

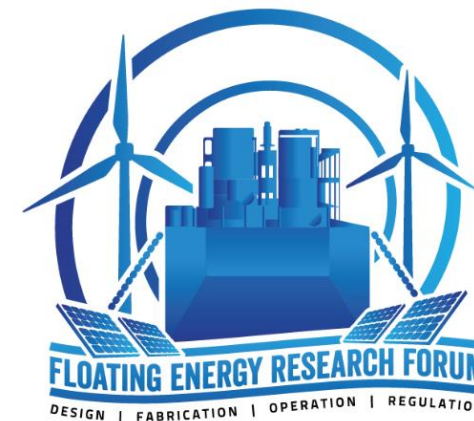


MOTIVATIONS TO USE COMPOSITES FOR FLOATING OFFSHORE UNITS

STEPHANE PABOEUF

JUNE 5TH

2024



SUMMARY

01

INTRODUCTION

02

FIBREGY

03

JIP
STRENGTHBOND
OFFSHORE

04

CONCLUSION

The background of the slide is a close-up photograph of a woven basket, likely made of bamboo or rattan, showing a complex diagonal twill weave pattern in shades of brown and tan. A white rectangular label is centered on the image, containing the title and number. A small red vertical line is positioned above the number '01'.

01

INTRODUCTION

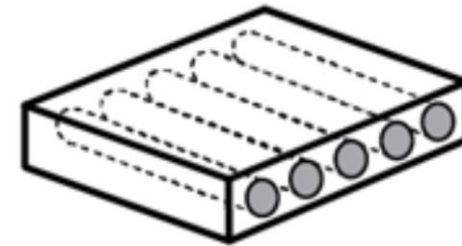
WHAT IS IT?



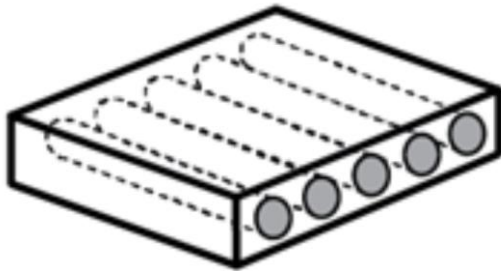
Resin



Fibres



Lamina

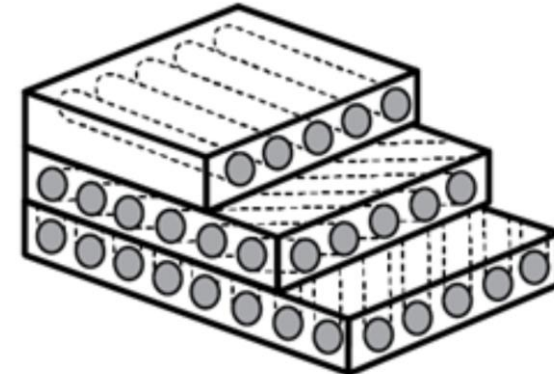


Lamina



n

n layers



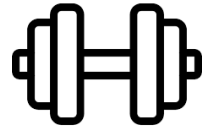
Laminate

WHY? BECAUSE



LIGHT

- | 70% lighter than steel and 40% lighter than aluminium



STRONG

- | Composites are much stronger than most other building materials (*when you consider the density of the material*)



RESISTANT

- | Composites do not rust or corrode



FLEXIBLE



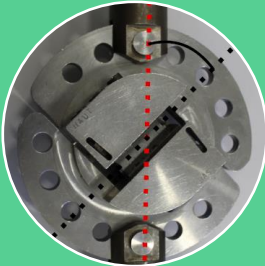





























- | Inherent design flexibility of composites allows complex shape to be produced



DURABLE

- | Composites hold up well against fatigue

RESEARCH PROJECTS

Large vessels	Appendages	Adhesives	Processes	Propellers	Marine Renewable Energy	Sustainability
						
  	 	    	    	    	   	

