

TotalEnergies

integrity management - Innovation Showcase

November 2024

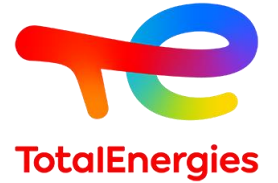


FE Research Forum

Innovation for reliability and performance throughout the complete
lifetime in the floating energy sector

Pioneers
for
100
years

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01

Innovation showcase

- SKIPE
- H3DDIP



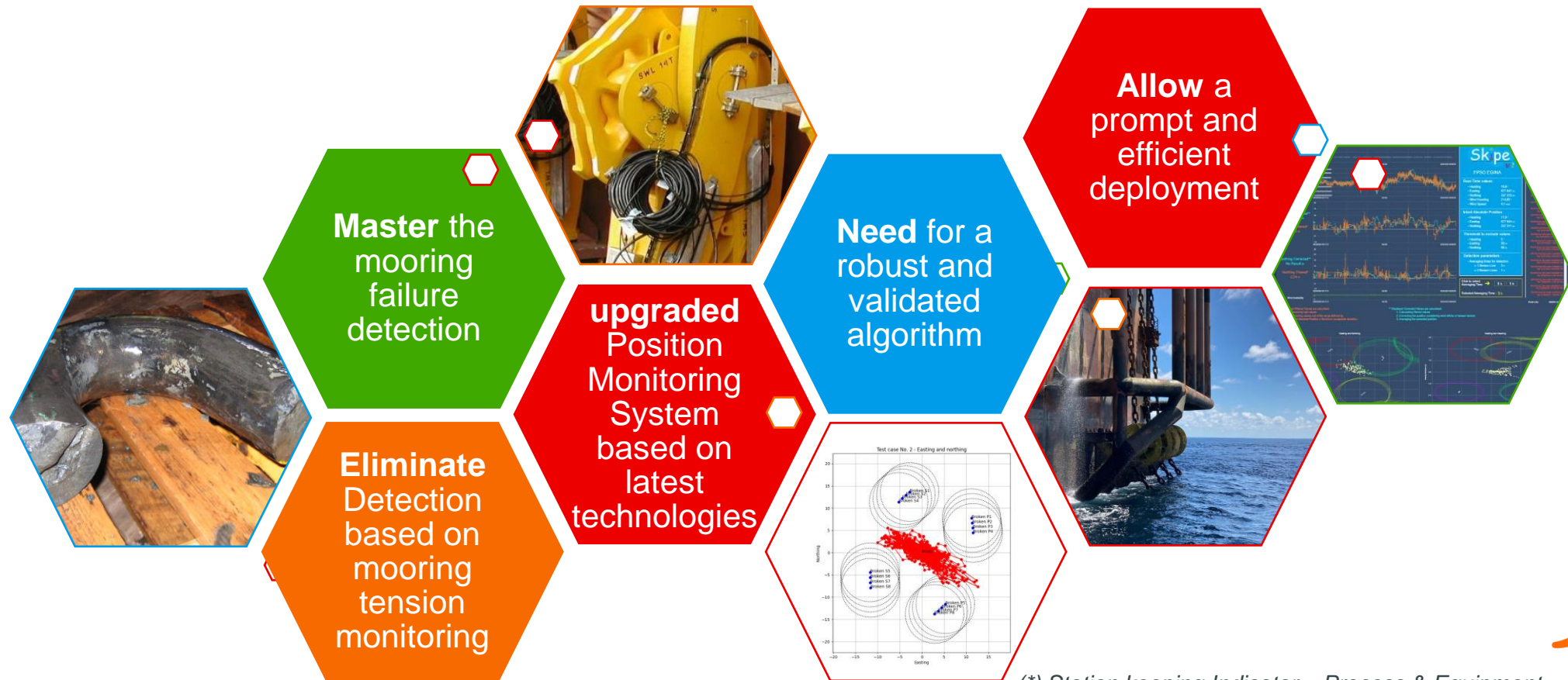
Detection of the mooring failure

Skipe^{V2}

Introduction SKIPE* V2

On our “ageing” floating units, the mooring tension monitoring is not reliable and costly to maintain.

