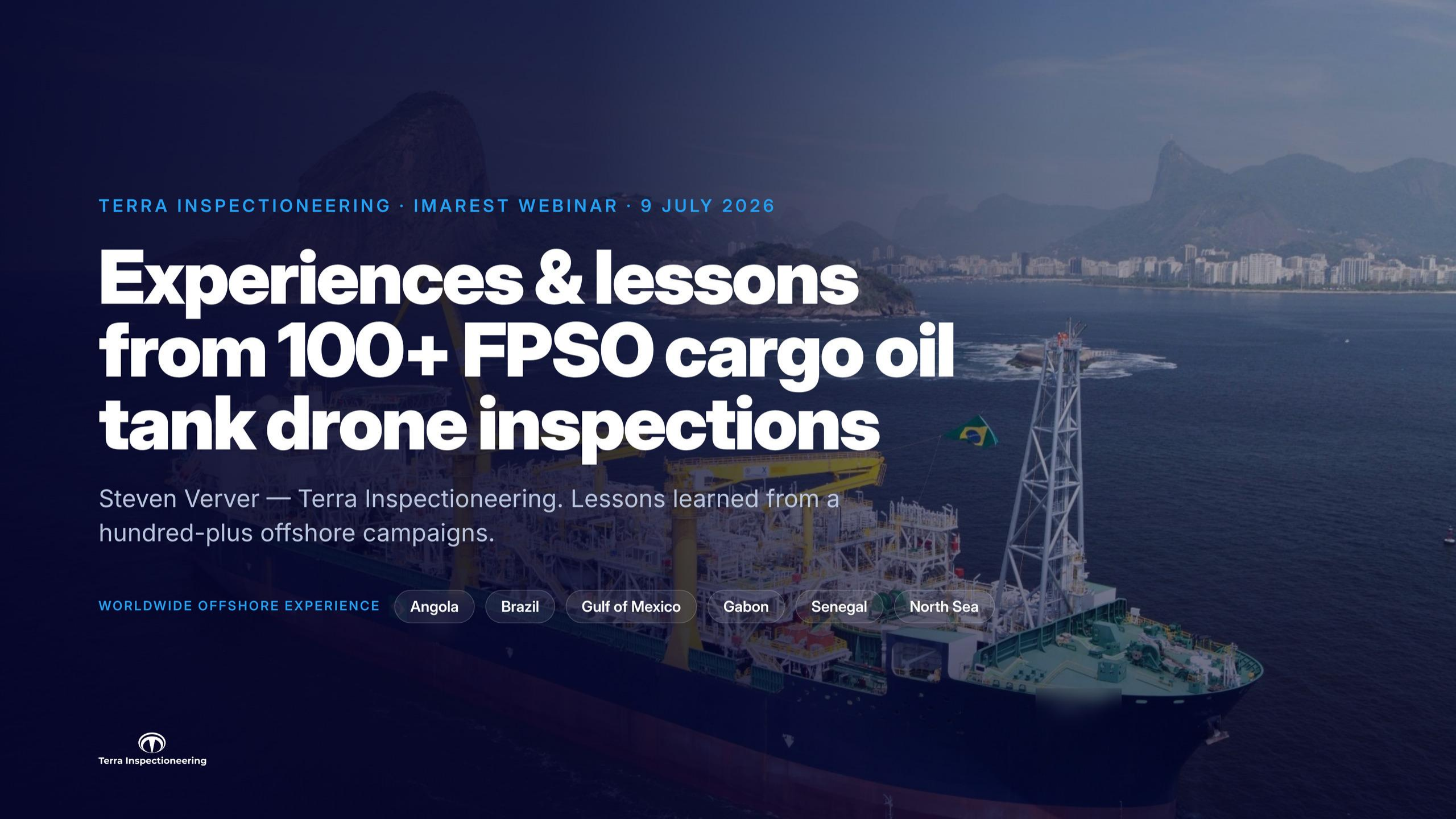
TERRA INSPECTIONEERING · IMAREST WEBINAR · 9 JULY 2026

Experiences & lessons from 100+ FPSO cargo oil tank drone inspections

Steven Verver — Terra Inspectioneering. Lessons learned from a hundred-plus offshore campaigns.

WORLDWIDE OFFSHORE EXPERIENCE

Angola | Brazil | Gulf of Mexico | Gabon | Senegal | North Sea



Terra Inspectioneering

YOUR SPEAKER



Steven Verver

Terra Inspectioneering

- Background in **AI**; in the drone industry since **2015**.
- Led the R&D behind our ultrasonic thickness-measurement drones.
- **Two patents** — an engineering and an operational view.

TRACK RECORD

100+ inspections

500+ tanks

Zero accidents

Worldwide operational coverage through Terra drone global & local partners

Local teams across Europe, Asia, Africa, Brazil and the USA.

TDBR INSPECTIONS

TerraDrone

THE BIGGER PICTURE · OUR PARENT GROUP

Part of the Terra Drone Group

TerraDrone

Tokyo Stock Exchange · 278A

A global enterprise drone & UAM solutions provider — founded 2016, headquartered in Tokyo, driven by one mission: **unlock "X" dimensions.**

#1
Global drone service provider (Drone Industry Insights)

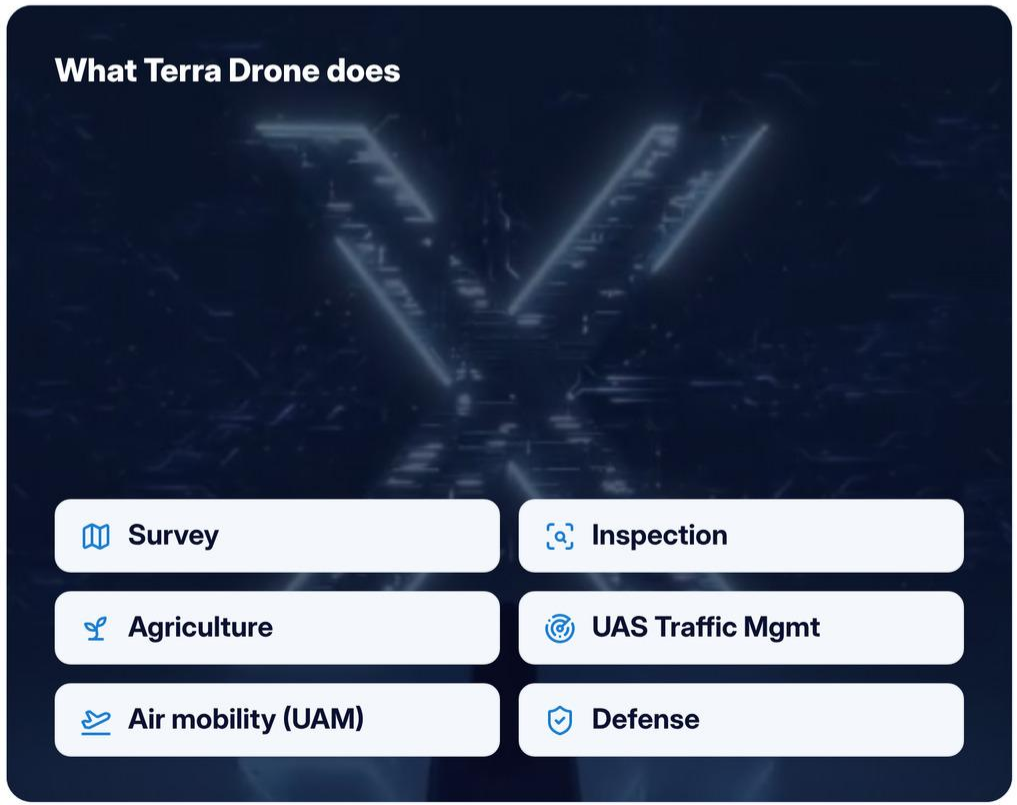
2016
Established · Tokyo HQ

20+
Active regions worldwide

3,000+
Projects delivered

550+
People across the group

What Terra Drone does



- Survey
- Inspection
- Agriculture
- UAS Traffic Mgmt
- Air mobility (UAM)
- Defense

Group companies · grown through acquisition

- **Terra Drone Japan** — LIDAR surveying, manufacturing
- **Terra Inspectioneering, Netherlands** — Confined space & FPSO tank inspection services — THIS IS US
- **Terra Drone Indonesia** — Drone survey & inspections
- **Terra Drone Agri - Malaysia** — Agricultural drone services
- **Terra Drone Arabia - KSA, Dubai** — Drone survey & drone-in-a-box solutions
- **Unifly — Belgium** — UAS traffic management
- **Terra Defense - Ukraine** — Interceptor drones
- **Nolvis - USA** — Drone manufacturing & sales

