

PANELS 3

Innovations in Floating Technology

“Substation Challenges”



Arnaud SALOU
Head of Technical Offshore Department



150 years of shipbuilding

We are a company of maritime construction and services :

- Investing for the future
- Stating out as a major player in the fields of energy transition
- Supporting improvement through an active R&D policy



250 acres

3,100 employees

8,000 persons on site



1,400 t of hoisting capacities

Steel transformation: 65,000 tons/year

ATLANTIQUE
OFFSHORE ENERGY

Our expertise : Design to Build

References

Best-in-class projects



Marine Renewable Energy

Project	Client	Location	EMR product	Substructure Type	Conceptual D.	FEED	Detailed D.
			WT: Wind Turbine OSS: Offshore Electrical Substation				
Iles d'Yeu & Noirmoutier Wind Farm - 496MW	Les Eoliennes En Mer de Vendée	FR.	WT - 8MW Siemens / previously 8MW ADWEN	Jacket	✓		
Dieppe & Le Tréport Wind Farm - 496MW	Les Eoliennes En Mer de Vendée	FR.	WT - 8MW Siemens / previously 8MW ADWEN	Jacket	✓		
Saint-Brieuc Bay Wind Farm - 496MW	Ailes Marines	FR.	WT - 8MW Siemens / previously 5MW ADWEN	Jacket	✓		
Saint-Nazaire Wind Farm - 480MW	Eolien Maritime France - EDF EN	FR.	OSS	Jacket	✓		
Fecamp Wind Farm - 498MW	Eolien Maritime France - EDF EN	FR.	OSS	Jacket	✓		
Calvados Project Wind Farm - 450MW	Eolien Maritime France - EDF EN	FR.	OSS	Jacket	✓		
Iles d'Yeu - Noirmoutier & Dieppe - Le Tréport Wind Farms	Les Eoliennes En Mer de Vendée	FR.	Meteorological Mast	Jacket	✓		
Saint-Nazaire, Fecamp & Calvados Project Wind Farms	Eolien Maritime France - EDF EN	FR.	Meteorological Mast	Jack-up concept	✓		
SEM-REV - Offshore Test Site	SeaRen partners: ADWEN, VALOREM, ECN, STX	FR.	WT - 8MW ADWEN	Jacket		✓	
Norther Wind Farm - 370MW - ELIA Beta Platform	Jan de Nul - CG	B.	OSS	Jacket		✓	
Norther Wind Farm - 370MW	Norther N.V.	B.	OSS	Jacket & Monopile	✓		
RENTEL Wind Fram - 309MW	RENTEL N.V.	B.	OSS	Monopile			✓
RAMPION Wind Farm - 400MW	Babcock International Group	UK.	OSS	Jacket	✓		
Galloper Wind Farm - 353MW	Galloper - Innogy	UK.	OSS	Monopile	✓		
HoheSee Wind Farm - 497MW	EnBW Energie Baden Württemberg	G.	OSS	Jacket		✓	
Deutsche Bucht Wind Farm - 252MW	Van Oord	G.	OSS	Jacket	✓		
MERKUR - MEG1 Wind Farm - 396MW	DEME - GeoSea	G.	OSS	Jacket	✓		
ARKONA Wind Farm - 385MW	E.ON	G.	OSS	Jacket			✓
Borssele Wind Farm - 750MW - Alpha & Beta Platform	Tennet TSO	N.	OSS	Jacket	✓		
East Anglia One Wind Farm - 714MW	Scottish Power R. - Iberdrola R.E.	UK	OSS	Jacket	✓		
Wind Farm - 500MW	Confidential	TW	OSS	Floating		✓	
KAZKAZIE Wind Farm - 272MW	RWE (Innogy)	G.	OSS	Monopile	✓		
OPTIFLOT Project	Ideol	World	OSS	Floating		✓	
NorthWester II Wind Farm - 224MW	Parkwind	B.	OSS	Monopile	✓		
Wind Farm - 800 MW	Confidential	USA	OSS	Monopile		✓	

