



# **ASSET INTEGRITY MANAGEMENT (AIM) SOLUTIONS FOR FLOATING ASSETS**

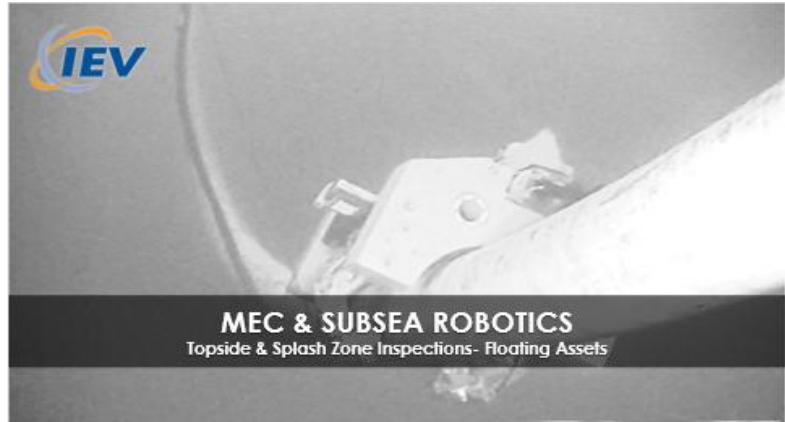
IEV CAPABILITIES STATEMENT



**Combining Disruptive Technologies and  
Proven Engineering Capabilities**

# AIM - FLOATING ASSETS - DASHBOARD

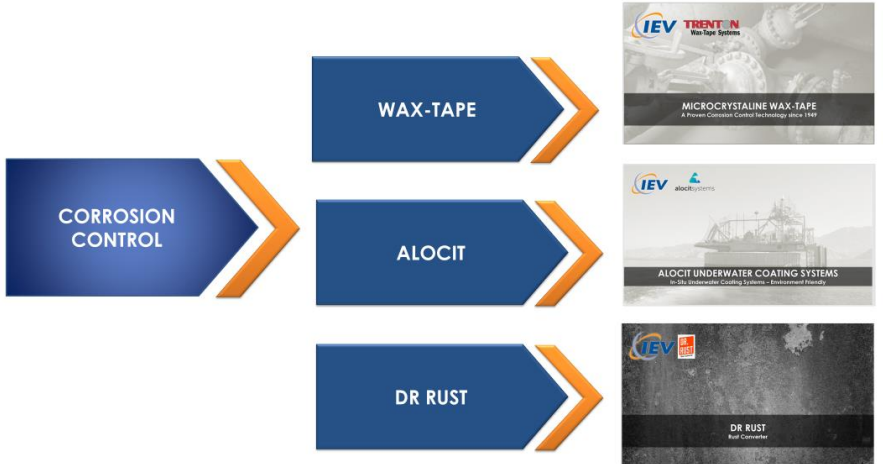
## ADVANCED INSPECTION



## FABRIC MAINTENANCE



### AIM - FLOATING ASSETS – CORROSION CONTROL





# **MEC & SUBSEA ROBOTICS**

**Topside & Splash Zone Inspections- Floating Assets**

# MEC & SUBSEA ROBOTICS: INTRODUCTION

*Offering safer operations, operational cost reduction & lower carbon footprint*, the robotic crawlers and subsea tooling have been developed and used to carry specific tasks on subsea pipelines, both rigid and flexible risers and structures.

## Target Applications

### Topside

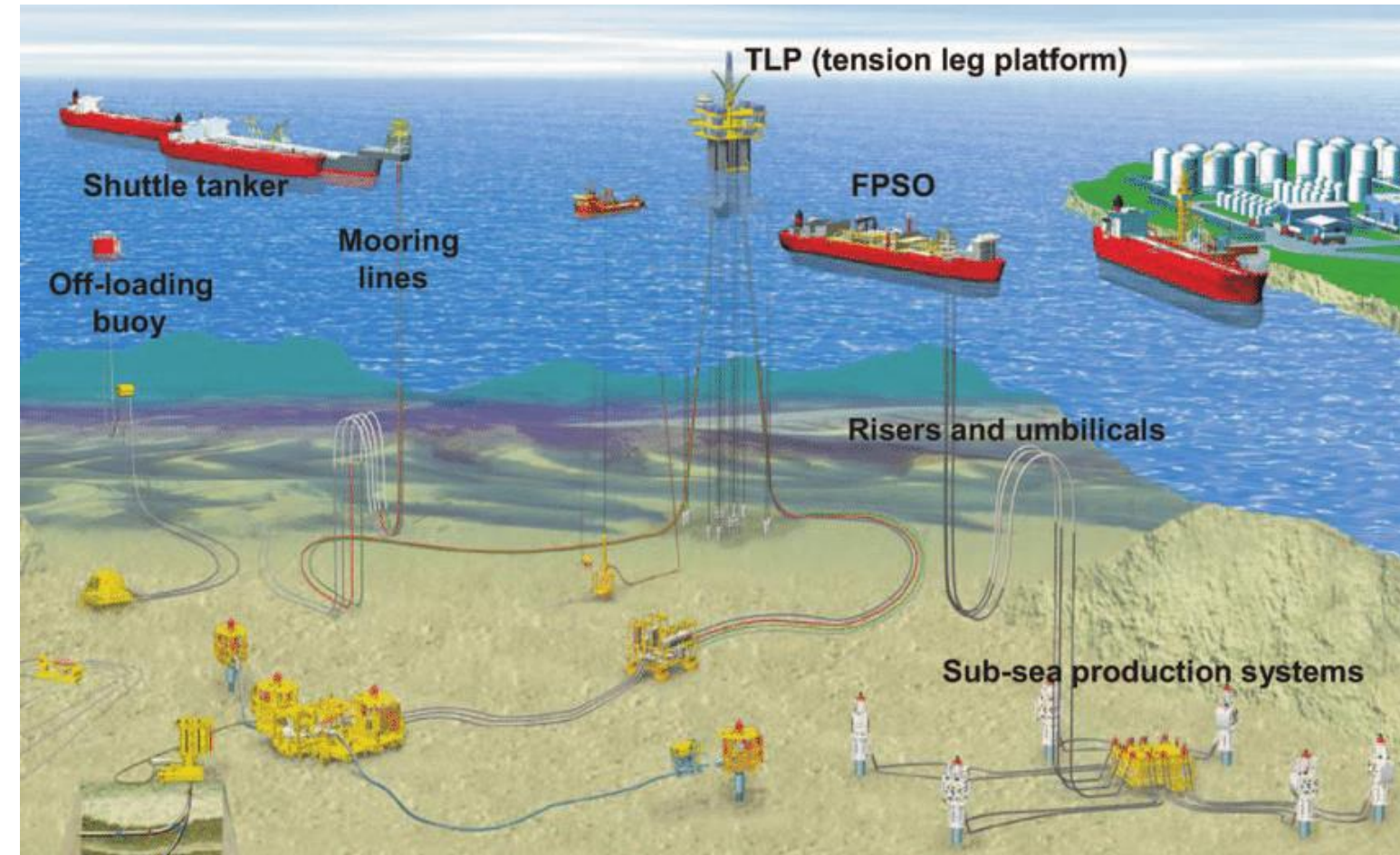
- Pressure Vessels
- Piping

### Splash Zone

- Risers
- Caissons
- Conductors
- Flex Joint
- Fairleads
- Mooring Chains
- Tension Legs
- Hulls
- Cargo and Ballast Tanks
- Spider Buoys

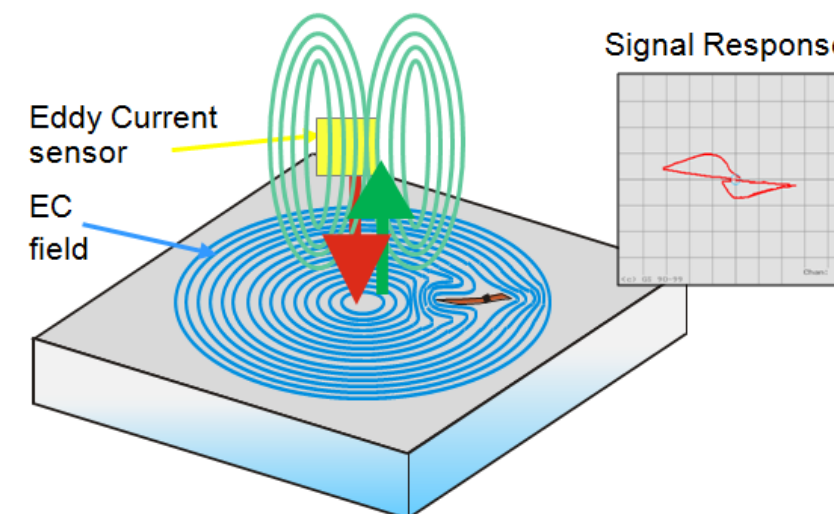
## Inspection Tasks

- ✓ Corrosion mapping
- ✓ MIC – Microbiological Corrosion detection
- ✓ CUI – Corrosion Under Insulation detection
- ✓ Insulated and Coated lines Corrosion mapping
- ✓ Caviblaster and HPWJ Cleaning
- ✓ Visual inspection (GVI/CVI)
- ✓ NDT Inspection above/below water
- ✓ Screening and Quantitative Inspection
- ✓ Flexible Risers flooded annulus detection
- ✓ Flexible Riser armor defects mapping
- ✓ Automated Subsea Inspection
- ✓ Bends Inspection
- ✓ Photogrammetry
- ✓ Measurements
- ✓ 3D modeling
- ✓ Life Extension
- ✓ Weld Inspection
- ✓ Critical Girth Weld inspection
- ✓ Tension Leg Girth Weld inspection
- ✓ Flow Assurance
- ✓ Emission Monitoring
- ✓ Oil pollution and emission detection

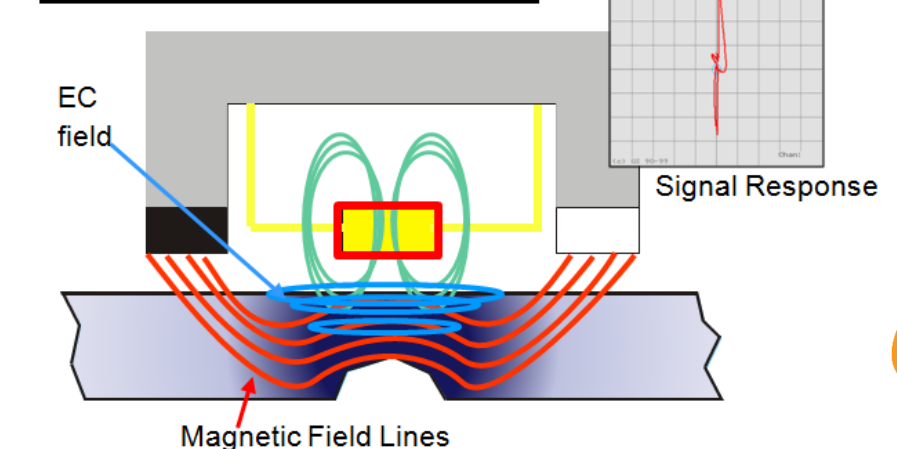


## Magnetic Eddy Current (MEC) Technology

The signal information (amplitude, phase, shape) provides online analyzable details related to **WALL LOSS**, **SIZE OF THE DEFECT** and **POSITION**.



## Detection of far side defects

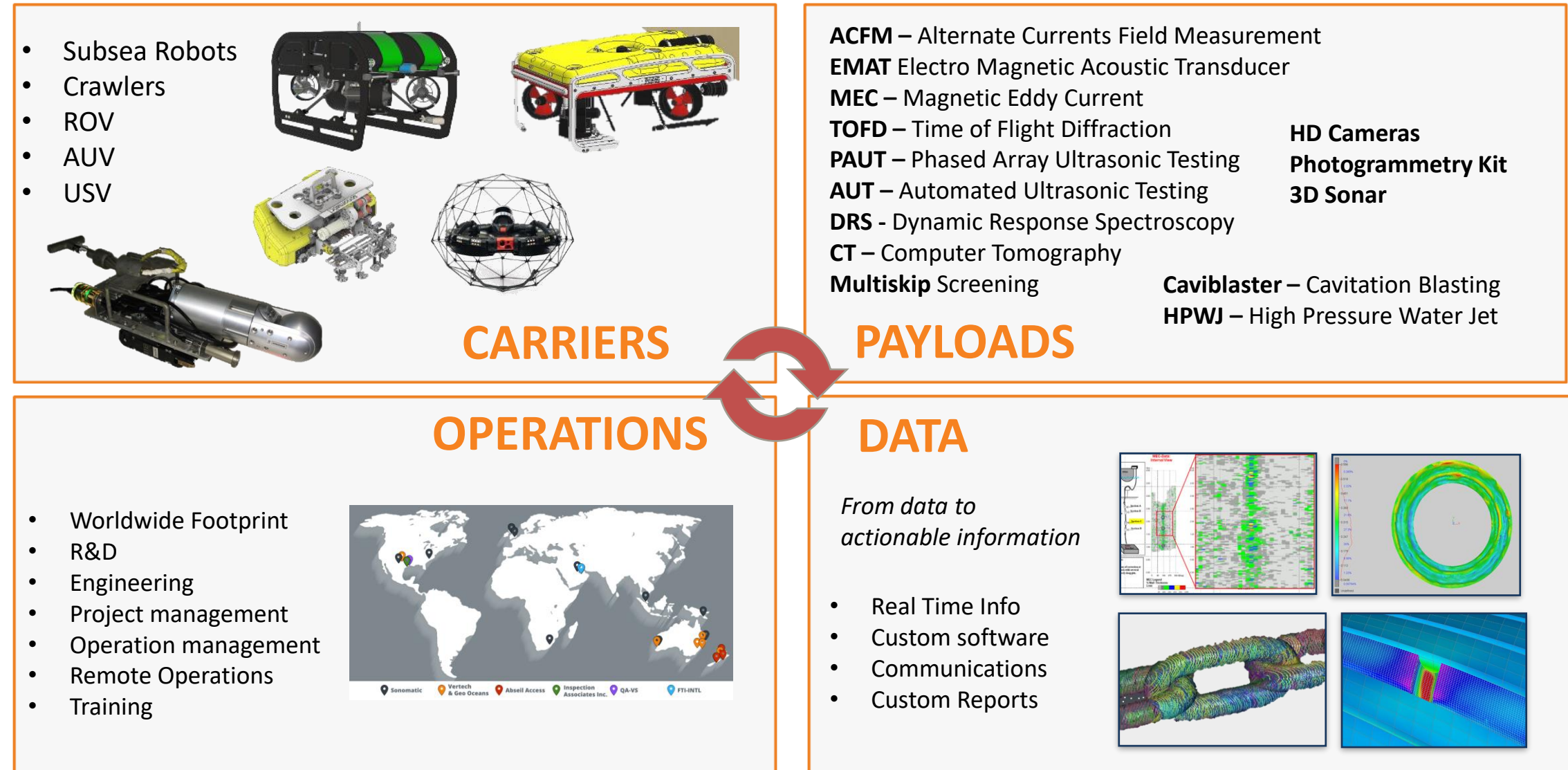


# MEC & SUBSEA ROBOTICS: VALUE PROPOSITION

## Offers the following:

- ✓ Platform based solutions
- ✓ Specialised inspection robots
- ✓ Resident vehicles
- ✓ Shared toolbox
- ✓ Rapidly deployable assets
- ✓ Remote operations
- ✓ Combination crawler/ ROV
- ✓ Bespoke inspection technique

- MEC and PECT are **complementary** and **redundant** techniques to increase the accuracy of the detection and **reduce false positive**.
- The MEC technique with its **accuracy and speed is more efficient and covers more area in a shorter time** as compared with conventional radiography.
- MEC is the tool of choice for straight pipe runs. However for complex geometries like pipe bends, PECT technology complements MEC and also provide redundancy.

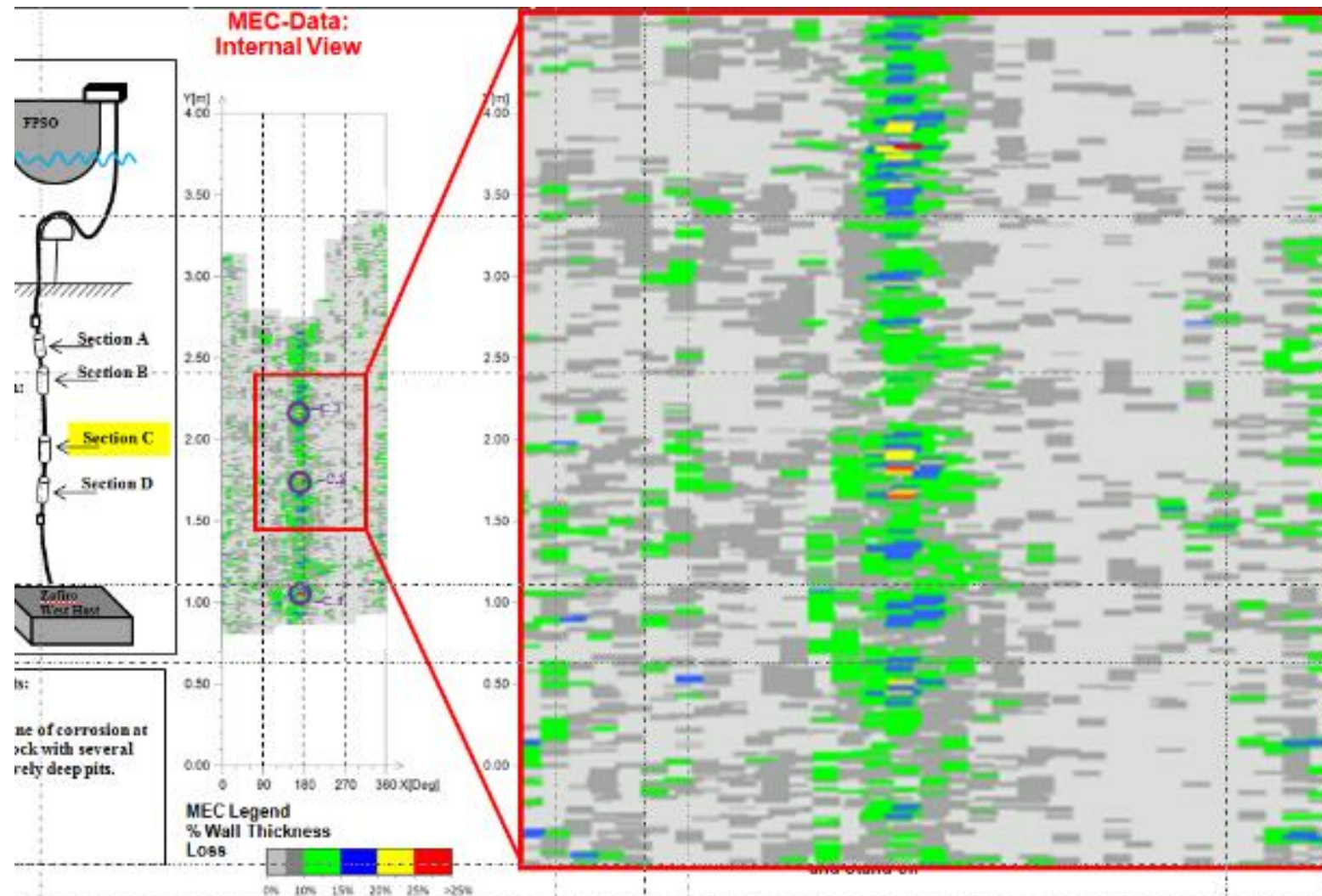


	MEC Technology	PECT Technology
<b>Speed</b>	High - as fast scanning (1ft/sec)	Low – as static measurement (2 sec each)
<b>Resolution</b>	Axial: $\geq 2\text{mm}$ (5/64"), Circumference : $\geq 10\text{mm}$ (0.39")	General : $\geq 50\text{mm} \times 50\text{mm}$ (2" x 2")
<b>Accuracy</b>	Range: +/- 10% (to potential +/- 5%)	Range $\geq$ +/- 10%
<b>Geometry reach</b>	Straight pipe areas	Straight and bend pipe areas

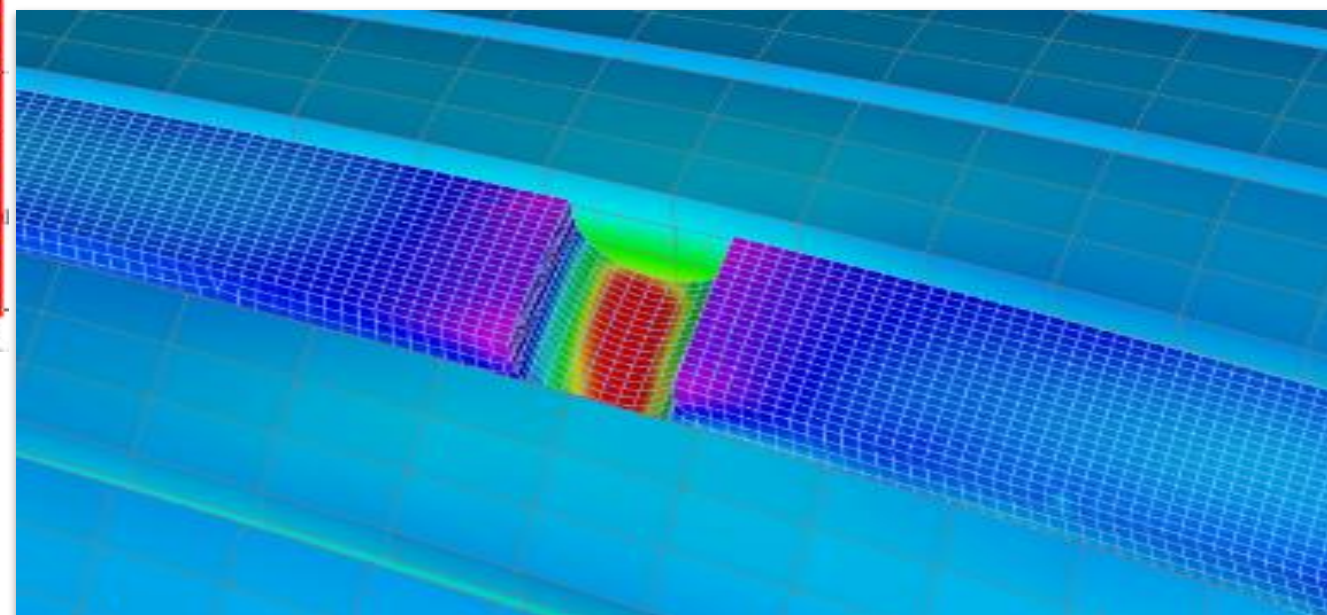
# MEC & SUBSEA ROBOTICS: TECHNOLOGY

## MEC – MAGNETIC EDDY CURRENT

- The technique allows to **scan through coatings**. Its high resolution identifies small volumetric isolated pitting up to general wall loss from inside or outside of the wall.
- The technique **requires little to no preparation** scanning above and below water with high speed and high accuracy.
- Well usable as fast scanning and mapping technique for **larger areas and distances in short time** above and below water.



