HydroQuest

Tidal turbines steel structures
Design optimization and industrial opportunities

15/09/2020

TIGER TIDAL STREAM INDUSTRY ENERGISER

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GENERAL PRESENTATION

OUR CORE TECHNOLOGY

A UNIQUE TURBINE CONCEPT

Two vertical, counter-rotating columns

Reliable in harsh conditions

Performant in turbulent flows

Suitable for a range of applications

Adaptable in size and power output

Reaching competitiveness

Strictly following the learning curve & LCOE evolution of wind turbine technologies

HydroQuest is a leading technology provider thanks to superior field performance

10 YEARS OF TECHNOLOGY DEVELOPMENT

MILESTONES

2010

2013
First river turbine connected to the grid
A world first with EDF in French Guiana

2014
CMN Partnership
Shareholding & Industrial partnership

2016
OceanQuest
Marine turbine project launch

2019
1MW prototype marine turbine
Immersed & delivers power

TIDAL POWER – A 100GW MARKET

FRANCE FIRST, WORLD SECOND

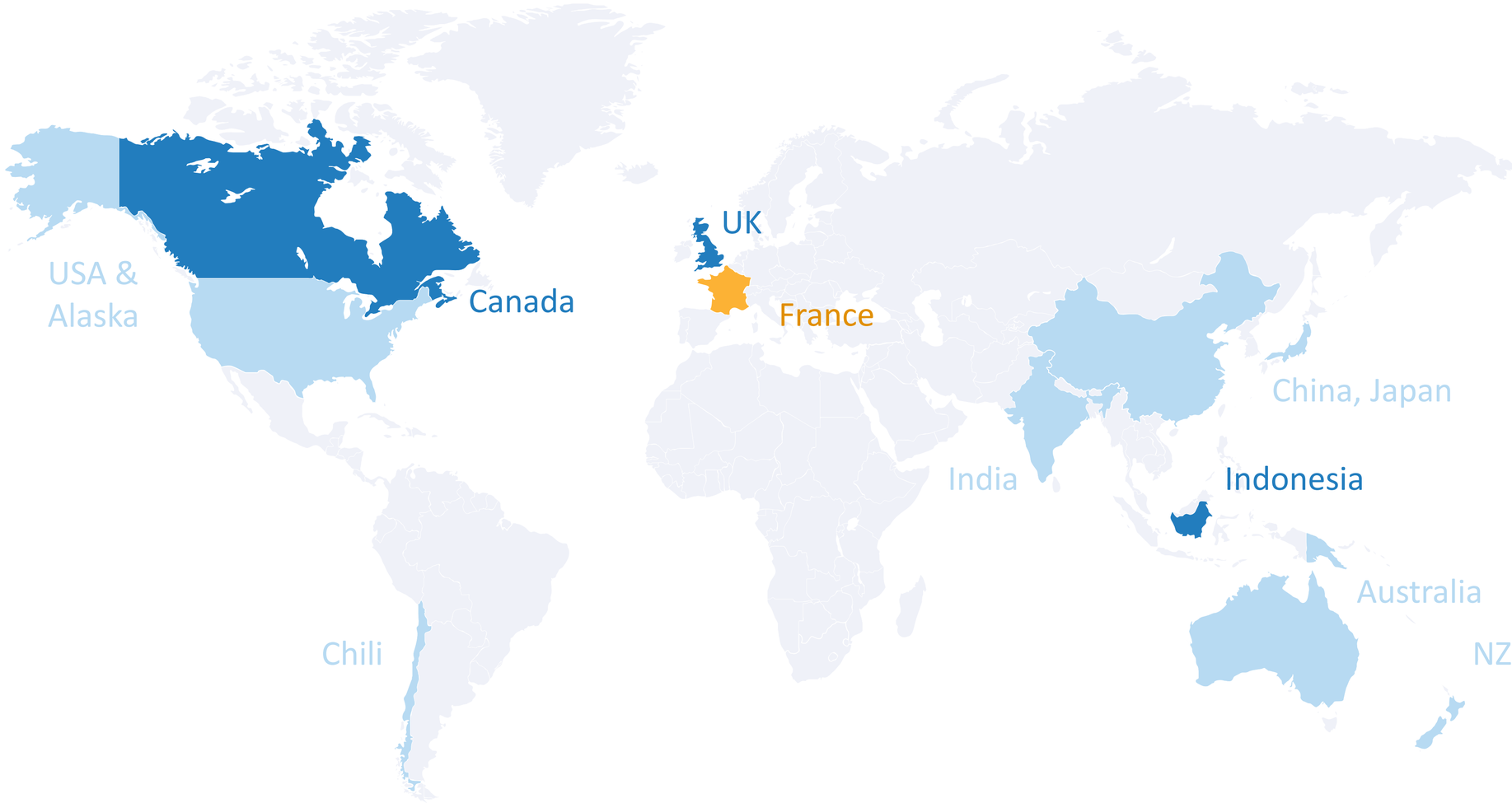
Step 1 – France
3 sites - 3.5GW (equ. 15bn€)