Westermost Rough electrical substation - Dong Energy

Main features

- Power: **210 MW**
- Jacket weight: **1 200 t**
- Jacket dimensions: **40 x 25 x 25 m**
- Topside weight: **1,500 t**
- Topside dimensions: **15 x 15 x 25 m**

Main steps

- Order: **December 2012**
- Delivery: **May 2014**

Scope of work

- Structure: Workshop design
- Outfitting: Basic and detailed design
- Fabrication of jacket, topside and piles
- Commissioning (onshore & offshore)
- Barge mobilization
- Load-out



Arkona Electrical Substation - E.ON

Main features

- Power: **385 MW**
- Type : **4 legged pre-piled**
- Jacket weight: **1,100 t**
- Jacket dimensions: **50 x 20 x 20 m**
- Topside weight: **4,100 t**
- Topside dimensions: **35 x 50 x 15 m**

Main steps

- Order: **June 2015**
- Delivery: **September 2018**

Scope of work

- Structural and electric engineering
- Jacket, topside and pile fabrication
- Commissioning (onshore & offshore)
- Transport and installation
- Maintenance (1+4 years)



Rentel Electrical Substation - Otary

Main features

- Power: **309 MW**
- Monopile + TP weight: **1,700 t**
- Monopile dimensions: **80 x Ø 7/8 m**
- Topside weight: **1,100 t**
- Topside dimensions: **32 x 17 x 20 m**

Main steps

- Order: **March 2016**
- Delivery: **May 2018**

Scope of work

- Design and engineering
- Sourcing
- Fabrication
- Commissioning (onshore & offshore)
- Transport & installation

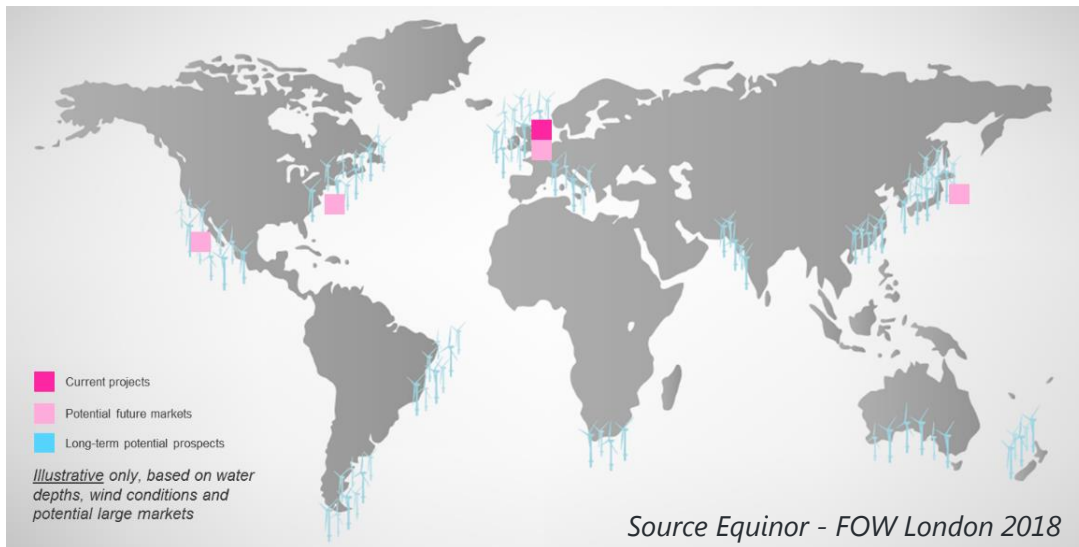
The market

Floating Offshore Wind



The Market

- Significant potential for floating offshore wind in deep waters (50-200m)



80%

Share of offshore wind
resources in water depth
>60 m

7,000 GW

Potential floating wind
capacity (Europe, Usa,
Japan)