- Vessel less than 90m

NR600



- Rudder in Composite Materials

NI590



- Bonded Assemblies

NR613



- Bonded Repairs

NI689



- Hull in Composite Materials

NR546



- Propeller in Composite Materials

NI663



- Current & Tidal Turbines

NI603



- Composite Fatigue Guideline

NI Fatigue





02

FIBREGY

Key figures

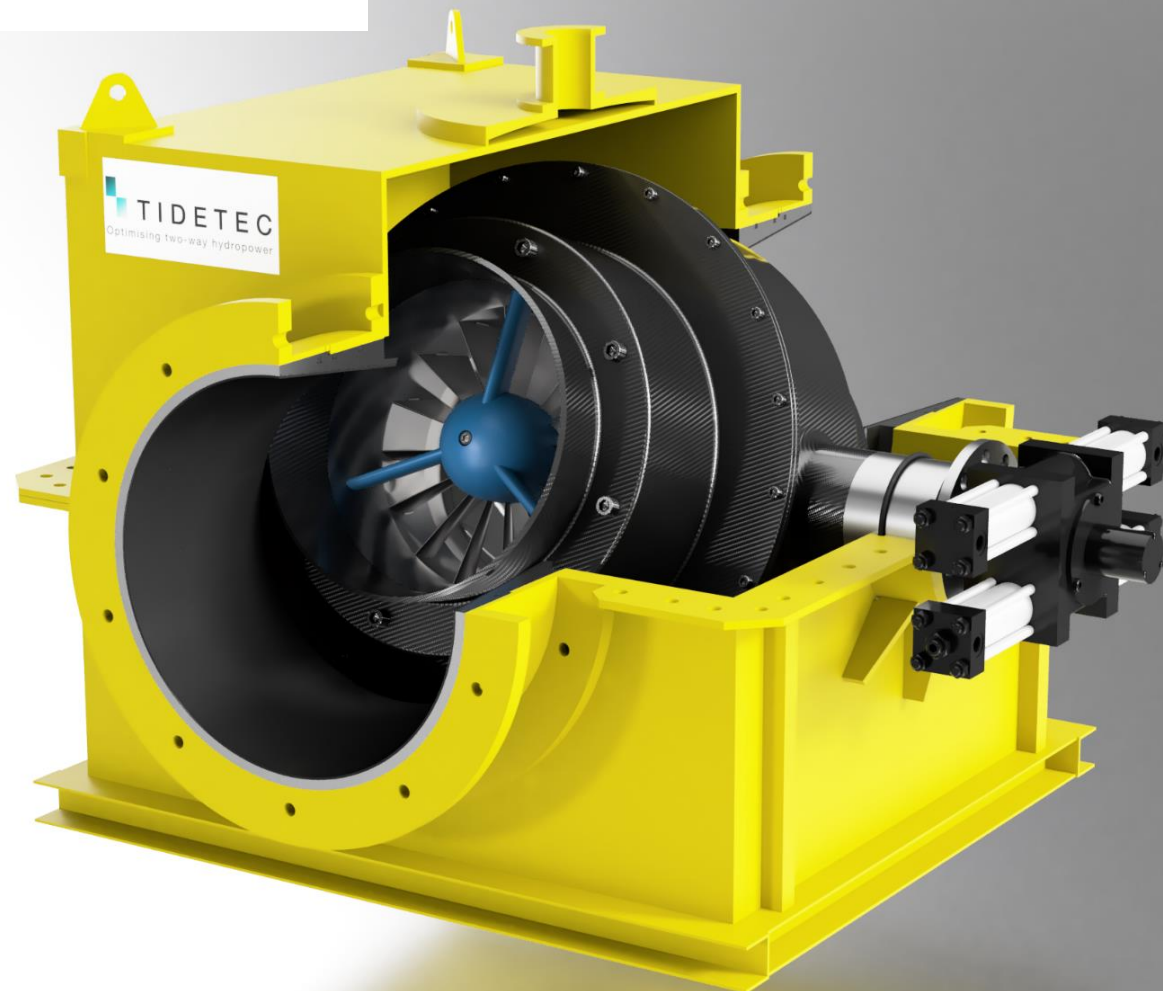
- | H2020-NMBP-ST-IND-2018-2020, LC-NMBP-31-2020, IA
- | 12 partners from 7 countries
- | 8 M€, funding 70%