Indication	EL [m]	Orientation [deg]	Length [mm]	Width [mm]	Surface Location	Max. Wall Loss [%]	Description
1	0.80	105	200	60	external	25	
2	-3.20	230	20	20	internal	20	
6	-6.00	170	50	30	internal	40	
7	-6.45	220	30	40	internal	45	
8	-6.70	50	50	50	internal	45	
9	-6.85	220	30	30	internal	50	
10	-6.90	240	25	30	internal	55	



Displaying c-scan mapping of the **internal** and **external** wall condition **separate** as well as **combined** is possible as well as **individual** defect sizing.

## MEC Offers:-

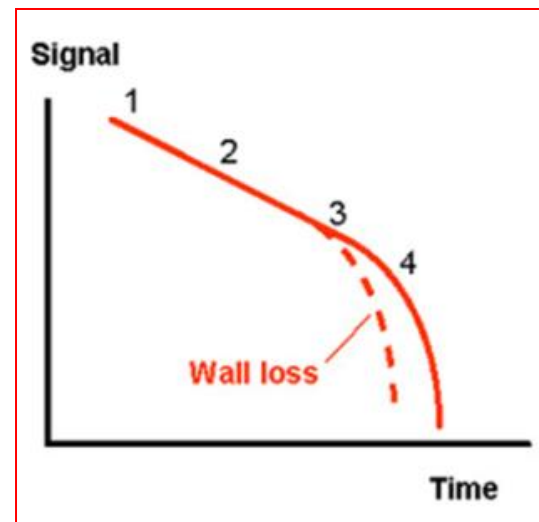
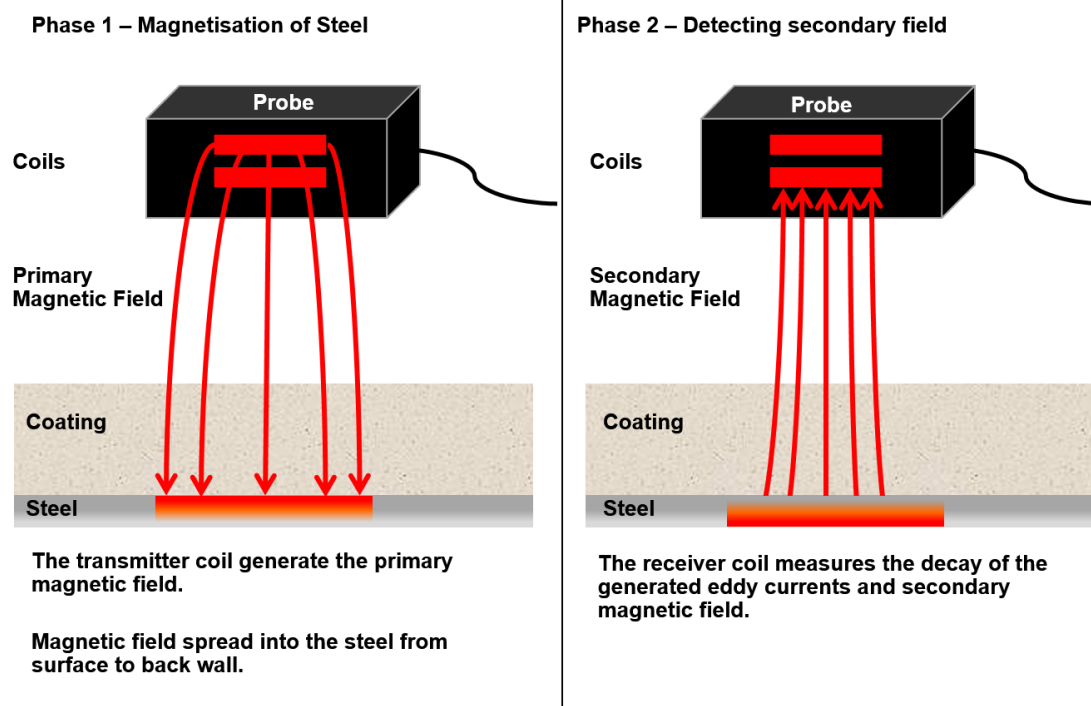
- IN-SERVICE INSPECTIONS
- FAST SCANNING
- INSPECT THROUGH VARIOUS TYPES OF COATINGS
- LOW INSPECTION PREPARATIONS
- HIGH POD - PROBABILITY OF DETECTION
- HIGH ACCURACY
- HIGH SENSITIVITY
- INTERNAL/EXTERNAL DEFECTS DIFFERENTIATION
- DETECTION OF ISOLATED PITS, CORROSION AREAS, CRACKS
- C-SCAN WITH MAPPING
- COST EFFECTIVE

# MEC & SUBSEA ROBOTICS: TECHNOLOGY

## PECT – PULSED EDDY CURRENT TESTING

The Pulsed Eddy Current Technique is a static type electromagnetic measurement technique.

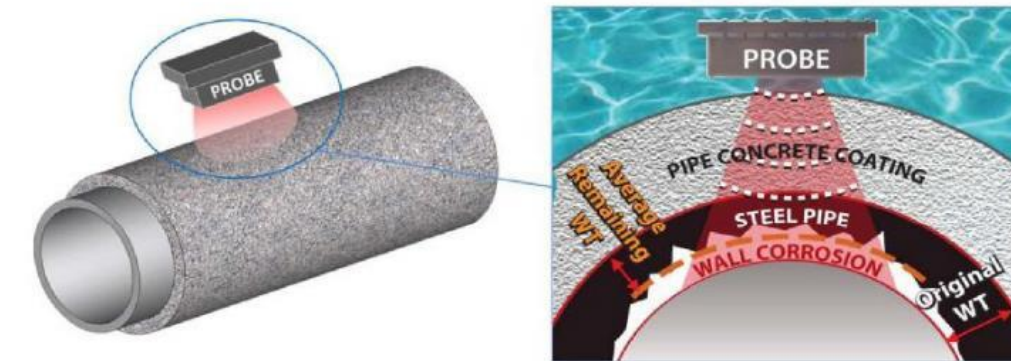
The sensor placed at the point to be inspected (footprint) generates electromagnetic pulses to the steel to be inspected. The pulsed primary field generates an eddy current field in the material which responds with a secondary field. In case of wall loss area larger than 10% than the footprint, the receiver coil measures the decay of the secondary field with a decreased response time which demonstrates wall loss.



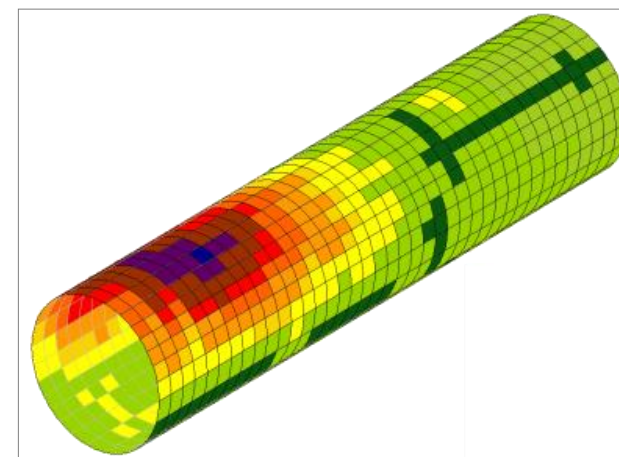
This PEC inspection is capable to be performed through thick coatings or insulations of up to 8". As an electromagnetic technique it won't require preparation or coating removal.

### PECT is used on:

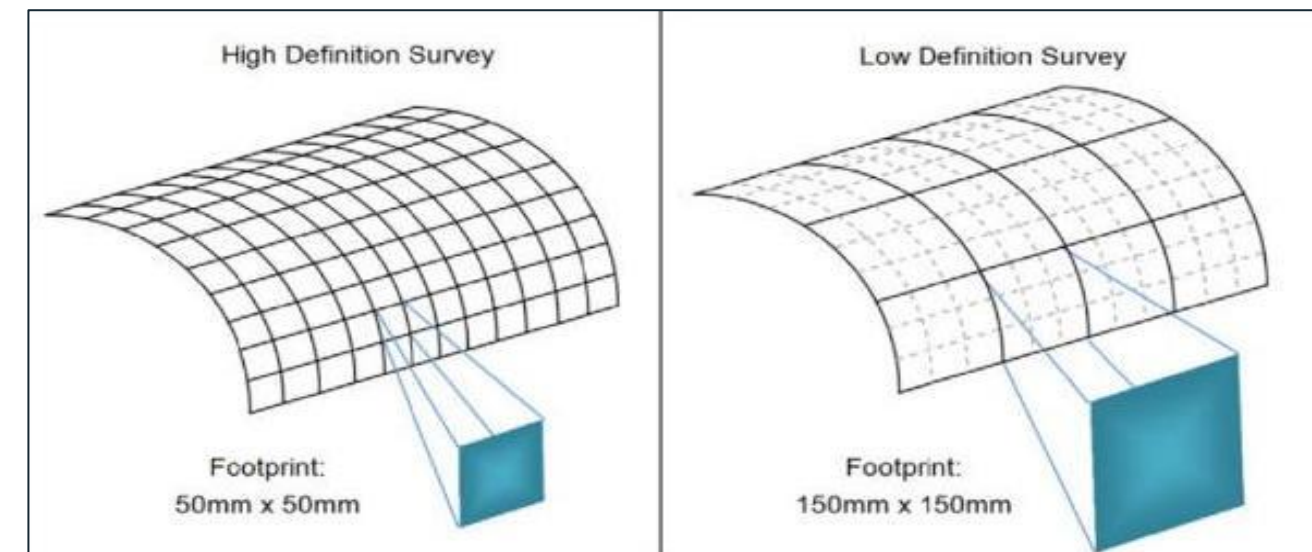
- Non-metallic pipe protection (concrete, composite wraps, coatings, and more)
- External corrosion product as blisters
- Corrosion under insulation (CUI)
- Marine growth
- Limited access areas as elbows, supports, valves



The measurement in the footprint area provides an average wall loss information.



Color coded wall thickness readings are displayed on the laptop during data recording. An Excel file can be produced as well.



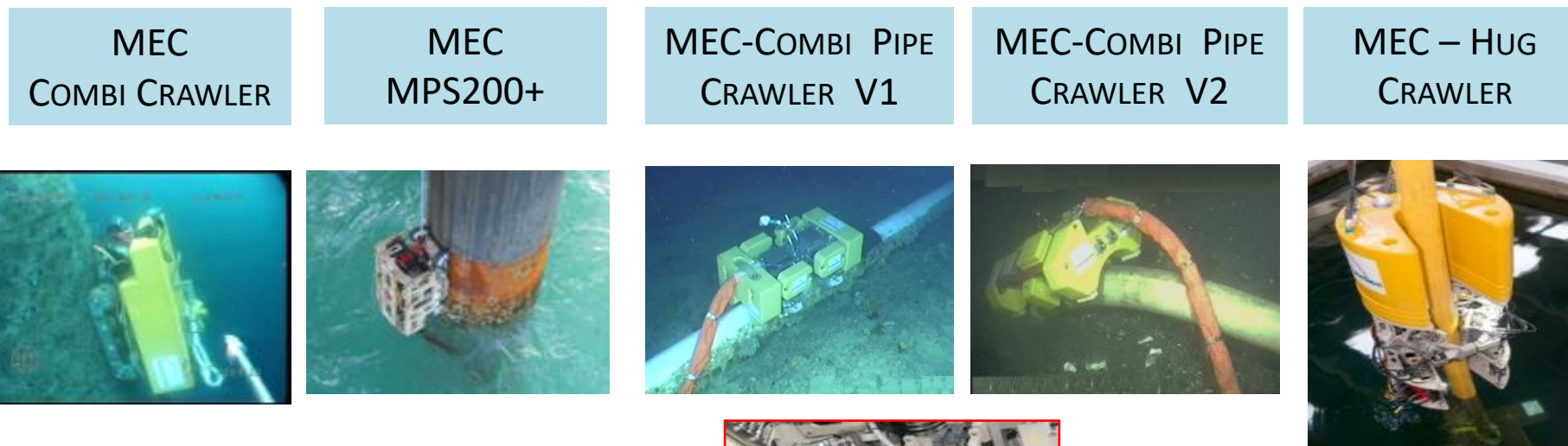
Acquisition can be performed in high and low resolution for fast screening.



# MEC & SUBSEA ROBOTICS: EQUIPMENT

## EQUIPMENT

### SUBSEA / SPLASH ZONE – MEC COMBI FAMILY



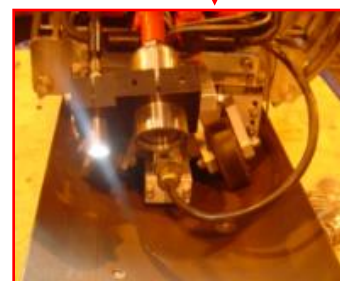
**CORE:** MEC Pole Shoe & Sensor Array

**FOCUS:** external/internal corrosion Mapping

ADD-ON Techniques for MEC-Combi concept



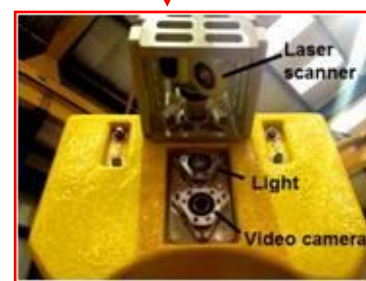
**UT Array**  
Absolute WT Mapping



**PEC**  
Average WT Mapping



**Eddy Current Array**  
Crack Detection



**Subsea Laser**  
Geometry Scan



**HD Camera**  
Visual Inspection

## APPLICATIONS

- Pipe OD : **2" to flat**
- Wall Thickness Range : **Up to 1 ½ "**
- Coating: **Up to ½ "**
- Length Range : **Not limited**;
- Temperature Range : **200°F / 90°C**
- Inspection Coverage : **360°** with multiple pass

## TYPICAL PERFORMANCES

- POD **>>95%**
- Ability to distinguish **internal/external** defects
- Fast scanning, max speed **90ft/min** (30m/min)
- Accuracy typical **+/- 10%**, (fine tune **+/- 5%**)
- Smallest Defect Size: **Ø 3mm**
- Resolution: **2mm** axial **10mm** circumferential
- Sizing Depth +/- 5% to **10%** of nominal Wall Thickness
- Wet/Dry inspection technique; no couplant and no coating removal required
- Capable of online pre-analysis of data with offline final data analysis

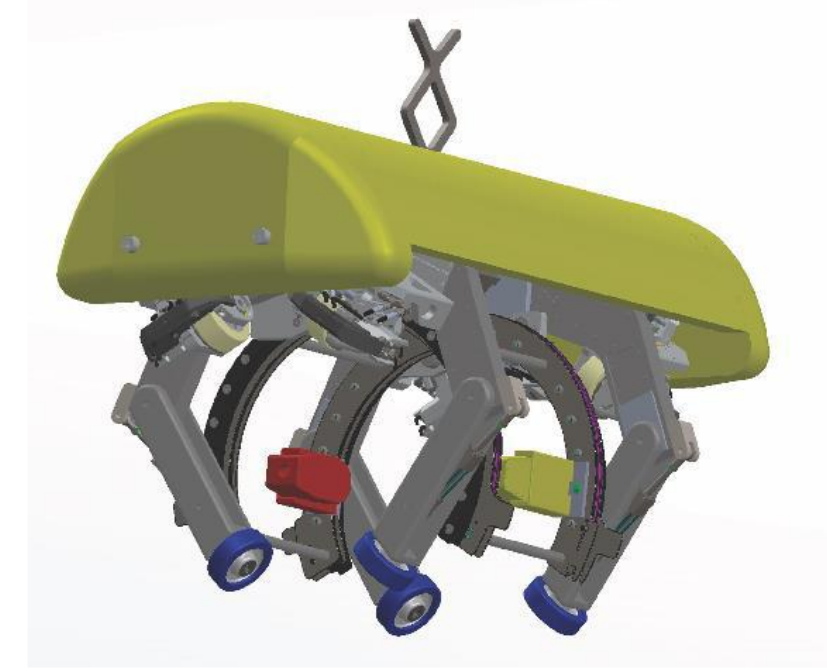
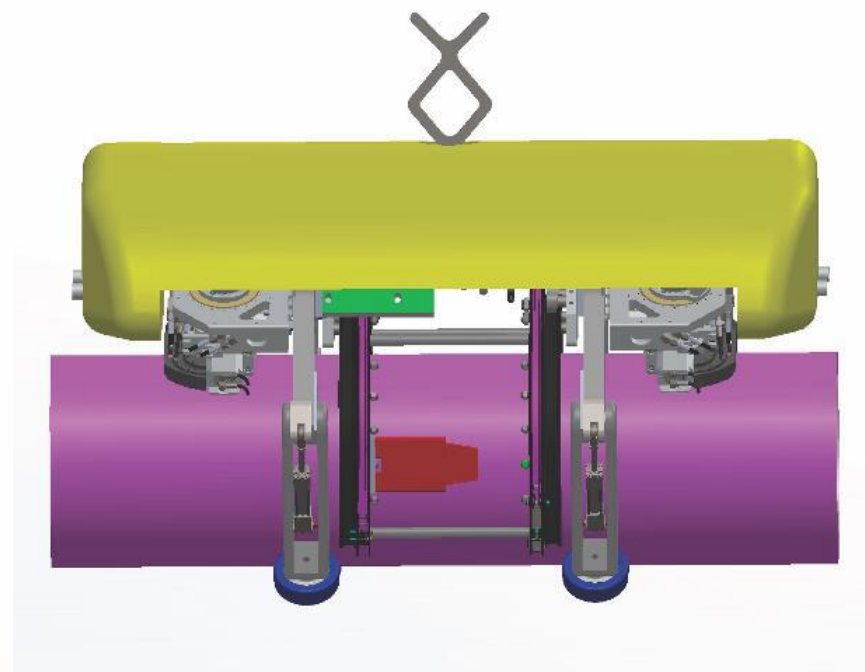
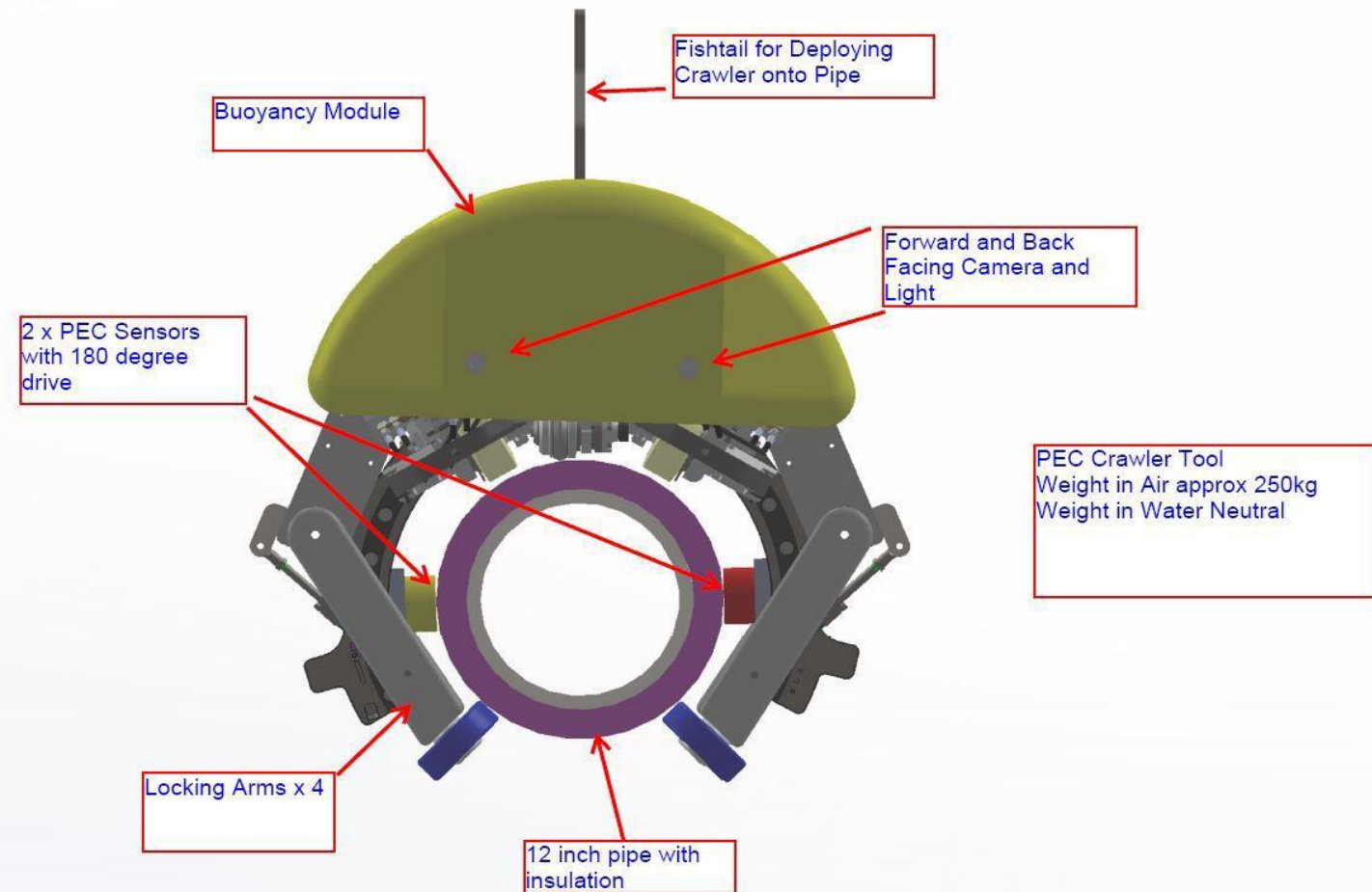
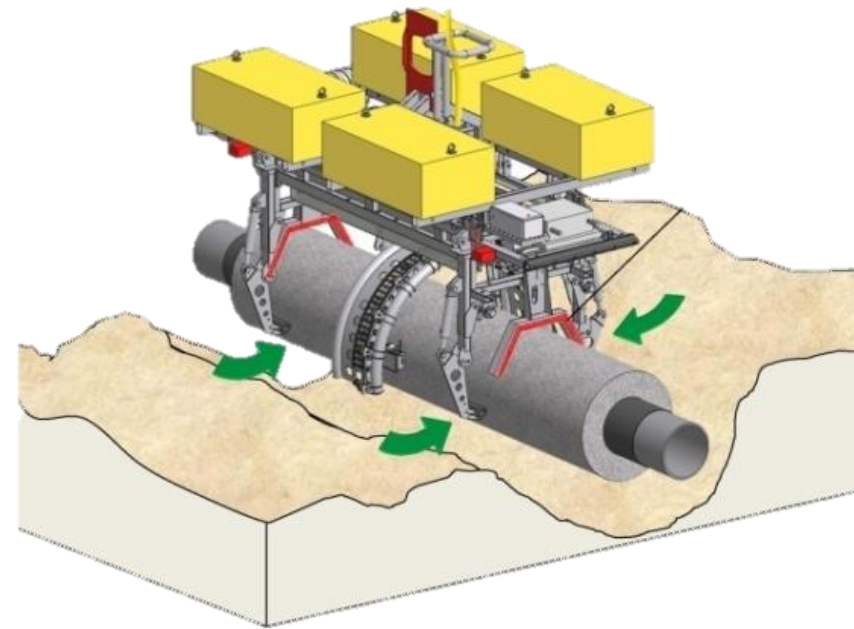
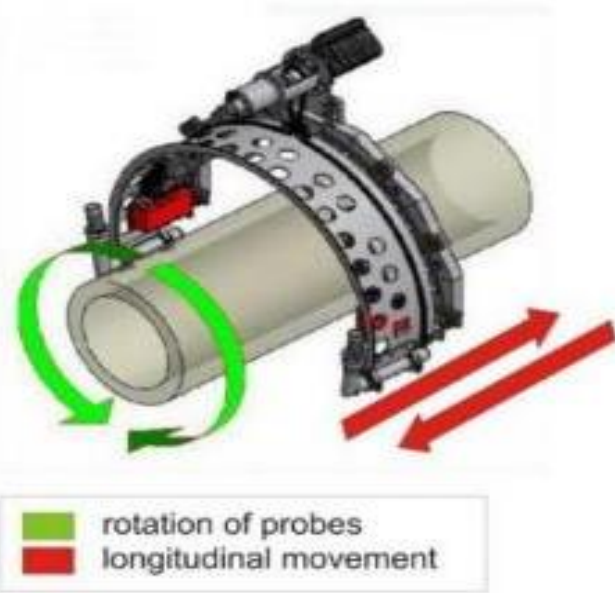
# MEC & SUBSEA ROBOTICS: EQUIPMENT

## EQUIPMENT

### SUBSEA / SPLASH ZONE – PEC CRAWLER

PEC - PULSED EDDY CURRENT

Multiple PEC probes on a ROV or Diver operated deployment frame.