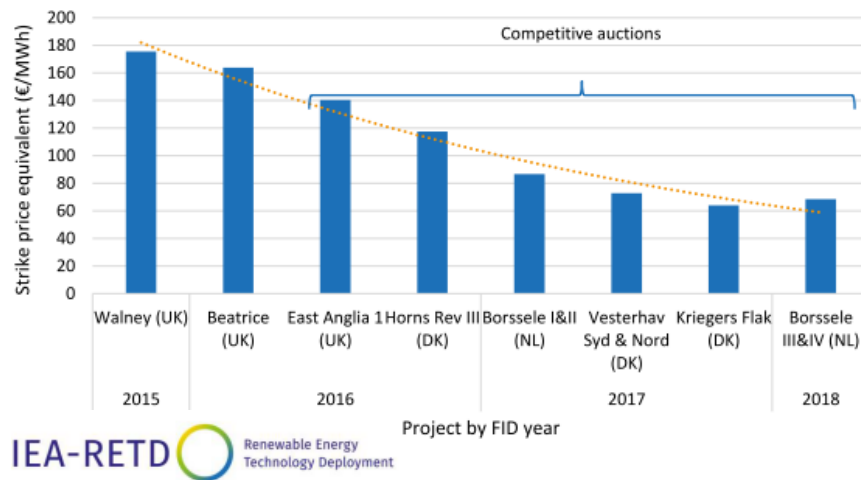
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OFFSHORE ENERGY



What market asks ?

LCOE reduction ...

Figure 12. Strike price equivalents in European offshore wind projects³⁶



... reliability, availability ...
and delivery lead-time optimization

The way is ...

To have a modular approach ...



...and repeating what is relevant

Two obvious observations

For all substations ...

Receive electrical energy from Wind Turbines
Generators

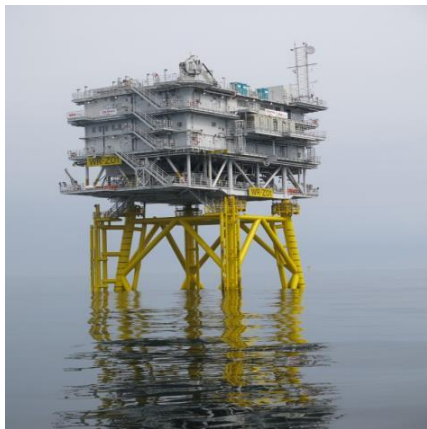
Transform Medium Voltage (33kV or 66kV) into
High Voltage (155kV or 220kV)

Export electrical energy to the grid

...the same function

Two obvious observations

With different designs ...



**Westermest Rough –
UK 2014**



**Rentel – Belgium
2018**



**Arkona – Germany
2018**

...that limit optimisation



SeeOs

Scalable Efficient Evolutive Offshore Station



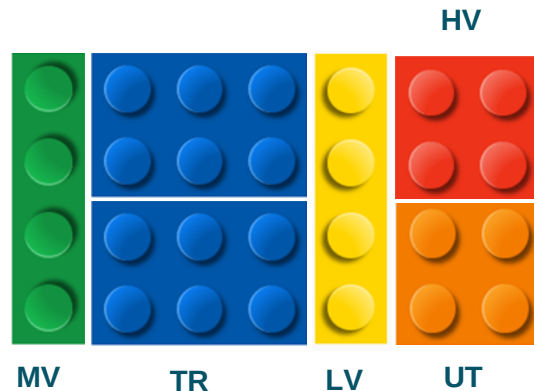
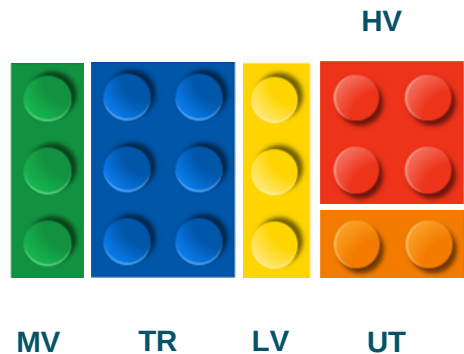
Two basic modules