AGENDA

What we'll cover tonight

TONIGHT'S FORMAT

1. Introduction by Chair
2. Presentation by Speaker
3. Q&A Session
4. Closing Remarks by Chair

TOPICS COVERED

01 Why drones for cargo oil tanks

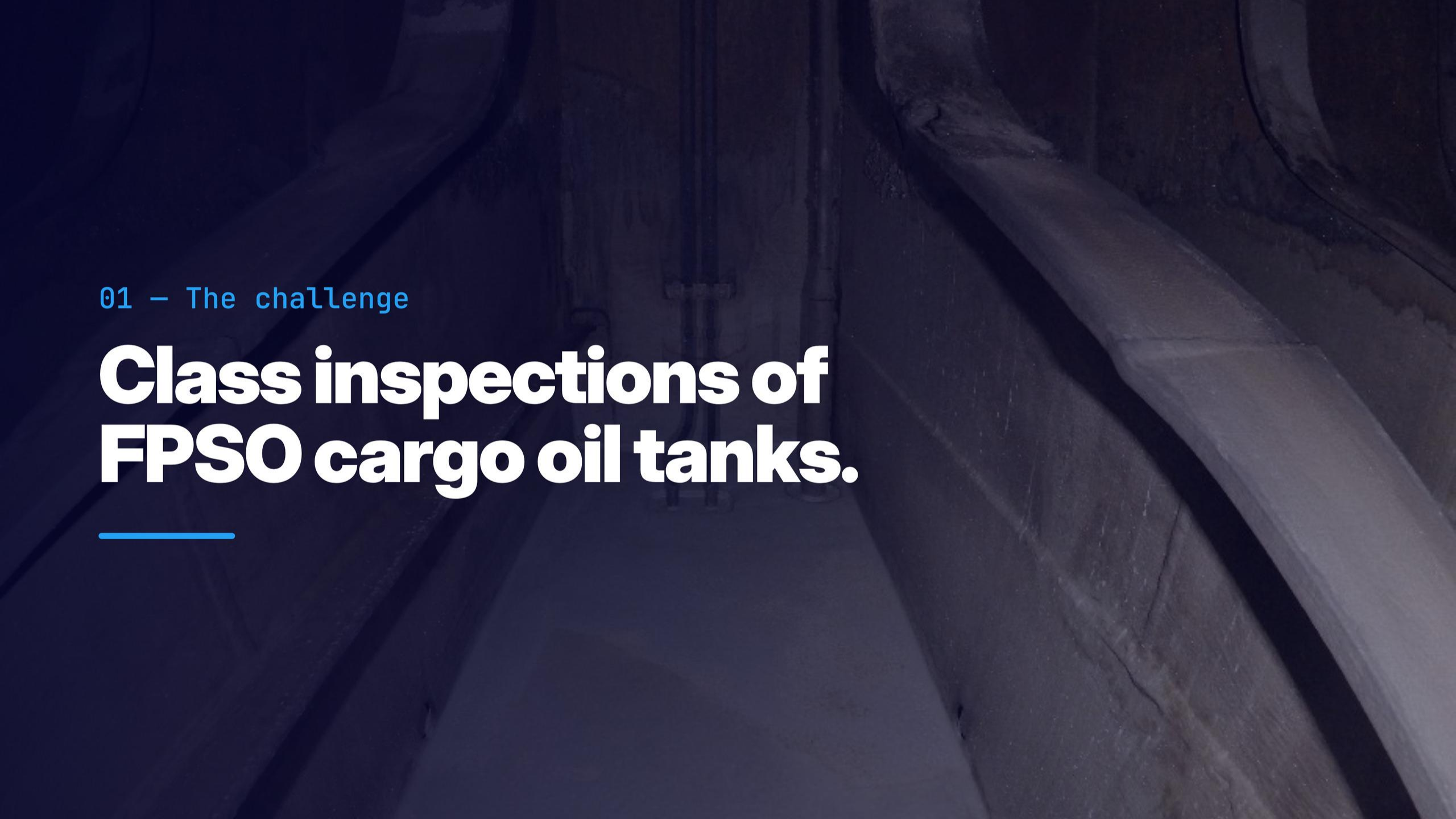
02 The technology: the Terra UT drone

03 Examples from the field

04 Challenges & lessons learned

05 Where this is heading next

06 Q&A



01 — The challenge

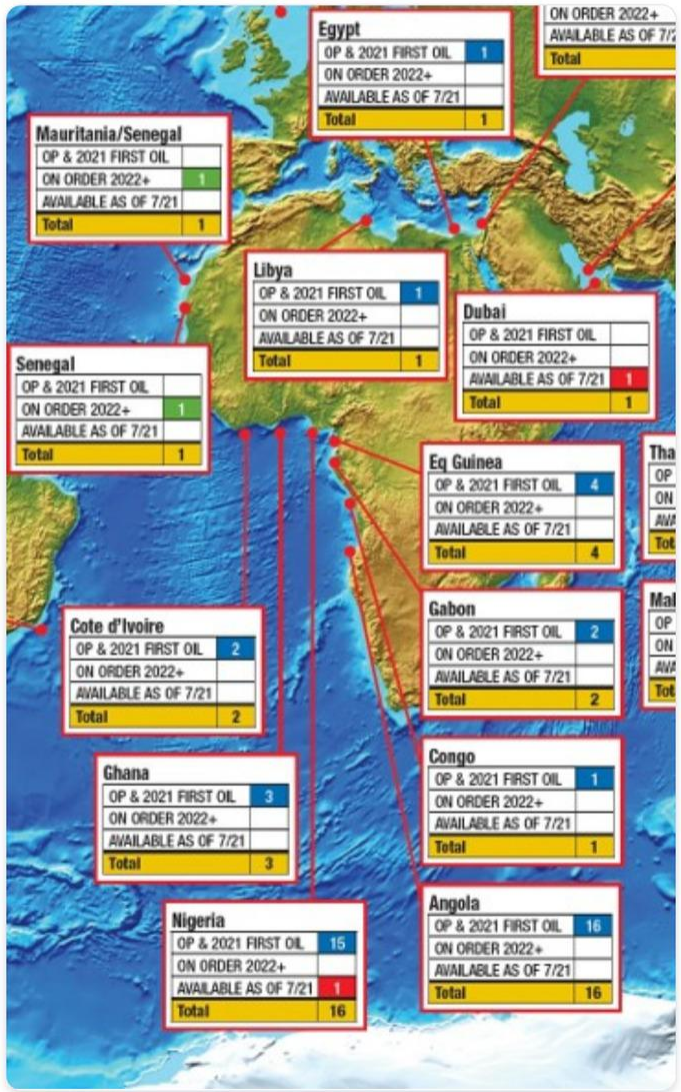
Class inspections of FPSO cargo oil tanks.