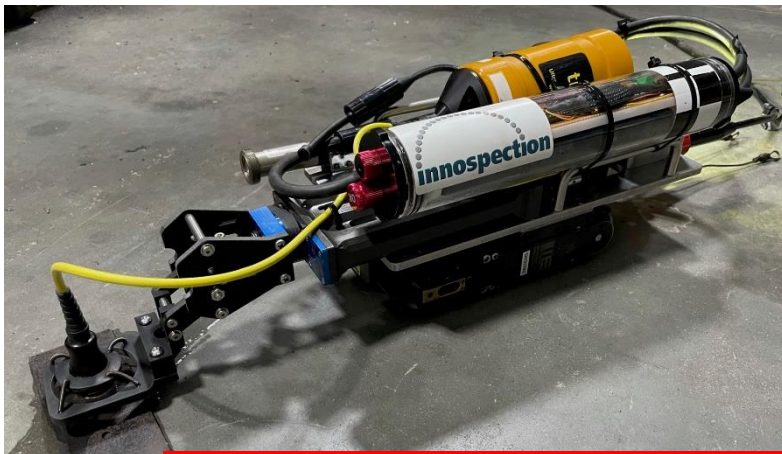
# MEC & SUBSEA ROBOTICS: EQUIPMENT

## EQUIPMENT

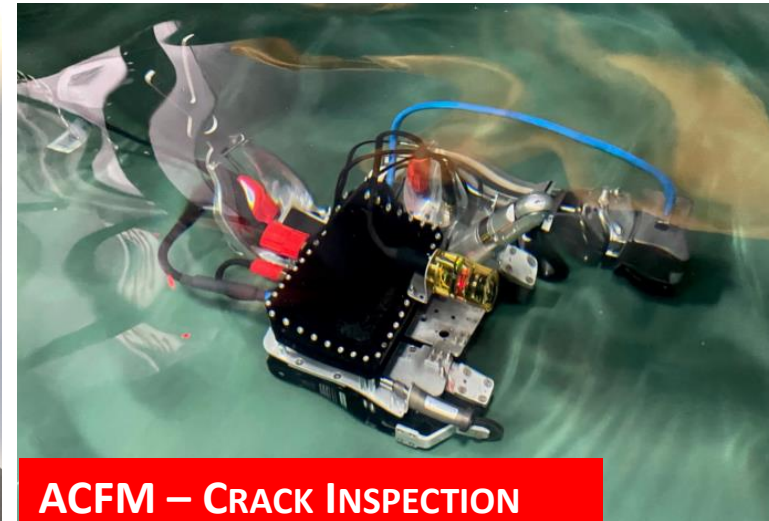
### SUBSEA / SPLASH ZONE ROBOTIC CRAWLERS



### GVI / CVI CONFIGURATION



### CAVIBLASTER CLEANING



### UT THICKNESS MEASUREMENT

### CP MEASUREMENT

### ACFM – CRACK INSPECTION



### SPECIAL MISSIONS CONFIGURATION

### 3D PHOTOGRAMMETRY

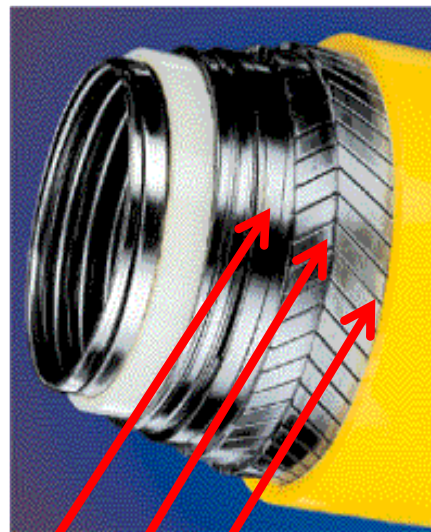


# MEC & SUBSEA ROBOTICS: FLEXIBLE RISER INSPECTION

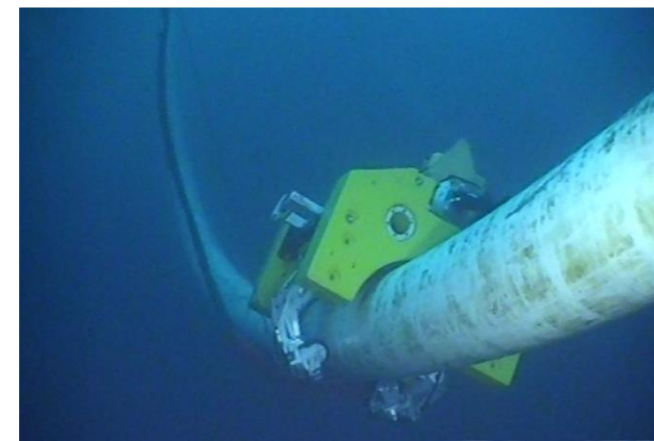
## MEC-FIT (Magnetic Eddy Current Flexible Riser Inspection Tool)



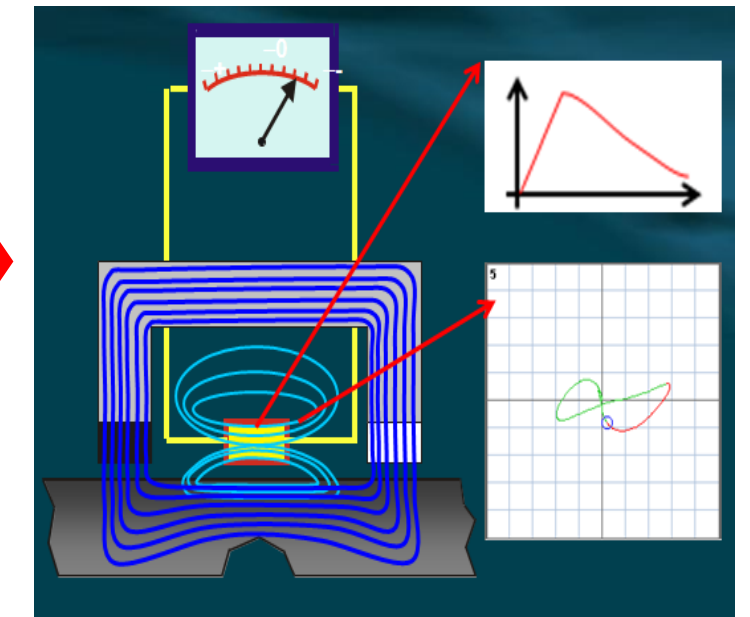
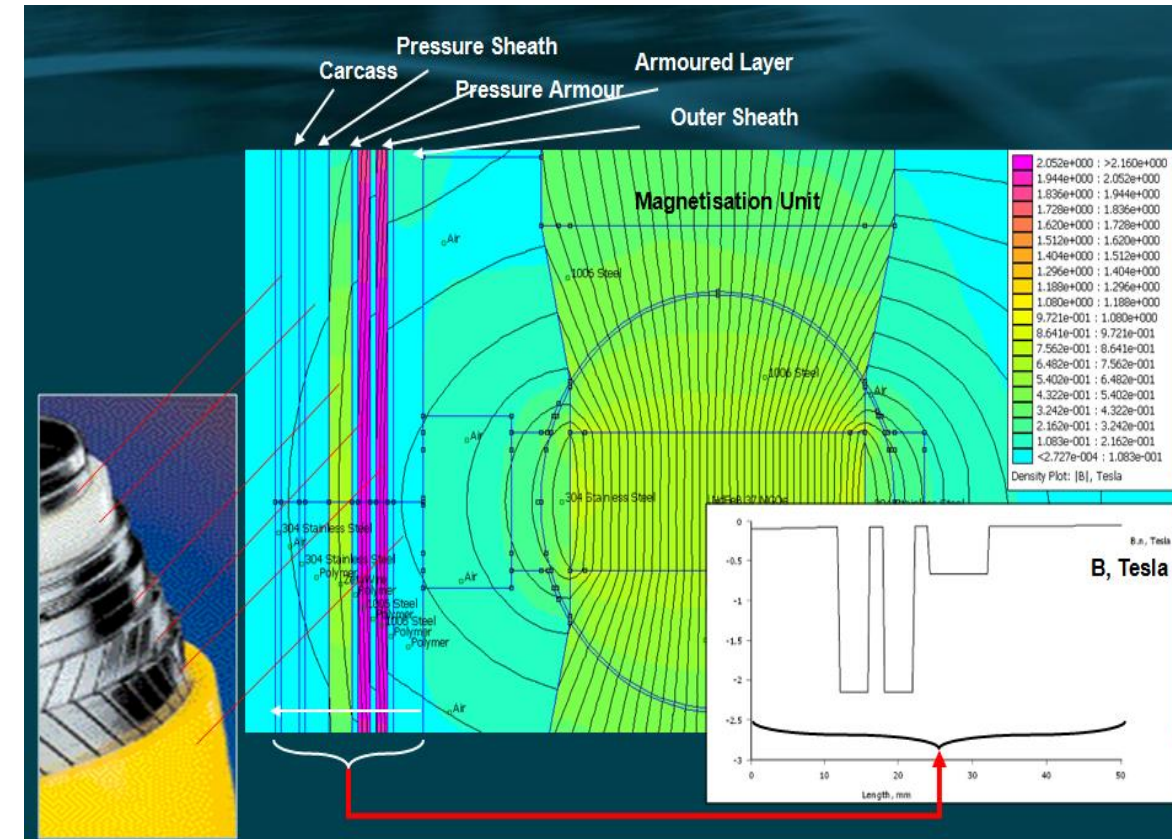
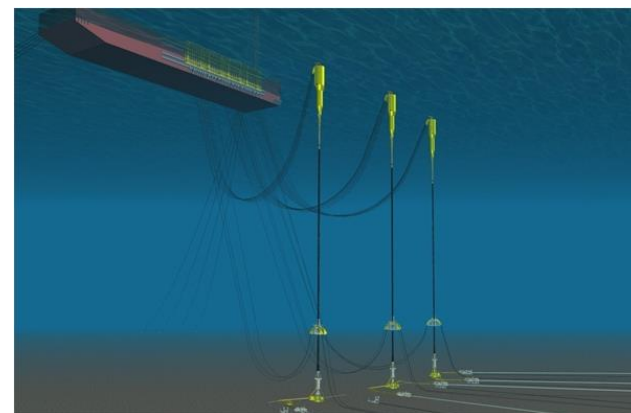
- Detection of corrosion / cracking in up to 3 wire layers by external scan
- Detection wire misalignment
- Distinguish defects / wire gaps/ wire/ misalignment
- Fast external scanning
- No couplant required
- Data for FlexIQ-Flexas Model



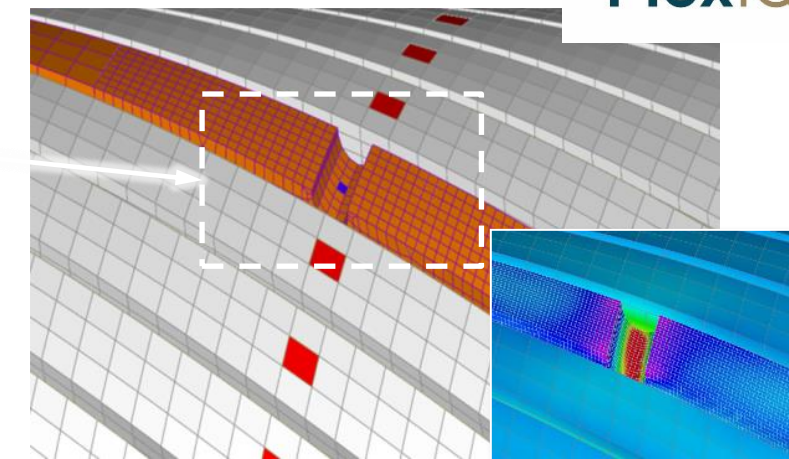
Pressure Armour wire Layer  
2<sup>nd</sup> Armour wire Layer  
1<sup>st</sup> Armour wire Layer



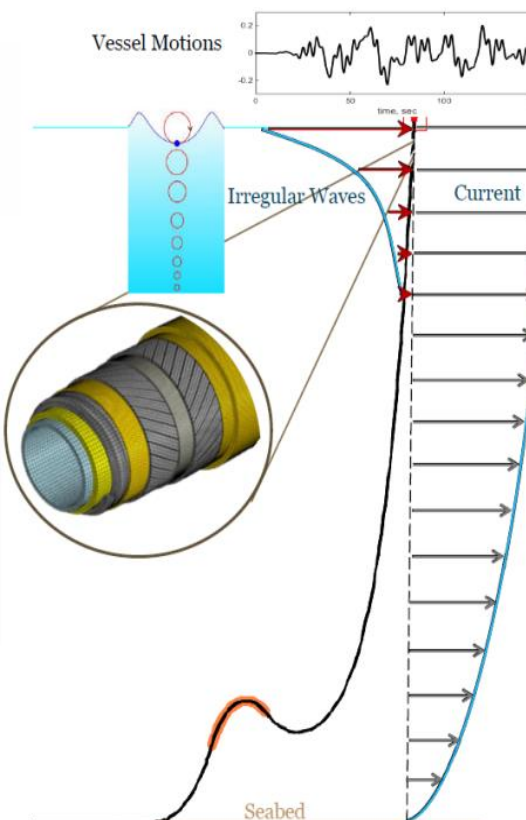
- External scan, detection in 2 (up to 3) layers; corrosion (pitting/general), cracking, wire misalignment
- Scanning in axial & circumferential direction
- Fast external scanning
- No couplant required



## Inspection Data Transfer - Riser Assessment



- Defect information for fatigue life predictions developed for damaged flexible pipe.
- Flexas (INTECSEA) as a support Solver.



# MEC & SUBSEA ROBOTICS: FLEXIBLE RISER INSPECTION

## Case Study- MEC-FIT (Magnetic Eddy Current Flexible Riser Inspection Tool)

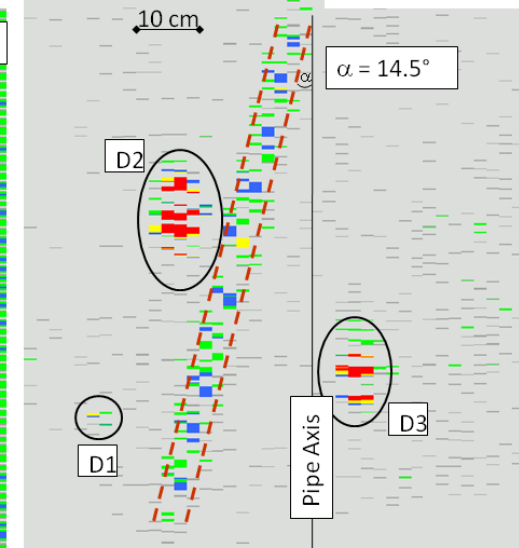
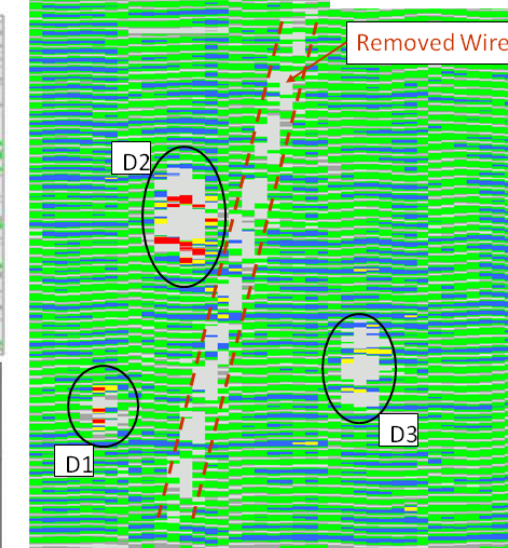
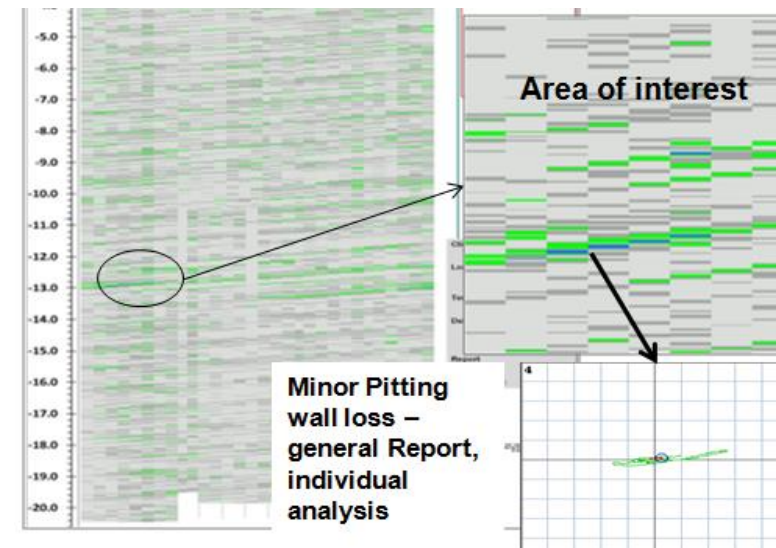
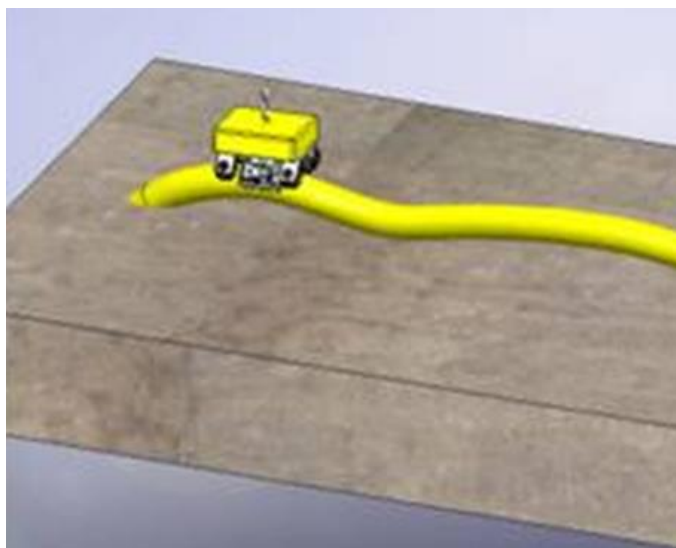
- Operation at a 4" Flexible Riser scanning with top side deployment tool MEC – Hug
- Detection target Pitting detection 1<sup>st</sup> & 2<sup>nd</sup> annular wire



- Subsea Flexible Pipe Flowline scanning in upheaval buckling area
- Detection target wire misalignment & local pitting/cracking 1<sup>st</sup> & 2<sup>nd</sup> annular wire