- One single module with one transformer

SeeOs1

- One larger module for two transformers

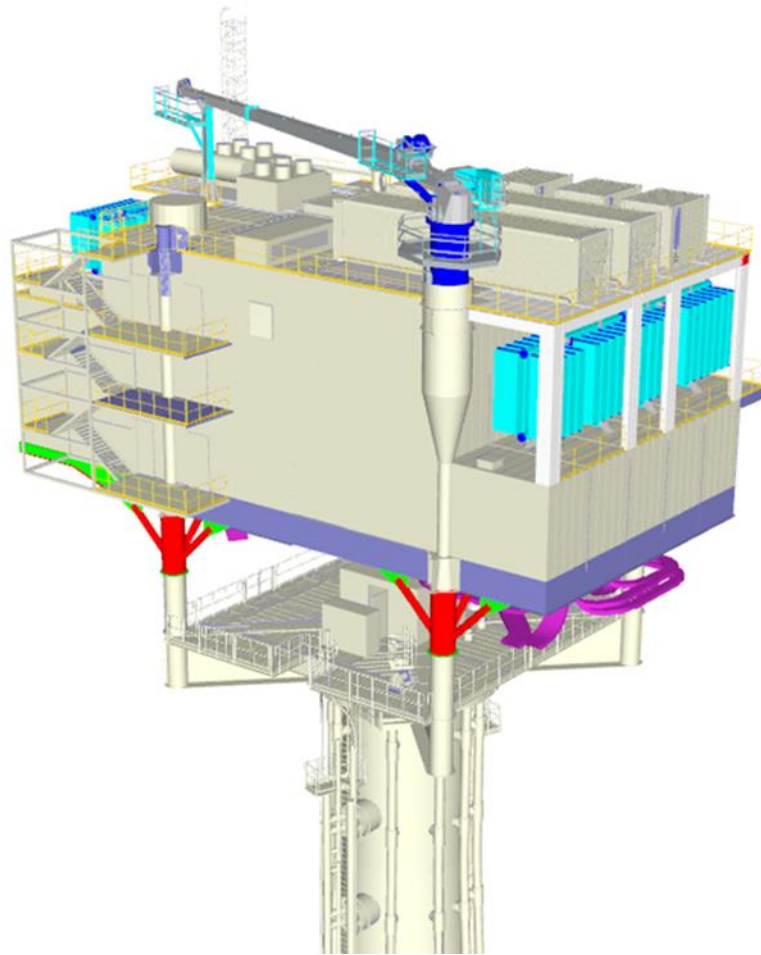
SeeOs1XL :



- Primary Structure pre-certified according to offshore standards
- To address all requirements (over 30 “options”) with a common philosophy



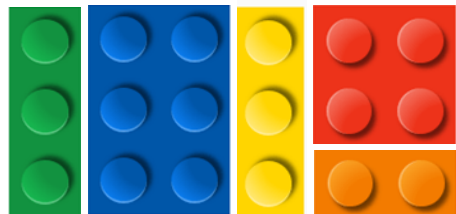
SeeOs1 Overview



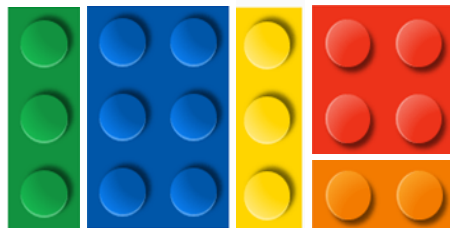
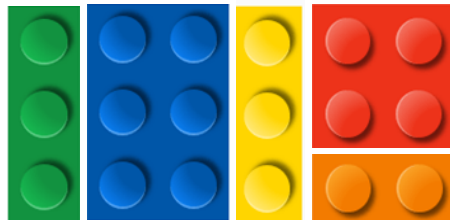
Scability to any power requirement