Step 2 – Replicating success with Canada, UK, Indonesia
Once first French site signed.

Opening 12GW (equ. 50bn€)

Step 3 – Diffusing technology
Smaller sites, 20GW (equ. 100bn€)

Step 4 - Rest of the world
60+ GW



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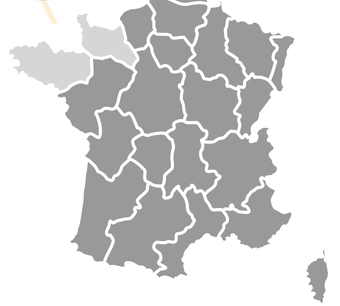
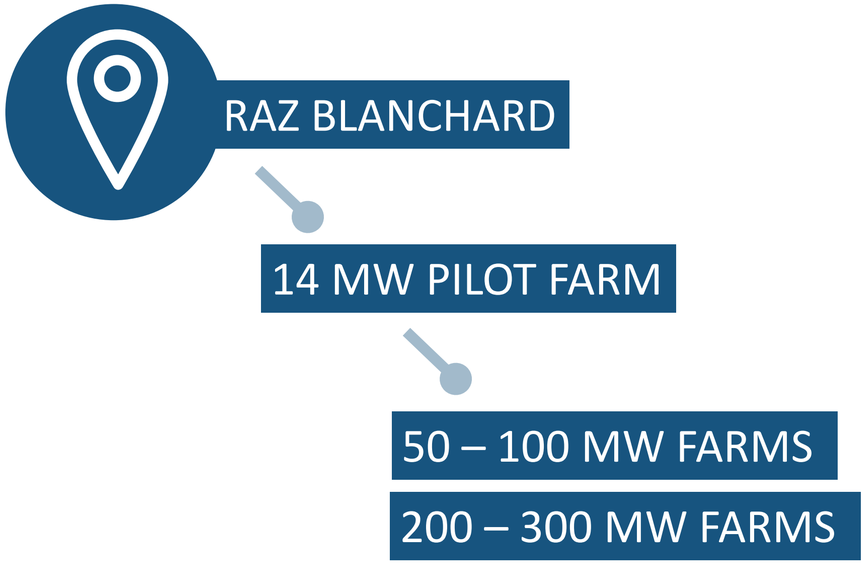
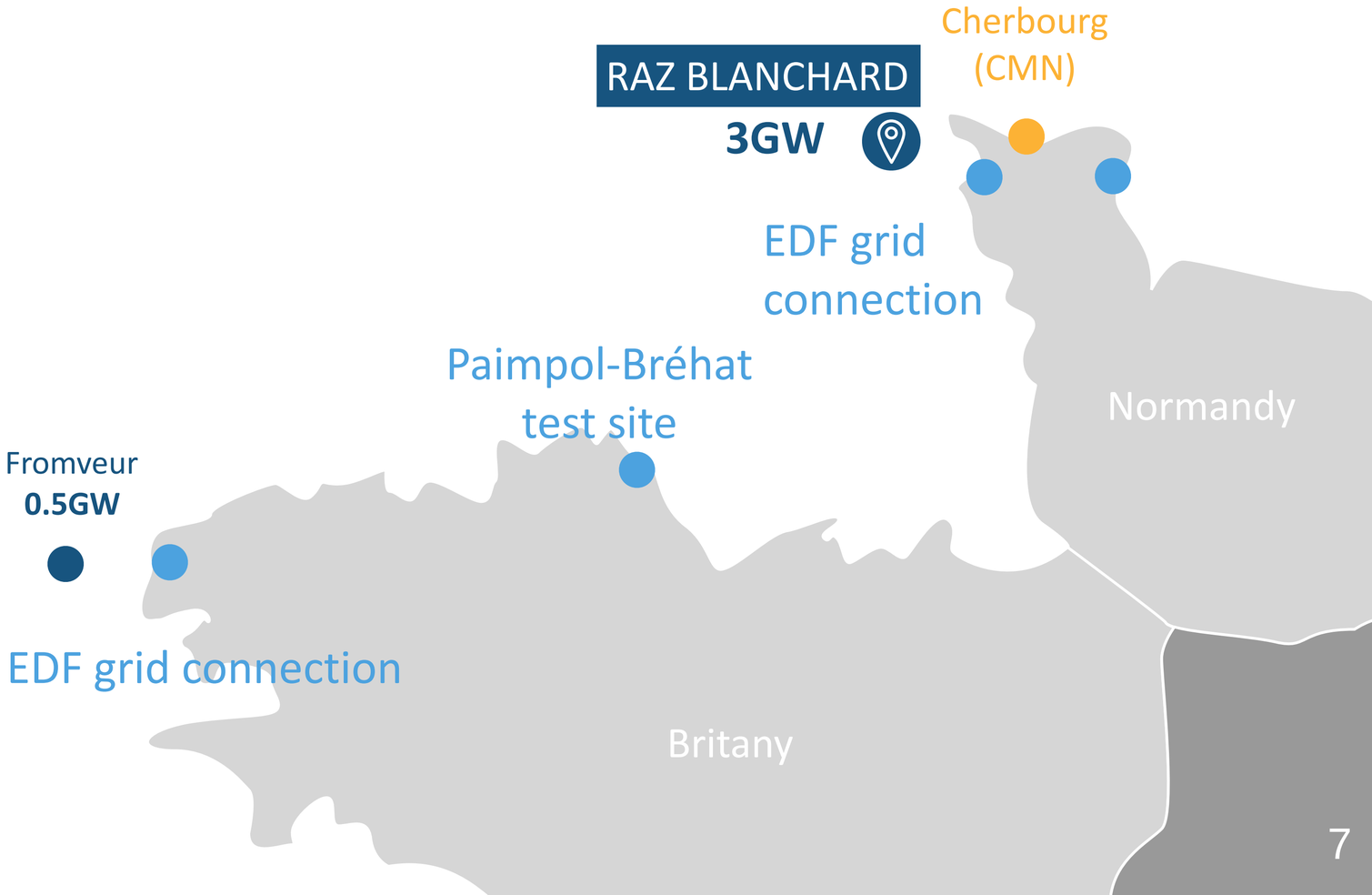