→ Need to adopt an overall strategy that address **Detection of mooring line failure**:



(*) Station keeping Indicator – Process & Equipment

Motivations & historical method: Skipe v1

Historical method: Skipe v1

- Submerged load sensors subject to **quick degradation**
- **Costly** to maintain/replace



2006-2010

2 failures on a FPSO

Discovered by diving inspection **18 months** after failure

Failure hidden in sensor noise and physical spurious effect

2018-2020

Deployment of Skipe v1

Works even if the tension sensor is not calibrated

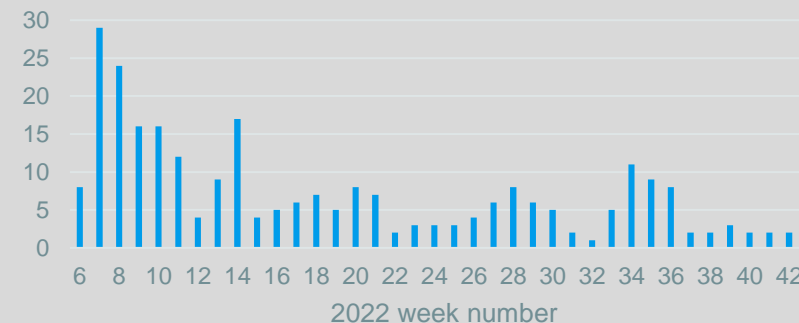
Event-based – reliability of sensors critical

Still too many false alarm

Detection quality

- Event-based method ► **no detection** when data are **not transmitted**
- **Many false alarms** due to data quality issues

Number of false alarms since Feb-22
(average 5.7 per week)



Digital solution for mooring line failure detection

► monitoring of Company assets mooring



Status-based method

Hardware

Position equipment and wind sensor



PI Server

Position correction service

PPP correction **3k€/year / FPSO** 

Corrections

Wind loads: available for all F(P)SO

Hawser tension: for buoys and tandem offloading

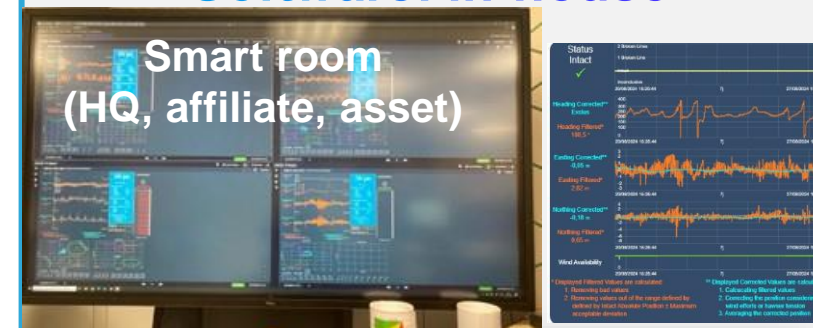
Damaged watch circles

Centers at equilibrium position with broken line(s)

Adjustable radius,

Software: in-house

Smart room
(HQ, affiliate, asset)



Performance standard

100% correct detection

0 false alarms

1 day max for detection of a broken line

2 broken lines detection in 1 hour

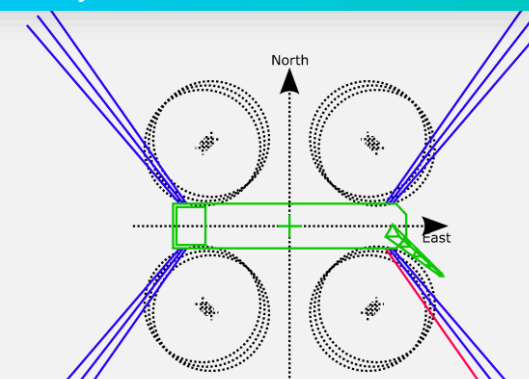
30,000+ synthetic failure simulations (per FPSO)



For one FPSO:

1M\$ CAPEX SAVING

1M\$/4y OPEX SAVING



Damaged watch circle algorithm

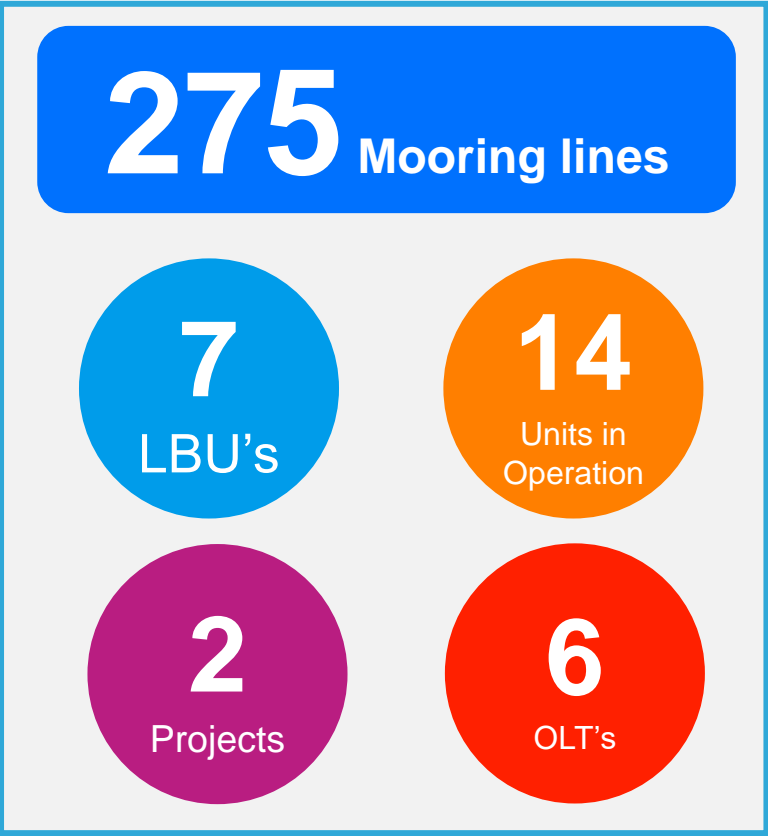
Deployment



38%



Objective to move to 100%

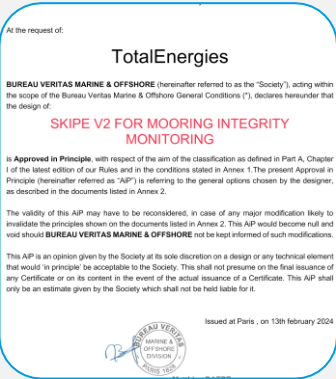


TotalEnergies

InnoTower



Patented algorithm



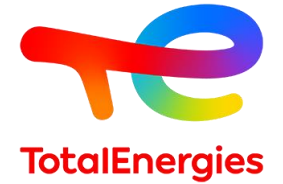
Approval in Principle by Classification Societies



Hull Digital inspection

H3DDIP

Introduction H3DDIP* V1



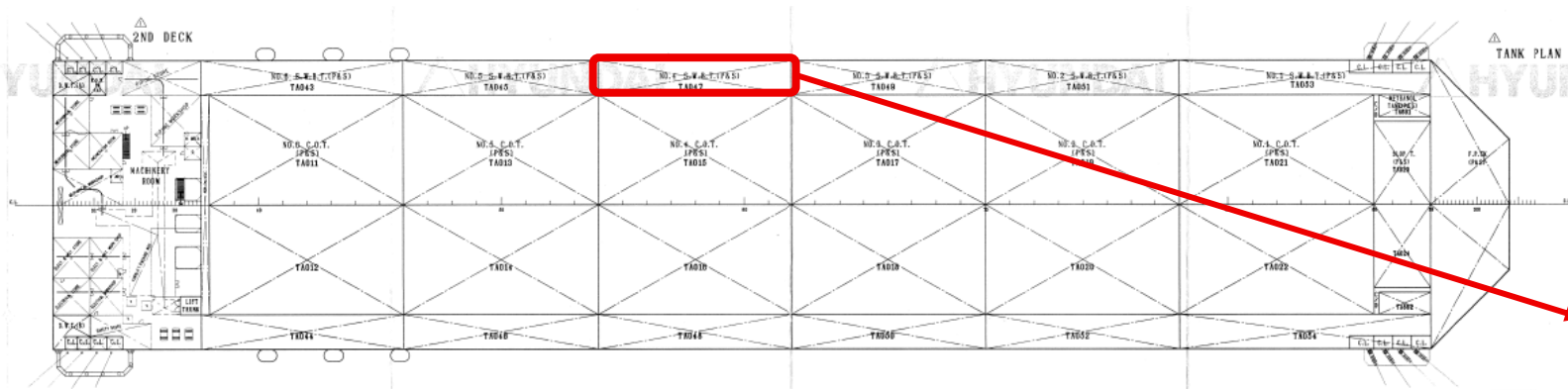
On our **ageing hull floating units**, corrosion & structural degradations are more & more frequent.