By adding modules

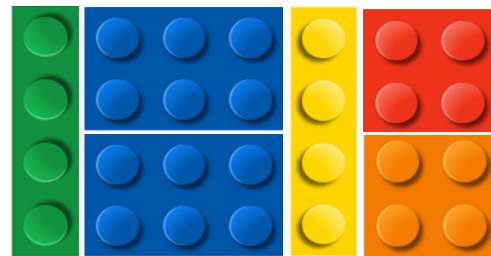
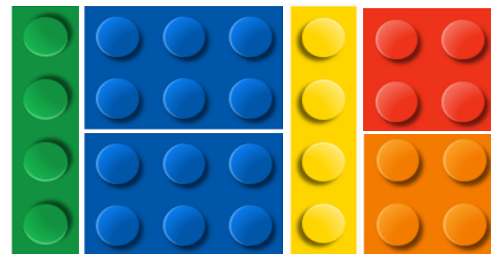
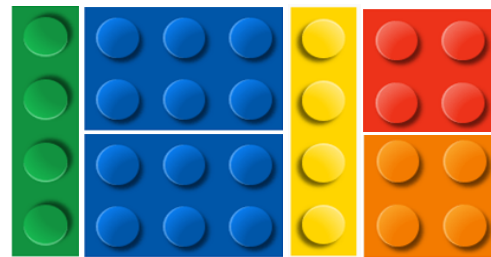
100
MW



SeeOs1



SeeOs2



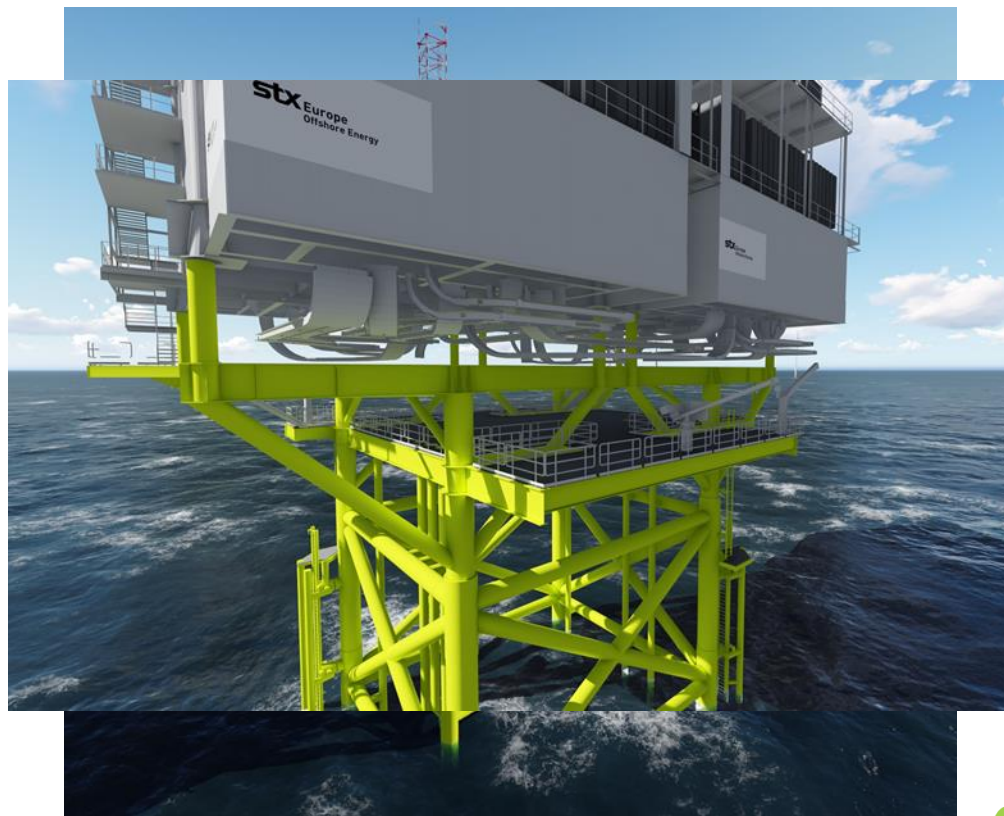
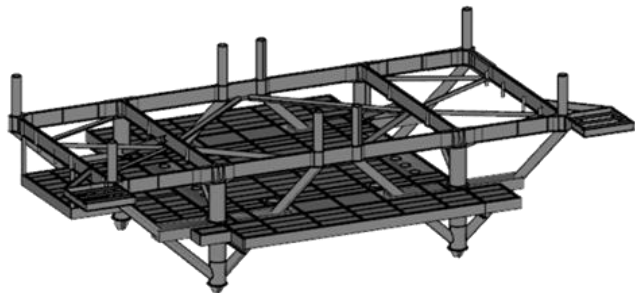
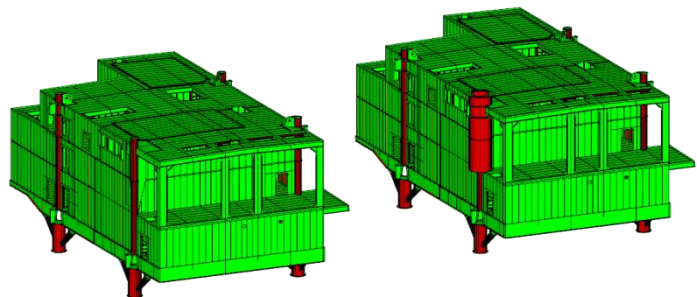
> 1 GW