Objectives

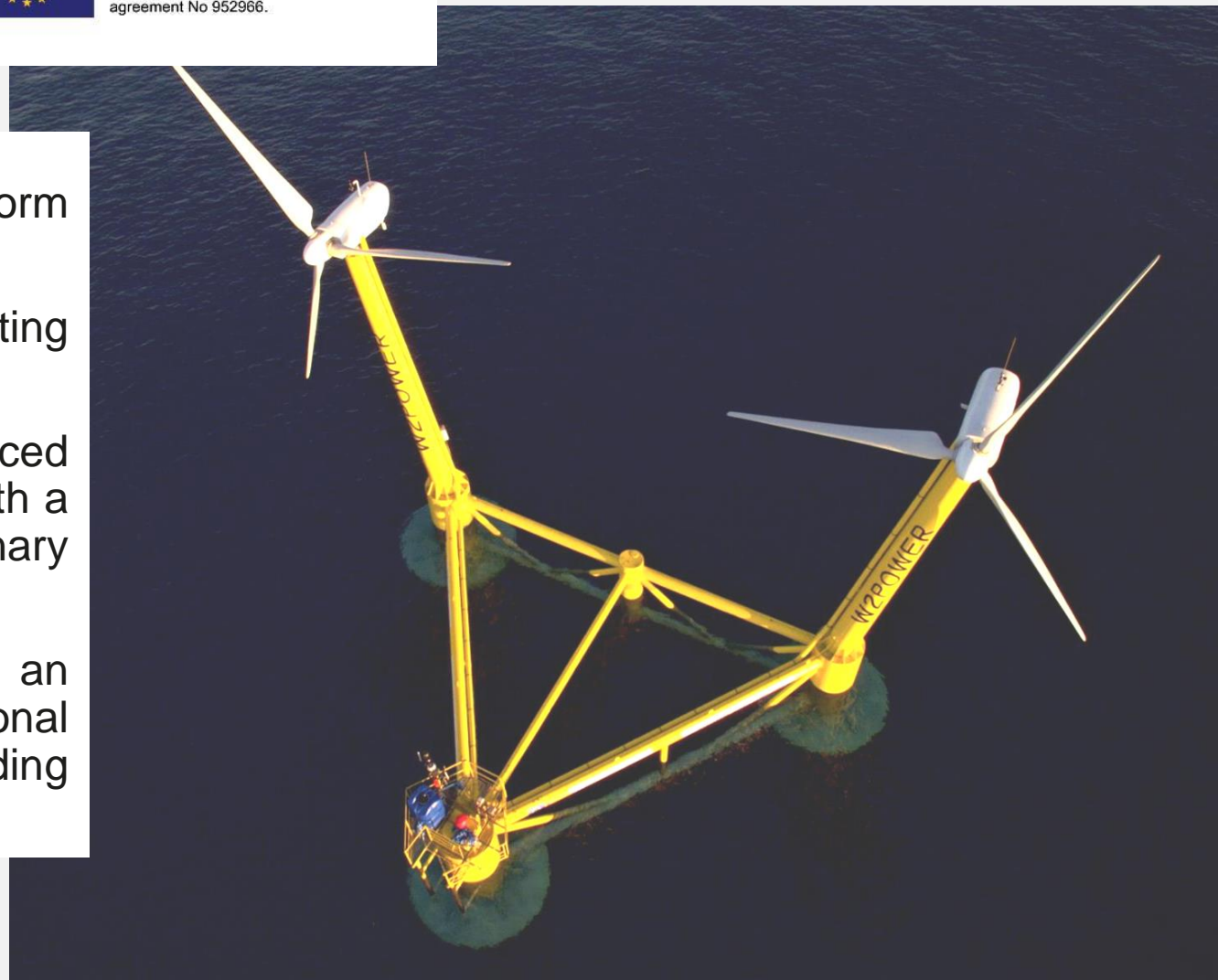
- | FIBREGY's main goal is to enable the extensive **use of FRP materials** in the structure of the **next generation of large offshore platforms**
- | **Motivations:**
 - | Reduce weight and maintenance costs
 - | Extend life
 - | Ease installation



- | **TIDETEC's** tidal power generator is likely to be the most cost-effective technology to harness tidal power.
- | The rotating turret is the core of the **TIDETEC's** concept, enabling optimal bi-directional functionality (compared to standard technology that only utilizes 60% of streams flowing back)
- | Furthermore, the cost of the complete 20 MW turbine will not be larger than the systems planned today.
- | **TIDETEC's** LCoE estimate for its current technology are within the range of 45-75 €/MWh.