<http://www.innospection.com/en/df/vids> and <https://youtu.be/9n0PpjAHCOM>

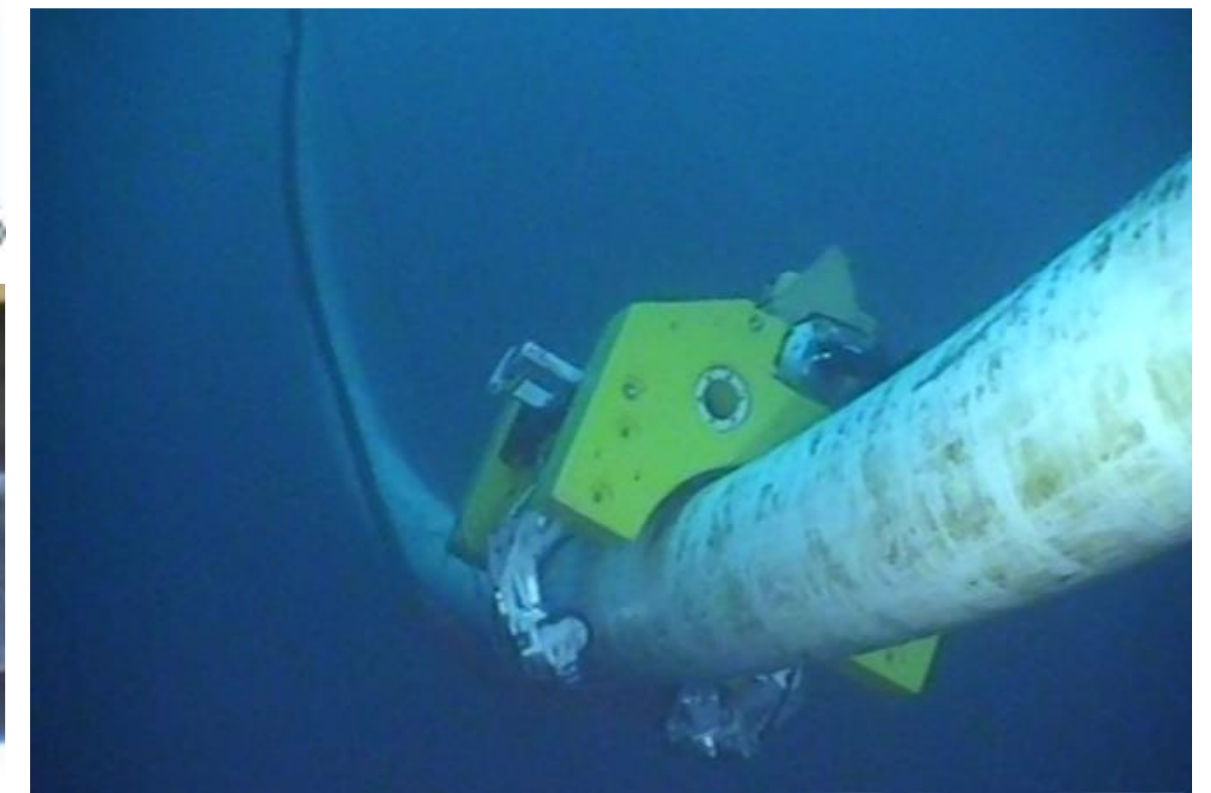
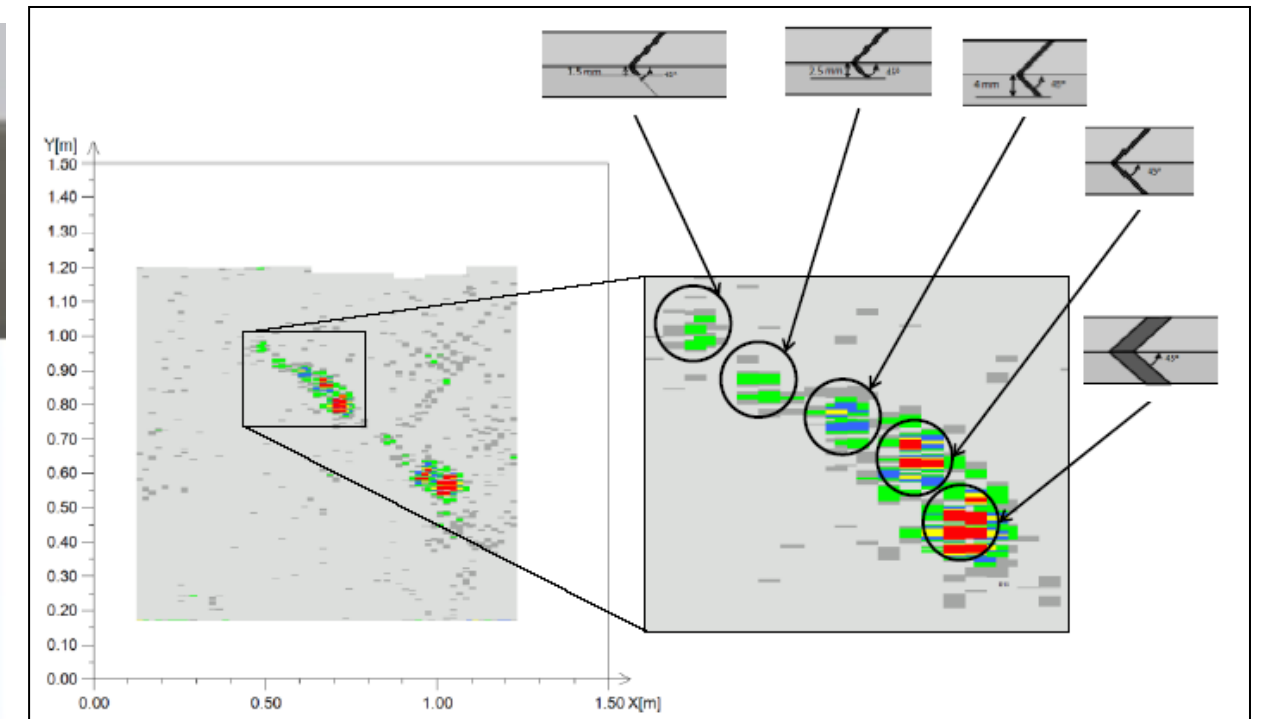
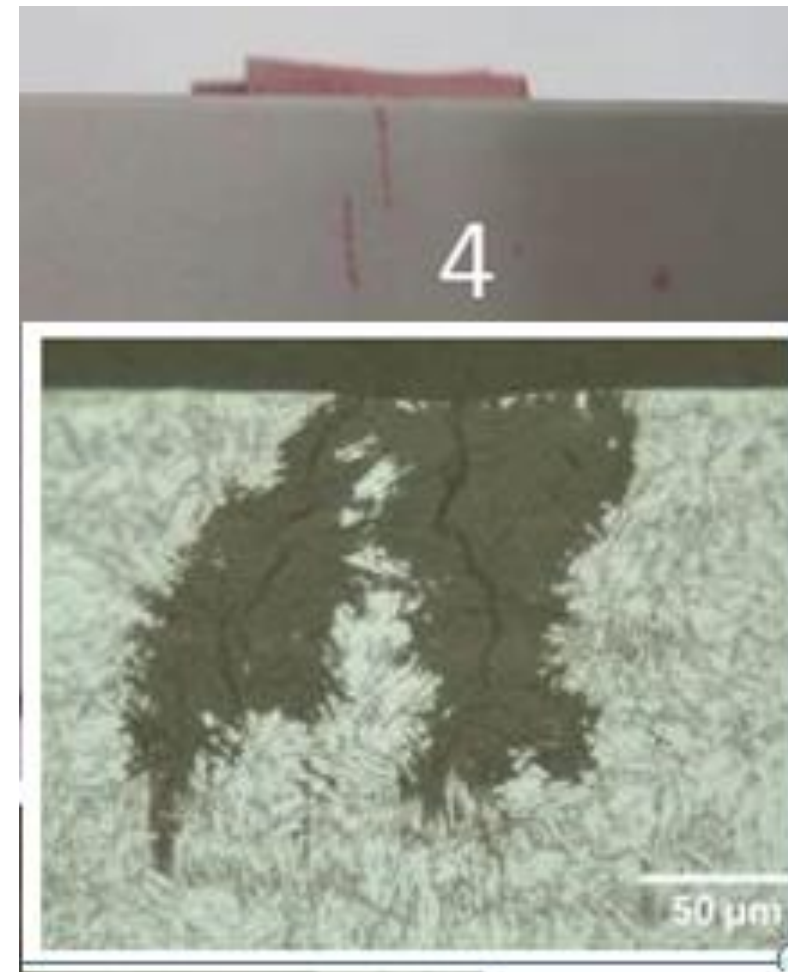
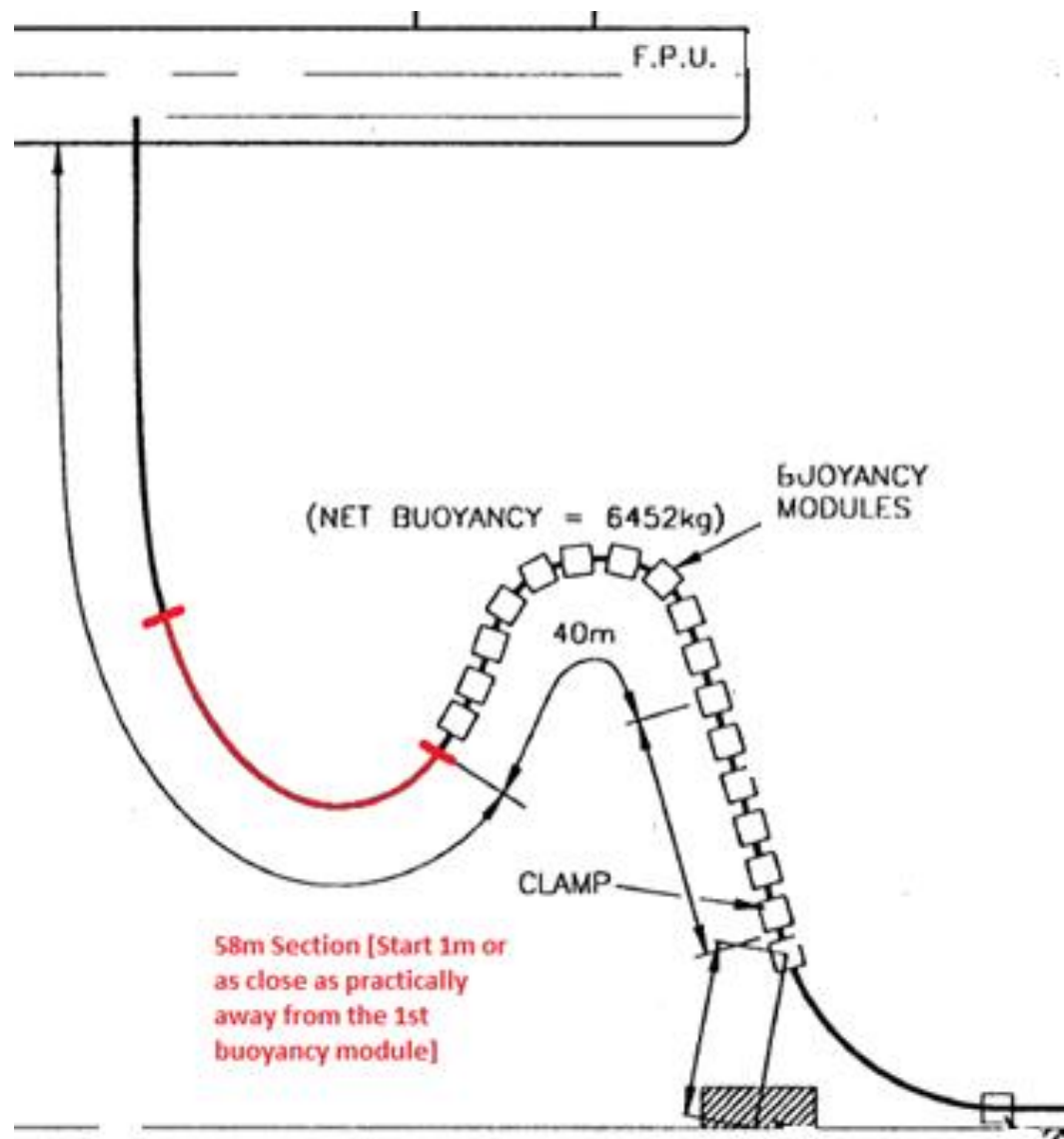


# MEC & SUBSEA ROBOTICS: FLEXIBLE RISER INSPECTION

## Case Study- MEC-FIT (Magnetic Eddy Current Flexible Riser Inspection Tool)

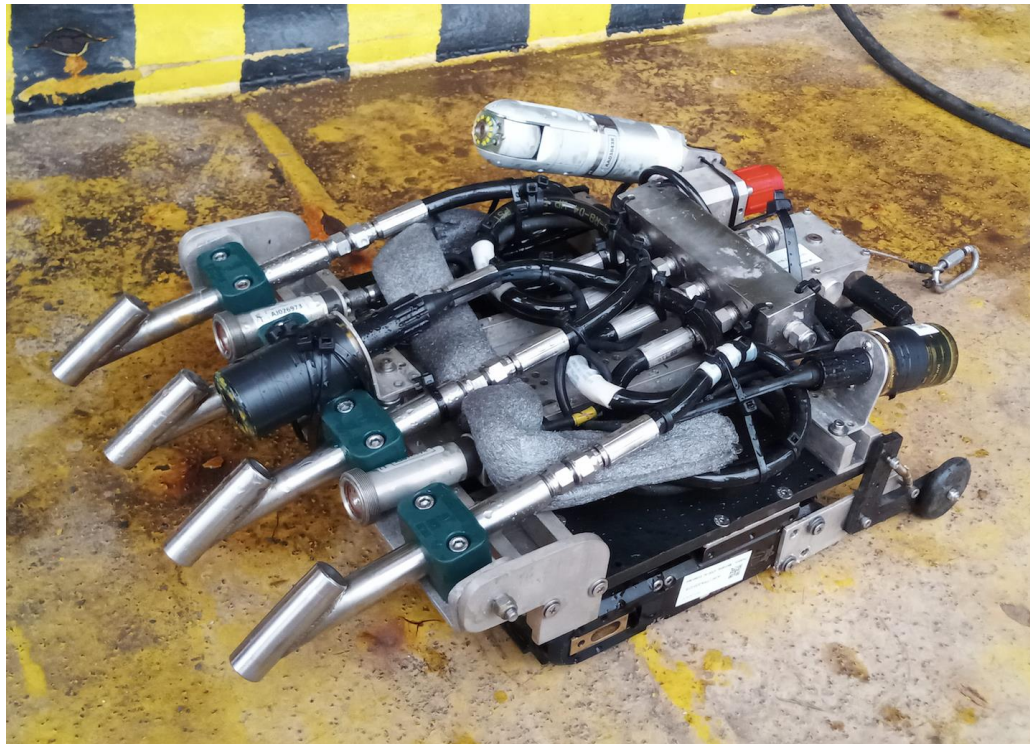
North Sea Case : Wire Crack Detection of 55 degree Wire Flexible Riser  
Flexible Riser set up: Armour wire SCC verification tests

- Target of the technique verification to detect tight cracking in single wire with expected orientation of 45° and 90° to the wire cross section.
- Cracking to be detected on the inner wire & outer wire layer.
- Self crawling MEC – Combi Scanner top site deployed



# MEC & SUBSEA ROBOTICS: MOORING CHAIN INSPECTION

## Case Study — Mooring Chain Inspection inside a Fairlead



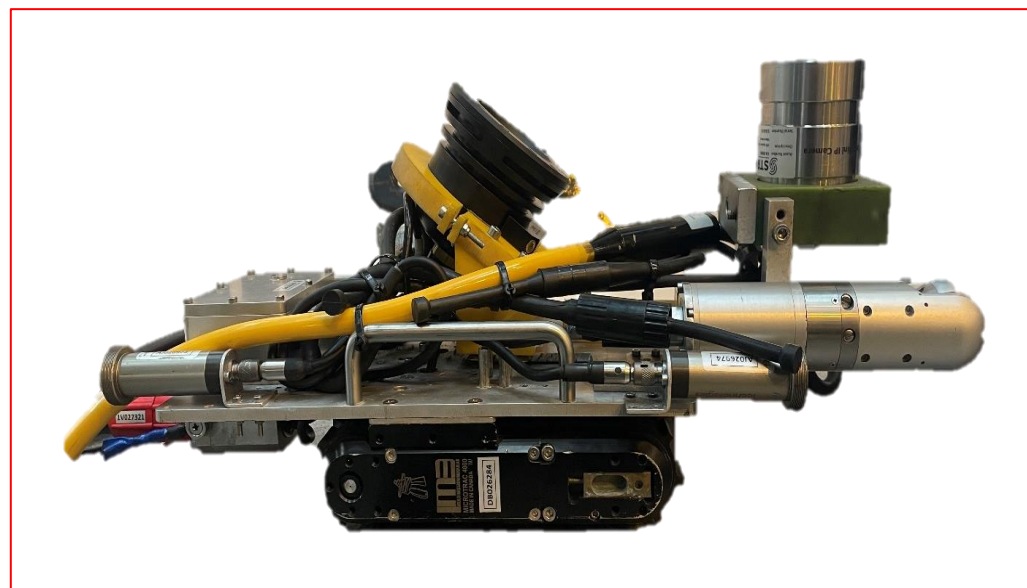
Robotic Crawler - Cleaning Configuration



Fairlead internal BEFORE Caviblaster cleaning



Fairlead internal AFTER Caviblaster cleaning



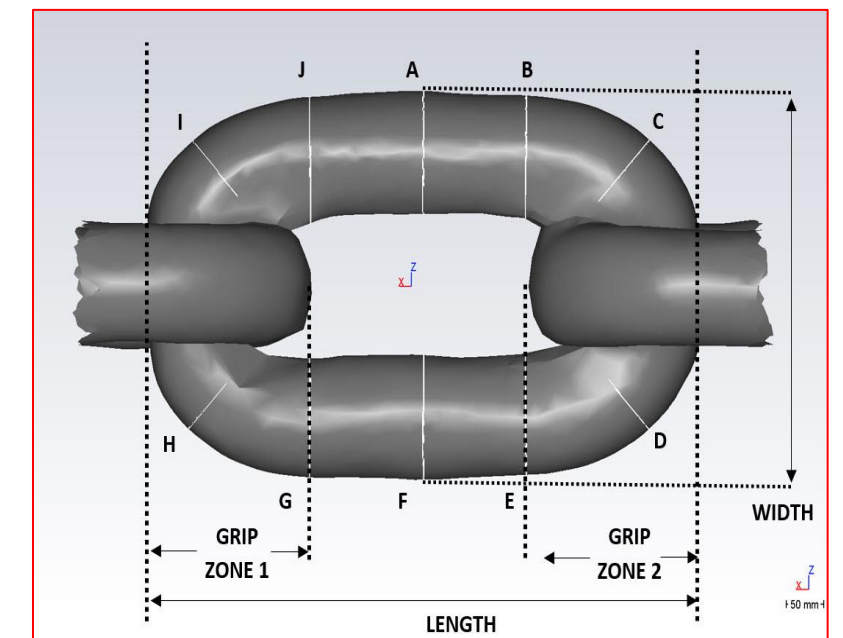
Robotic Crawler - Photogrammetry Configuration



Mooring Chain Measurable 3D Model



Mooring Chain Image





# ADROV

Small, Versatile and Multi-functional



# ASSET DEPLOYED ROV (ADROV): INTRODUCTION

## + Subsea Inspection & Survey

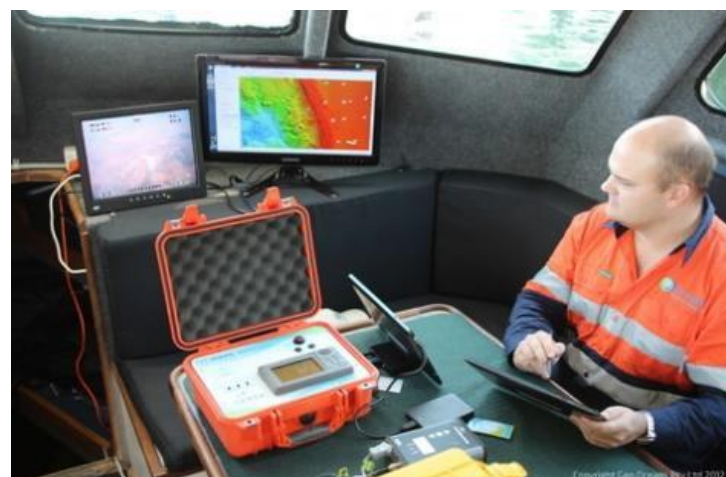
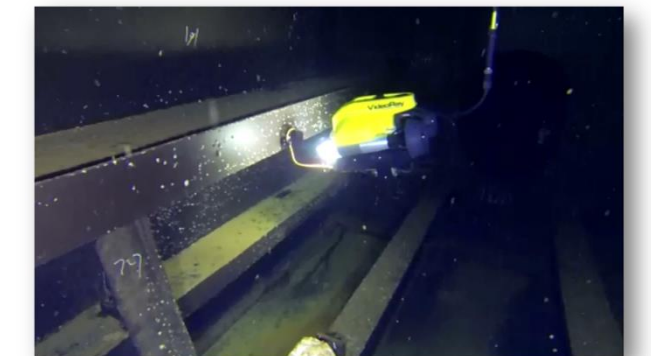
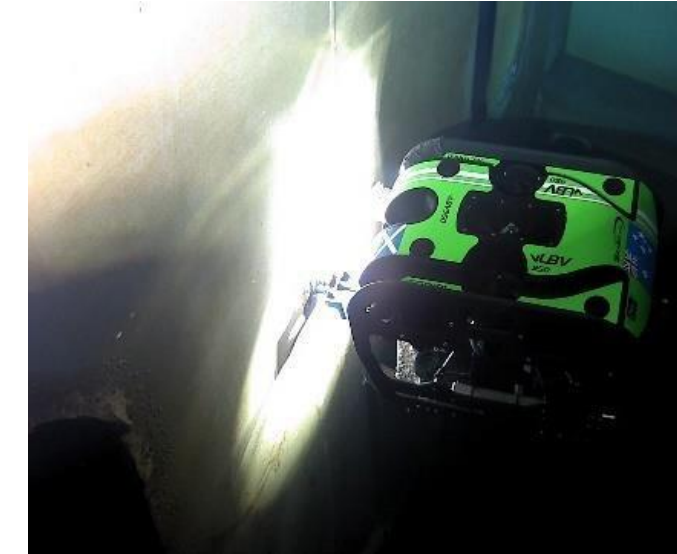
- Conventional & Advanced NDT
- ACFM & CP Inspection
- HD CVI/GVI & Photogrammetry
- Sonomatic Deployment tool

## + Sub Sea Maintenance & Repair

- HP Blasting, Brushing and cleaning
- Crane IRM package
- Flare Integrity package

## + Marine Science

- Coral & rig to reef Monitoring
- Habitat mapping & Monitoring
- Oil Spill Response Monitoring



# ADROV: EQUIPMENT SPECIFICATIONS

## ROV Equipment

- Mini ROV CSS - Observation ROVs
- Subsea Crawlers
- Magnetic attachment systems
- ROV Tether Management System
- Digital Video Recorders

## Cameras

- HD Cameras
- Tooling cameras
- Stereo 3D Camera System (modelling)
- Probe camera (20mm OD with 4 m spool)