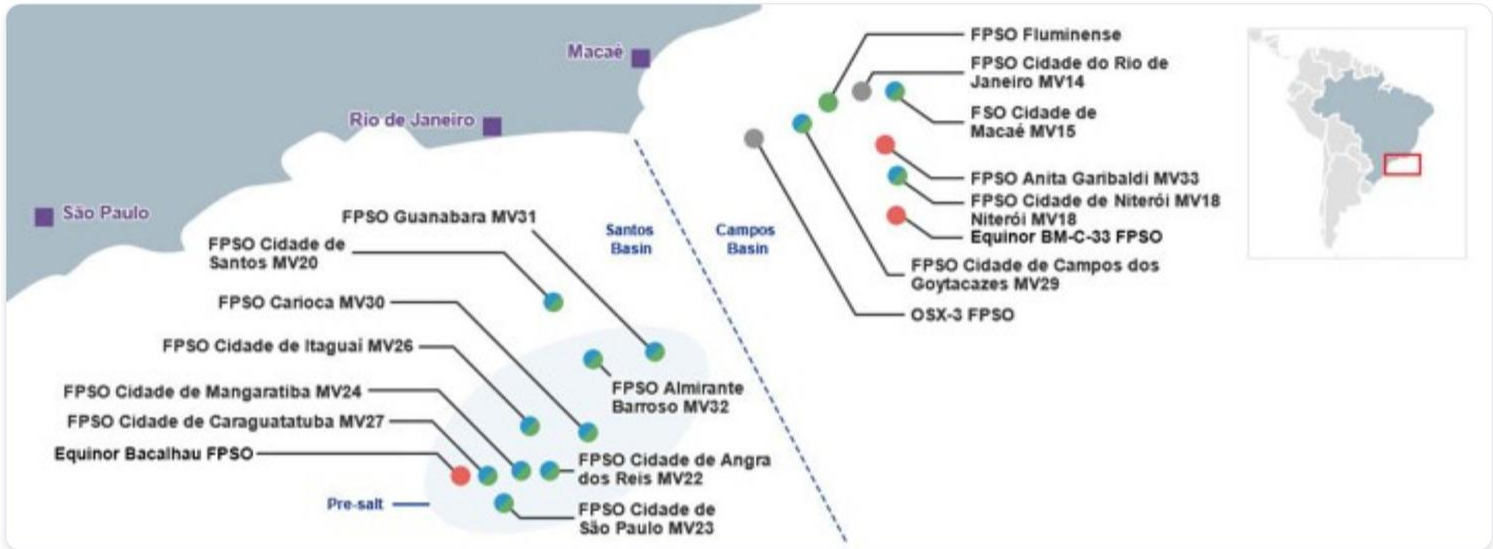


Floating Production, Storage, and Offloading

WHERE THE FLEET IS

FPSO locations — mainly Brazil and Africa

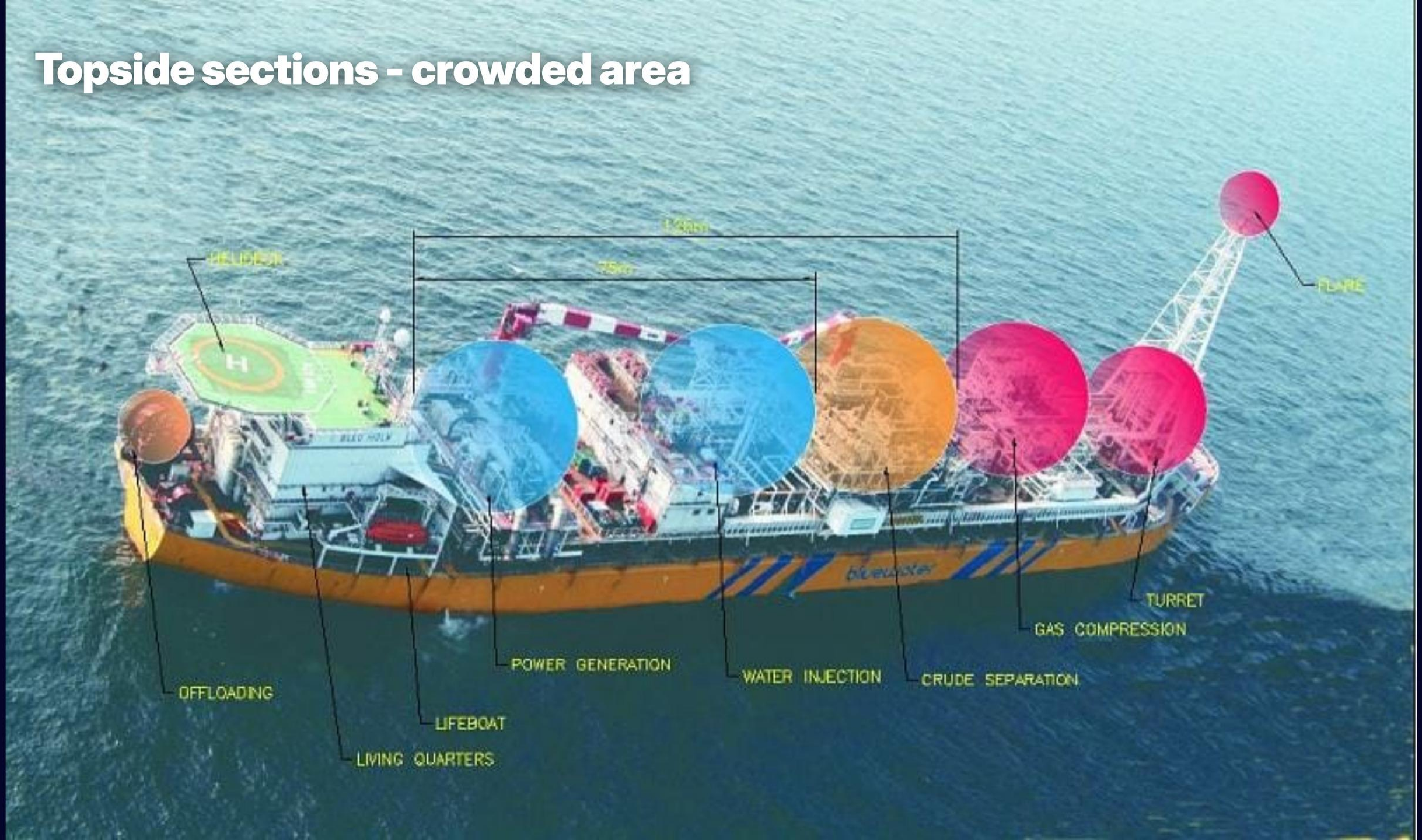




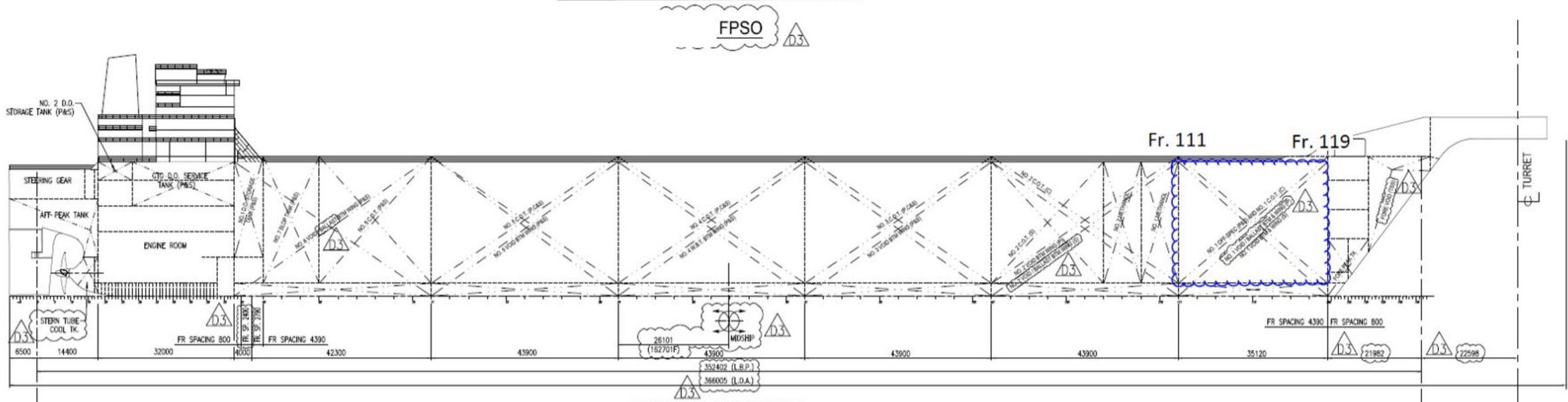
OTHER LOCATIONS

- Gulf of Mexico
- Asia
- North Sea
- Australia
- Guyana

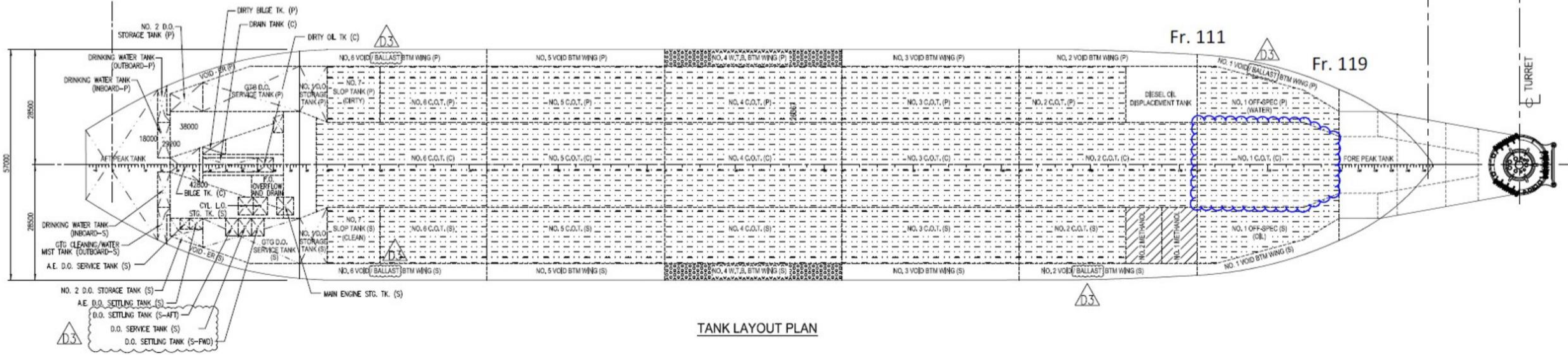
Topside sections - crowded area



CAPACITY PLAN



STARBOARD SIDE PROFILE

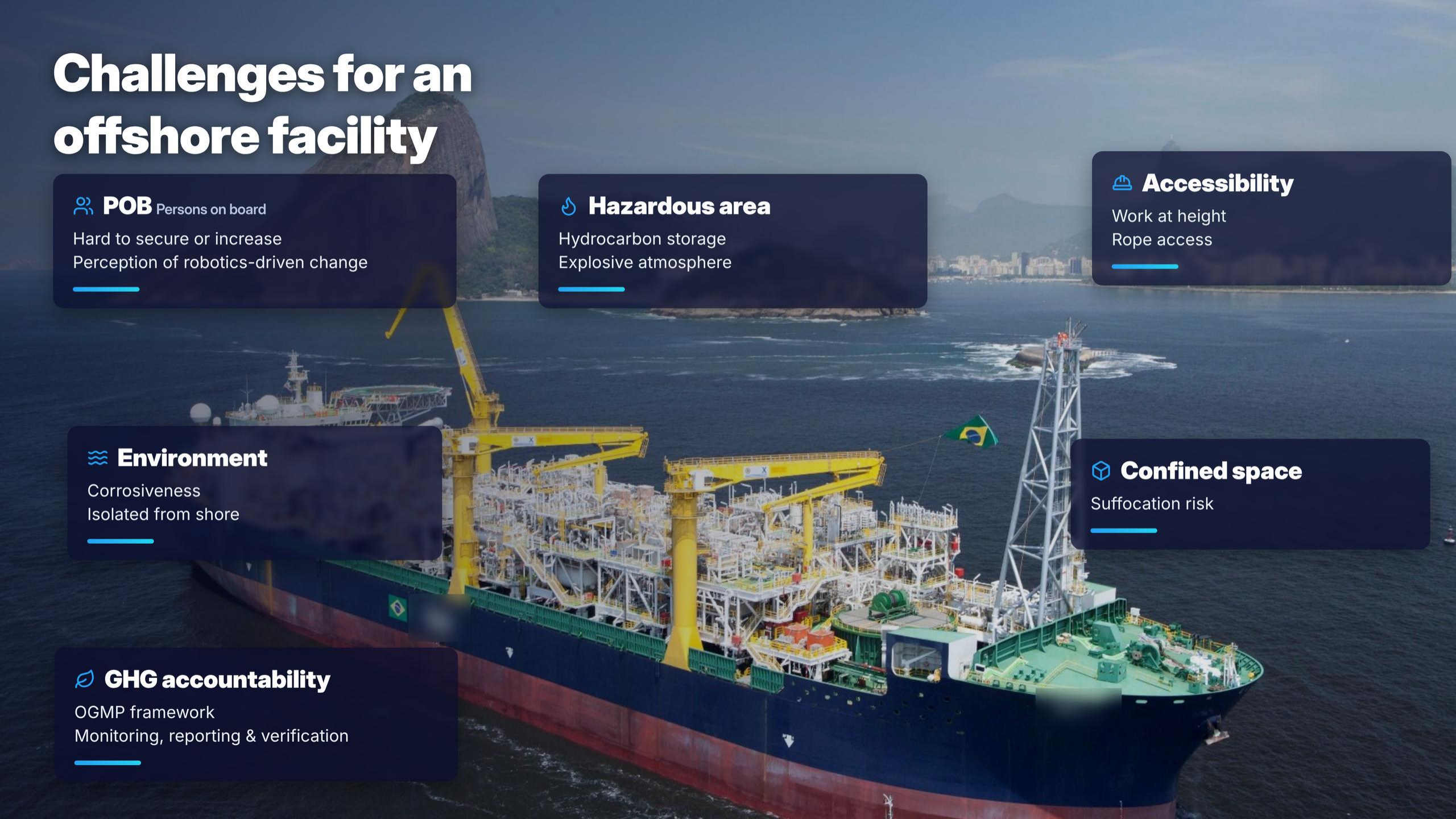


TANK LAYOUT PLAN

Under water: christmas tree



Challenges for an offshore facility



POB Persons on board

Hard to secure or increase
Perception of robotics-driven change

Hazardous area

Hydrocarbon storage
Explosive atmosphere

Accessibility

Work at height
Rope access

Environment

Corrosiveness
Isolated from shore

Confined space

Suffocation risk

GHG accountability

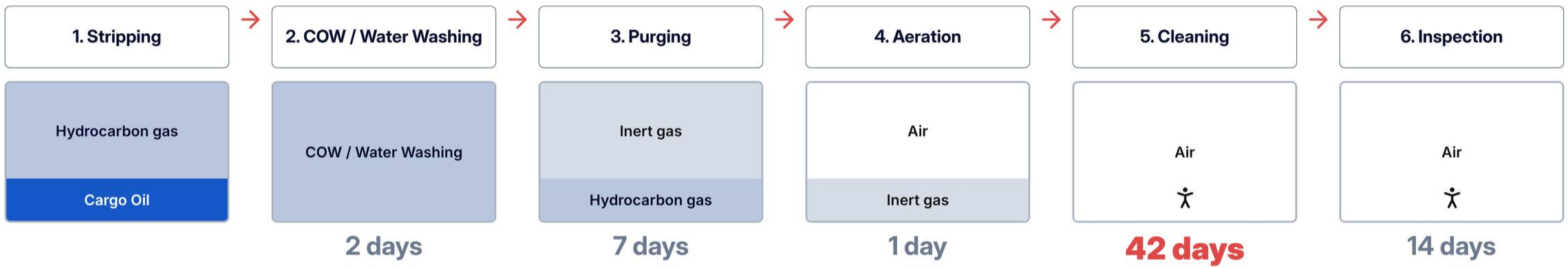
OGMP framework
Monitoring, reporting & verification

THE CURRENT METHOD · ROPE ACCESS

Inspecting cargo oil tanks

A cargo oil tank (COT) inspection is required every 5 years under ABS rules, combining close visual inspection (CVI) and ultrasonic thickness measurement (UTM). Rope access is the most used method — but it has some challenges.

Tank preparation is long before inspection can even start



	PROBLEM	OVERVIEW
	Large POB consumption	A typical COT is 51 m (L) × 22 m (W) × 30 m (H). Inspecting one manually consumes easily 5 people × 2 weeks POB.
	Stricter regulations	Since early 2021, rope access to deck transverses, longitudinal stiffeners and flat walls is prohibited; structures must provide anchorage points.
	Work at height & confined-space entry	Dangerous work is required. A fatal accident occurred during a cargo oil tank inspection offshore Brazil in 2021.[1]



1. Publicly reported fatal accident during a cargo oil tank rope-access inspection, offshore Brazil, 2021.

SAFETY

Before & after





THE ANSWER · REMOTE INSPECTION TECHNIQUES

Drone inspections







Less POB
Shorter campaigns, fewer people on board.

Less downtime
Lower production loss for the operator.