- | **W2POWER** is a twin semi-submersible platform concept developed by **ENEROCEAN**.
- | It enables a rated of 12 MW on one simple floating platform.
- | **W2POWER** is currently one of the most advanced multi wind turbine designs, and the only one with a 1/6 prototype already deployed at the Canary Islands.
- | It is also one of the most promising, with an expected LCoE reduction versus conventional semisubmersible wind turbines of 20%, according to the conclusions of the DEMOWIND project.





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952966.



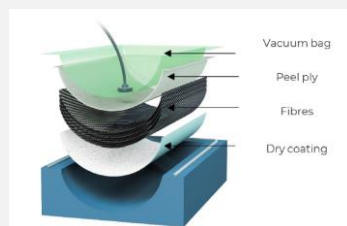
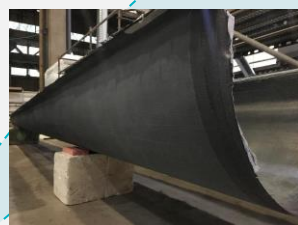


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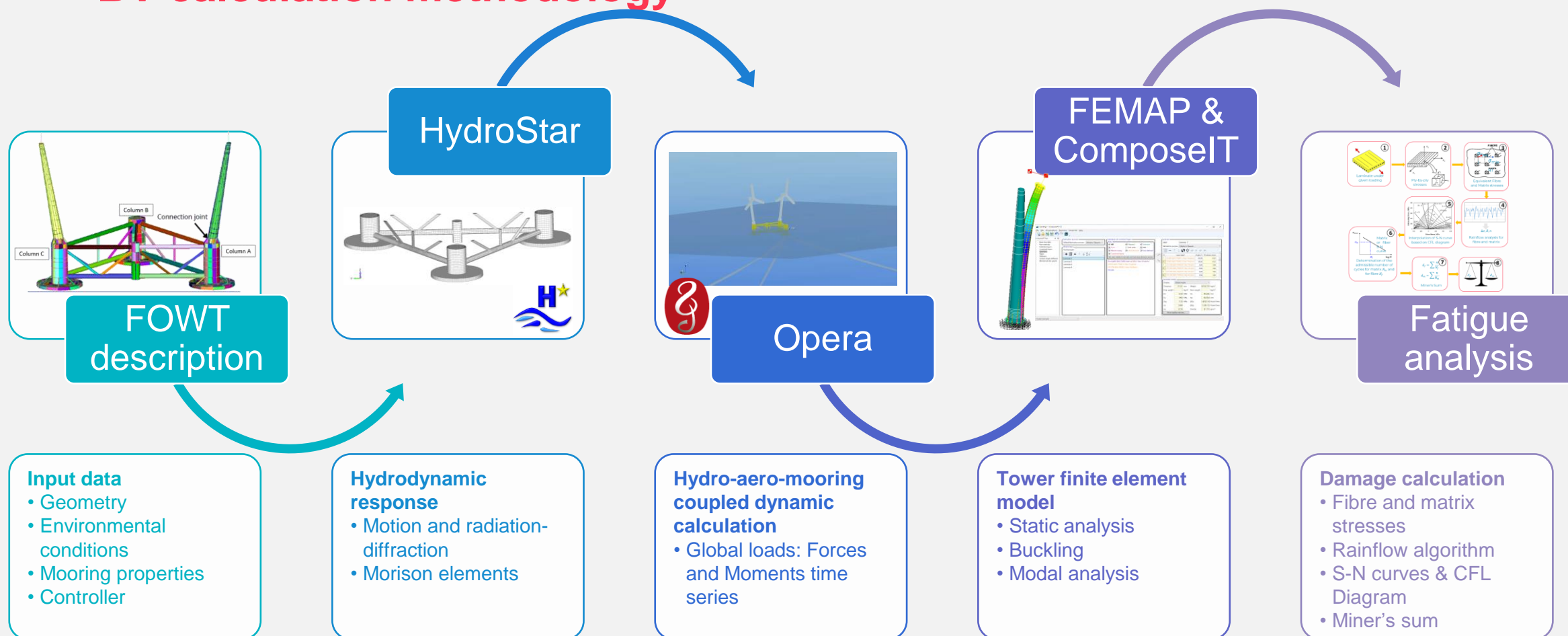