TIDAL POWER – STEP 1 – FRANCE

THE *FRENCH CONNECTION*

- 2 sites = equivalent to 2 nuclear plants
  Generating power night & day
- Easy connection to the grid
  Reduced deployment costs
- Local high tier industry partner
  With proven track record & easy access to sites





SUPPLY CHAIN

The CMN partnership

- CMN: French leading shipbuilder (civil & military)
- Decades of industrial manufacturing expertise
- Adequate production capabilities
- Located in Cherbourg – facing Raz Blanchard
- Industrial partnership, especially for Raz Blanchard deployment (30 km)

Local supply chain specific features

- To reduce costs, final assembly always to be performed as closed as possible to tidal sites
- Manufacture close to quay side, able to receive Offshore Construction Vessel
- Adequate production capabilities

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1MW prototype project

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1MW PROTOTYPE

PROJECT PRESENTATION

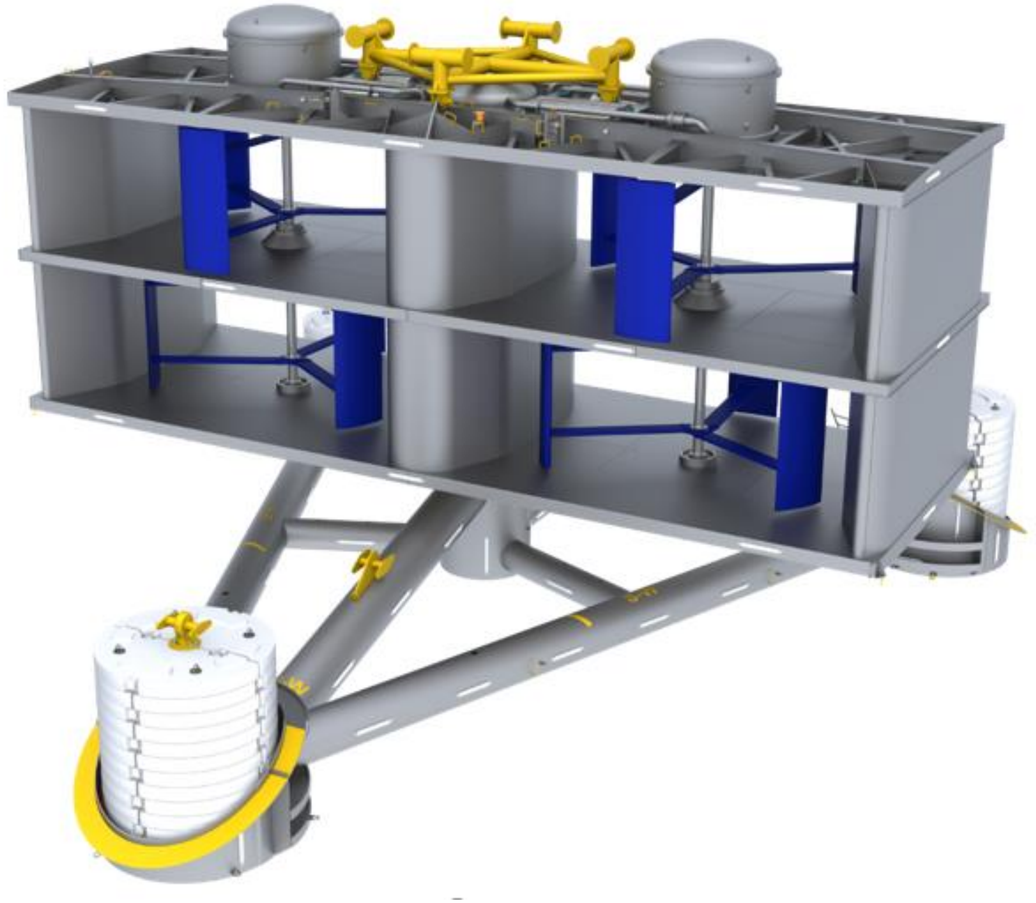
TIGER TIDAL STREAM INDUSTRY ENERGISER

Turbine description

1	**OceanQuest 1** turbines 4 rotors of 8 m diameter x 4 m high
1 MW	**Nominal output power / unit**
280 T	**Dry weight** Overall dimension of 21 m long x 16 m high
20 month	**Total fabrication duration** 6 month for final assembly in CMN workshop

Foundation description

250 T	**Foundation Dry weight** Overall dimension of 28 m x 24 m
1000 T	**Cast iron Ballast Dry weight**



PROJECT PRESENTATION

Installation

April 2019	**Foundation, ballast, turbine**
DP 400T	**Normand Vision** 4 days of operation

Operation

91%	**Availability rate**
IEC62600	**Power curve certified by Bureau Veritas**
2021	**Decomissioning and inspection**

LEARNINGS

Design

- High environmental loads for angle of incidence >20°
- Ducted structure and horizontal plates induce high wave loads
- Weight of horizontal plates regarding to total turbine weight

→

- Suppression of lateral ducts
- Improvement of the performance by engineering the rotor

Manufacture

- Optimize weigh and welding length
- Parallelize manufacturing process to optimize cost and schedule

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New generation : OceanQuest 2.5

