Chevron

human energy

Inspection of Large Storage Tanks using Robotic Systems in Oil Refineries

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Advanced Inspection Systems for Inspection and Maintenance of Oil Facilities

- For several years Chevron has been working with research centers and technology companies to develop inspection alternatives that would allow to:
  - Reduce Inspection costs, time and operational disruption
  - Reduce or avoid risk to inspectors In dangerous locations
  - Increase the quality of inspection data

- We have been focusing on Inspection of large storage tanks while in Service, and inspection of Pressure Vessels and Storage Vessels to avoid confined space entries.

Remote Inspection of Pressure Vessels; Technology Status

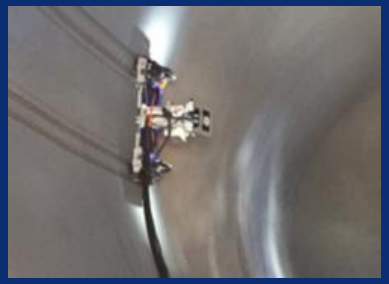
- **Inspection of pressure vessels for internal visual inspection using robotics will have a definite impact on:**
  - Confined Space Rescue, Hole Watch and Fire Watch teams
  - Work Permits on Confined Spaces
  - Vessel isolations/ process disconnections
  - Internal scaffold construction –in some cases

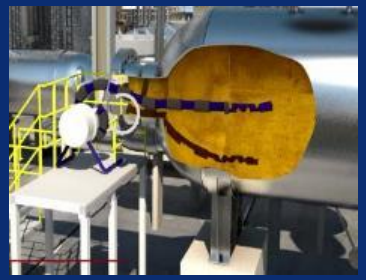
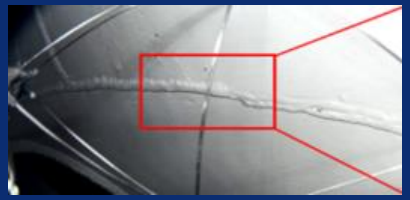
- **We will use a "tool-box" approach multiple tools may be needed to access complicated geometry vessels and with internal structure.**

  Goal is to have enough information to write an API-510 report.
- **If evidence of damage or corrosion is detected, other tools will be used for additional NDE, OR confined space entry will be needed.**
- **Devices have been tested and going trough final fine-tuning. Ready for testing and demonstrations.**

No-Entry inspection systems for Pressure Vessels

- Multiple systems have been developed over the last few years and have been tested for performance.
- Several vendors offer now robotic systems for inspection, and are becoming available in most locations.
- Solutions based on flying, crawling and robotic arms are targeted.
- What you may not know is that you can:
  - Save Time and Cost
  - Increase the quality of the information and reach of inspection with these tools.




Robotic Tank Floor Inspections

- **Drivers:**
  - We are convinced that the Business Case is clear for In-Service tank floor inspections as long as:
    - We can safely operate this system
    - We can avoid or reduce any environmental impact
    - The system collects enough data, with enough quality to have enough confidence to extend the internal inspection period per API-653 or other applicable requirements.
  - This type of inspection systems will allow us to change the way we do inspection, as we can repeat it at almost any time, which will allow us to observe corrosion behavior and optimize the period of safe operation of the tanks.
  - We are also aware that this is a new technology. Additional work and development may be needed to reach optimal results.

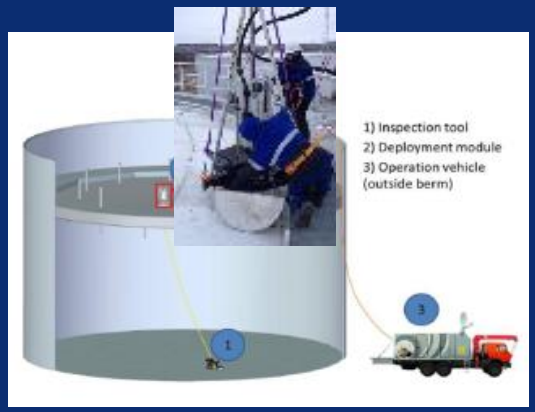
DIAKONT System

- An Inspection system was developed by DIAKONT with Chevron Support, called Stingray. It has been tested and the first version is now available:

http://www.diakont.com/energy_services/online_storage_inspection.html

Chevron Considers this system development completed and ready for use with the following limitations:

- Do not use in tanks with explosive atmospheres. The Stingray version certified for these conditions will be ready after the middle of 2018.
- This system will not work if sediments, sludge or similar materials have accumulated in the floor and cannot be displaced by the Stingray system. Pre-cleaning with other remote systems may be required.



http://www.diakont.com/energy_services/online_storage_inspection.html

Online Tank Floor Inspection

Diakont STINGRAY Online Tank Floor Inspection System:

- API 653 tank floor inspection service for filled tanks
- Class 1 Div. 1 system
- Complete NDE coverage, including annular ring critical area
- Motorized brush, plow, and jets for sludge displacement
- Real-time automated tank floor mapping
- 3D imaging sonars for obstacle avoidance
- Entire system bonded, for anti-static and voltage equalization
- Fail-safe redundancy and emergency retrieval features

STINGRAY

Utilizes a combination of MFL for detection, and a 96-element UT array for sizing

DIAKONT

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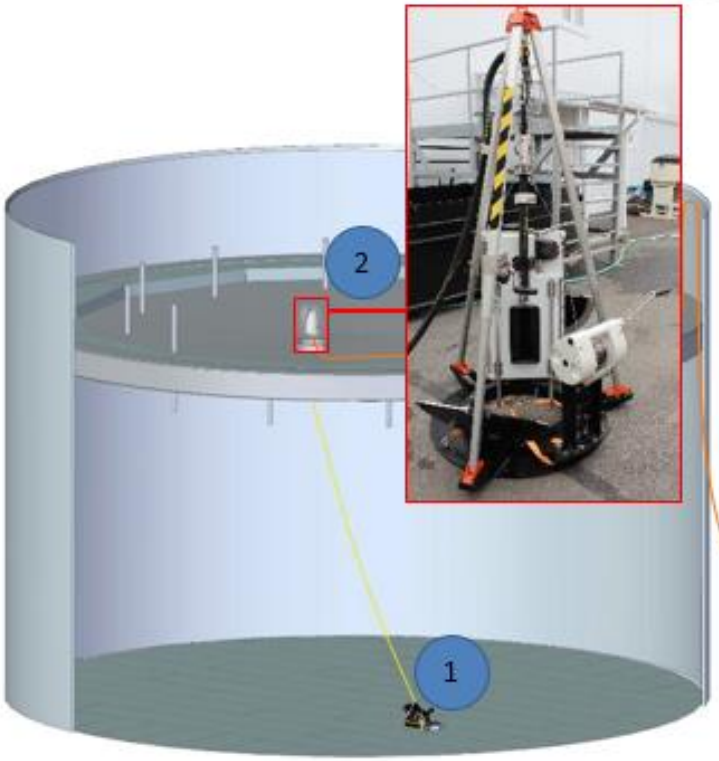
System Deployment

- Temporary hatch fitted in place of manway blind following roof launch
- Cable seals to block VOC emissions
- Environmental basin fastened around manway during robot recovery

Hatch seal with vapor seal for umbilical cable



1) Inspection tool
2) Deployment module
3) Operation vehicle (outside berm)