Life Extension of our floating units is now a standard expectation in TotalEnergies.

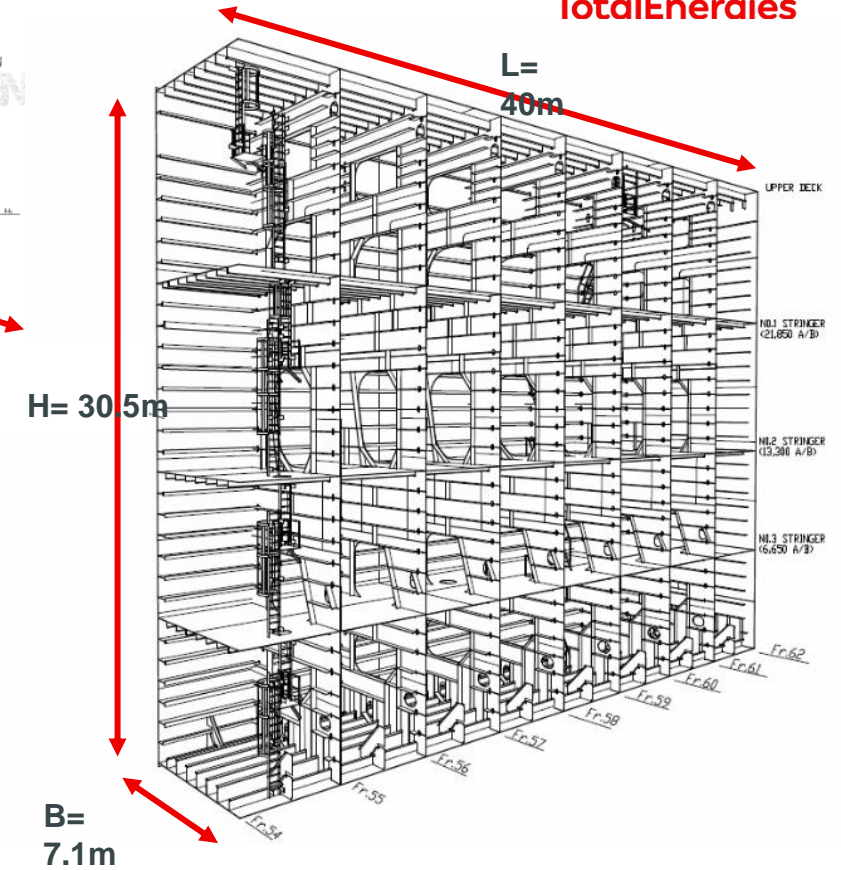
→ Need to adopt an overall strategy that address **Hull integrity management of our ageing assets**:



Motivations H3DDIP - How it was done previously



FPSO: Length: 300m / Breadth: 59.6m / Depth: 30.5m



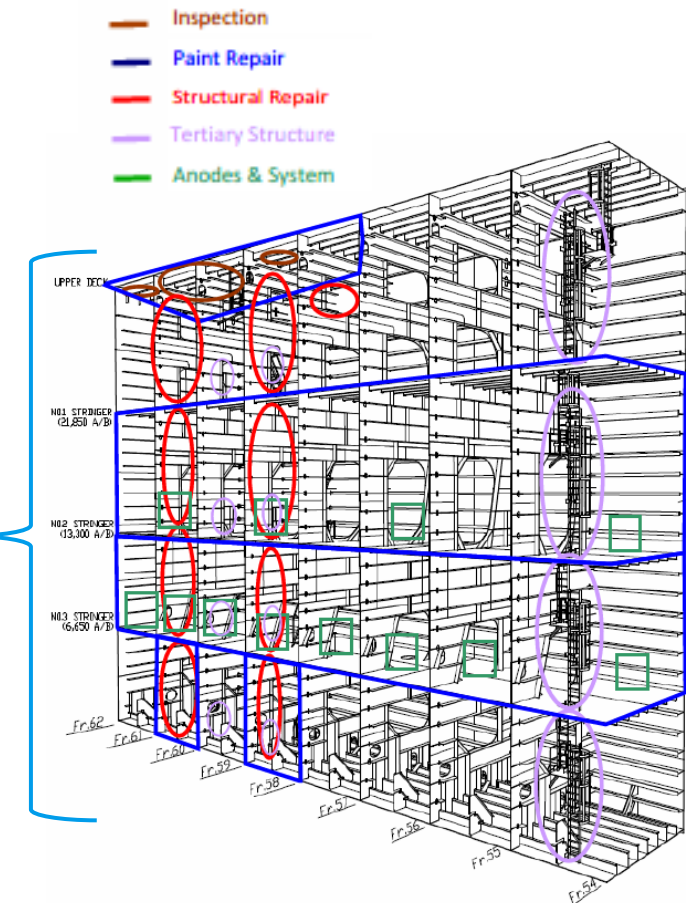
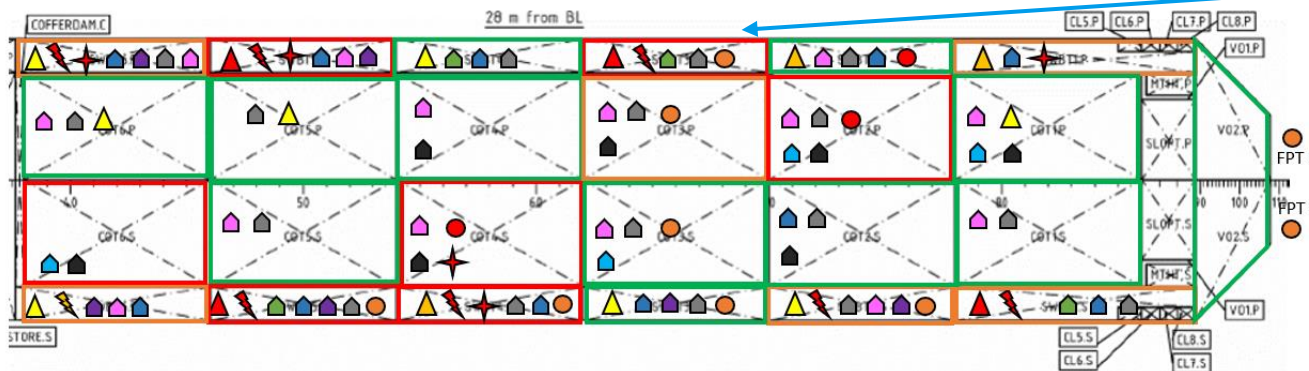
Characteristics & Constraints

- 16 WBT – confined spaces
- Several sub-compartments inside one WBT
- Manhole min size 600*800

Motivations H3DDIP - How it was done previously

- WBT inspection with confined space entry
- Inspection report (pdf files), & paper reporting on dwgs
- Identification of the integrity and coating notification
- Based on these information Tanks condition & work evaluation is prepared and maintained updated for all tanks
- Organize primary activities to be done at tank opening and plan for required manpower & material

Hull tank condition and maintenance repair Plan



inspection process and preparation/execution of repair works takes weeks/months

Motivations H3DDIP: implement innovation - scouting culture



Mitigate confined space hazard



Upgrade the maintenance in opera.
cond. of our ageing assets
Improve time to identify integrity threat
Meet the growing demand for inspection
and repair.



Be able to anticipate repair work,
be efficient in the diagnostics, reduce
the POB for intervention



Digitalize our inspection and reporting
techniques on Platform,
control the evolution of integrity

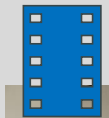
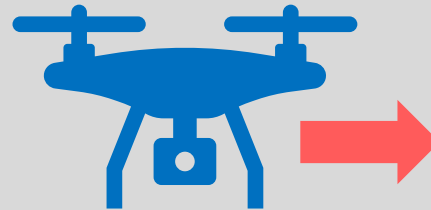


Extensibility – NEXT !
Scale your innovation in manageable
increments for quick deployment