SeeOs3 XL

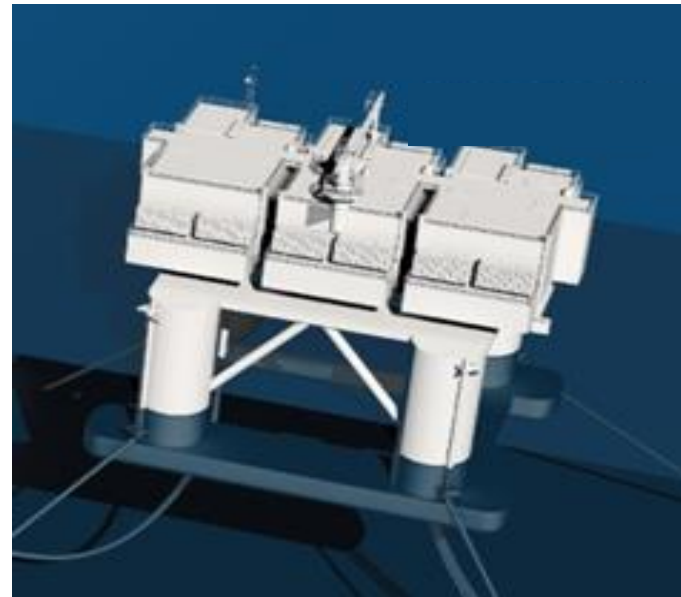


To obtain SeeOs2, you need

2 modules SeeOs1 and a Support Base Frame



Flexibility - Substructures



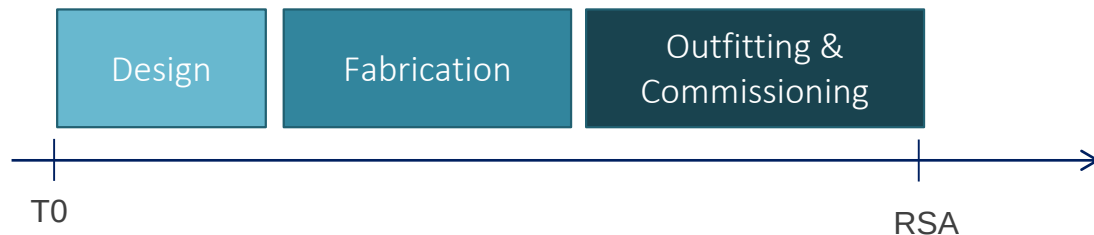
adapted to any type of substructures

Time reduction

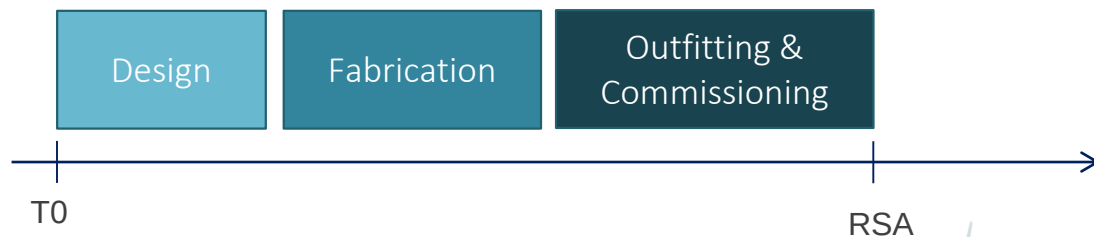
→ Standard Time Frame



→ Approved SeeOs design and Re-use



→ Robust Process/Methods & experience





VINEYARD WIND – FEED - CIP



Main features

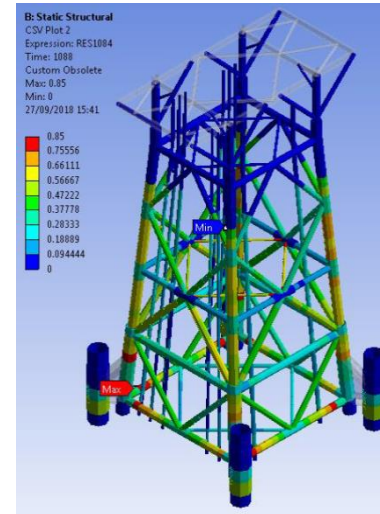
- Power: **700 MW**
- Type : **SeeOs2 on 4 legged post-piled substructure**
- Jacket weight: **1,700 t + Support Base Frame : 300 t**
- Jacket dimensions: **60 x 27 x 28 m**
- J-Tubes : 12 array + 2 export
- Topside weight: **4,300 t**
- Topside dimensions: **33 x 15 x 15 m**