## Navigation

- Scanning Sonar
- Sonar reflectors

## Cleaning

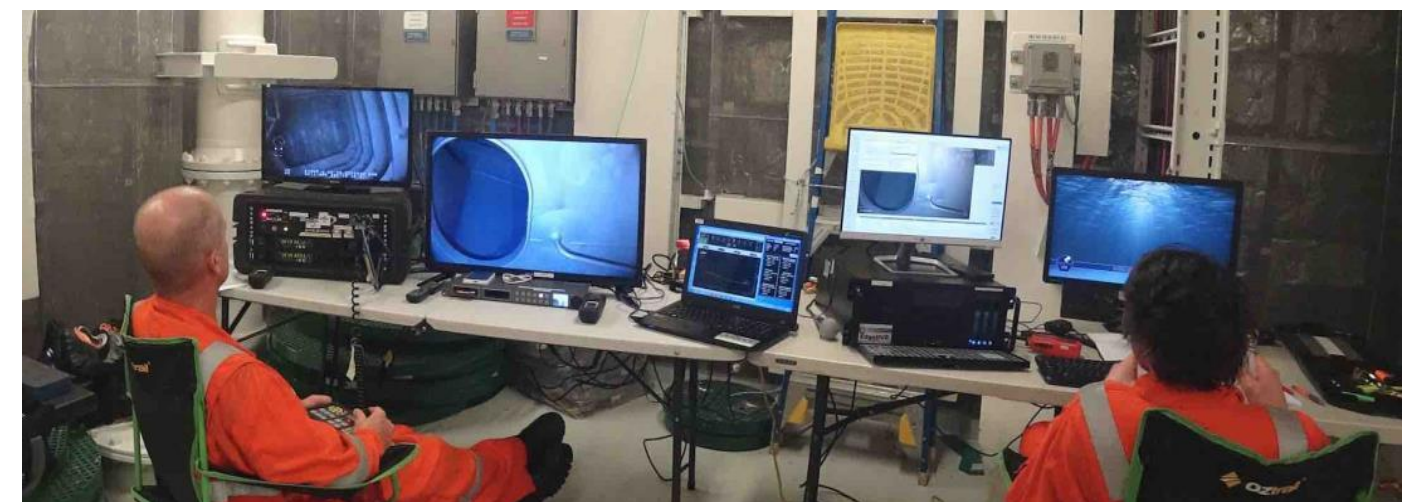
- Water Blaster
- Mechanical Spot Cleaning Tool
- Dredge

## Tools

- Manipulator Arms
- Chain Calliper / Gauges
- Inclinometers

## NDT / Sensors

- Ultrasonic Thickness Probes
- Cathodic Protection Probes
- Accelerometers



# ADROV: EQUIPMENT SPECIFICATIONS

## Other technology integrated with the Mini-ROV CSS

### NDT / Sensors

- Weld crack NDT
- Eddy current
- Flooded Member  
Detection

### Navigation / Survey

- Survey-grade  
positioning
- Multi-beam sonar
- Laser scanner or profiler

### Cleaning tools

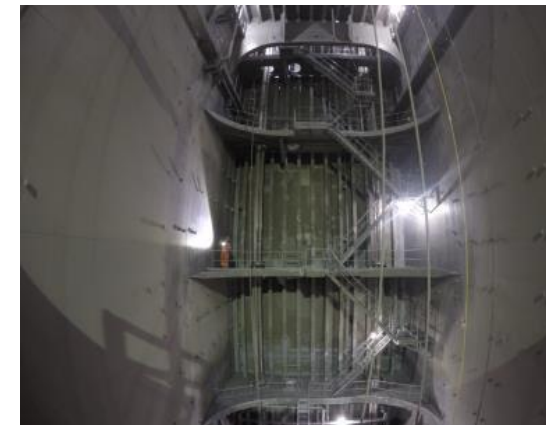
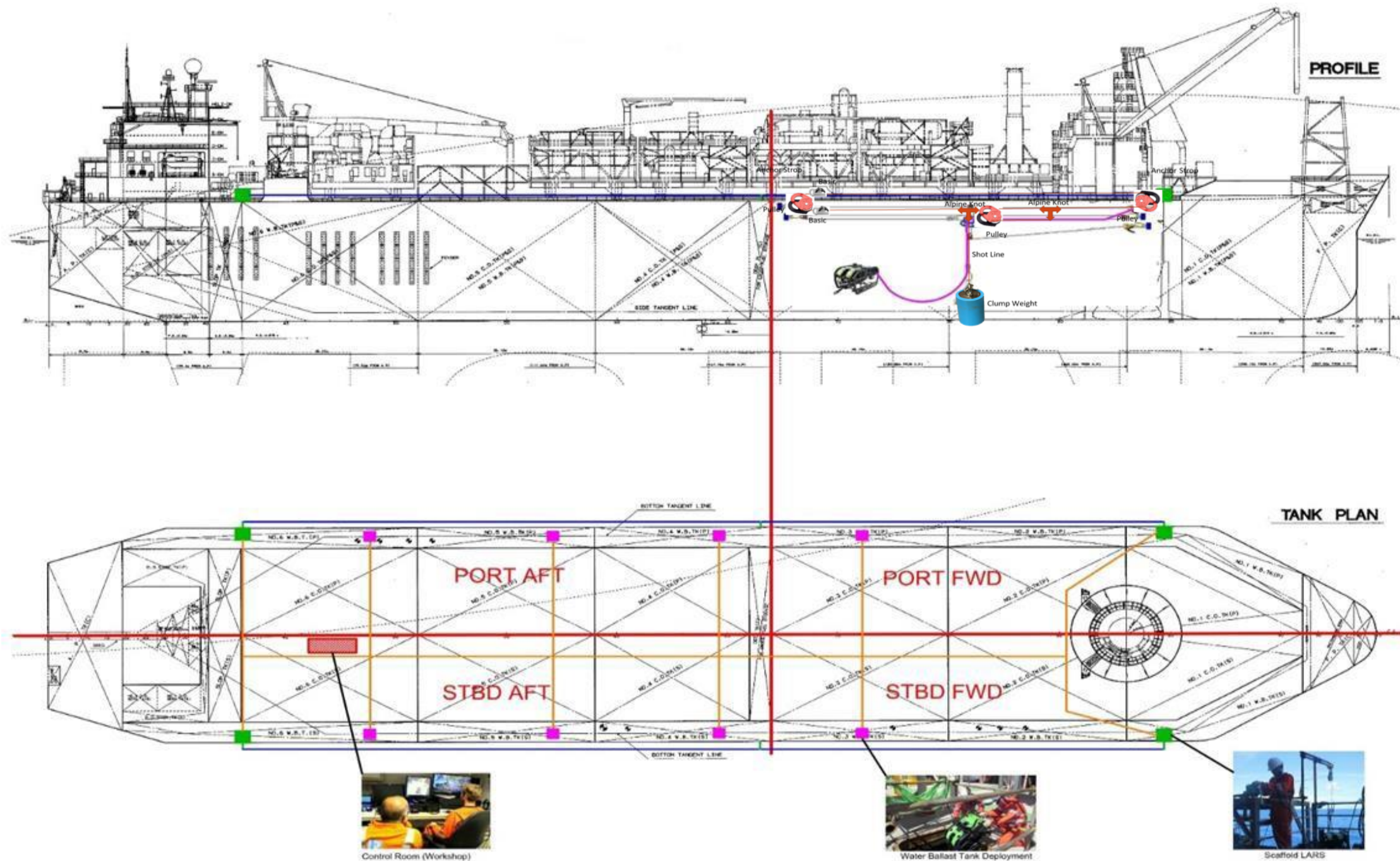
- High Pressure Water  
Blaster
- Mechanical scraper
- Dredging
- Flail tool

### Tools

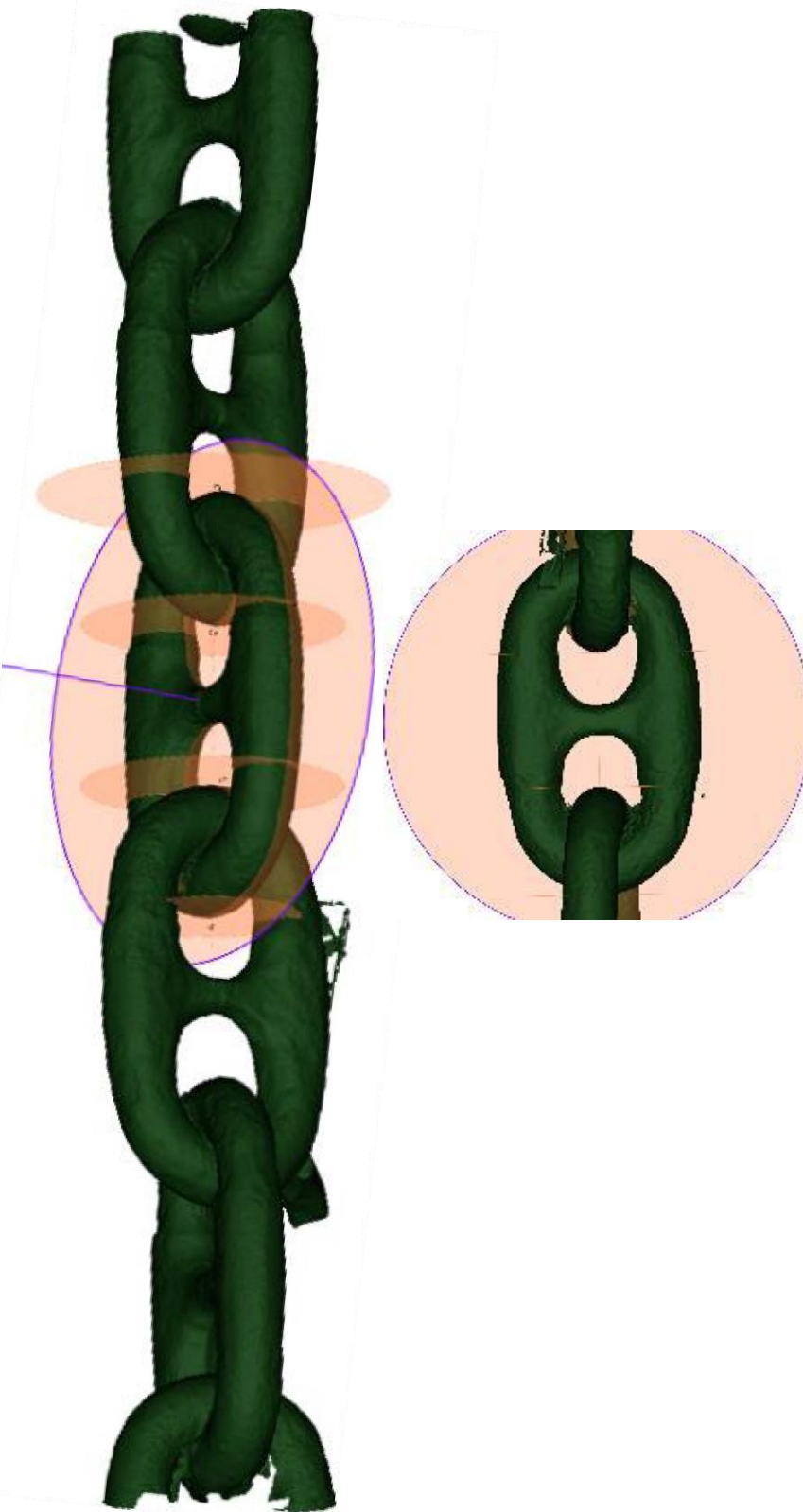
- Penetration isolation  
plugs
- Torque tool
- Seabed sediment  
collection



# ADROV: FPSO ROV CLASS INSPECTION



# ADROV: FPSO MOORING INSPECTION



Start	End	Nominal	Measured	Error	Scale error
10	11	20	20.037	0.037	0.19%
12	13	20	19.518	-0.482	2.41%
14	15	20	19.606	-0.394	1.97%
10	12	50	49.983	-0.017	0.03%
11	13	50	50.064	0.064	0.13%
12	14	50	50.136	0.136	0.27%
13	15	50	49.977	-0.023	0.05%
10	14	100	100.076	0.076	0.08%
11	15	100	100.027	0.027	0.03%



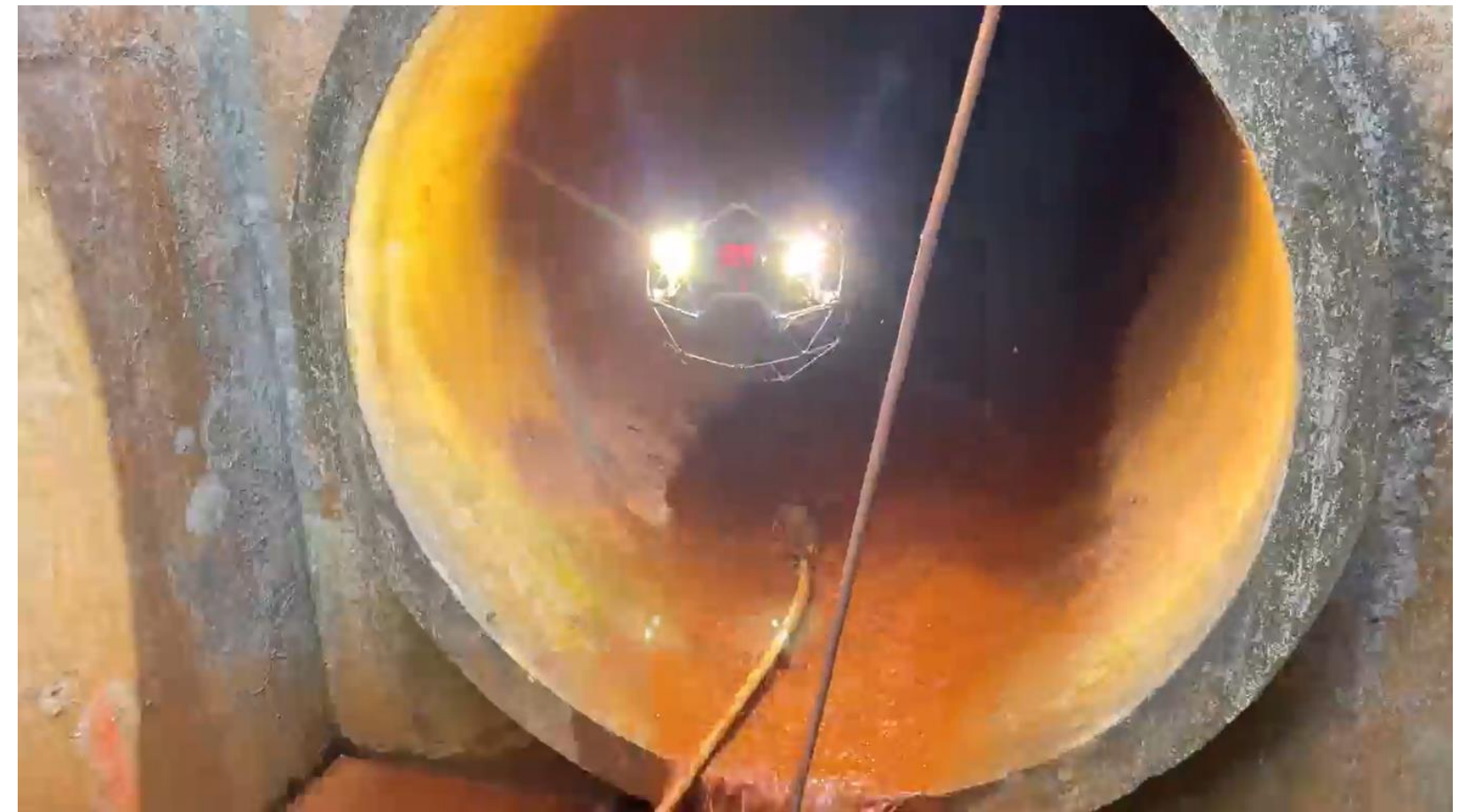


# DRONES IN FLOATING ASSET INSPECTIONS

# AUAV: DRONES IN ASSET INSPECTION

Established in 2013, AUAV is an Australian based company which offers topographical survey, inspection, 3D modeling, and consulting services for drone applications on the following scope:-

- Pipeline easement surveys.
- Flare stack inspections.
- Gas leak detection.
- Corrosion monitoring.
- Internal confined space inspections of tanks and ducting.
- Offshore digital engineering.



# DRONES IN FLOATING ASSET INSPECTION

Internal drone asset inspections use lightweight impact-tolerant drones designed to protect the airframe and camera. The drones can enter closed and confined spaces and inspect:

- Interior of tanks
- Ducting
- Pressure vessels
- Large bore piping
- Other GPS-denied environments





# DRONES IN FLOATING ASSET INSPECTION : BENEFITS

- **Safer:** Avoids human intervention in risky areas such as inaccessible areas, confined spaces, heights, or hazardous zones.
- **Faster:** Depending on the type of assets, inspection duration is cut down by 2 to 10 times over traditional methods.
- **Cost-effective:** Reduce/ no shutdown/ downtime, no need for rope access, EWP or helicopters for inspections
- **Better Data Capturing:** Better coverage on the whole asset inspection, with high-resolution imagery and an optional 3D model for record-keeping. Automated defect and change detection between inspections are also possible.
- **Access to Inspection Results:** inSite online data platform has been designed to provide drone inspection results to all stakeholders.



# DRONES IN FLOATING ASSET INSPECTION: CAPABILITIES

## The following defects can be detected efficiently:-

- Cracking
- Corrosion
- Wear and tear
- Missing parts such as nut and bolts
- Distortion
- Hot areas

## Drone Data Analysis, Processing & Reporting:

- Data processing, analysis and reporting provided.
- Reporting on specialist areas of expertise via collaborative partners, ie; solar farm analysis or telco tower reporting.
- Has leading edge “AI” analysis machine learning solutions.
- In-house software enables analysis and measurement of specific issues.
- Able to provide consultation and in-house drone inspection program to suit the Client needs.
- Can be fully customised to suit Client’s requirements and accessible via cloud-based online data platform: AUAV inSite.



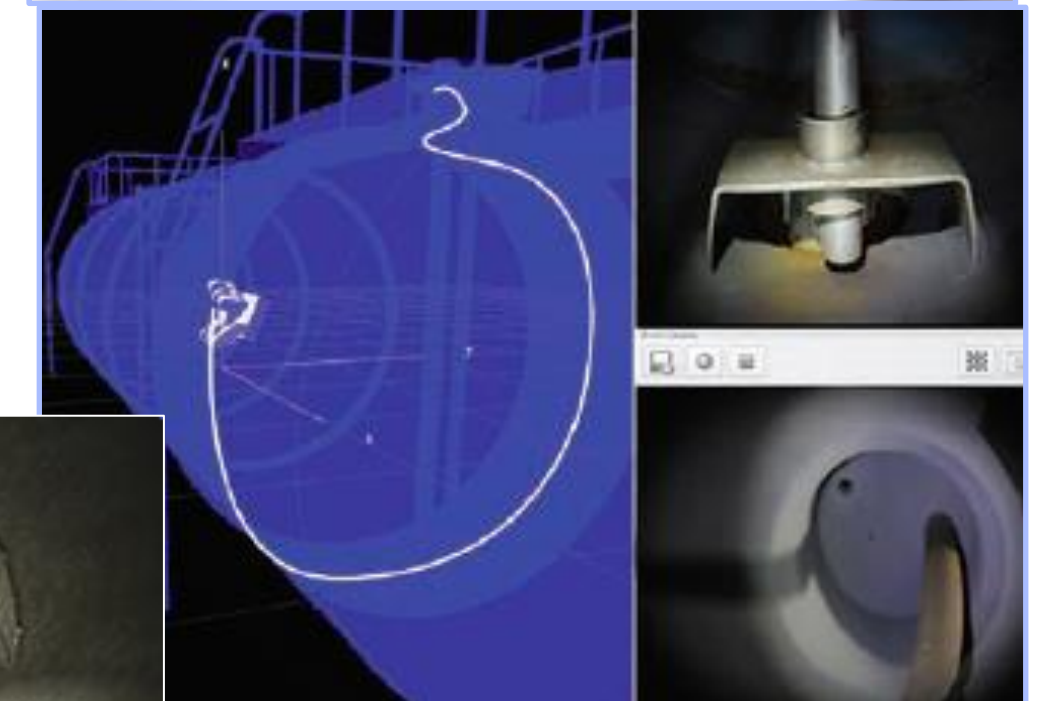
# RDVI FOR FLOATING ASSET INSPECTIONS

# REMOTE DIGITAL VISUAL INSPECTION (RDVI)

RDVI is the use and application of Remote Digital Video Camera systems to internally inspect equipment without the need for Confined Space Entries and to minimise Intrusive requirements.

## RDVI Applications

- Front End Engineering and Design for RDVI
- Pre-Inspection planning & assessment
- RDVI specific Inspection & Test Plans and Vessel Access Plan development
- Hydrocarbon enriched Environment Inspections
- RDVI In- service Inspections
- FOSAR (Foreign object Search & Retrieval)
- QA / QC Inspection verification



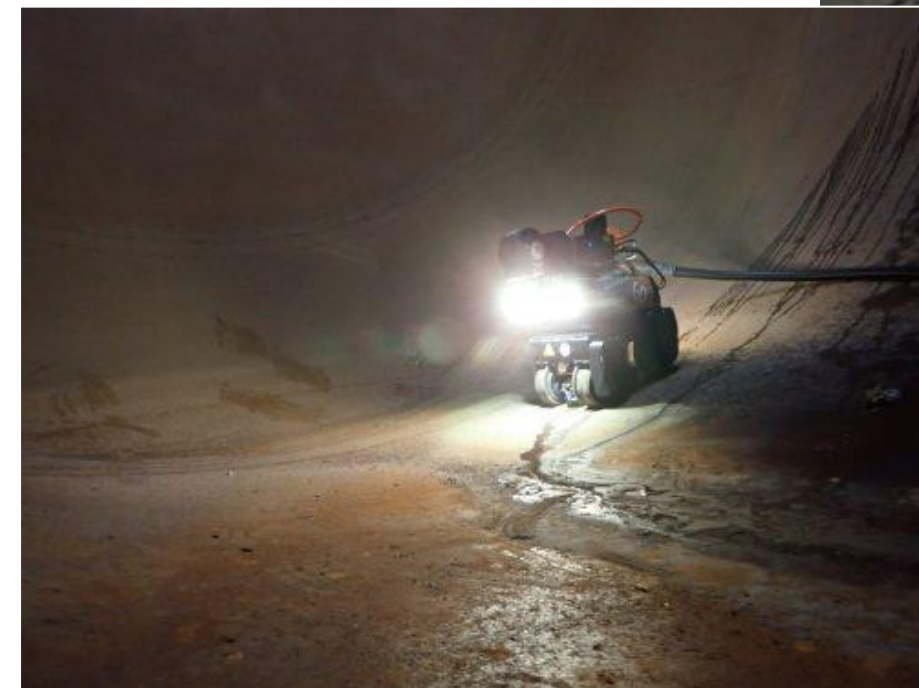
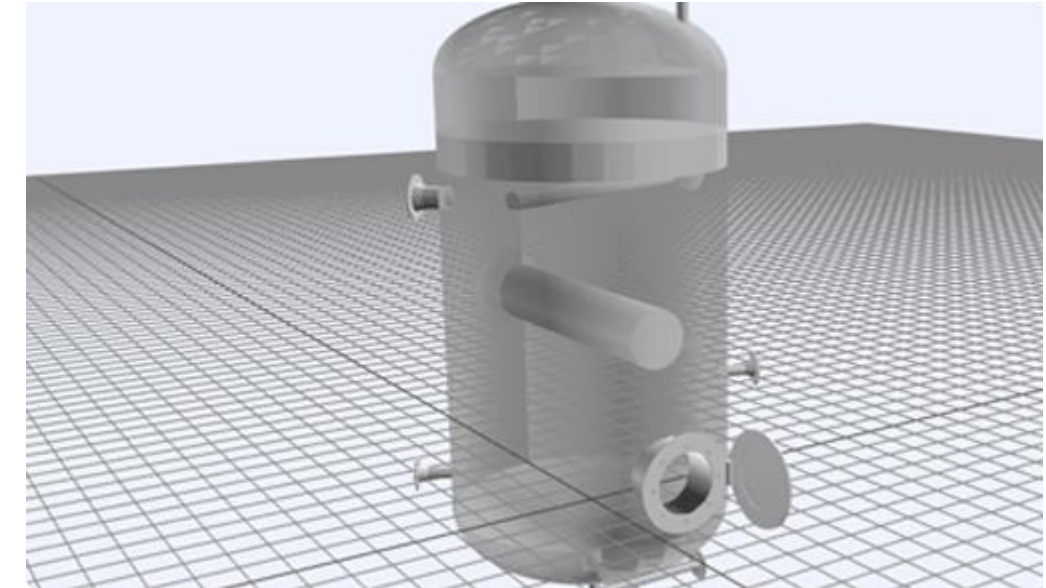
# RDVI: BENEFITS

- Reduce Shutdown time frames
- Reduce Shutdown costs
- Reduce Confined Space Entries
- Reduce Intrusive access requirements
- Improve Asset Integrity Management
- Align with other NII techniques
- Improve process integrity
- Improve maintenance planning
- Improve process evaluation
- Reduce risk profiles
- Improve safety records



# RDVI : CAPABILITIES

- Leak point reduction.
- Significant reduction of inspection activities and duration.
- Historical RDVI data application.
- Identification of high-risk locations.
- Online Inspections.
- Reduction in resources required for inspection.
- Dedicated and systematic inspection access with focused inspection points/ targets.
- Simulated planning and inspections.
- RDVI specific work pack generation.
- Integration with dedicated NII processes and NDT methods.
- Proprietary and remote NDT applications.