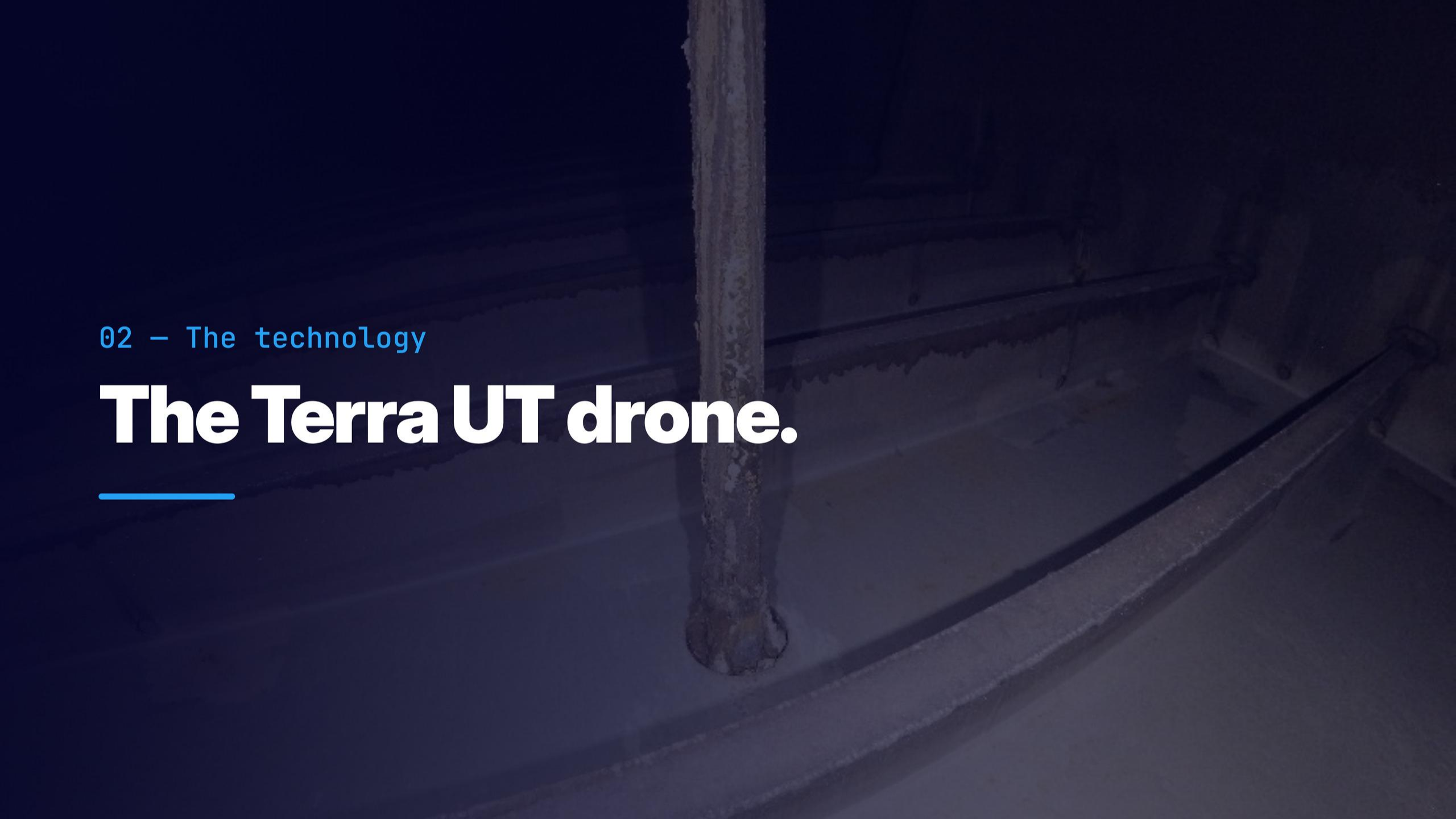
Safer
Less confined-space entry or work at height.

Two lenses
Visual (GVI/CVI) + ultrasonic thickness (UTM) together.

Now formally recognized as an alternative means of access, under an approved methodology, by:

ABS · DNV·GL · BUREAU VERITAS

+ RINA, Lloyd's Register, ClassNK



02 — The technology

The Terra UT drone.



THE PLATFORM · TERRA UT DRONE

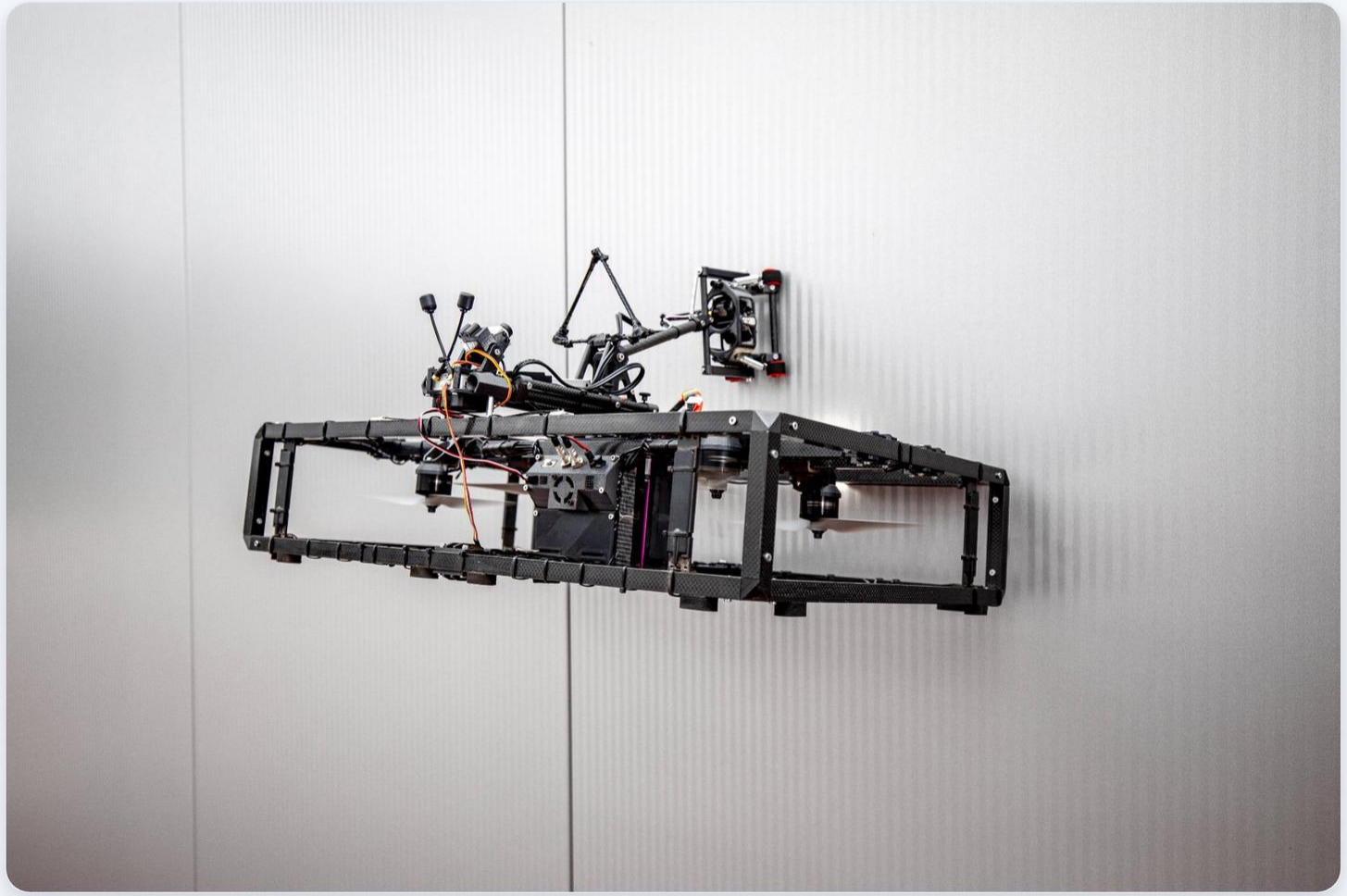
8+ years of experience in UT drone applications in onshore assets

We solved:

- **Geometrical challenges** — beam drone, roof drone
- **Couplant gel application** — peristaltic pump, medicinal gel
- **Surface preparation** — integrated cleaning brush
- **Probe selection** — 5 MHz, 10 MHz, single & dual element
- **Data sync** — A-graph synced to the cloud
- **NoBo certification** — Lloyd's, Kiwa, Vinçotte, DNV
- **Echo-to-echo measurements** — measuring through coating
- **Coating thickness measurements** — using Elcometer device