Combined Technologies -> Drone – Lidar – AI

Virtual reality -> Corrosion detection + geovisualisation 3D point clouds



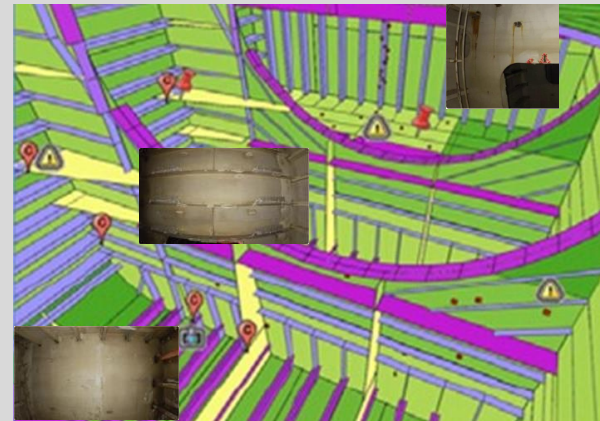
Video flight &
point cloud Lidar



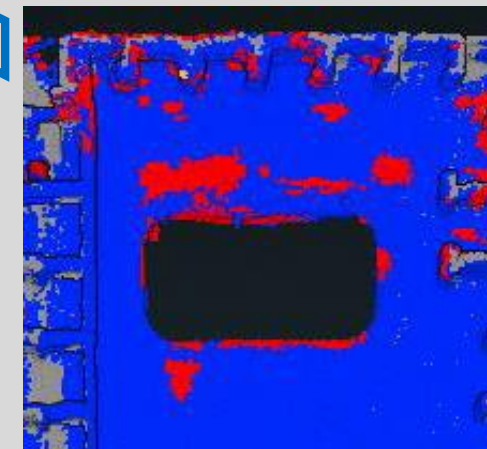
Process & capture



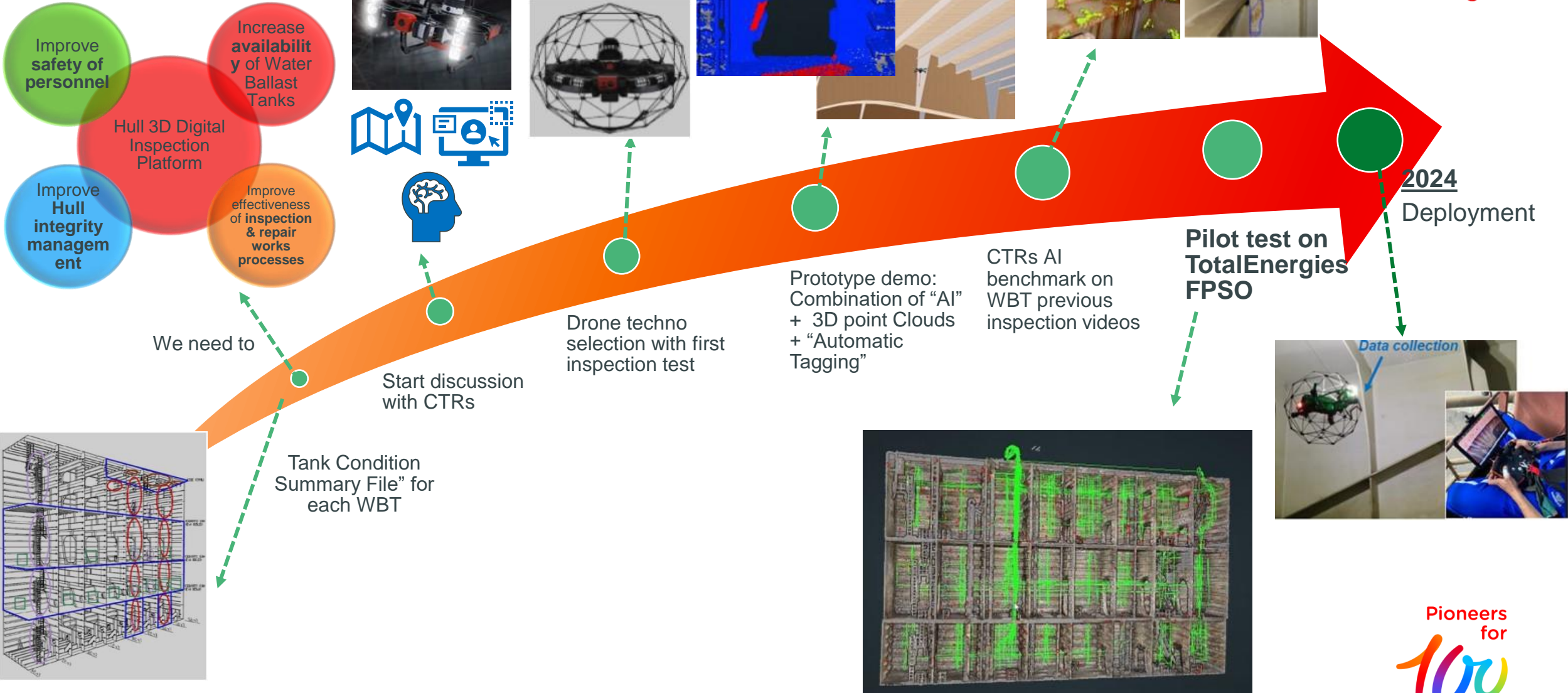
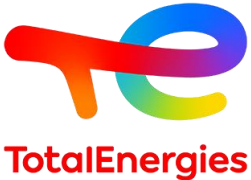
Raw data reduced to Digital platform