Tower manufacturing

- | 2 half hulls in carbon fibres
- | Epoxy resin
- | Infusion process
- | Bolted connections
 - | Hull
 - | Bottom to platform
 - | Top to turbine



BV calculation methodology



Conclusion

- | Investigation on the use of composite materials for Floating Offshore Wind and Tidal Turbines
- | Highlight motivations for using composites:
 - | Weight reduction
 - *Tower weight reduced by 65% compared to steel*
 - | Maintenance costs reduction
 - *Around -11% for composite structure*
 - | High fatigue resistance
- | Development of calculation methodologies
 - | Whatever materials used
- | Development of Guidance Notes



Conclusion

| Project guidelines covering:

- | Certification scheme
- | Materials
- | Design conditions and Load cases
- | Structural design requirements
- | Safety factors
- | Stability
- | Fire safety
- | Inspection, Life cycle considerations

| Public documents available on: SCIPEDIA

<https://fibregy.eu/>



Development, engineering, production and life cycle management of improved FIBRE-based material solutions for the structure and functional components of large offshore wind energy and tidal power platforms

D4.7 (WP4): Project guidelines and recommendations for using FRP in large OWTPs

[Responsible Partner](#): BV

[Contributor\(s\)](#):

03

JIP STRENGTHBOND OFFSHORE



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CONTEXT

Many offshore units aged worldwide

- | Corrosion is a common problem

- | Lifetime extension

Hot repair

- | Crop & renew

- | Large scaffolding work

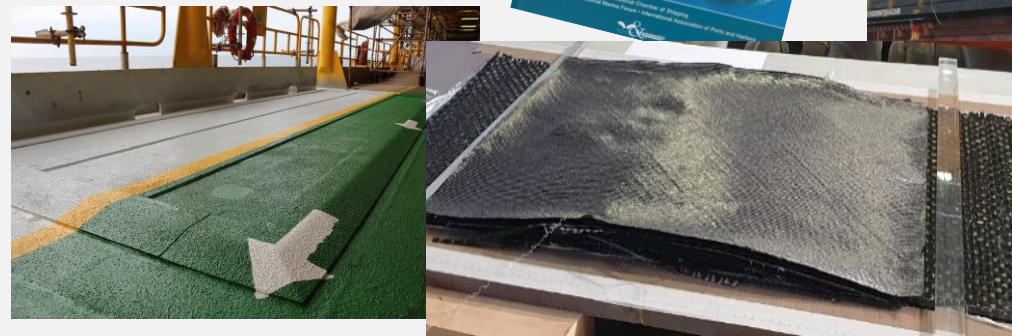
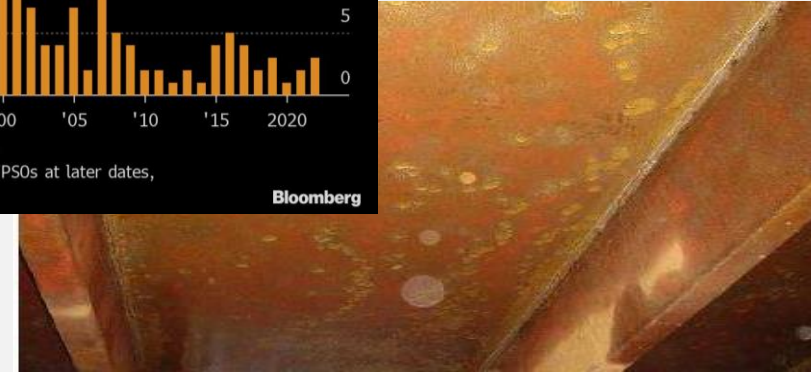
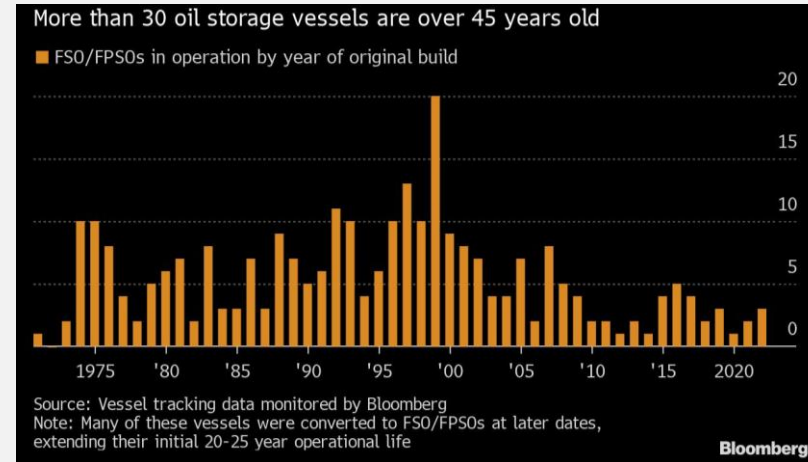
- | Heavy down time