THE PLATFORM · TERRA UT MODULE

Terra UT drone



Terra UT drone



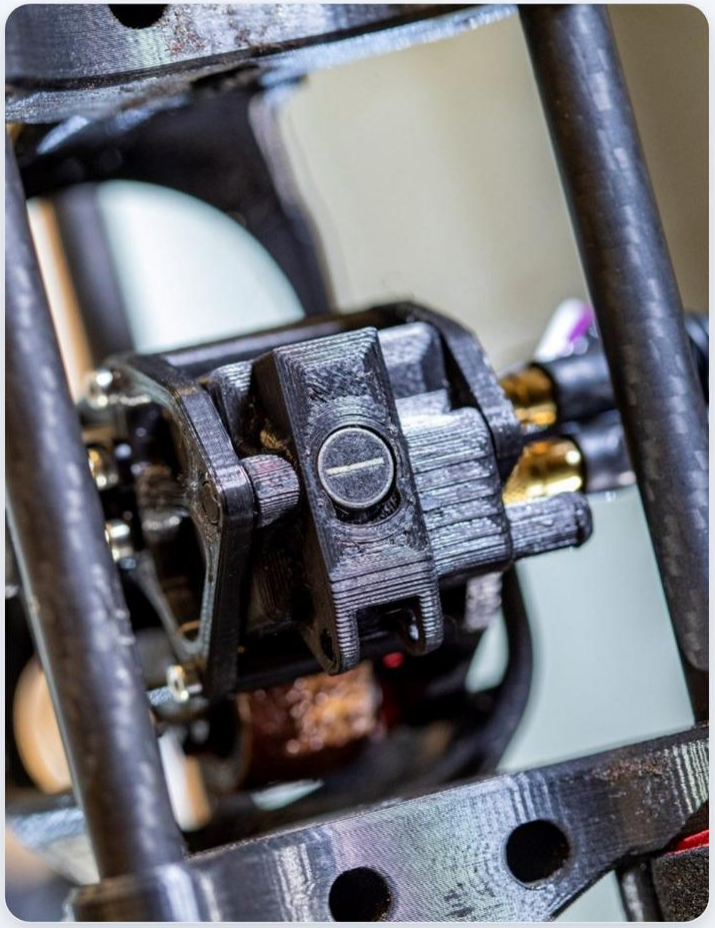
Integrated couplant gel pump

THE PLATFORM · TERRA UT MODULE

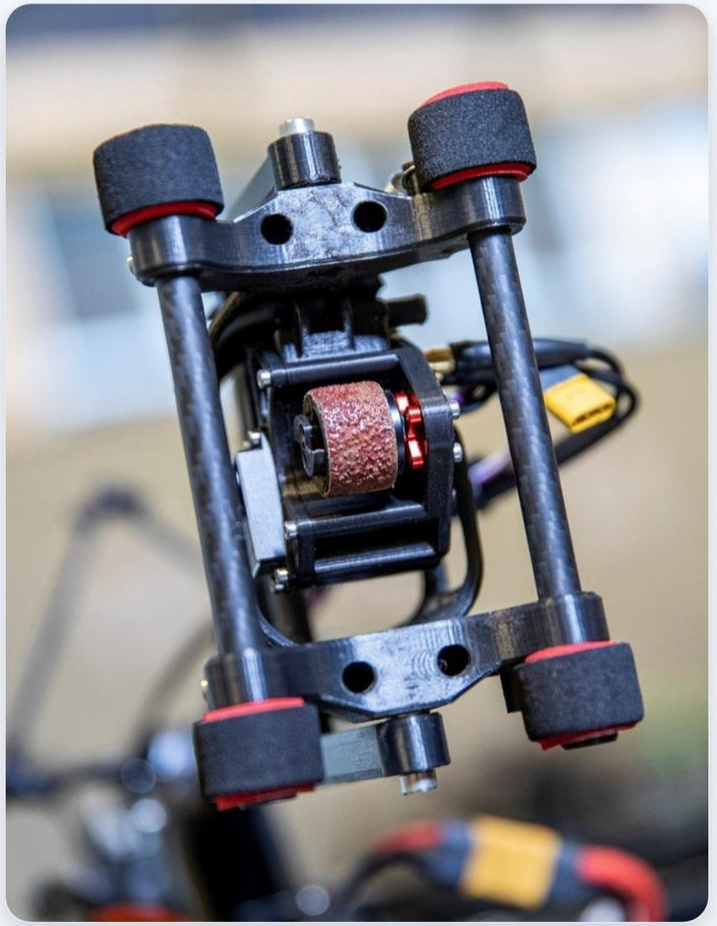
Integrated surface preparation



Integrated UT and cleaning module



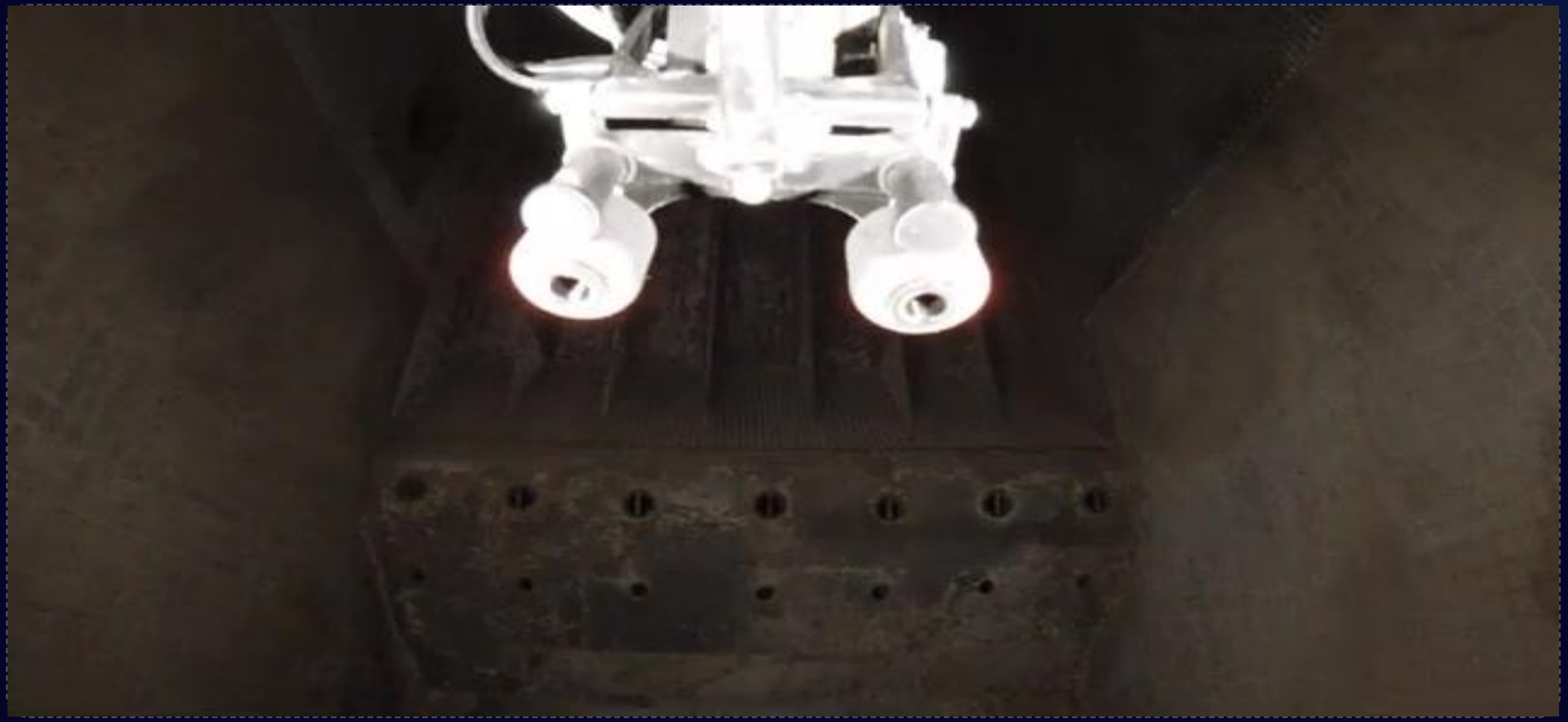
UT probe



Cleaning brush

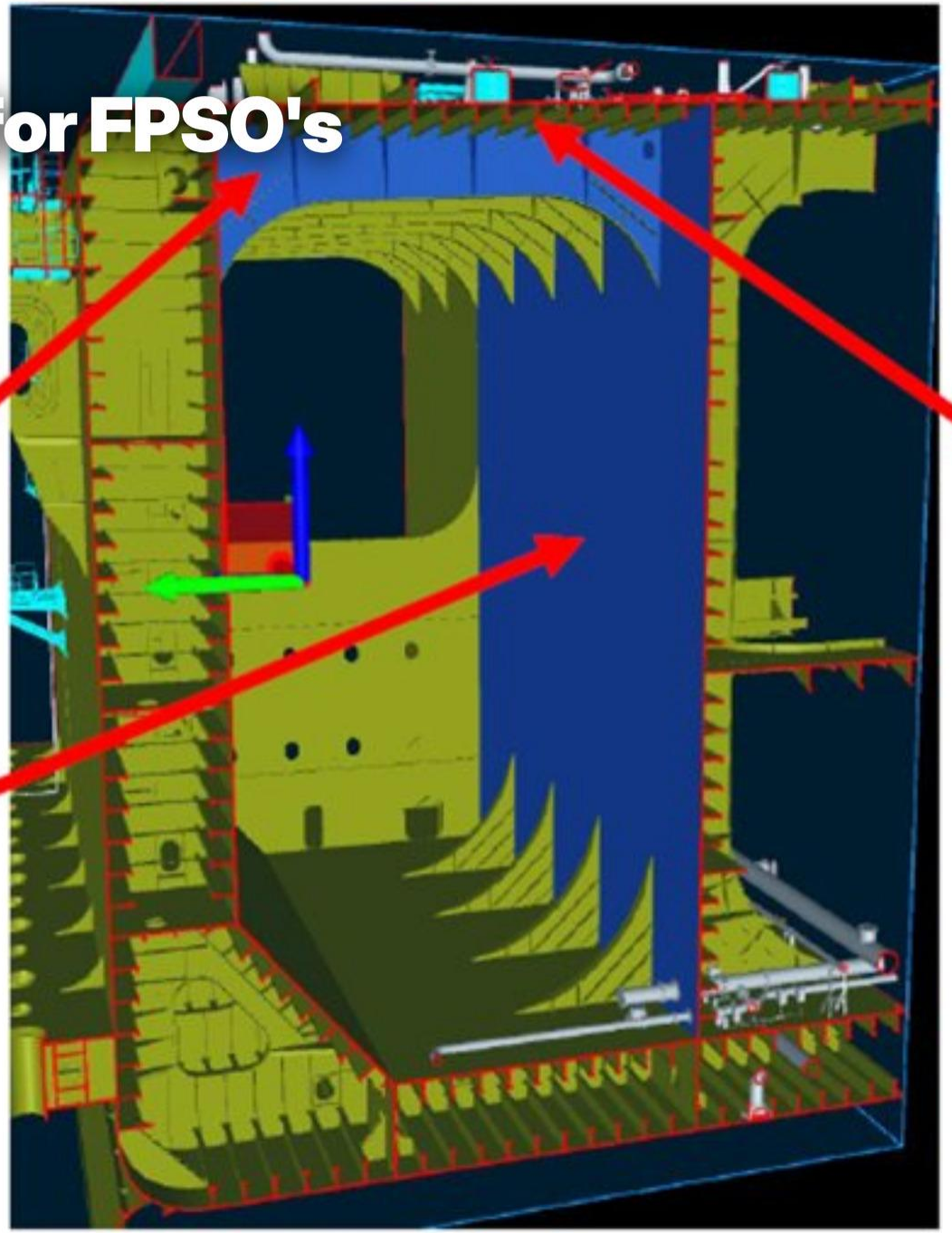
UT DRONE IN ACTION

Example cleaning process



THE CHALLENGE(2023)