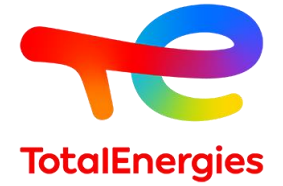
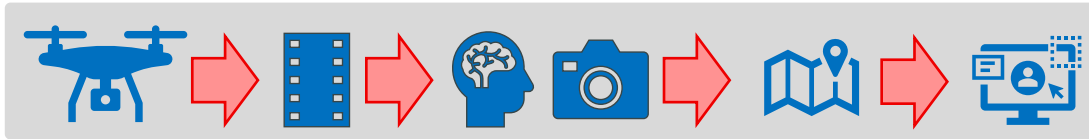
Geolocate & overlays 3D



H3DDIP: From Scouting to deployment



H3DDIP: Deployment



Deliverables – Digital platform :

- 3D viewer for general overview of corroded areas
 - AI data processing & 3D visualization to enhance:
 - Preliminary scope for coating/repairs
 - Areas of concerns for metal loss
 - Needs for scaffoldings, Steels ... etc
- **Available to all stakeholders** (improve decision-making, reduce errors, and automate manual tasks)

5. Findings

1. Principal Analysis by groups
 - Number of anomalies: 1000 (Total) 100 (Sample)

Category	Count	Percentage
Corrosion	800	80%
Cracks	150	15%
Other	50	5%

2. Detailed Analysis by members

3. Transverse sections by frames
 - Number of sections: 100 (Total) 10 (Sample)

Frame	Count	Percentage
Frame 1	10	10%
Frame 2	20	20%
Frame 3	30	30%
Frame 4	40	40%

4. Longitudinal sections
 - Number of sections: 100 (Total) 10 (Sample)

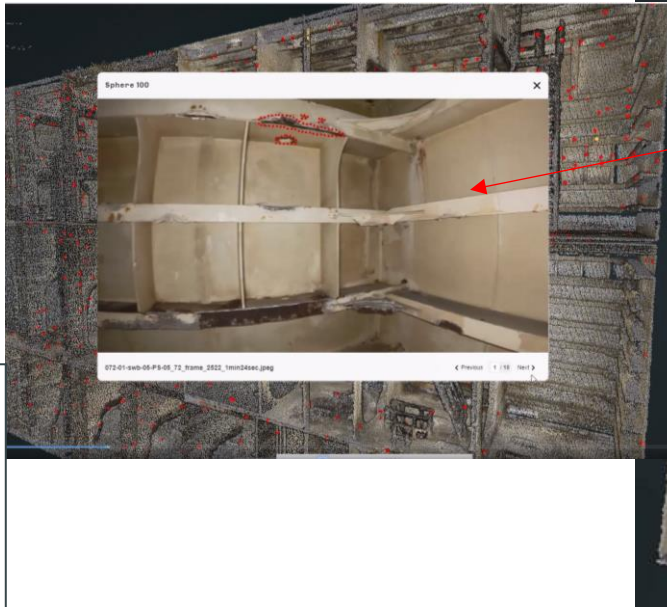
Section	Count	Percentage
Section 1	10	10%
Section 2	20	20%
Section 3	30	30%
Section 4	40	40%

5. Upper deck & stringer sections
 - Number of sections: 100 (Total) 10 (Sample)

Section	Count	Percentage
Section 1	10	10%
Section 2	20	20%
Section 3	30	30%
Section 4	40	40%

6. Photos of anomalies
 - Number of photos: 100 (Total) 10 (Sample)

Photo	Count	Percentage
Photo 1	10	10%
Photo 2	20	20%
Photo 3	30	30%
Photo 4	40	40%



02

Innovation process focus

Think Big – Act small (products deployment steps)

- What processes do SKIPE and H3DDIP innovations share ?

12 months for project execution and deployment



Structured in Agile team to achieve its ambition



Innovation roadmap : deploy quickly & right to fail



- The Innovation process used; is all about breaking down the barriers that slow down innovation, making it easy to identify and test new tech solutions to solve operational issues.