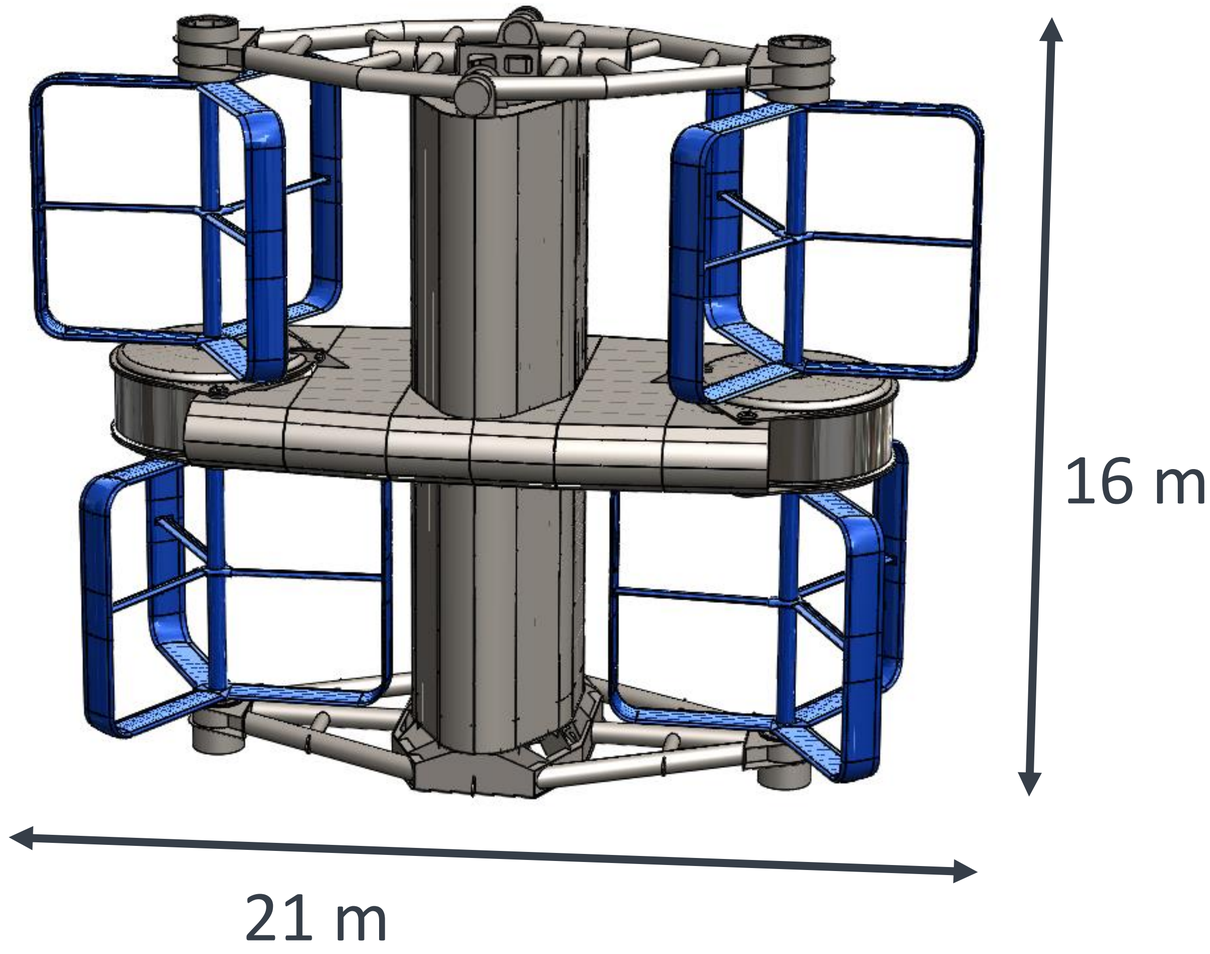
STRUCTURE

Turbine description

1	**OceanQuest 2.5** turbine 4 rotors of 8 m diameter x 6 m high
2,5 MW	**Nominal output power / unit** At rated speed of 3,7 m/s
200 T	**Dry weight** Overall dimension of 21 m long x 16 m high
15 month	**Total fabrication duration** 3 month for final assembly