Main steps

- Order: **June 2018**
- Delivery: **September 2018**

Scope of work

- Design & engineering
- Jacket, topside and piles



Concerning the floating substructure

FLOATING SUBSTRUCTURE SHOULD NOT INCREASE SUBSTATION CAPEX



5 to 10 % Wind Farm CAPEX

FULL ONSHORE ASSEMBLY

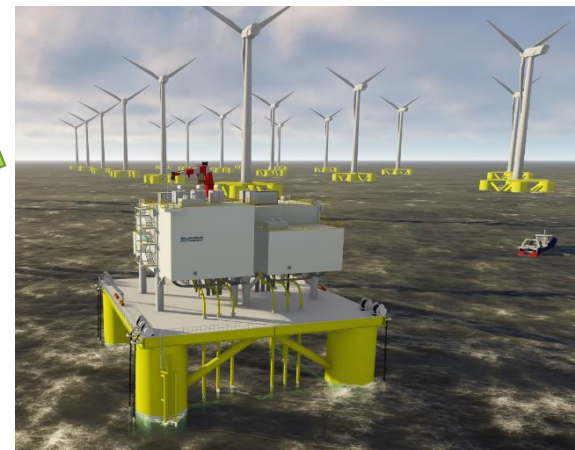
USUAL MANUFACTURING

**LIMITED GEOTECHNICAL HAZARD
SENSITIVE**

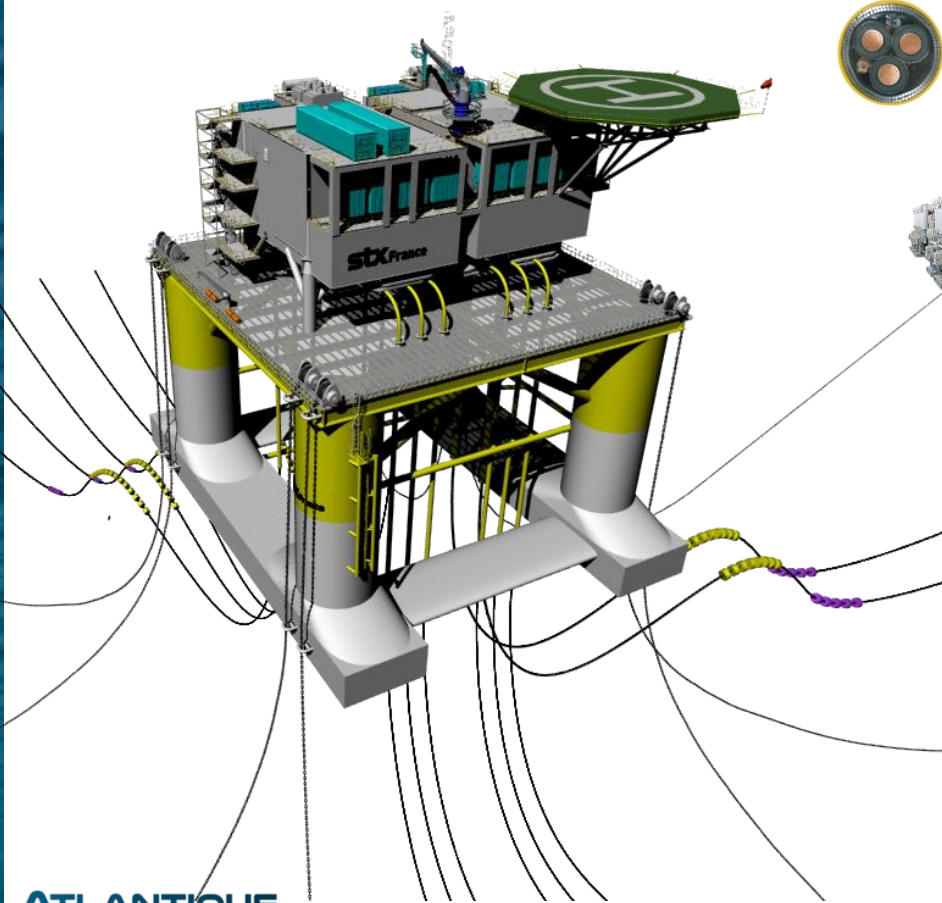
**LIMITED DEEP WATER
IMPACTS**



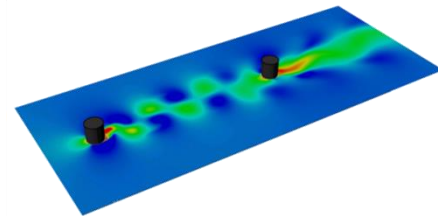
**FLOATING WINDFARM
SUBSTATION CAPEX**



Floating Substation Challenges



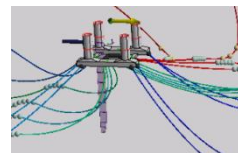
HV DYNAMIC
CABLES



EQUIPMENT OPERABILITY



STANDARD
SHORTCOMINGS



MOORING LINES

CONCLUSIONS

FLOATING SUBSTATION DEVELOPMENT DRIVEN BY GLOBAL OUTLOOK:
MANUFACTURABLE, INSTALLABLE, RELIABLE & THOUGHT FOR MAINTENANCE