# RDVI : OTHER APPLICATIONS / INSPECTIONS

- Propane / Ethylene / Methane Chiller
- Dehydration Beds
- Regeneration Packages
- Separators & Condensers
- De-aerators
- Shell and Tube
- Reboiler Exchangers
- Fin Fan Exchangers
- Headers
- Acid Gas Incinerators
- Flare Knock Out Drum
- Pressure Piping
- Flow Meters
- Coil Systems
- Heat Recovery Steam Generators
- Steam Systems
- Turbines & Generator Packages
- Absorbers
- Air & Nitrogen Receivers
- Process Control – Valves etc
- Scrubbers
- Electric Exchangers

- PCHE's
- Membrane Filters
- Compressors
- Columns





# REMOTION

Robotic Solutions for Surface Treatment &  
Splash Zone Operations



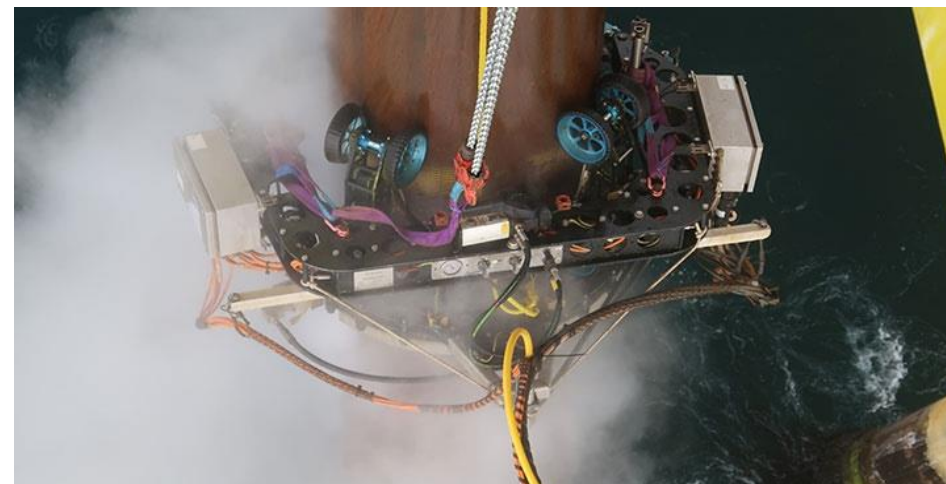
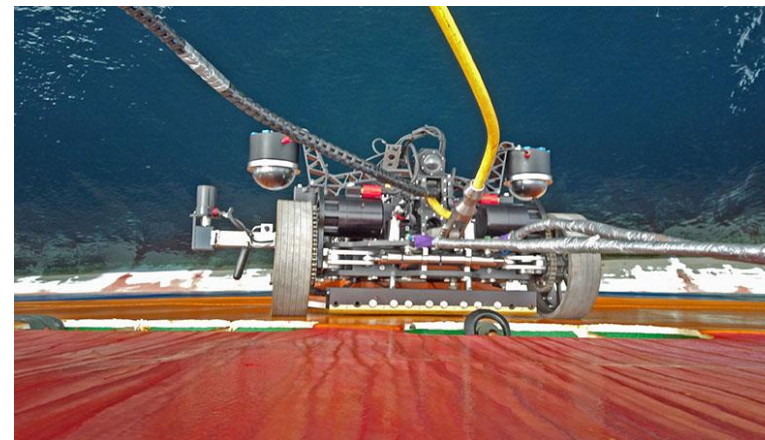
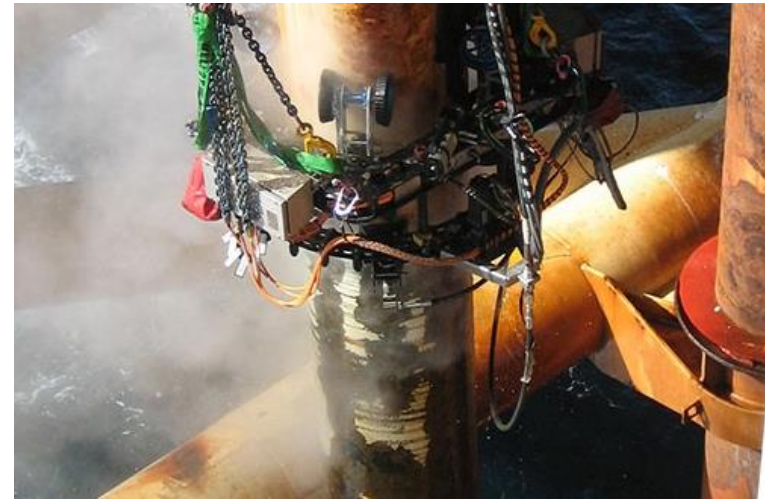
# REMOTION: INTRODUCTION

**REMOTION specialises in using robotics to carry out Splash Zone Operations and hard to reach places on:**

- Offshore Floating Assets
- Offshore Platforms
- Tank Farms
- Wind Farms

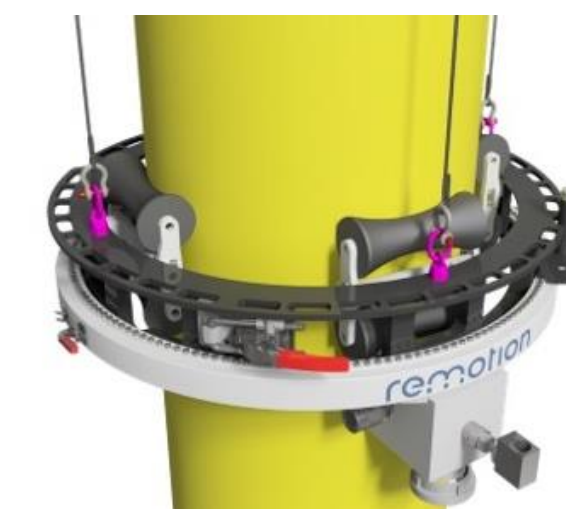
REMOTION robotics are used for the following:

- Patented Magnetic ROVs for hull inspections, cleaning and NDT
- Unique Complete Remote Surface Treatment System
- Cost effective and time saving tools for cleaning, surface treatment, NDT, inspection and weld repairs



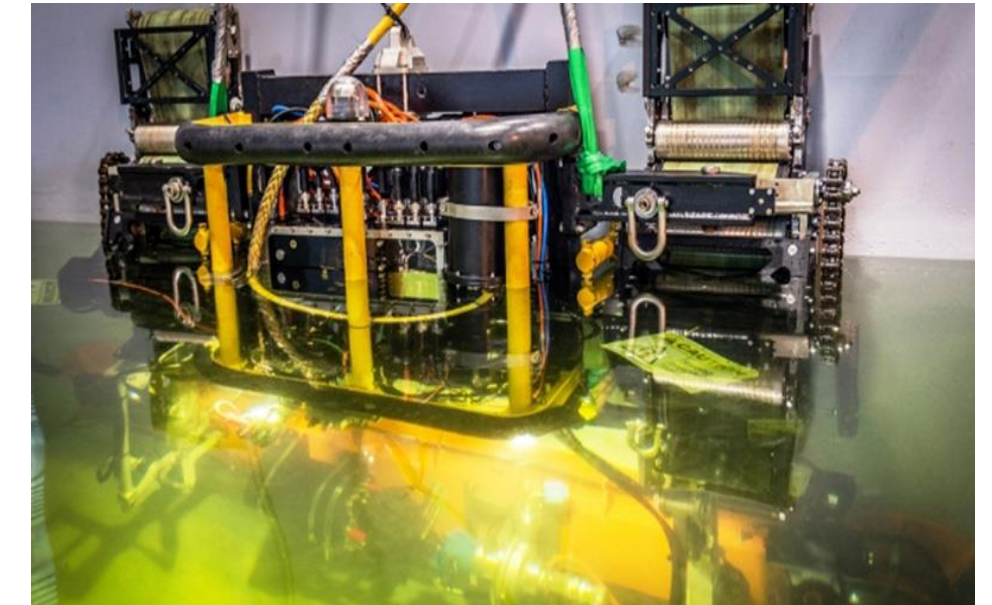
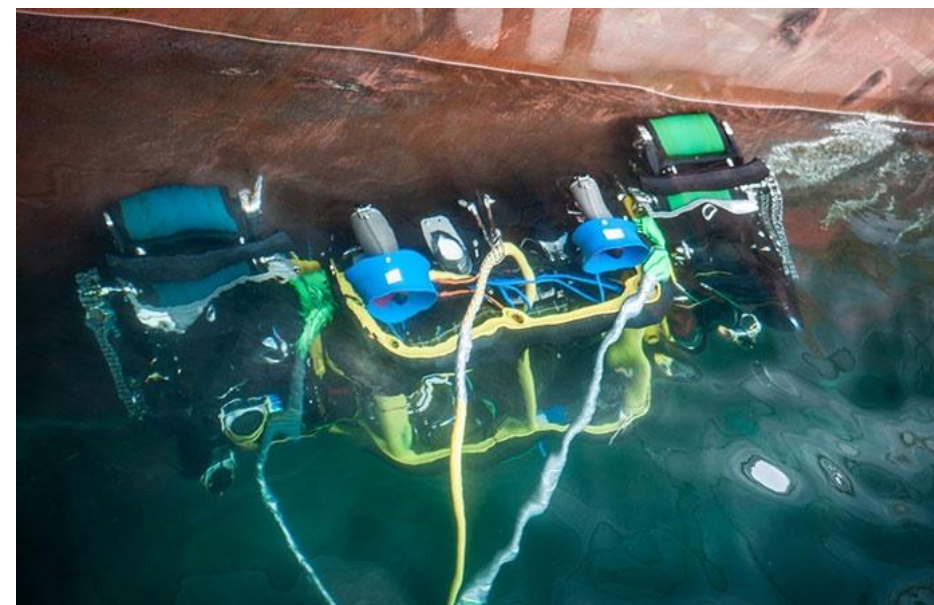
# REMOTION: CAPABILITIES

- Splash Zone Specialists
- Asset Deployed Tools
- Provides a Stable Platform for Inspection
- Work in Wave Heights up to 4.5m Hs
- Marine Growth Cleaning with HP and UHP Water Blasting
- Complete Surface Treatment System
- Paint Removal
- Sandblasting
- Paint Spraying
- Hull Crack Weld Repairs using unique vacuum coffer dams
- Asset Hull Inspection in accordance with DNV-OSS-102
- Weld Inspection
- Remote NDT
- Ultrasonic Wall Thickness Measurements
- Sea Chest Plugging



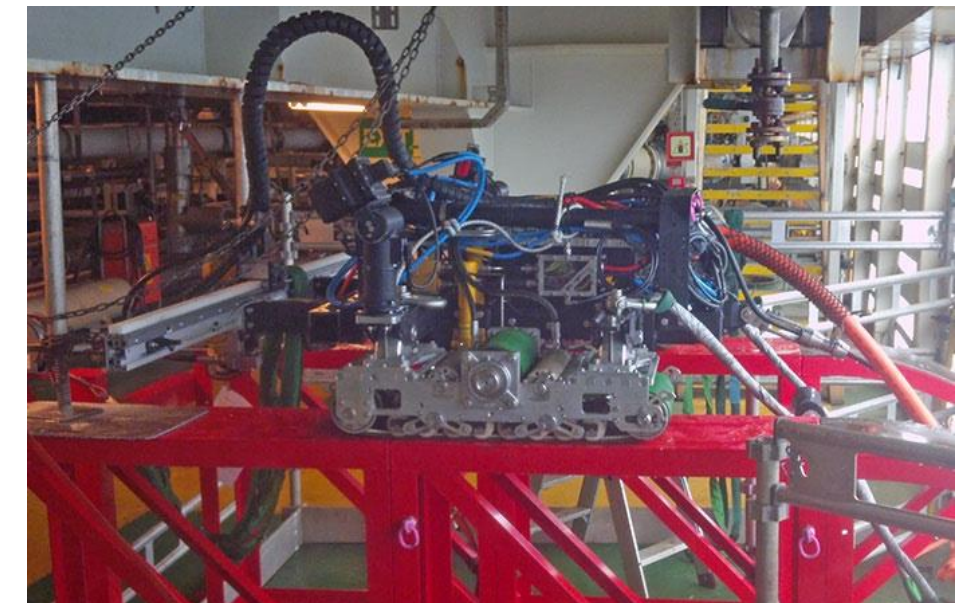
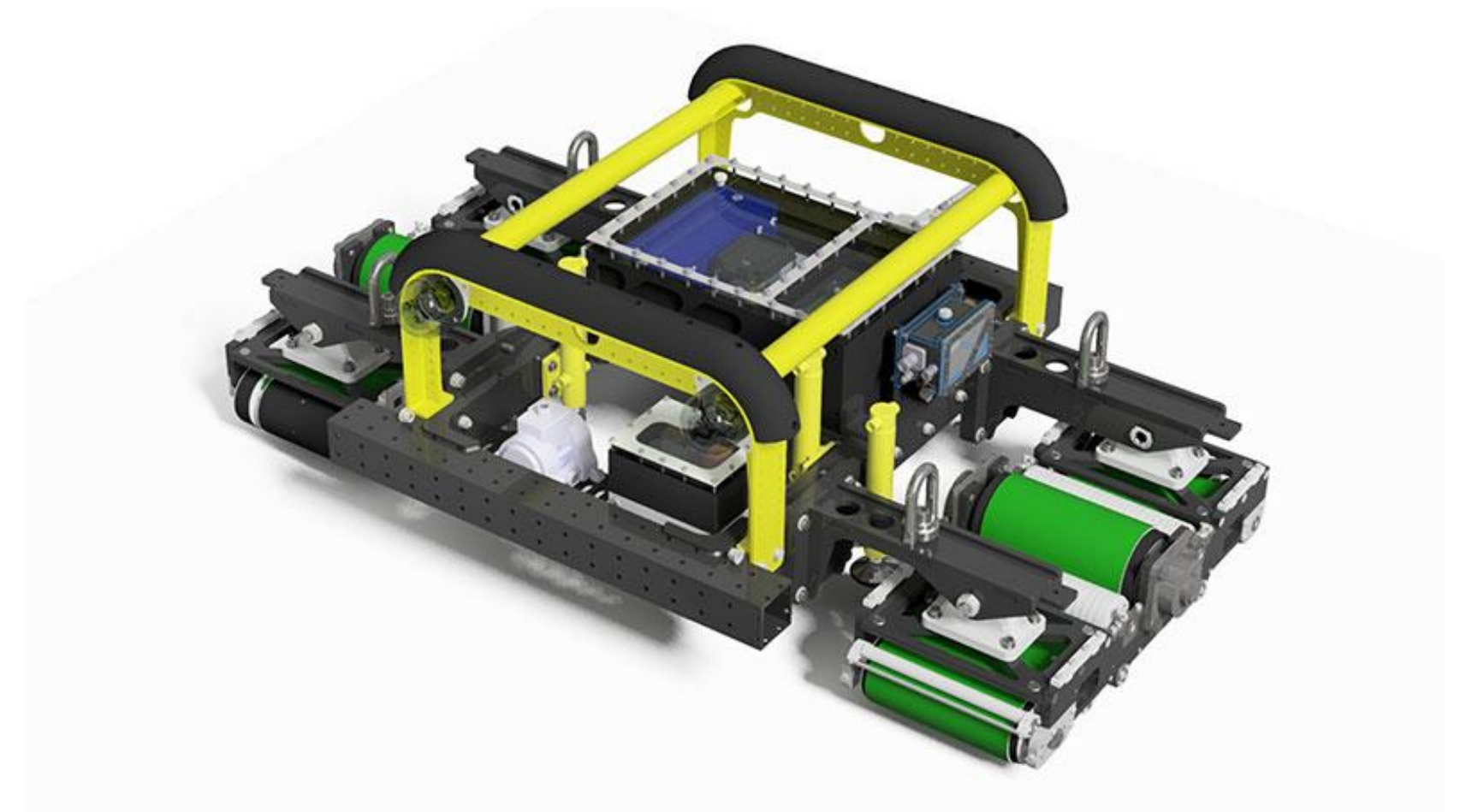
# REMOTION: GOLIATH M-ROV

- For Large Area Cleaning, Paint Removal, Inspection and NDT
- Carries NDT equipment e.g. Ultra Sonic Wall Thickness Measurement, Weld Inspection and Repair
- Asset deployed by LARS or Crane
- Hydraulically operated with on-board HPU and valve pack
- 4 magnetic belt drive motors
- Operates in the splash zone up to 4.5m Hs wave height due to low build profile and reduced hydrodynamic drag
- Payload: 200Kg
- Depth Rating: 50m
- Max. Magnetic Force: 3200Kg
- Dimensions W x L x H: 2136 x 1857 x 546
- Dry Weight: 600Kg
- Footprint – 14ft Control Container, Umbilical and Safety winches



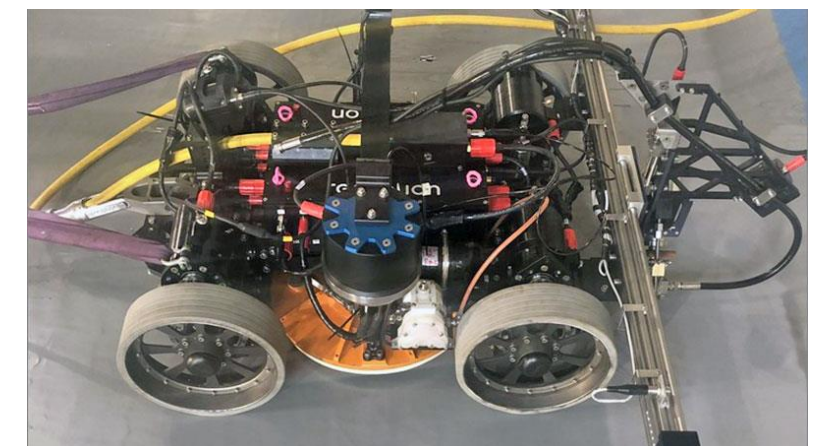
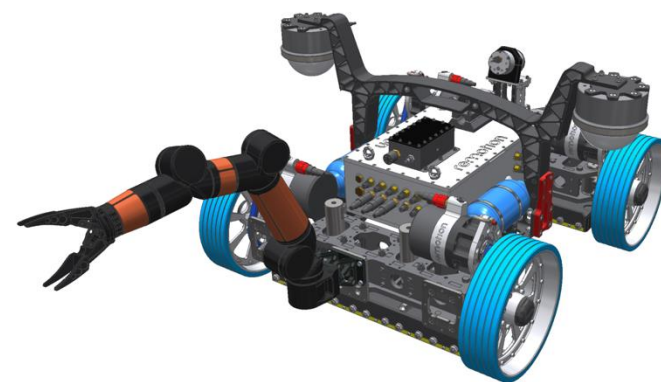
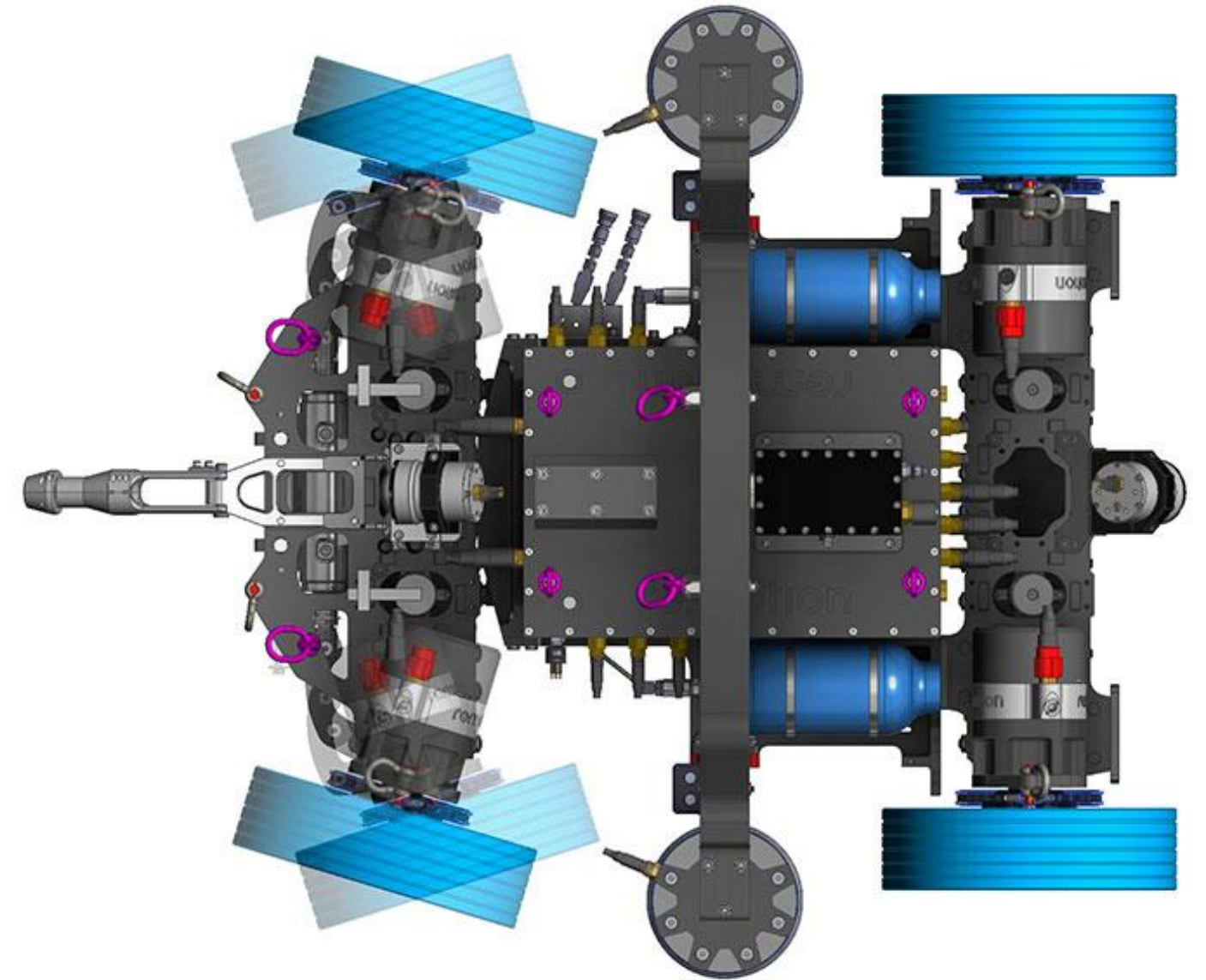
# REMOTION: HERCULES M-ROV