Foundation description

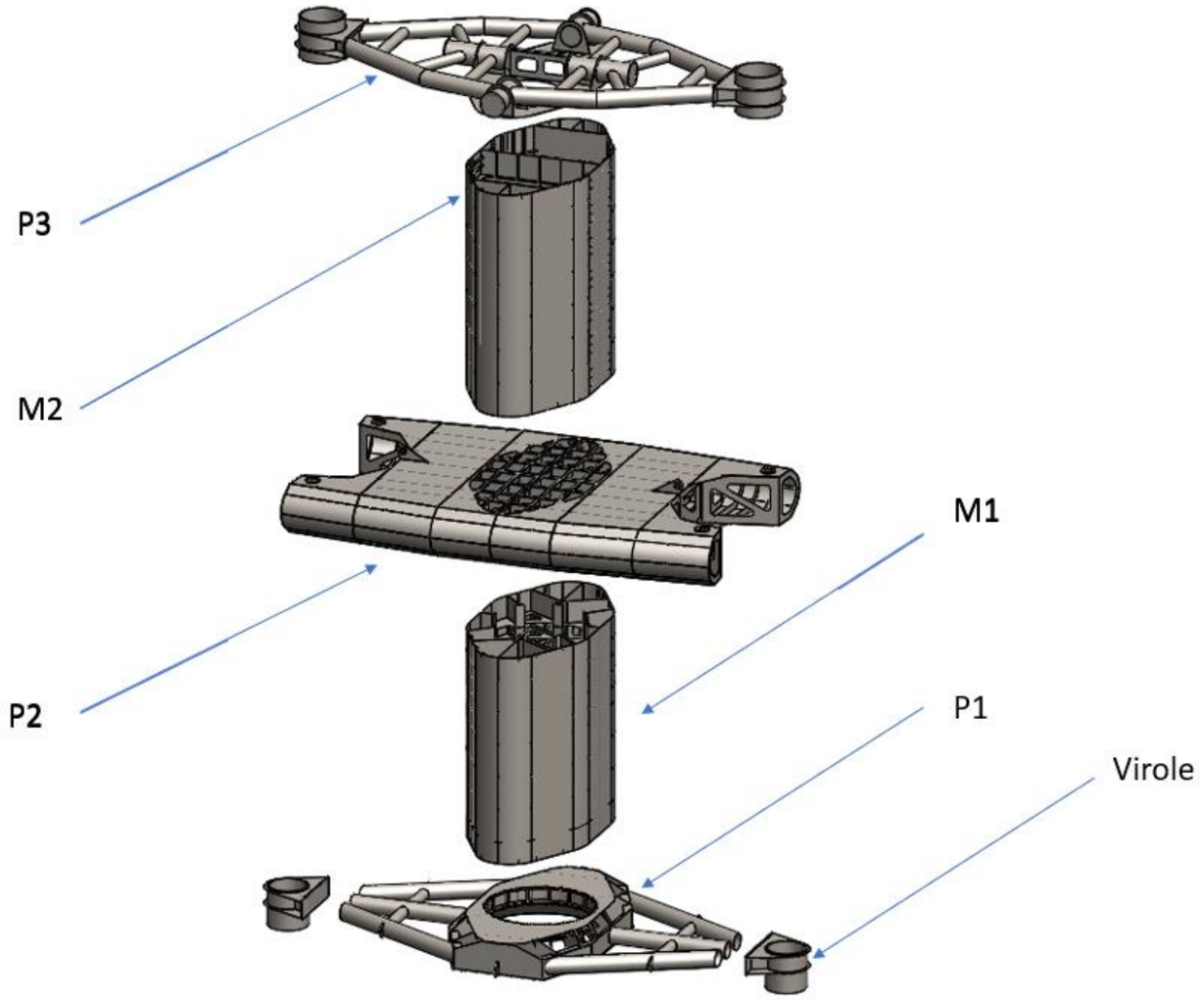
250 T	**Foundation Dry weight** Overall dimension of 28 m x 24 m
1800 to 2400 T	**Cast iron Ballast Dry weight** Depending on site characteristics



STRUCTURE

- **Sub-elements of the structure in S355**

P3	**13 T** Overall dimension of 1000 x 15 000 x 7800
M2	**13 T** Overall dimension of : 6800 x 3700 x 7000
P2	**23 T** Overall dimension of 3200 x 13000 x 8300
M1	**15 T** Overall dimension of 6400 x 3700 700
P1	**13 T** Overall dimension of 1000 x 11600 x 7500



Water tighten elements

Design

- Water tighten elements
- Design pressure : 5 to 7 bars
- Overall dimensions : 5,7 m high x 2,5 m diameter
- Weight : 5 Tons
- Quantity : 2 x turbine

