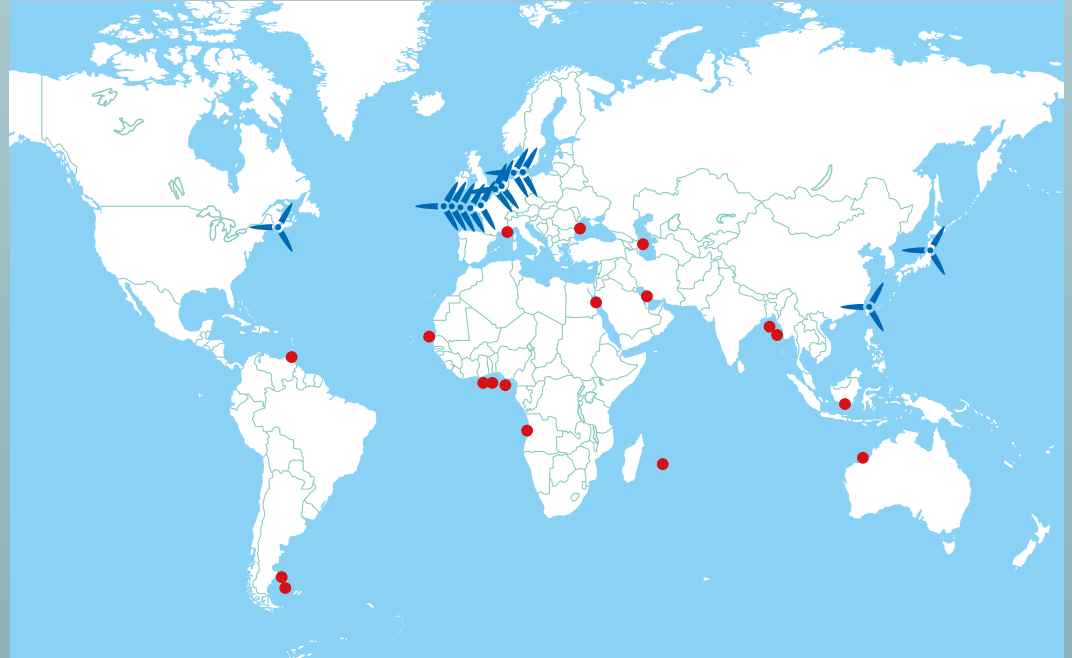



Occupational Health and Safety
Industrial Risks Management
Environmental Management
For the offshore industry
Since 2005 - 130 employees.



Industrial plants and structures monitoring for operation and maintenance optimization
20 years of experience.

We have a strong experience in the offshore industry over the seven seas, based on detailed engineering projects we achieved under demanding requirements for quality and reliability



Oil&Gas and Civil-Engineering 



Henry DUPOUY
Project Manager
President of MAREAL and CETEAL



Pascal HEISEL
Inventor
R&D Director
Civil-engineer since 1983



CETEAL: MAREAL's sister company, addressing Marine Renewable Energy and Civil Engineering



MAREAL is involved on the Oil & Gas and LNG sectors since 2002



MAREAL is part of the STAPEM OFFSHORE group since October 2016

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