- Compact M-ROV for subsea Inspection, NDT, Cleaning.
- Fibre telemetry allows a wide range of equipment to be fitted e.g. NDT Ultra Sonic Wall Thickness Measurement, Weld Inspection and Repair
- Asset deployed by LARS or Crane
- Hydraulic operation with topside HPU; on-board valve pack
- 2 magnetic belt drive motors
- Operates in the splash zone up to 3.5m Hs wave height due to low build profile and reduced hydrodynamic drag
- Payload: 100Kg
- Depth Rating: 150m
- Max. Magnetic Force: 1600Kg
- Dimensions W x L x H: 1686 x 1140 x 588
- Dry Weight: 400Kg
- Footprint – 14ft Control Container, Umbilical and Safety winches



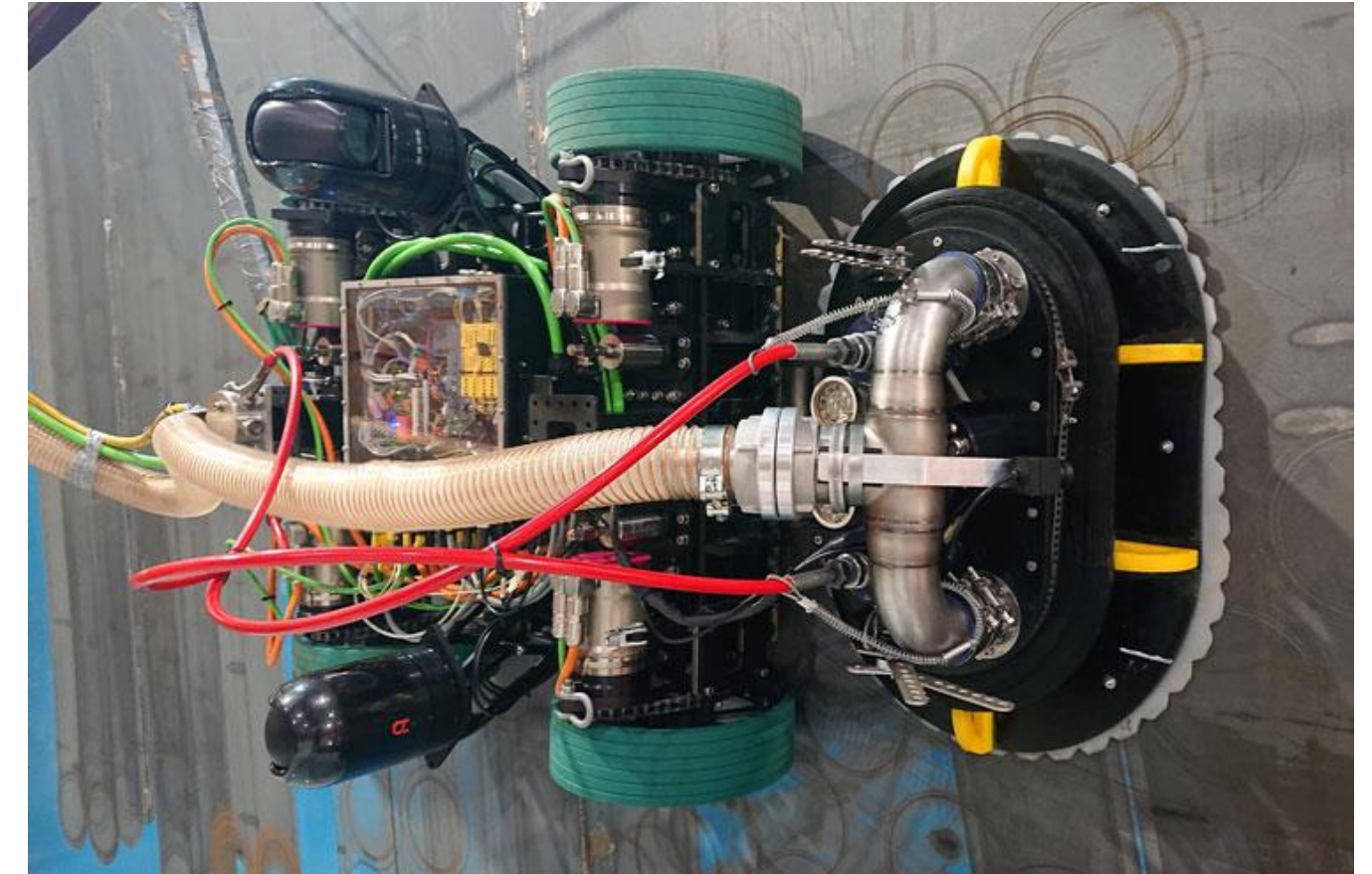
# REMOTION: ACHILLES M-ROV

- Very compact, highly manoeuvrable M-ROV for subsea Inspection, NDT, cleaning.
- Fibre telemetry allows NDT, Ultra Sonic Wall Thickness Measurement and Weld Inspection tools to be fitted
- Asset deployed by LARS
- Electric operation
- 4 large diameter wheels combined with Adaptive Magnetic Suspension provide high magnetic force
- Operates in the splash zone up to 3,0m Hs wave height
- Payload: 100Kg
- Depth Rating: 150m
- Max. Magnetic Force: 1200Kg
- Dimensions W x L x H: 977 x 1110 x 700
- Dry Weight: 250Kg
- Footprint – 14ft Control Container, Umbilical and Safety winches

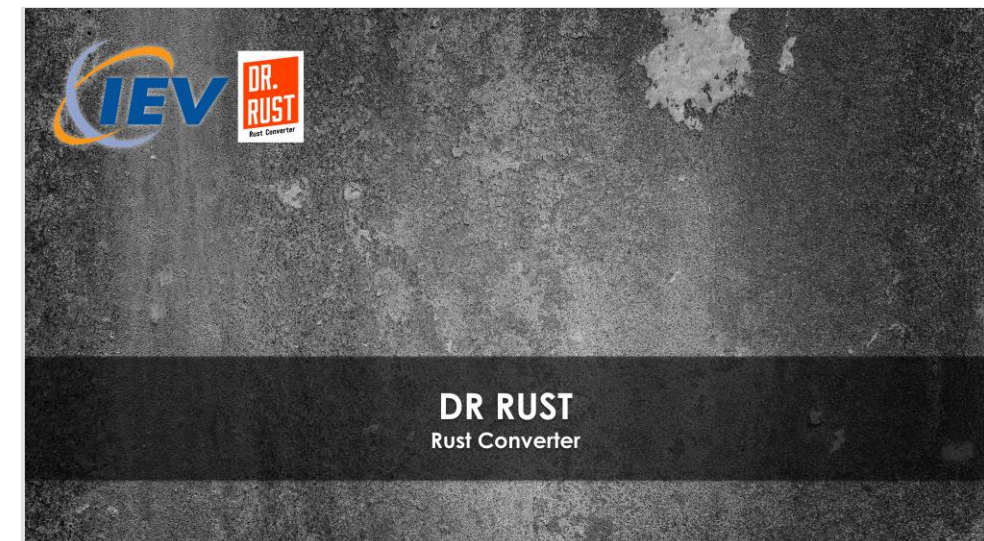


# REMOTION: ROBOCOAT - HELIOS M-ROV

- Remote operated, efficient and complete surface treatment and coating system
- Zero emissions to the environment
- Removes old coating, sandblasts and re-paints the surface
- Asset deployed by Launch Ramp
- Electric operation
- 4 large diameter wheels combined with Adaptive Magnetic Suspension
- Closed Loop vacuum system to capture all paint residues
- Ultra High pressure water blasting tool (40 l/min, 2,700 Bar) removes old coating.
- All removed coating is captured through a vacuum hose to the surface into a filtering unit
- Dust free, automatic spraying booth for airless spraying.
- Equipped with inbuilt filter and suction to keep the spray dust and fumes under control
- Tool can be precisely calibrated for the required WTF (wet film thickness)



# AIM - FLOATING ASSETS – CORROSION CONTROL





**TRENTON**  
Wax-Tape® Systems

# MICROCRYSTALLINE WAX-TAPE

A Proven Corrosion Control Technology since 1949



# TRENTON WAX-TAPE SYSTEMS

## Tape

- Microcrystalline Wax and Corrosion Inhibitors on non-woven synthetic fabric
- A 2+1 step solution – Primer - Tape + OuterWrap (if required)
- Thick thermoplastic coating (avg 2mm)
- Tape firms up providing excellent adhesion and mechanical strength.

## Primer

- A blend of microcrystalline wax, plasticizer, and corrosion inhibitors.
- Paste like consistence
- Displace moisture and wet surface



# TRENTON WAX-TAPE SYSTEMS

1. Inert and **not biodegradable**
2. Conformability to **irregular fittings**
3. Compatibility with many **types of materials**
4. **Minimal** surface preparation
5. **Easy to apply** – Easy to cut and mold into desired shape
6. Can be applied over **wet surfaces**
7. **Hydrophobic** - Acts as a barrier that prevents contact with air, water, and micro-organisms.
8. **No drying or curing time**
9. **Expands and contracts** based on the operating environment.
10. Resistance to **weathering and UV (sunlight)**.
11. Will **not dry or crack**.
12. **Environment Friendly** - Non-toxic, non-carcinogenic, low Volatile Organic Components (VOCs)
13. Can be **painted** after tape firms up. (Acrylic Latex, or other waterbased paints, etc.)



# TRENTON WAX-TAPE SYSTEMS

WAX-TAPES	Wax-tape #1	Wax-tape #2	HT-3000
Color	Brown	Aluminium (Grey)	Brown
Thickness	1.8 – 2.3 mm	1.8 – 2.3 mm	2.5 mm
Dielectric strength	236 volts/mil (9,2 Kv/mm)	170 volts/mil (6,7Kv/mm)	200 volts/mil (8Kv/mm)
Operating temp	-45°C – 49°C	-45°C – 60°C	-1°C – 110°C
Application temp	-17°C – 43°C	-17°C – 60°C	-1°C – 110°C
Operating position	underground, underwater, high condense lines	aboveground and belowground	aboveground and belowground
Recommendation	Outerwrap		



PRIMER	Pile primer	Temcoat primer 3000
Color	Brown	Brown
Pour point	Non melting	
Flash point	350°F (176°C)	
Dielectric strength	100 volts per mil (4Kv/mm)	
Application temperature	32°F – 200°F (0°C – 93°C)	0°F – 230°F (-18°C – 110°C)



# TRENTON WAX-TAPE SYSTEMS

## WAX-TAPES SYSTEMS FOR DIFFERENT APPLICATIONS ON OFFSHORE ASSETS

A range of Wax-Tape systems are available for different applications such as:

- 1) System for complex components including Flanges, valves, bolt & nuts, riser clamps, gantry joints and structural supports at low and high temperature
- 2) System for dynamic and static pipe supports
- 3) System for piping at low & high temperature, and wet & dry conditions
- 4) System for splash zone areas
- 5) System for underwater risers and pipelines

# PIPES & PIPELINES



Pipes



Condensing Pipelines



Bends

# VALVES & FLANGES



Valves



Flanges



Pipe Supports

# MOORING CHAINS



# TRENTON WAX-TAPE SYSTEMS

## **NORTH AMERICA**

- Atmos Energy
- BP
- Chevron
- Columbia Gas
- Consumers Energy
- DTE Energy
- Enbridge
- National Grid
- Florida Keys Water Authority
- Northern Natural Gas Co.
- ONEOK
- Shell
- Transcanada
- Texas Gas
- Williams

## **SOUTH AMERICA**

- Ecopetrol
- PEMEX
- Petrobras
- Promigas SA
- Transportation Gas Del Norte (TGN)
- Transportadora de Gas del Sur-TGS

## **EUROPE**

- Air Liquide
- GRTgaz
- INEOS
- TOTAL EP
- Lyondellbasell
- TIGF (formerly TOTAL Gas)

## **ASIA**

- Exxon Mobil
- Map Ta Phut Tank Terminal Co., Ltd (MTT), Thailand
- Samsung C&T
- Singapore Refining Co.
- Air Liquide, Saudi Arabia
- MARAFIQ, Saudi Arabia
- Gasal, Qatar
- Qatar Petroleum
- Petronas, Malaysia
- Petron, Malaysia
- Rock Cavern, Singapore
- Singapore LNG Terminal
- Singapore Refining Company
- Stolthaven, Singapore

- PetroVietnam
- Hyundai Vinasin Shipyard, Vietnam
- PTTEP, Thailand
- Mubadala, Thailand
- Hyundai Oil Bank, Korea
- Samsung Total, Korea
- LG Chemical, Korea
- Samsung BP, Korea
- JSTT-DOW, Korea
- YNCC, Korea

## **North Africa**

- Sonatrach / Saipem (Eni Group)
- GRTG-SONELGAZ

## **Africa**

- TOTAL





**alocitsystems**



# **ALOCIT UNDERWATER COATING SYSTEMS**

**In-Situ Underwater Coating Systems – Environment Friendly**

# ALOCIT UNDERWATER COATING SYSTEMS (ALOCIT)

- Two component coating system – Alocit Resins and Hardener
- 100% solids
- VOC free
- Can be applied using brushes, rollers or other application unit (piston pump system).
- Environmentally friendly
- Any colors in accordance to RAL standards



# ALOCIT : BENEFITS

- **Hard Wearing**
- **Easy to Apply**
- **Applicable on:**
  - **Wet and Oily Surfaces**
  - **Concrete or Steel**
- **Resist MIC and ALWC**
- **Superior Adhesion**

MIC : Microbial Induced Corrosion  
ALWC : Accelerated Low Water Corrosion



# ALOCIT : ABRASION RESISTANCE TEST



SIRIM-QAS



SIRIM QAS International Sdn. Bhd. (Company No.: 410334-X)  
 CHEMICAL & CONSUMER SECTION, Building 16, No.1, Persiaran Dato' Menteri, P.O.Box 7035, Section 2, 40700 Shah Alam,  
 Selangor Darul Ehsan, Malaysia  
 Tel. no: 03-55446651/55446658 Fax. no: 03-55446688

## TEST REPORT

REPORT NO. : 2013KL0157 PAGE : 1 OF 2

This Test Report refers only to samples submitted by the applicant to SIRIM QAS International Sdn. Bhd. and tested by SIRIM QAS International Sdn. Bhd. This test report shall not be reproduced, except in full and shall not be used for advertising purposes by any means or forms without written approval from Managing Director, SIRIM QAS International Sdn. Bhd. Please refer overleaf for Conditions Relating To The Use of Test Report.

Applicant/Manufacturer : A & E SYSTEMS SDN. BHD.  
 No 26, Jalan Pendaftar U1/54,  
 Seksyen U1, 40150 Shah Alam,  
 Selangor Darul Ehsan, Malaysia.

Product : EPOXY PAINT

Reference standard / Method of test : PTS 30.48.00.31-P (1999) - PETRONAS Technical Standards  
 ASTM D4060-07 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

Description of sample : Received one (1) sample of EPOXY PAINT for testing which was labeled as:  
**Brand : ALOCIT**  
**Model : 28 SERIES**

Date received : 10<sup>th</sup> January 2013

Job No. : J20131400066

Description of overall test result : The submitted test sample as described in this test report had been tested against the above Reference Standard and complied with the requirements of the specified test.

Issue date : 29<sup>th</sup> January 2013

Approved Signatory

(ABDUL AZIZ HARON)  
 Senior Technical Executive

(HAHNAS MAHBUT)  
 Head,  
 Chemical & Consumer Section (CEST),  
 Testing Services Department.

## TEST REPORT

REPORT NO. : 2013KL0157 PAGE : 2 OF 2

This report refers only to samples submitted by the applicant to SIRIM QAS International Sdn. Bhd. and tested by SIRIM QAS International Sdn. Bhd. This test report shall not be reproduced, except in full and shall not be used for advertising purposes by any means or forms without written approval from Managing Director, SIRIM QAS International Sdn. Bhd.

### Test Results

Product : EPOXY PAINT  
 Brand : ALOCIT  
 Model : 28 SERIES

Test Method : ASTM D4060-07 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

### Test Condition:

Wear cycles	1000 revolutions	
Load	1000 g	
Type of abrasive wheel used	CS 10	
Conditioning of sample and tested	Temperature 25°C, Relative Humidity 65%.	
Acceptance Criteria PETRONAS Technical Standards PTS 30.48.00.31-P	150mg/1000cycles/1kg load using wheel CS 10	
No.	Type of Test	Results
1.	Abrasion Resistance,	
1.1	Weight Loss, mg	49.7
1.2	Wear Index in mg/1000 revolutions/ 1kg	49.7

ABDUL AZIZ HARON  
 Senior Technical Executive  
 Chemical & Consumer Section  
 SIRIM QAS International Sdn. Bhd.

- ASTM D4060-07
- Abrasion Resistance
- Petronas Technical Standard
- PTS 30.48.00.31-P

### Acceptance Criteria:

- 150mg
- 1000 cycles
- 1kg load
- Wheel CS10

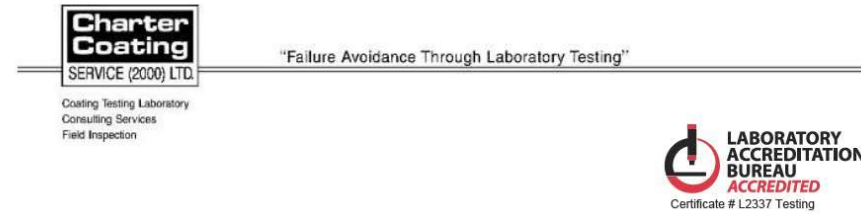
**RESULT:**  
**49.7mg**



# ALOCIT : WATER-ABSORPTION TEST



Charter Coatings, Canada



"Failure Avoidance Through Laboratory Testing"

BIN MOOSA & DALY LTD. L.L.C.

LABORATORY QUALIFICATION TESTING  
OF  
ALOCIT COATING SYSTEM  
AS PER OMAN GAS COMPANY S.A.O.C.  
REQUIREMENTS FOR WET AREA APPLICATION

AUGUST 2013

0592-13-01

PREPARED BY:  
SHAILESH K. DHOKE, PH.D.

APPROVED BY:

REVIEWED BY:  
MICK BROWN, PH.D.