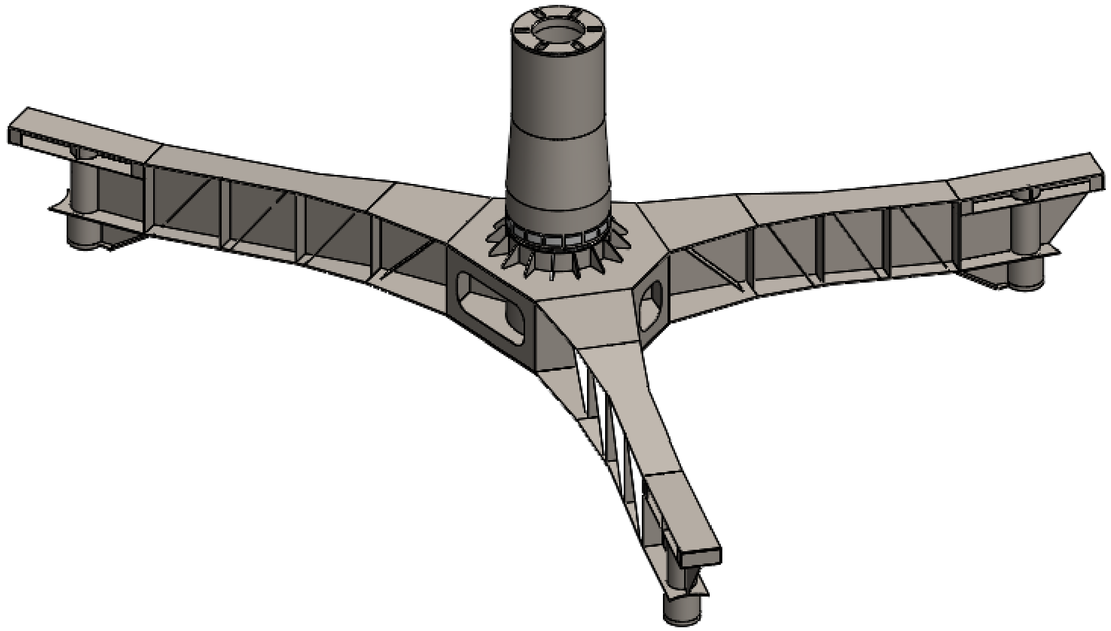
FOUNDATION

Design

- Carbon steel S355
- Overall dimensions : 31 m x 27 m
- Total weight : 250 Tons

Final assembly

- Assembly located at quay side
- As close as possible to site installation



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ROAD MAP

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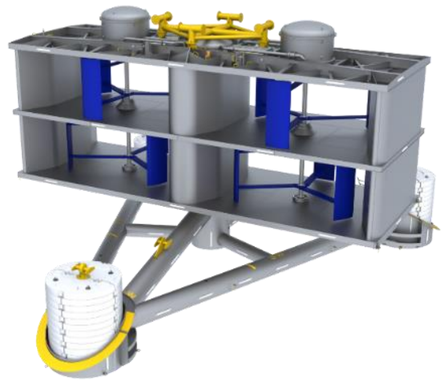

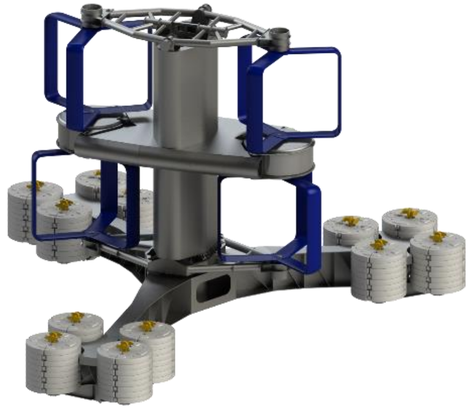

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Numbers of turbines made / year		1	5	4	0	10	15	15	30	30
Projects		Raz Blanchard pilot project		Project on dev.		Commercial deployment				
Cumulative power (MW)	0	2.5	15	20	20	57	107	170	232	295

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CONCLUSION

CONCLUSION

INDUSTRIAL OPPORTUNITIES IN FRANCE

- Manufacture of sub-elements
- Manufacture of water tighten structures
- Manufacture and assembly of foundations

INDUSTRIAL OPPORTUNITIES IN OTHER TIDAL SITES

- Manufacture of sub-elements
- Manufacture of water tighten structures
- Manufacture and assembly of foundations
- Assembly of the turbine

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THANKS FOR YOUR ATTENTION

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