Cold repair

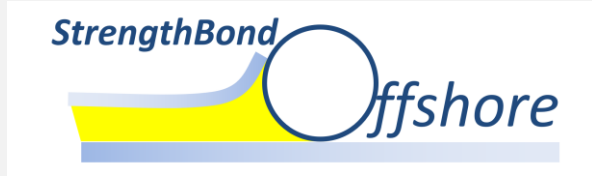
- | Non-intrusive solution

- | No stop production

- | Short down time



JIP STRENGTHBOND OFFSHORE



Joint Industry Project led by BV on Bonded Composite Patch Repair

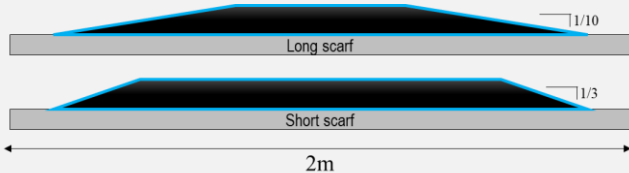
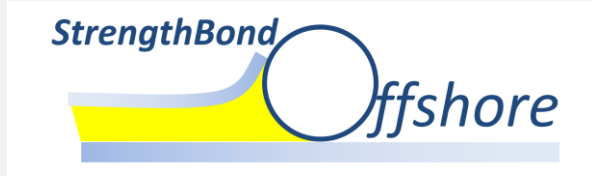
| Partners:



| Objective goals:

- | Produce **clear, practical and industrially applicable design guidance** for assessing bonded repairs
- | Develop a **robust methodology for strength analysis and fatigue prediction**
- | **Assess key numerical and design tools** and produce best-practice guidelines for using them to perform strength analysis
- | **Refine test set-ups and methodology for characterization of the key data to feed numerical design tools**
- | Develop **manufacturing protocols and quality checks** for bonded repair materials