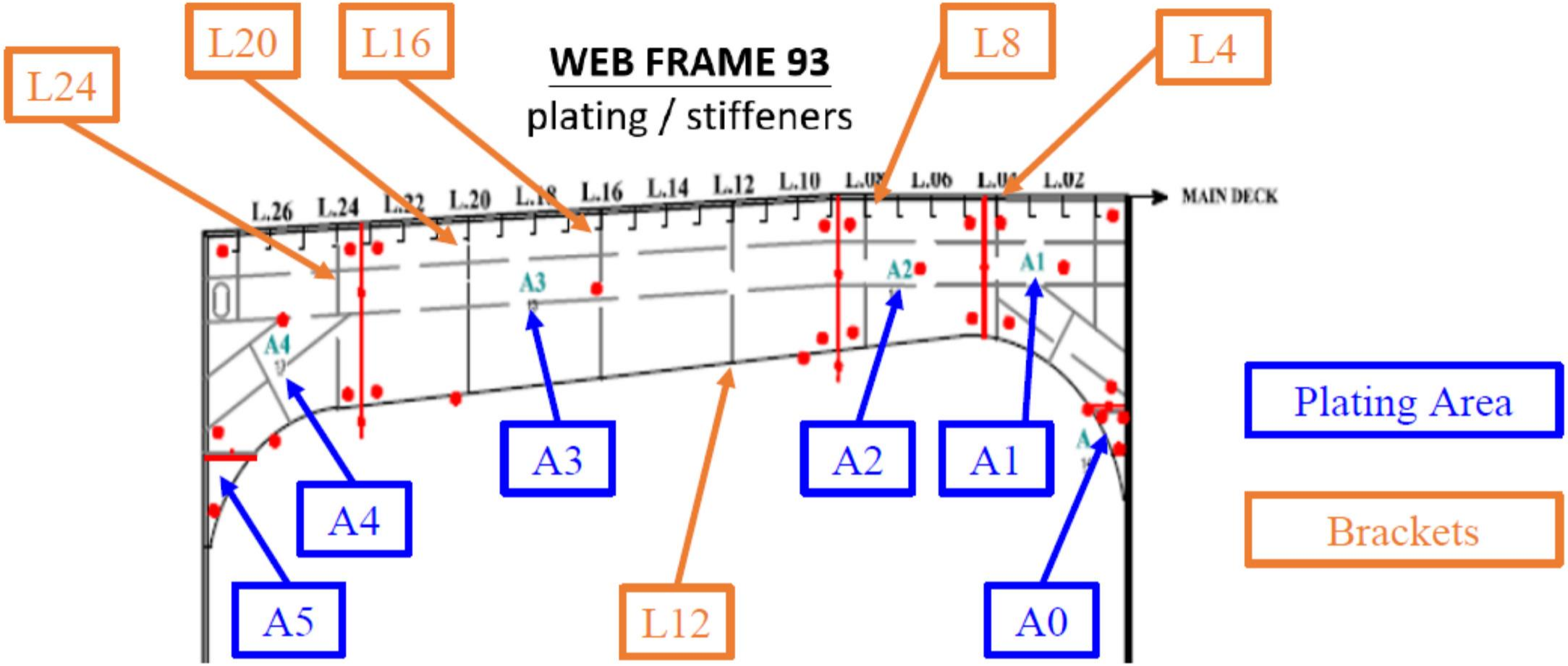
Application for FPSO's



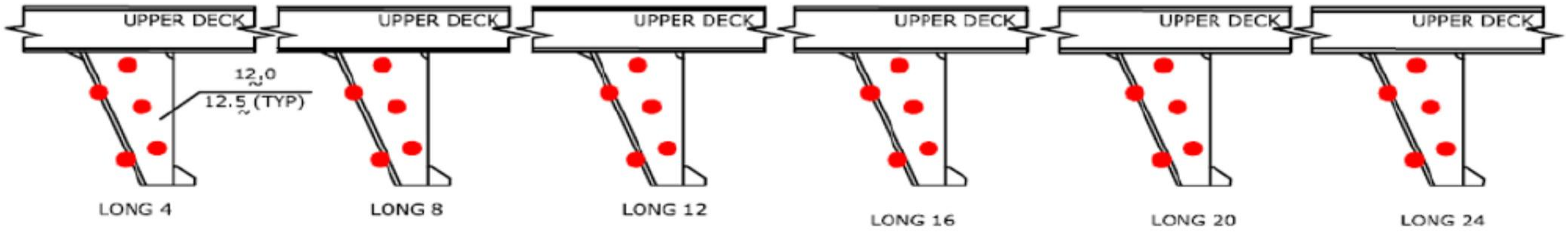
Deck Trans

Flat Wall

Deck Longitudinal Stiffener



UPPER DECK BRACKETS

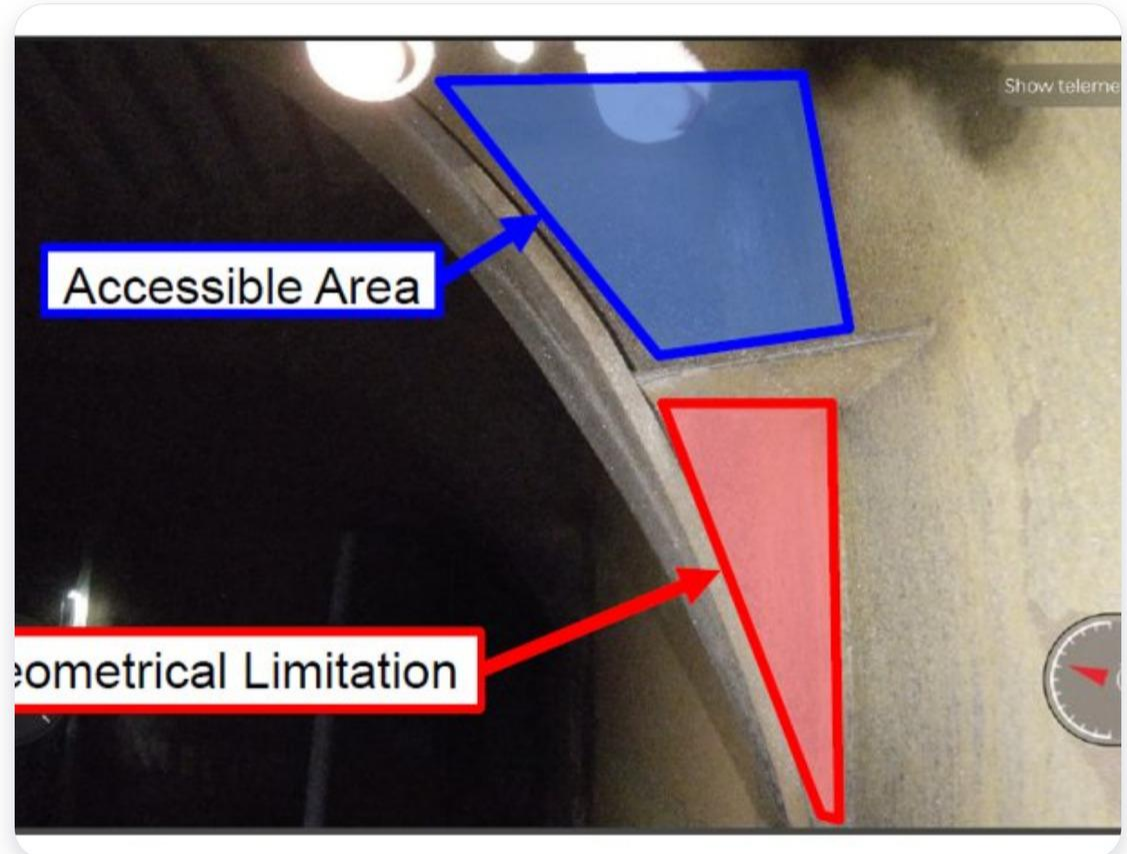


FROM ONSHORE TANKS TO FPSO'S

Implementation for FPSO applications

We learned that FPSO required additional functionality

- ⚠ **Huge tanks, battery life is an issue**
  → Solution: tether option for extended flight time
- ⚠ **Additional geometrical challenges (diagonal bars, pockets, coils)**
  → Solution: in-flight adjustable probe arm (reaches corners, flat walls, complex geometry)
- ⚠ **Advanced surface preparation**
  → Hammer module, scraper module
- ⚠ **Risk of hydrocarbon vapours**
  → Gas sensor