We need to :

- Identify, understand technical problem & Find a solution
- Test them rapidly
- Deploy proven solution

Main Objectives :

- Deliver innovative industrial solution in short term
- Accelerate projects by mobilizing teams, methodologies and tools
- Culture of innovation inspired by “right to fails”

turning failure into fuel for innovation & quick industrial deployment



03

Way Forward & Conclusion

Conclusion

Future Directions and Opportunities - Embrace change



- The discussion is to complement the current innovation efforts conducted through the FPSO/FER Forum rather than replace them.

To ensure reliability and performance of mature assets, the innovation cycle should focus on reducing project duration for quick deployment

SquallMoor
HITS
SCORTCH
MCA-mooring components
4D Fatigue
CrackGuard
MONITAS
Chain OPB fatigue
Etc



FER forum is a unique ecosystem comprising academic institutions, universities, laboratories, technology providers, engineering contractors, suppliers, Energy companies, etc...



Accelerate & Quick deployment ?



12 months

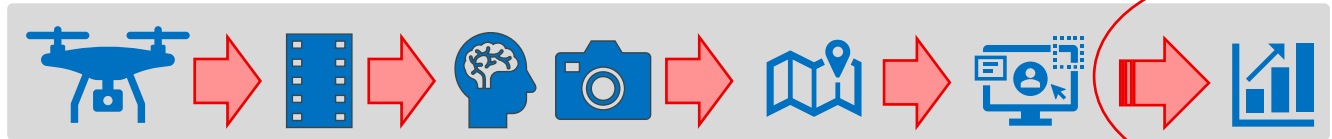


Digital Twin - Connect Real with Virtual

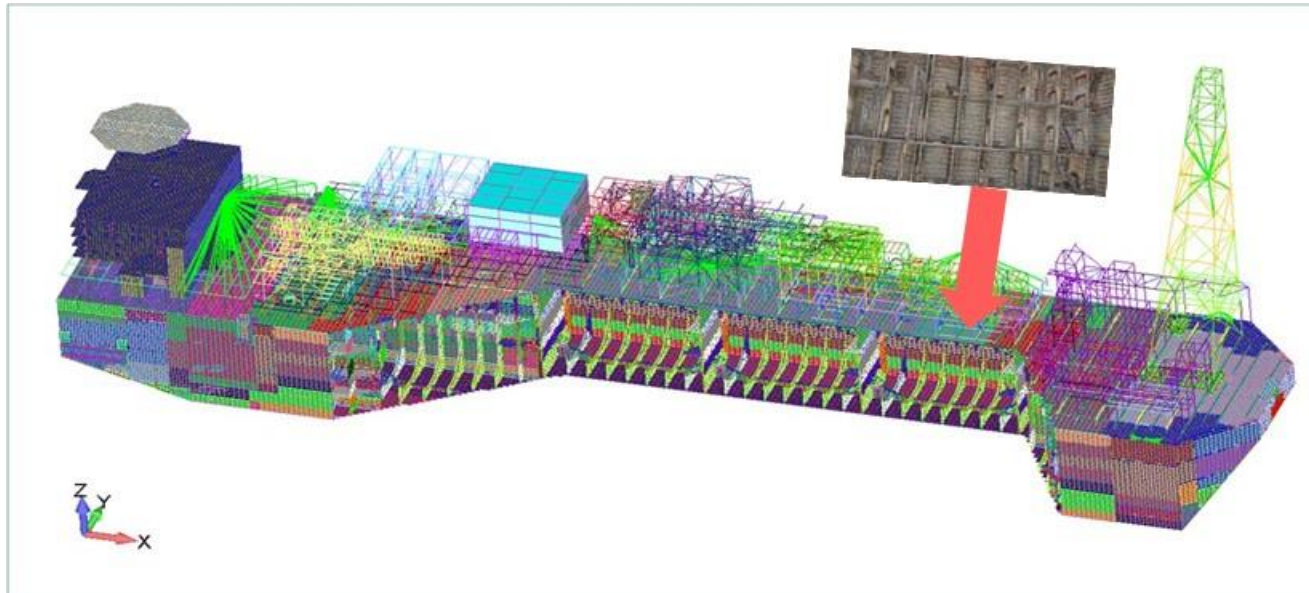
Digital Twin – Make it happen & Make it useful !

Let's take benefit from

- Digital solution
- New technology,
- AI development (or Not !)



Extensibility : Drone can accommodate the UT in parallel with the LiDAR



Thank you!