CURRENT TOPSIDES READY FOR FLOATING



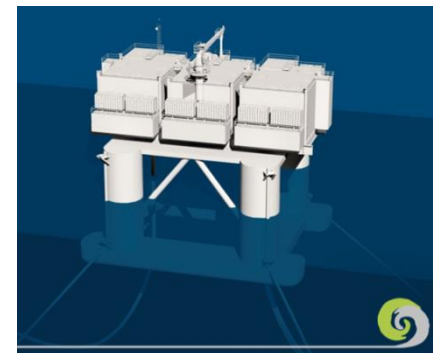
IDENTIFY SITE SPECIFICITIES AND MOST SUITABLE SUBSTRUCTURE
(sizes, weight, mooring, motions, ... multi-criterias optimisation)



RISK BASED DESIGN TO DRIVE AN HV DYNAMIC COMPLIANT FLOATING
SUBSTATION



INNOVATION & ADDED VALUE FOR OUR FINAL CUSTOMERS : MAINTENANCE, DIGITAL DATAS, AI,...



HOW TO CONTACT US ?



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HOW TO GO FARTHER TOGETHER ?

- ☐ we want to bring our experience to develop the American offshore wind market
- ☐ we would be happy to cooperate on common Research & Development topics
- ☐ we welcome curious and motivated students/trainees
- ☐ we recruit in a wide range of activities (shipbuildings, marine energy, ...)

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Thank you ! Merci !