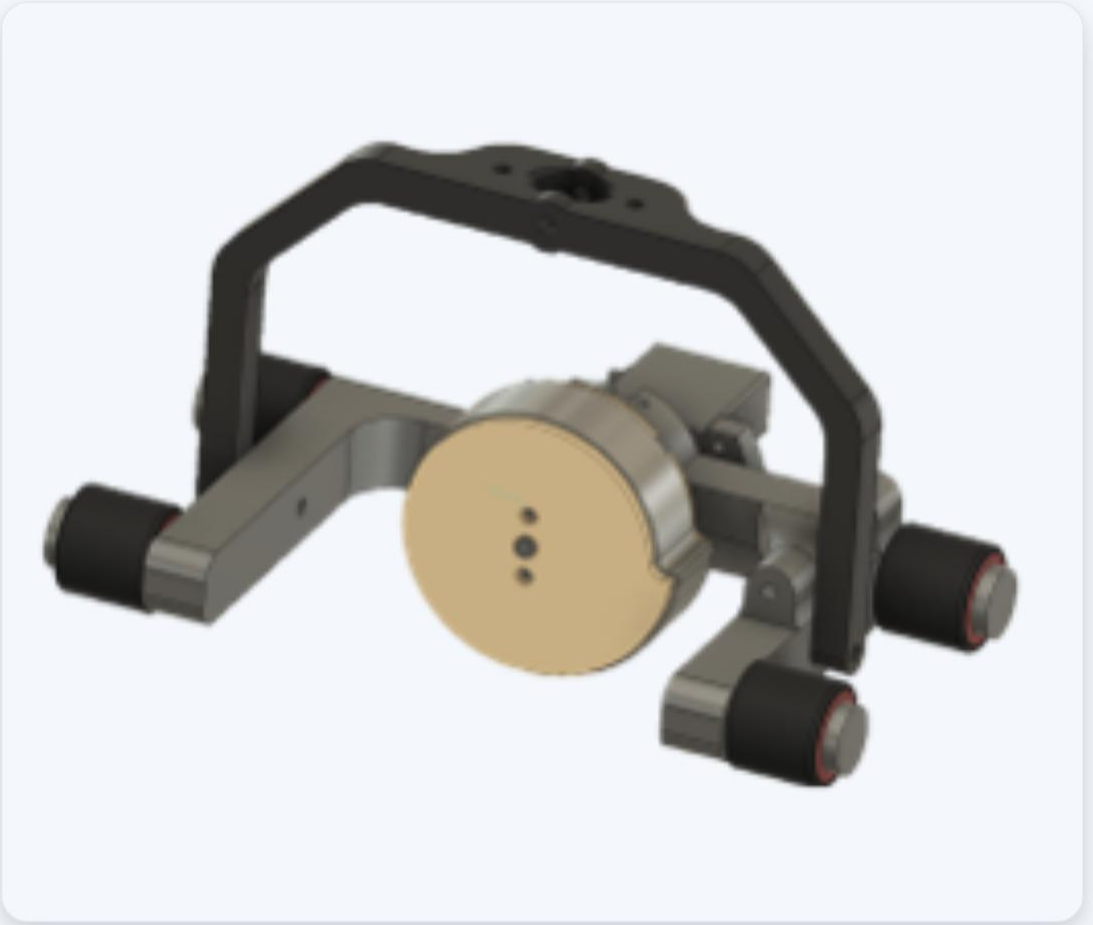


LESSON LEARNED: SCALING CAN BE REMOVED

Hammer module



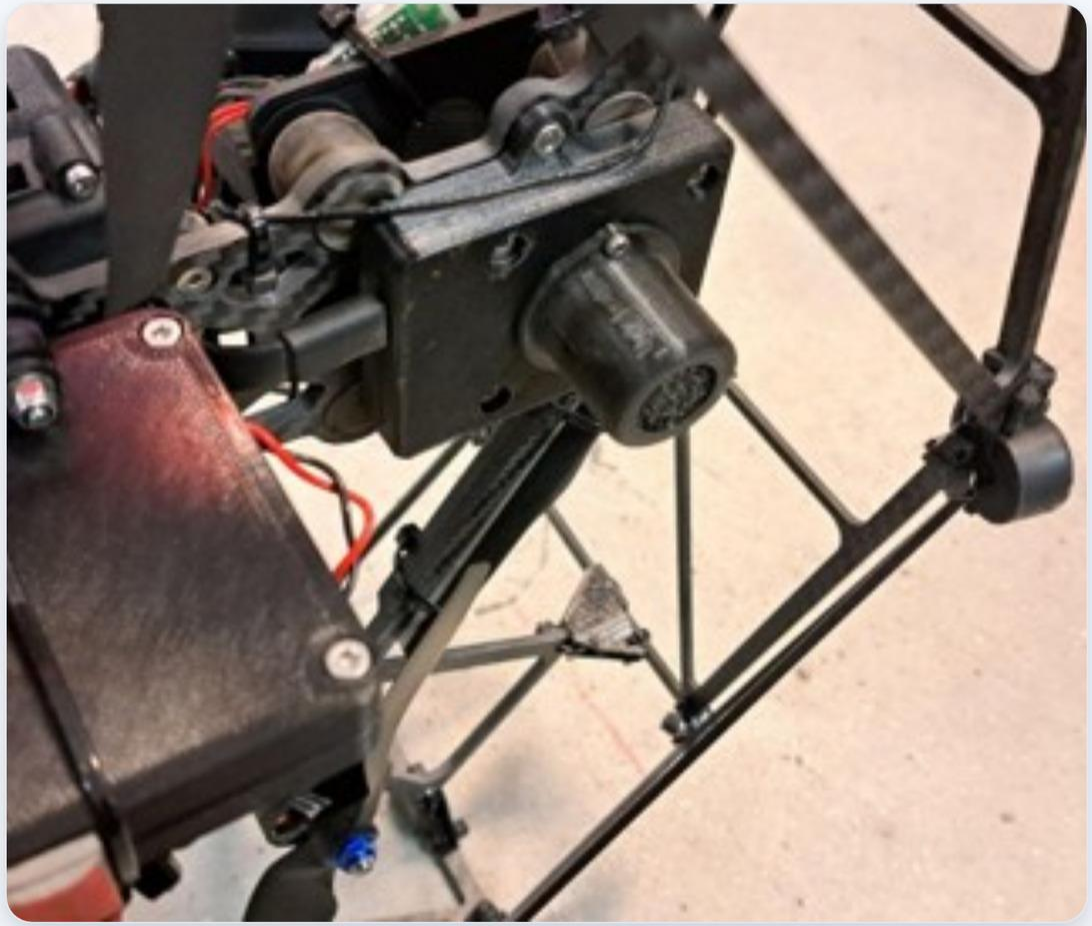
Hammer module in action



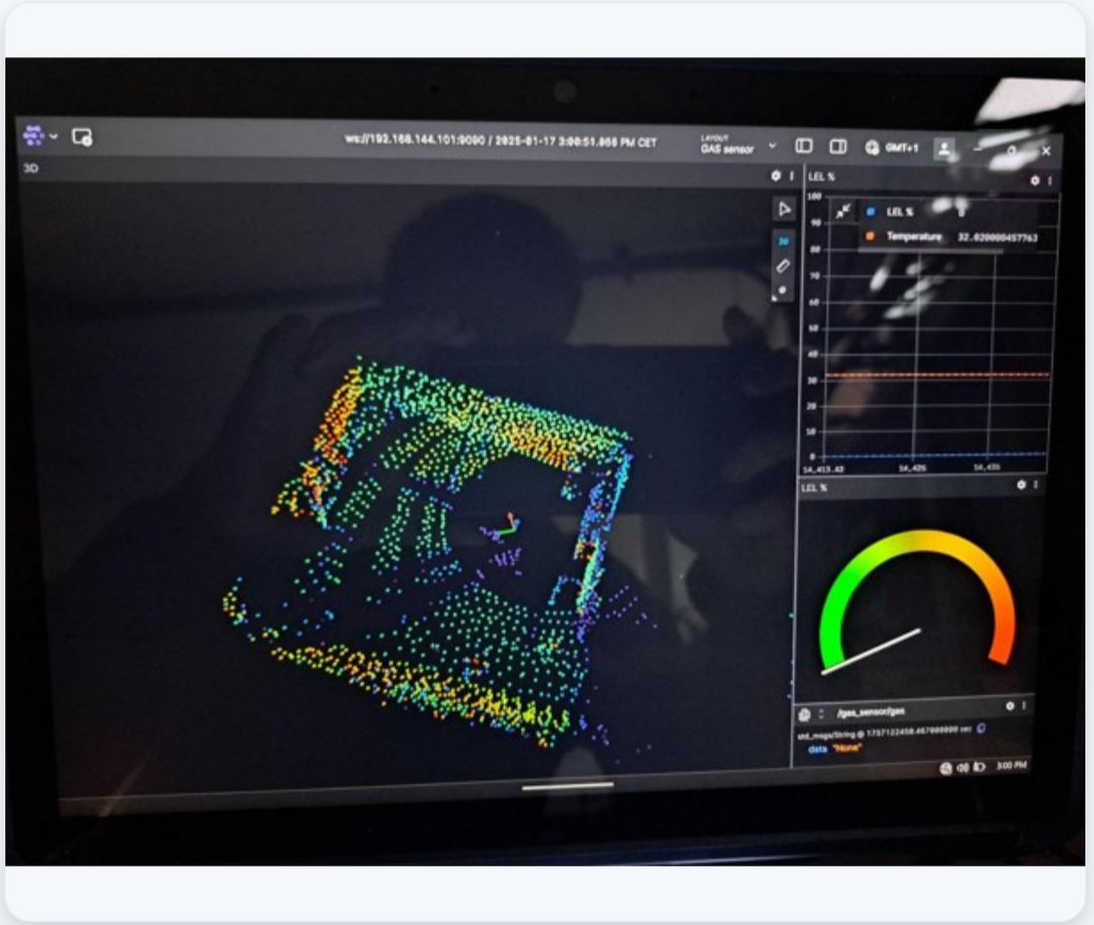
Hammer module

LESSON LEARNED: SCALING CAN BE REMOVED

Gas detector



Live gas-sensor readout (LEL %)



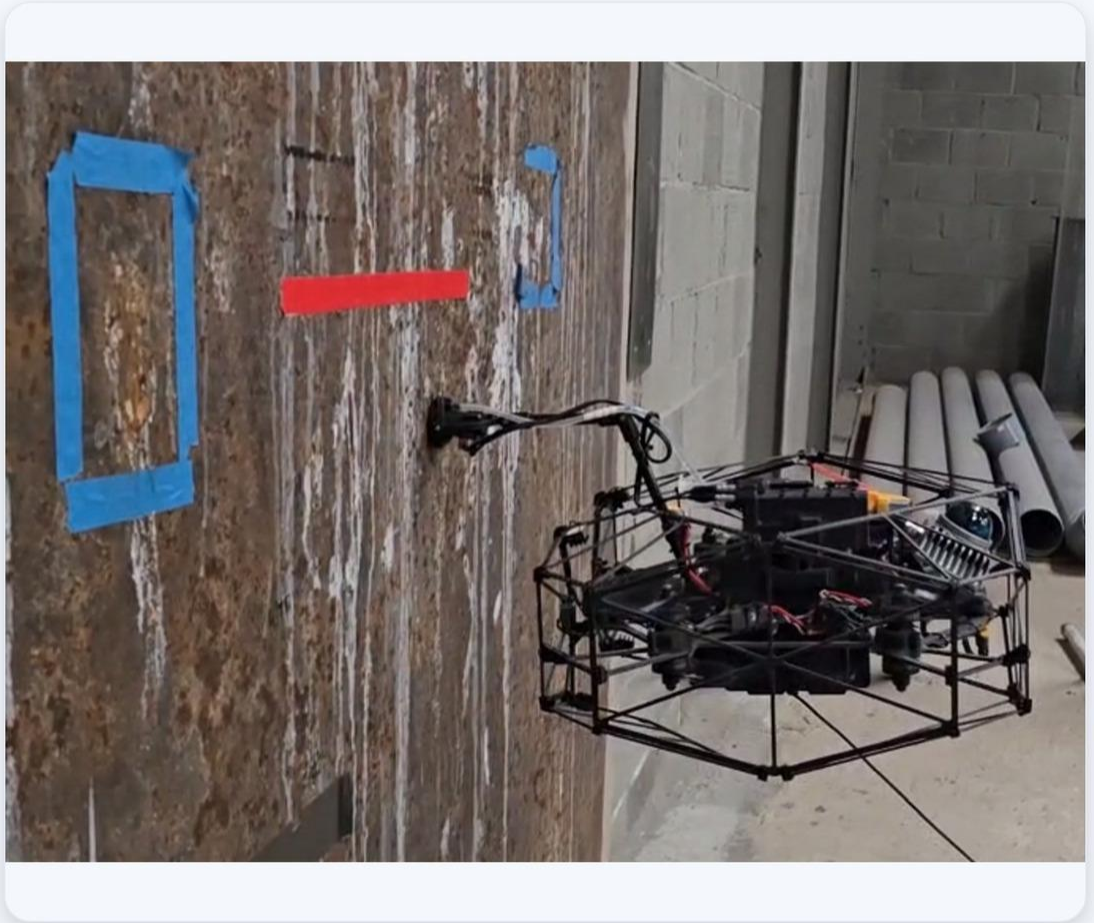
Gas sensor mounted on the platform

LESSON LEARNED: 10 MINS FLIGHT TIME IS NOT ENOUGH FOR BIG FPSO TANKS

Tether module



Tether ground station



Tethered drone

TRACK RECORD · 2024–2026

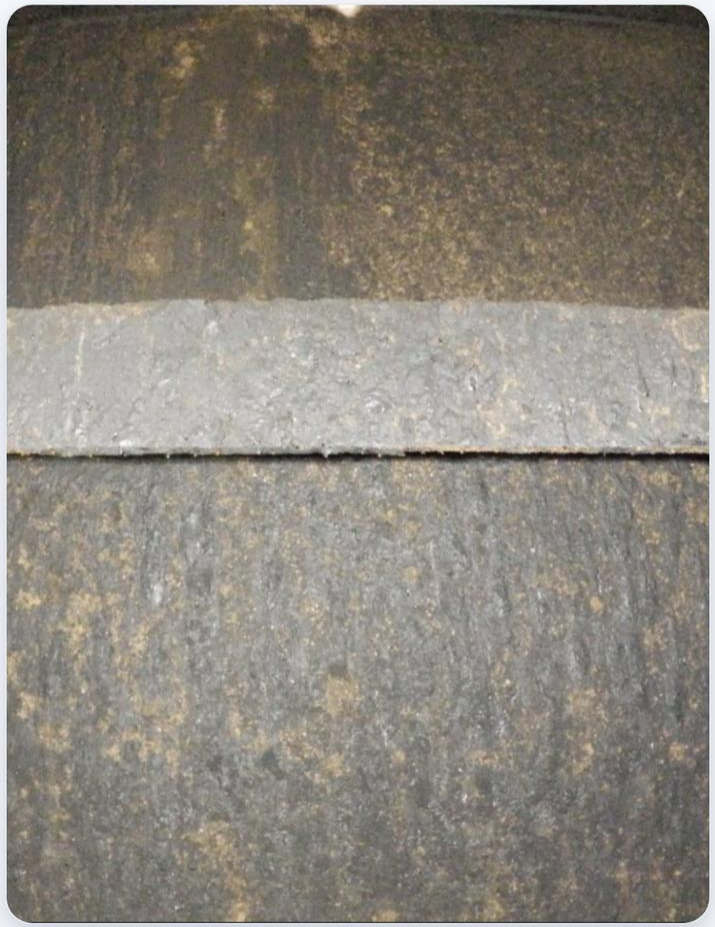
32 mobilizations, five regions, zero accidents

Every campaign: two weeks, two persons on board. Combined visual (CVI/GVI) + ultrasonic thickness (UTM).