  
AMAL AL-BORNO, PH.D.  
PRESIDENT

CHARTER COATING SERVICE (2000) LTD.  
WATER ABSORPTION OF THE COATING  
(ASTM D570-98(2010))

Project Number:	0592-13-01	Test Duration:	1 day
Tested By:	Dr. X. Chen	Test Temperature:	23 ± 2°C and 60 ± 2°C
Date Started:	June 6, 2013	Test Solution:	Distilled water
Date Finished:	June 7, 2013	Coating Name:	ALOCIT Coating System

Temperature (°C)	Test Sheet ID	Length x Width x Thickness (cm)	Conditioned Weight (g)	Wet Weight (g)	Amount of Water Absorbed (g/m <sup>2</sup> )	Pass /Fail*
23	WA1	7.62 × 2.68 × 0.033	1.0884	1.1021	6.7	7.0 Pass
	WA2	7.56 × 2.66 × 0.041	1.3169	1.3318	7.4	
	WA3	7.68 × 2.63 × 0.036	1.1225	1.1364	6.9	
60	WA4	7.67 × 2.70 × 0.037	1.1980	1.2104	6.0	6.2 Pass
	WA5	7.62 × 2.65 × 0.043	1.2303	1.2413	5.4	
	WA6	7.65 × 2.63 × 0.040	1.2742	1.2885	7.1	

\*Acceptance criteria: < 40 g/m<sup>2</sup> for the test at 23°C, < 70 g/m<sup>2</sup> for the test at 60°C

Approval Authority: Dr. Amal Al-Borno FM-505-00-68 Rev 2 (29/07/2010)

No. 6, 4604 - 13 Street N.E., Calgary, Alberta T2E 6P1 Canada Tel. (403) 250-3027 Fax (403) 250-1254  
www.chartercoating.com

Charter Coating Service (2000) Ltd.  
0592-13-01 Laboratory Qualification Tests of ALOCIT Coating System as per Oman Gas Company S.A.O.C. Requirements for Wet Area Application

41

- ASTM 570-98
- Water Absorption Test
- Underwater application
- Tested for Oman Gas

Acceptance Criteria:

- < 40 g/m<sup>2</sup> at 23°C

**RESULT:**  
**7.0 g/m<sup>2</sup>**



# ALOCIT : ADHESION TEST



Charter Coatings, Canada

Charter Coating SERVICE (2000) LTD. Coating Testing Laboratory Consulting Services Field Inspection		CHARTER COATING SERVICE (2000) LTD. PULL-OFF ADHESION DATA SHEET (ISO 4624:2002)																															
<p>Project No: _____ Inst: _____ Coating: _____</p>		<p>Project Number: 0592-13-01 Date: June 3, 2013 Instrument: Patti Jr. apparatus (IV) Temperature: 60°C/140°F Coating Name: ALOCIT Coating System Tested By: S. Rao</p>																															
<table border="1"> <thead> <tr> <th>Sample ID</th> <th>Coating Thickness (mils)</th> <th>Pull-off Strength Value (psi/MPa)*</th> <th>Nature of the Fracture**</th> </tr> </thead> <tbody> <tr> <td>A1</td> <td></td> <td></td> <td></td> </tr> <tr> <td>A2</td> <td></td> <td></td> <td></td> </tr> <tr> <td>A3</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Sample ID	Coating Thickness (mils)	Pull-off Strength Value (psi/MPa)*	Nature of the Fracture**	A1				A2				A3				<table border="1"> <thead> <tr> <th>Sample ID</th> <th>Coating Thickness (mils)</th> <th>Pull-off Strength Value (psi/MPa)*</th> <th>Nature of the Fracture**</th> </tr> </thead> <tbody> <tr> <td>A4</td> <td>20.5 - 37.6</td> <td>2249 psi / 15.5 MPa</td> <td rowspan="3">Pass Average 2322 psi / 16.0 MPa</td> </tr> <tr> <td>A5</td> <td>17.4 - 24.0</td> <td>2395 psi / 16.5 MPa</td> </tr> <tr> <td>A6</td> <td>19.7 - 28.7</td> <td>2322 psi / 16.0 MPa</td> </tr> </tbody> </table>	Sample ID	Coating Thickness (mils)	Pull-off Strength Value (psi/MPa)*	Nature of the Fracture**	A4	20.5 - 37.6	2249 psi / 15.5 MPa	Pass Average 2322 psi / 16.0 MPa	A5	17.4 - 24.0	2395 psi / 16.5 MPa	A6	19.7 - 28.7	2322 psi / 16.0 MPa	<p>*Cutting tool was used for cutting through cured adhesive and the paint coating to the substrate, round the circumference of the dolly Acceptance criteria: Min.10 MPa Note: Substrate is _____ Size of loading fixtures: 0.5 inches Loading</p>	<p>*Cutting tool was used for cutting through cured adhesive and the paint coating to the substrate, round the circumference of the dolly Acceptance criteria: Min.10 MPa Note: Substrate is designated as "A", Primer (black) as the first coat ("B") and Coating (white) as the second coat ("C") Size of loading fixtures: 0.5 (inches) Loading fixtures were applied to the coating surface.</p>
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A5	17.4 - 24.0	2395 psi / 16.5 MPa																															
A6	19.7 - 28.7	2322 psi / 16.0 MPa																															
<p>PREPARED BY: SHALESH K. I REVIEWED BY: MICK BROWN, P</p>	<p>Figure 2. _____ Figure 2 shows cl _____ at 23°C/73°F. No basecoat. The co adhesive strength. MPa, 17.9 MPa, a coating passes the</p>	<p>Figure 3. _____ Figure 3 shows cl _____ at 60°C/140°F. T cohesive failure, i A4, A5 and A6 v strength was 16.0</p>	<p>**Pull-off Adhesion as per ISO 4624</p> <table border="1"> <tbody> <tr><td>A</td><td>is cohesive failure of substrate;</td></tr> <tr><td>A/B</td><td>is adhesive failure between substrate and first coat;</td></tr> <tr><td>B</td><td>is cohesive failure of first coat;</td></tr> <tr><td>B/C</td><td>is adhesive failure between first and second coats;</td></tr> <tr><td>C</td><td>is cohesive failure of second coat;</td></tr> <tr><td>n</td><td>is adhesive failure of the nth coat of a multi-coat system;</td></tr> <tr><td>n/m</td><td>is cohesive failure of the nth coat and the mth coat of a multi-coat system;</td></tr> <tr><td>-Y</td><td>is adhesive failure between final coat and adhesive;</td></tr> <tr><td>Y</td><td>is cohesive failure of adhesive;</td></tr> <tr><td>YZ</td><td>is adhesive failure between adhesive and dolly.</td></tr> </tbody> </table>	A	is cohesive failure of substrate;	A/B	is adhesive failure between substrate and first coat;	B	is cohesive failure of first coat;	B/C	is adhesive failure between first and second coats;	C	is cohesive failure of second coat;	n	is adhesive failure of the nth coat of a multi-coat system;	n/m	is cohesive failure of the nth coat and the mth coat of a multi-coat system;	-Y	is adhesive failure between final coat and adhesive;	Y	is cohesive failure of adhesive;	YZ	is adhesive failure between adhesive and dolly.										
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<p>No. 6, 4604 - 13</p>	<p>Charter Coating Service (2000) Ltd. 0592-13-01 Laboratory Qualification Tests of ALOCIT Coating System as per Oman Gas Company S.A.O.C. Requirements for Wet Area Application</p>	<p>Charter Coating Service (2000) Ltd. 0592-13-01 Laboratory Qualification Tests of ALOCIT Coating System as per Oman Gas Company S.A.O.C. Requirements for Wet Area Application</p>	<p>Charter Coating Service (2000) Ltd. 0592-13-01 Laboratory Qualification Tests of ALOCIT Coating System as per Oman Gas Company S.A.O.C. Requirements for Wet Area Application 15</p>																														

- ISO 4624:2002
- Adhesion Test
- Underwater application
- Tested for Oman Gas

## Acceptance Criteria:

- Min 10MPa

**RESULT:**  
**Average 16 Mpa**  
**2322 psi**



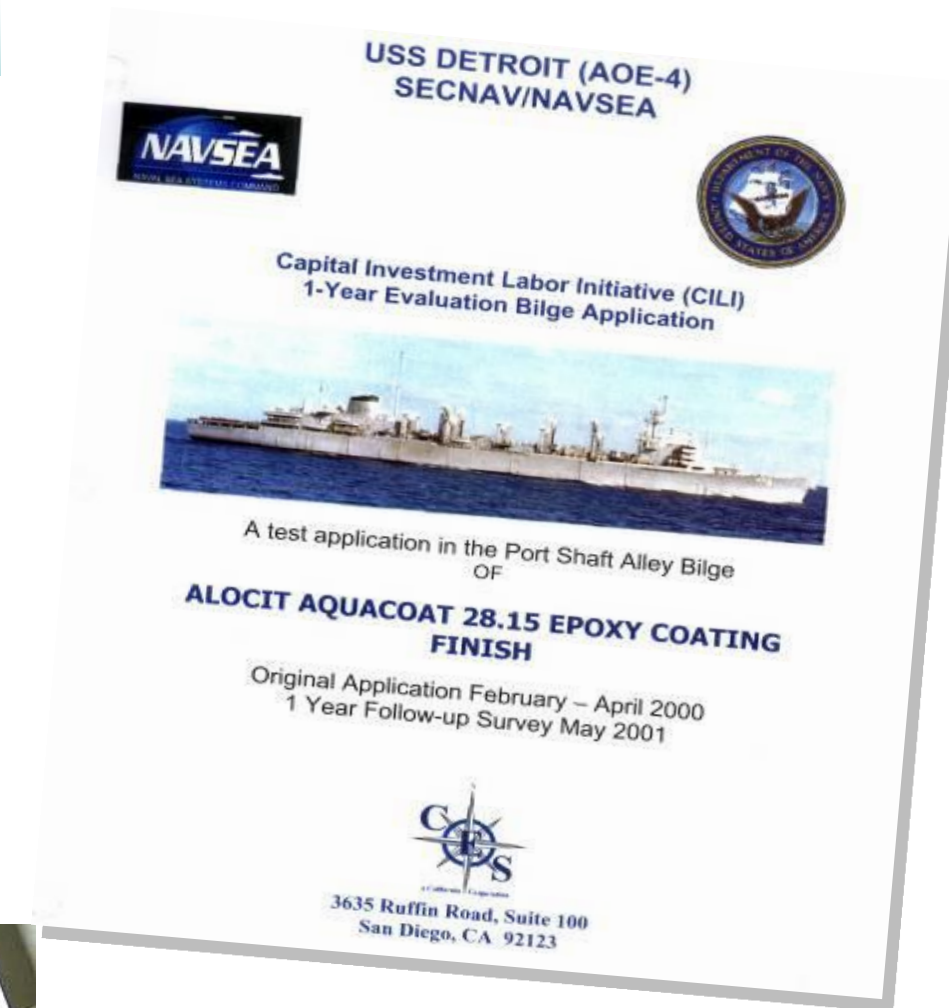
# ALOCIT : USS DETROIT

## USS Detroit

Full scale test application in the Port Shaft Alley Bilge completed in 2000 as part of the NAVSEA approval process. Follow up inspection by CES for NAVSEA in 2001 found the Alocit 28.15 coating to be 'performing flawlessly in severe service'



The finished Port Shaft Alley bilge area



# ALOCIT : SBM COATING REPAIR (OMAN)



## SBM Coating Repair (OMAN)

- 2 coats system
- 300 $\mu$  per coat
- Application by Alocit Round Hand Brush
- 1<sup>st</sup> coat Alocit 28.15 Tropical White
- 2<sup>nd</sup> coat Alocit 28.15 Tropical Black





# ALOCIT FOR FLOATING ASSETS

As Alocit is an environmentally friendly with 100% solids coatings, it is design for the ease of application by the divers and can be applied in the wettest and difficult areas:

- **Oil & Gas Vessels**
  - FPSO, FSO, FSU, FDPSO, FSRU, FLNG, etc...
    - Ballast Tanks
    - Mooring Chains
    - Hulls
    - Sweating Pipes, Valves and Flanges
- **SBMs**





# DR RUST

Rust Converter

# DR RUST - OVERVIEW

- Dr. Rust - Rust Converter is a unique fast drying coating formulated for treatment of rusted surfaces. It **stops rust instantly and prevents future rusting**.
- Dr. Rust **neutralizes rust and transforms/converts it into a tough black primer** that binds to the surface and provides a barrier for effective long-lasting corrosion protection. No more sandblasting, heavy scraping, or grinding.
- Dr. Rust converts the rust formed from the oxidation of steel and iron into a **paintable anti-corrosive layer**. The cured coating is impermeable, tough and durable, preventing further corrosion.
- When dry, the dark black/grey coating acts as an **effective primer** for colored top-coat application and provide tenacious **inter-coat adhesion**.
- It is **water based, with no chlorinated, chrome containing pigments or toxic solvents**.
- It can be used as a finish coat or as a primer.



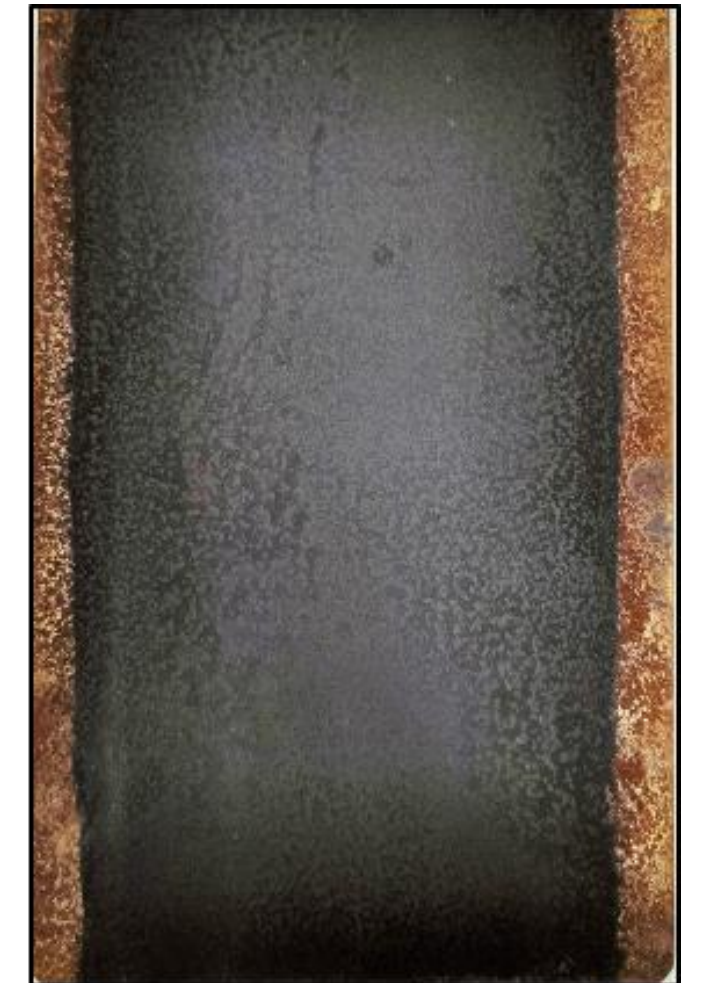
# DR RUST – 3 WAYS

Dr. Rust - Rust Converter acts in three ways

- **Inactivates existing rust:** Unstable ferric hydroxide, formed in the beginning of the corrosion process of iron, is transformed into an inert complex which serves as a protective barrier, halting the corrosion process immediately.
- **Formation of a passivating protective coating:** the formed complexes combine with the unique resin in Rust Converter creating a non-permeable coating, providing anti-corrosion protection.
- **Functions as a corrosion inhibitive primer:** A package of corrosion inhibitive pigments and unique ion exchange technology prevents rust by sacrificial, barrier and inhibition mechanism.



Before Dr. Rust



After Dr. Rust



# DR RUST : KEY FEATURES

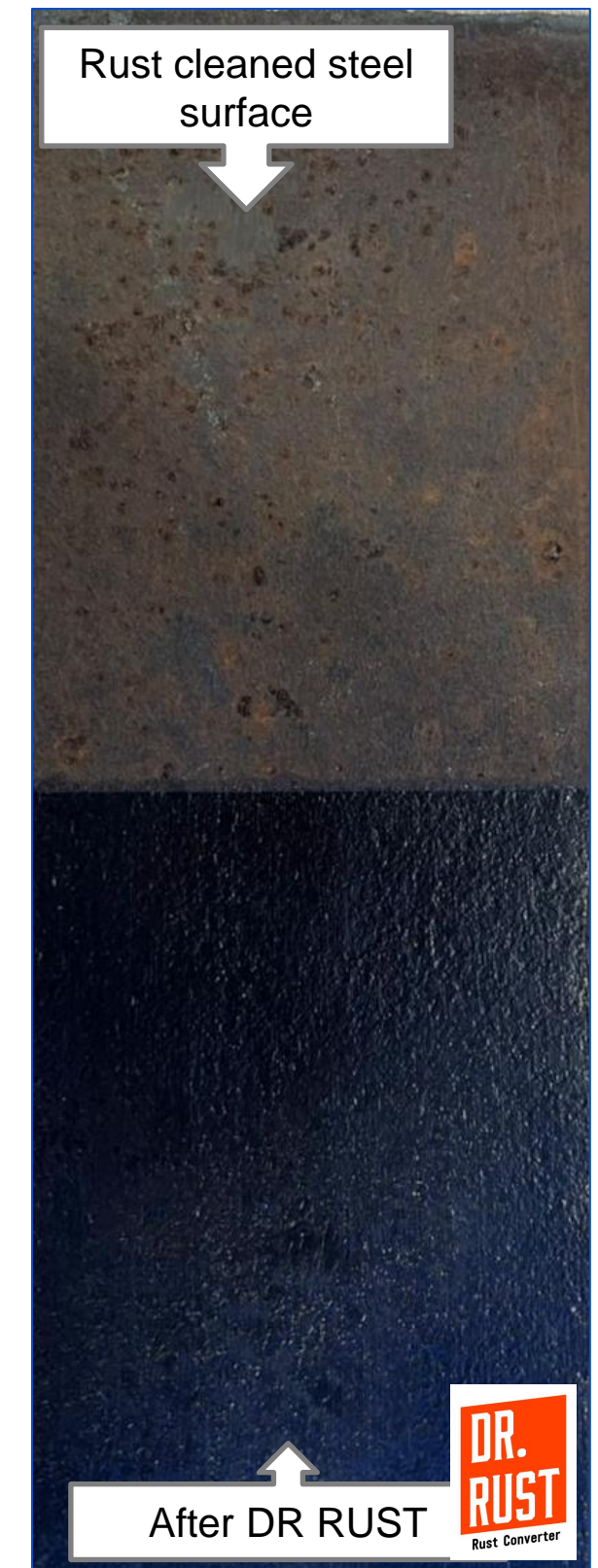
Some of the **key features** are as following:

- ✓ Ready to use
- ✓ Rapid rust conversion. Stops rust instantly
- ✓ No need to sand blast or scrap the surface; No clean ups required
- ✓ Rapid drying
- ✓ Converts the rust through the surface depth and forms a black coating
- ✓ Excellent Adhesion
- ✓ Excellent durability against weather
- ✓ Waterborne technology, Environmentally Safe
- ✓ Applicable over variety of metal surfaces
- ✓ Versatile in application methods; Sprayable, Brushable

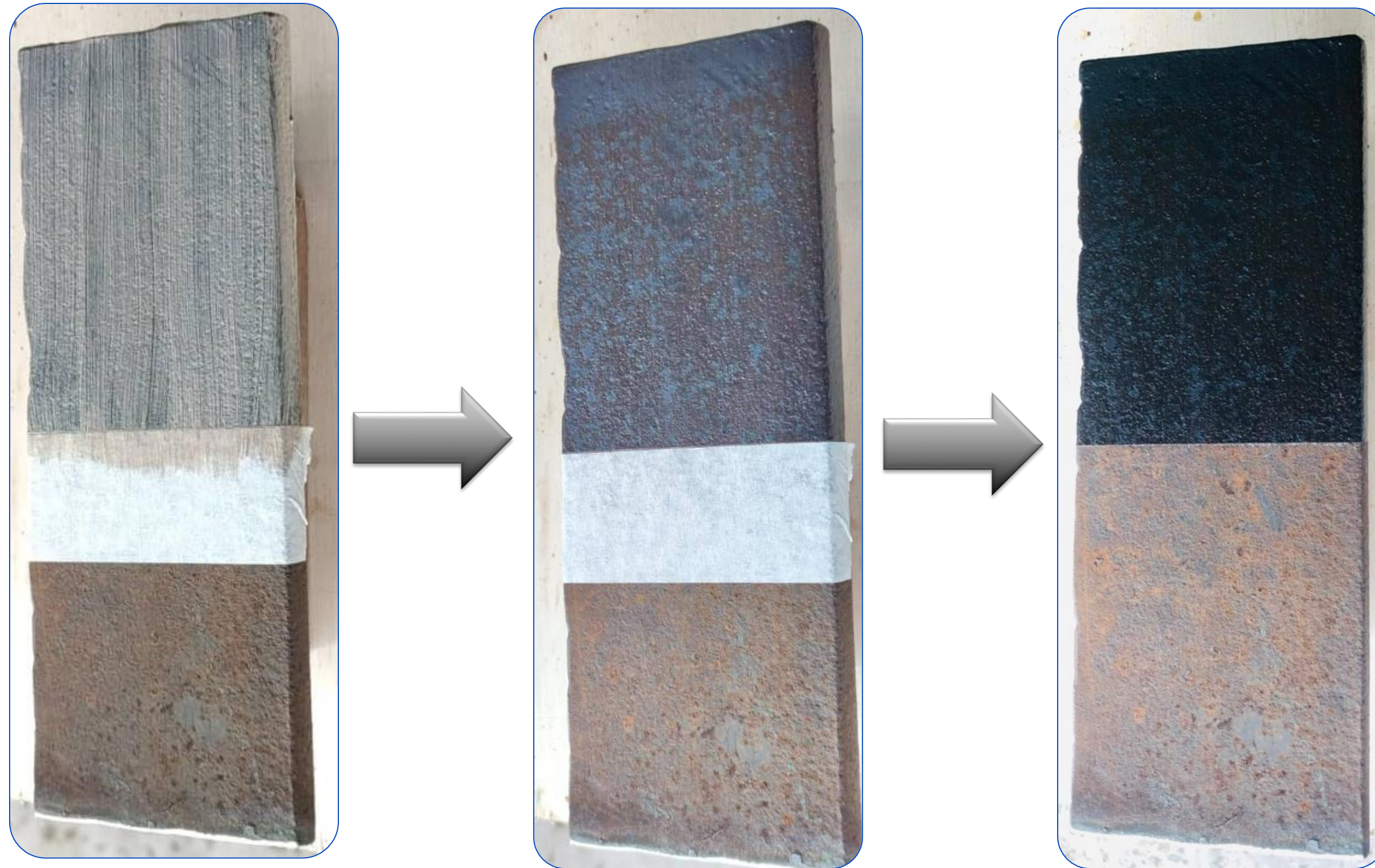


# DR RUST : HOW EASY IS IT TO APPLY?

- 1) Surface Preparation** - Remove loose rust, grease, dirt and paint residue with the aid of a wire brush, grinding discs, etc. Keep surface dry and clean.
- 2) Open Dr Rust bottle** and stir well before use and before each layer of application. Dr Rust has no pot-life.
- 3) Use standard or synthetic bristle brush / roller or sprayer** for application depending on the area of coverage.
- 4) Dr Rust will cure to a dry dark grey finish** within 5 – 15 minutes depending on the environment and temperature. Leave for 24 hours before over painting.
- 5) Keep unused Dr Rust bottle sealed** in a well-ventilated area (approx. 25 deg C). Use within 12 months from the date of manufactured.



# DR RUST : HOW EASY IS IT TO APPLY?



Between 5 – 30 mins



# DR RUST – SPECIFICATIONS

PRODUCTS / SPECIFICATIONS	DR. RUST - EXTREME
Appearance	Off-white
Odor	Odorless
Density (g/cc)	1.2-1.4
Recommended film thickness	4-5 mils
Coverage @1 mil	7 m <sup>2</sup> /Liter
Recommended Number of coats	Minimum 2
Technology	Waterborne
Corrosion resistance/Sal spray, ASTM B117, Top Coated Substrate: Plain CRS	2,000 hours
pH	4.5 – 5.5
Rust Conversion (minutes)	20-40 minutes
Recoat time	4 hours
Heat resistance	Up to 200° C







remotion



*Creating Value through Disruptive Technologies*



## **IEV GROUP SDN. BHD.**

Address:

Level 5, Menara PKNS, Block A,  
No. 17 Jalan Yong Shook Lin,  
46050 Petaling Jaya, Selangor

Tel: +6 (03) 7931 9921

E: [info@iev-group.com](mailto:info@iev-group.com)