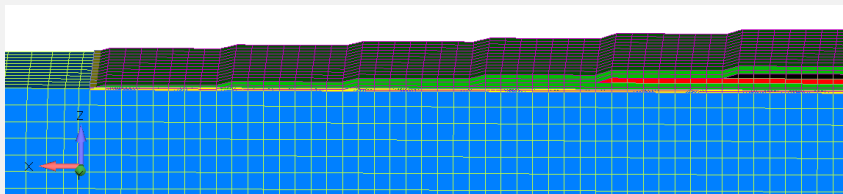
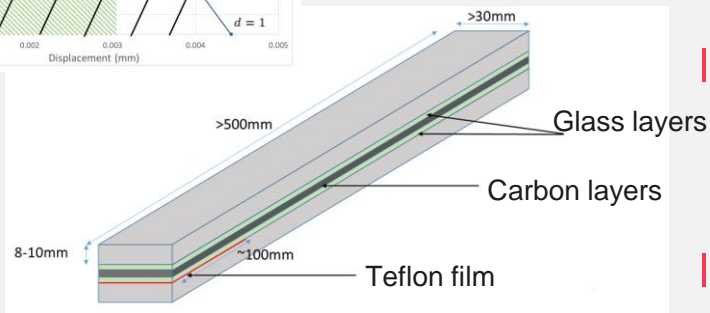
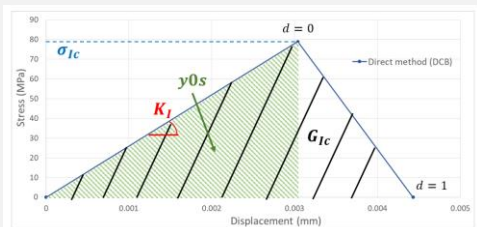
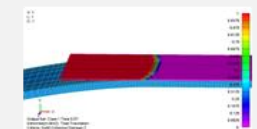
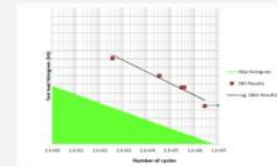
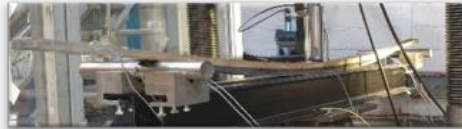
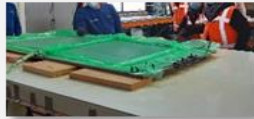
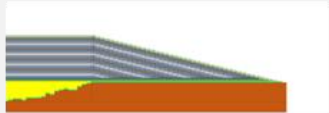
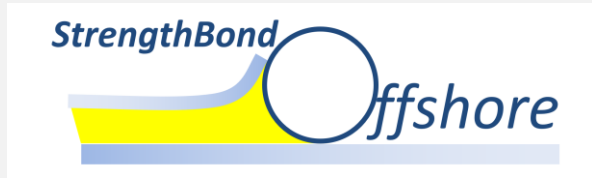
JIP STRENGTHBOND OFFSHORE




More than 250 specimens tested
≈150 Numerical simulations
30 Deliverables
14 Scientific publications
1 PhD thesis + 1 Post-Doc
➔1 Project guideline

Report No.	D6.1	BV No.	AT16169
Project:	Joint Industrial Project – Strength Bond Offshore		
Title:	D6.1 Bonding Repair Project Guideline		
Stéphane Pabouët (SPF) Quentin Sourisseau (GSU) Maxime Deydier (MDR)	Stéphane Pabouët (SPF) Olivier Dahot (ODT)	1	25/10/2022
Written by: (Name, Signature)	Verified by: (Name, Signature)	Revision	Date

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- | **New specimens** have been defined for the determination of **interface properties**.
- | Comparison of **experiments** and **numerical model** results confirmed the **robustness of the approach**.
- | **Efficient and accurate methodology** for the **design assessment of bonded repair** for marine and offshore applications.
- | **Pave the way to qualification** of bonded repair solutions.



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Written by: (Name, Signature)	Verified by: (Name, Signature)	Revision Date

JIP DURABOND OFFSHORE



New BV JIP initiative:

- | to be confident on the long-term behaviour of composite patch repair
- | to understand different damage mechanisms and the competition between them
- | to challenge existing safety factors