YEAR	REGION	SCOPE	MOBILIZATIONS	CLASS
2026	Angola offshore	COT + WBT, CVI+UTM	3	BV
2026	Brazil offshore	COT + WBT, CVI+UTM	4	ABS
2026	Gulf of Mexico	COT, CVI+UTM	2	DNV
2025	Angola offshore	COT + WBT, CVI+UTM	2	BV
2025	Gabon offshore	COT + WBT, CVI+UTM	1	DNV
2025	Senegal offshore	Outdoor drone survey, CVI	2	—
2025	Brazil offshore	COT + WBT, CVI+UTM	4	ABS
2025	Gulf of Mexico	COT + Ballast, CVI+UTM	2	DNV
2024	Angola offshore	COT + WBT, CVI+UTM	1	—
2024	Gabon offshore	COT + WBT, CVI+UTM	1	DNV
2024	Brazil offshore	COT + WBT, CVI+UTM	4	ABS
2024	Gulf of Mexico	COT + Ballast, CVI+UTM	2	DNV
2024	North Sea offshore	COT + WBT, CVI+UTM	4	DNV

LESSON LEARNED: TANK CLEANLINESS

Surface condition affects inspection speed * 10



Hard scale due to oxidation (bad)



residual oil film (good)



Clean condition (excellent)

LESSON LEARNED: TANK CLEANLINESS

Bottom sludge





bottom with good cleaning condition.





bottom with oil sludge.

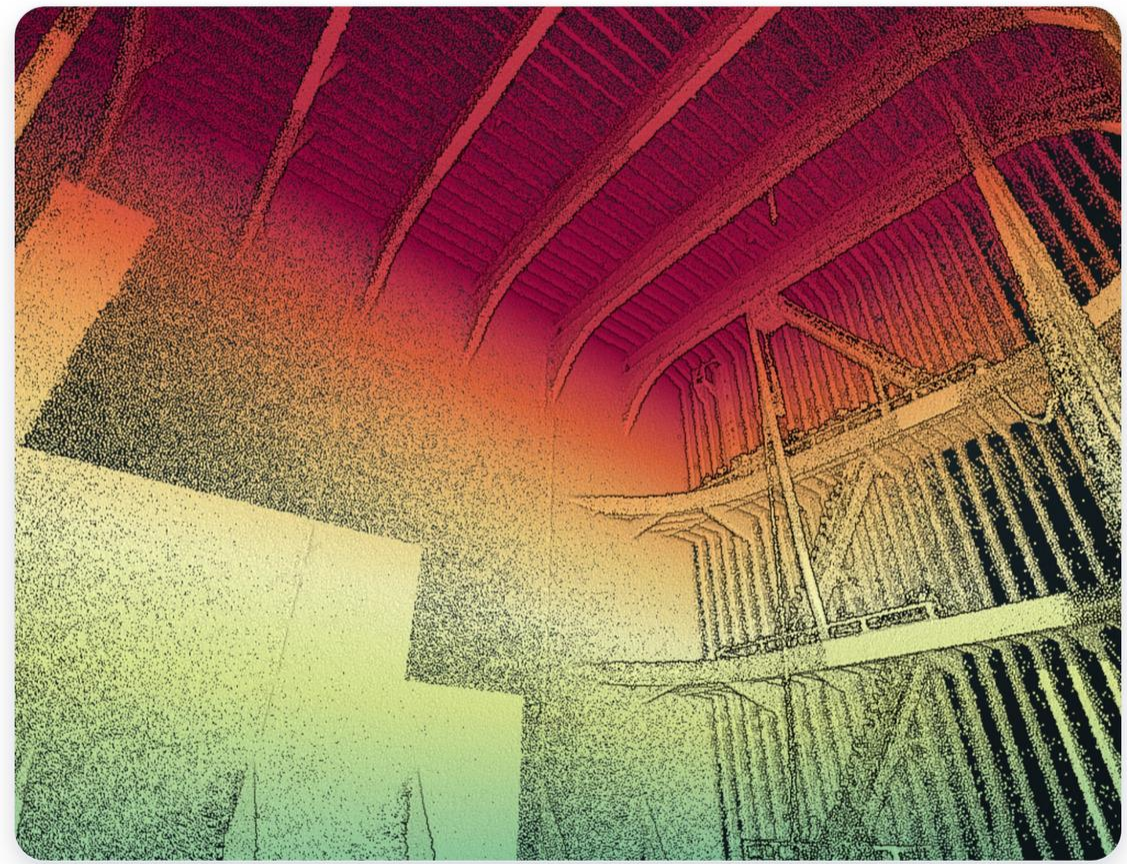
3D INSPECT PLATFORM

Real world examples

Report, inspection data, original video and UT readings — all in one environment.

- ✓ Point-cloud model + per-frame condition data
- ✓ Original footage layered on the model
- ✓ Client, engineer & surveyor, same view
- ✓ Review a whole tank without entering it

Example report



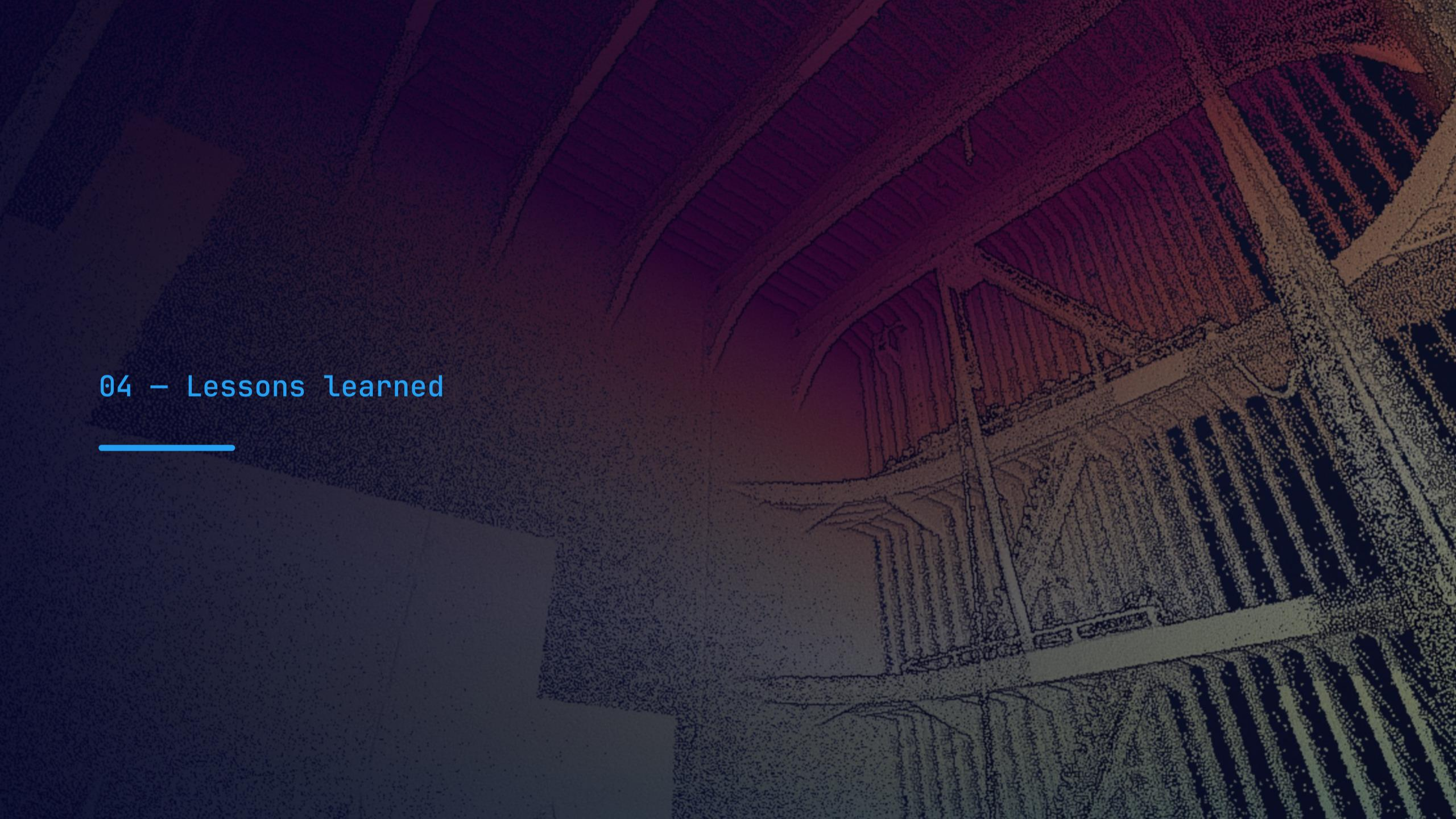
GENERAL STATISTICS · 100+ REPORTS REVIEWED

General finding from our practice

Good

The large majority come back rated Good, with nothing further to say.

Anode depletion / missing anodes	most common
Coating degradation / blistering	common · Fair
Localized corrosion, real material loss	only via re-measure
Confirmed crack, closed by NDT	1 case
Suspicious area needing escalation	a handful
Visual & UT disagreeing at a point	≥ 1 · run both
Tank too dirty for UT to work	1 case



04 — Lessons learned

LESSONS LEARNED SUMMMARY

Technical & operational

Cleanliness = inspection time

Drones can do advanced surface preparation, but it slows down the inspection process very much.

90%+ from the drone

The last few percent: a 3 pax team that can do drone inspection + rope-access as backup.

1 COT Tank = 1 week

Roughly a team of 2 operators can inspect a typical COT tank in a few days, so a full mobilisation takes roughly a week.

Hard physical limits

Tank-bottom sludge no drone can clean; occasional stuck drones. Plan and budget for both.

Complex geometry

Corners, brackets and stiffeners are why the adjustable probe arm matters. Also heating coils can be a challenge.

Entry vs non-entry

Manned enty speeds up drone inspection a lot. Operating from outside the tank might be Atex issue because deck is Atex zone 1.

LESSONS · LOGISTICS

50%

of what makes a project succeed or fail is logistics — not flying.

Batteries are hard to ship

Banned on many helicopters — often shipped in advance by vessel through a different chain. A delay there delays everything.

Six-plus hours by boat

In some countries helicopter transports are banned altogether. So all equipment ánd personell has to be shippen by 6 hour+ vessel trips.

Local partners de-risk it

Customs, transport routes, aviation regulation and permitting knowledge — local partners or clients support + good preparation are vital for offshore operations.

05 — LOOKING AHEAD

Future developments

Ex-proof ground station

Opens operating envelopes currently off-limits.

EMAT sensor

Technology works. Class approval in progress

High temperature environment

Execution in high temperature environment (up to 70 degrees)

Drone in a box

Permanent drone presence at vessel, operation from onshore. Thus zero POB.

In progress — not shipping next month.

KEY TAKEAWAYS

Mature technology — proven result

- **Class-recognized** alternative to rope access.
- **Safer & faster**, with lower POB cost.
- **90%+ from the drone**; 100% with a hybrid team.
- **Logistics, prep, people, trust** matter as much as hardware.

A GENUINE QUESTION

Where do you see opportunities for Remote Inspection Techniques in your own operations?

THANK YOU

Questions?

Steven Verver · Terra Inspectioneering

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Terra Inspectioneering