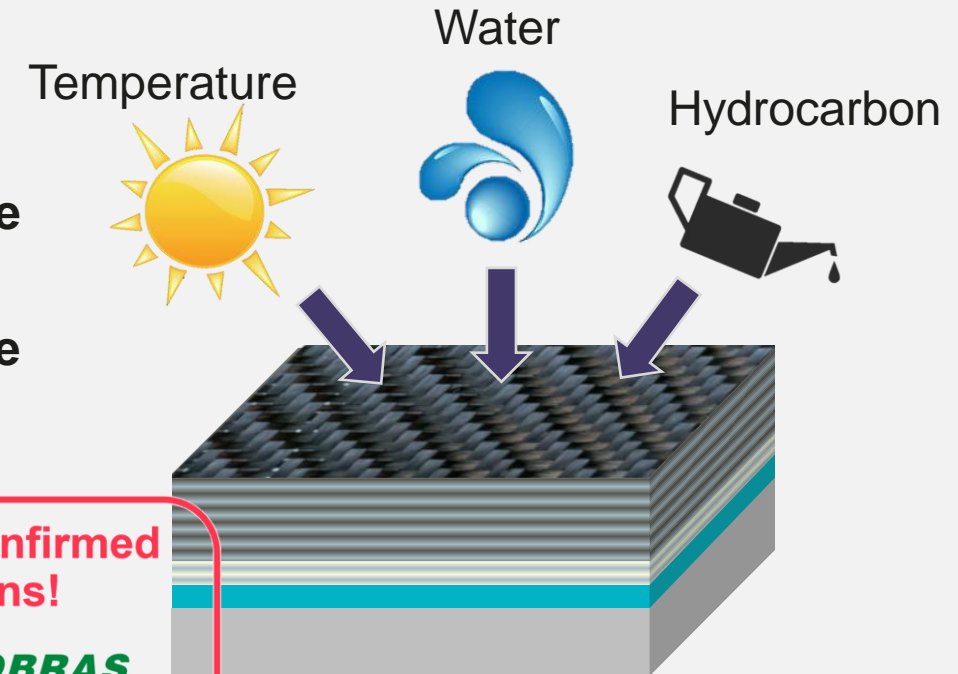
Large testing campaign

- | 300 specimens will be tested
 - | Small to Full size (2 m length)

Numerous numerical simulations

- | All specimens type will be simulated
- | Long-term behaviour extrapolation

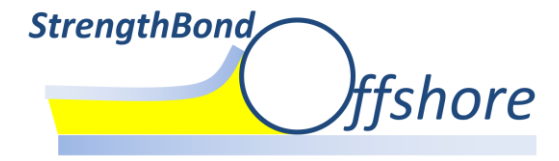
Collaboration with 3 Universities:



They have already confirmed their participations!

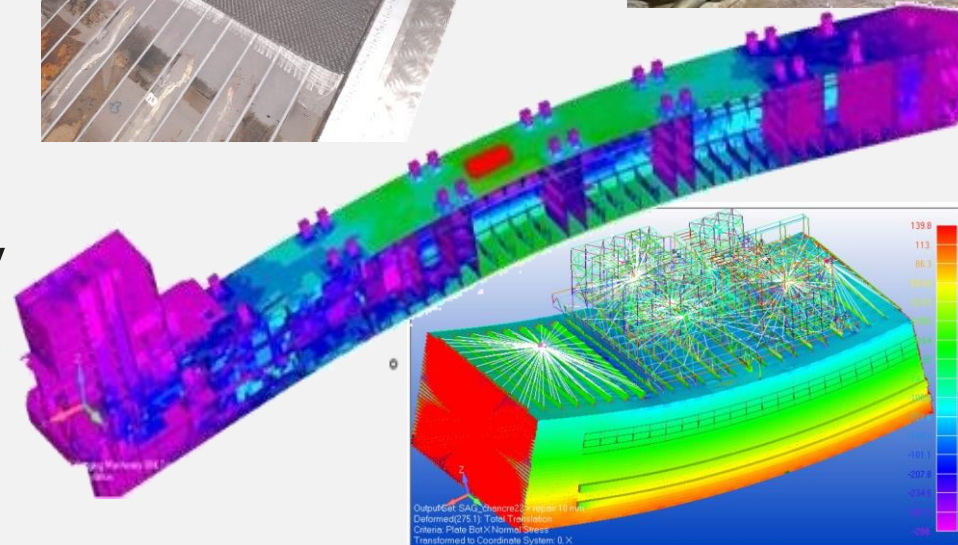


JIP STRENGTHBOND OFFSHORE



Composite repairs offer lot of advantages:

- | **Cost-effective solution**
 - | Easy and quick to install
 - | No stop of production
- | **Immune to corrosion**
 - | Less maintenance
- | **Efficient solution**
 - | Restore the structural integrity
 - | Flat surface or 3D geometries



04

CONCLUSION

CONCLUSION

Motivations for using composite materials are:

For structure in composites:

- 1) **Corrosion resistant**
 - | Less maintenance costs
- 2) **Lightweight materials**
- 3) **Design flexibility**
- 4) **Fatigue resistant**

For composite repairs:

- 1) **Cold repair**
 - | Non-intrusive solution
 - | Easy, quick and cheap
- 2) **Efficient solutions**
 - | Restore integrity
- 3) **Design flexibility**

Fire safety can be an issued but can be managed:

- **New materials**
- **Protection, detection**
- **New approach**



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