DIAKONT

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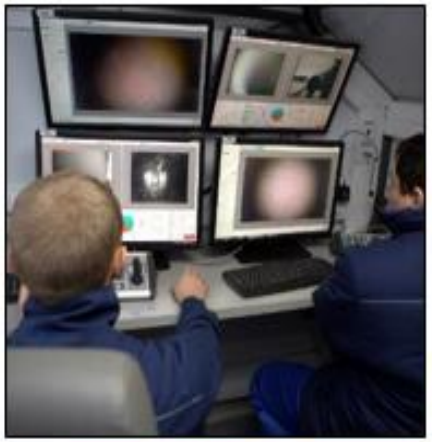
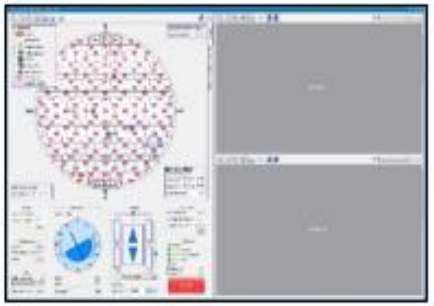
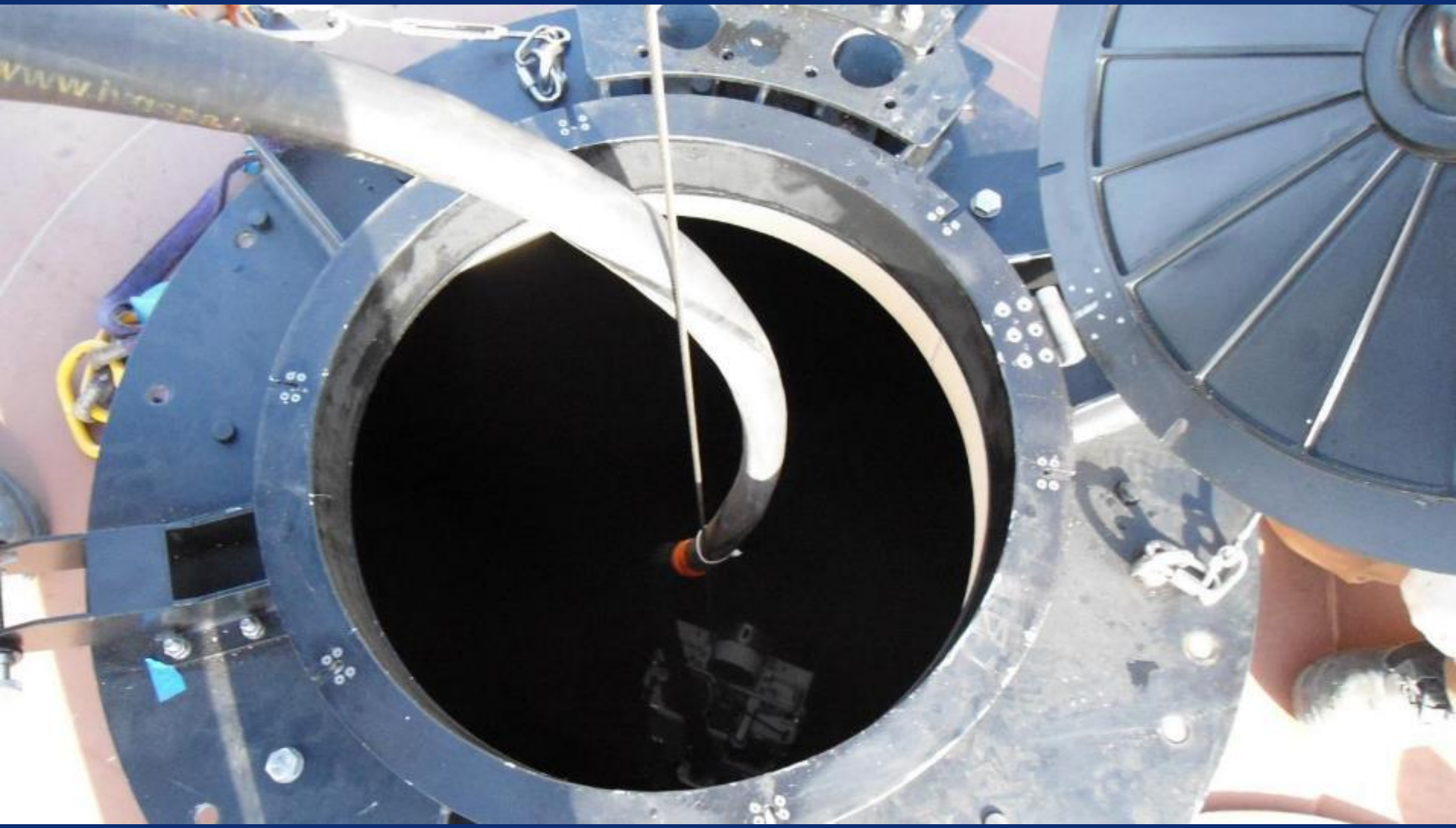
NDE Control Center

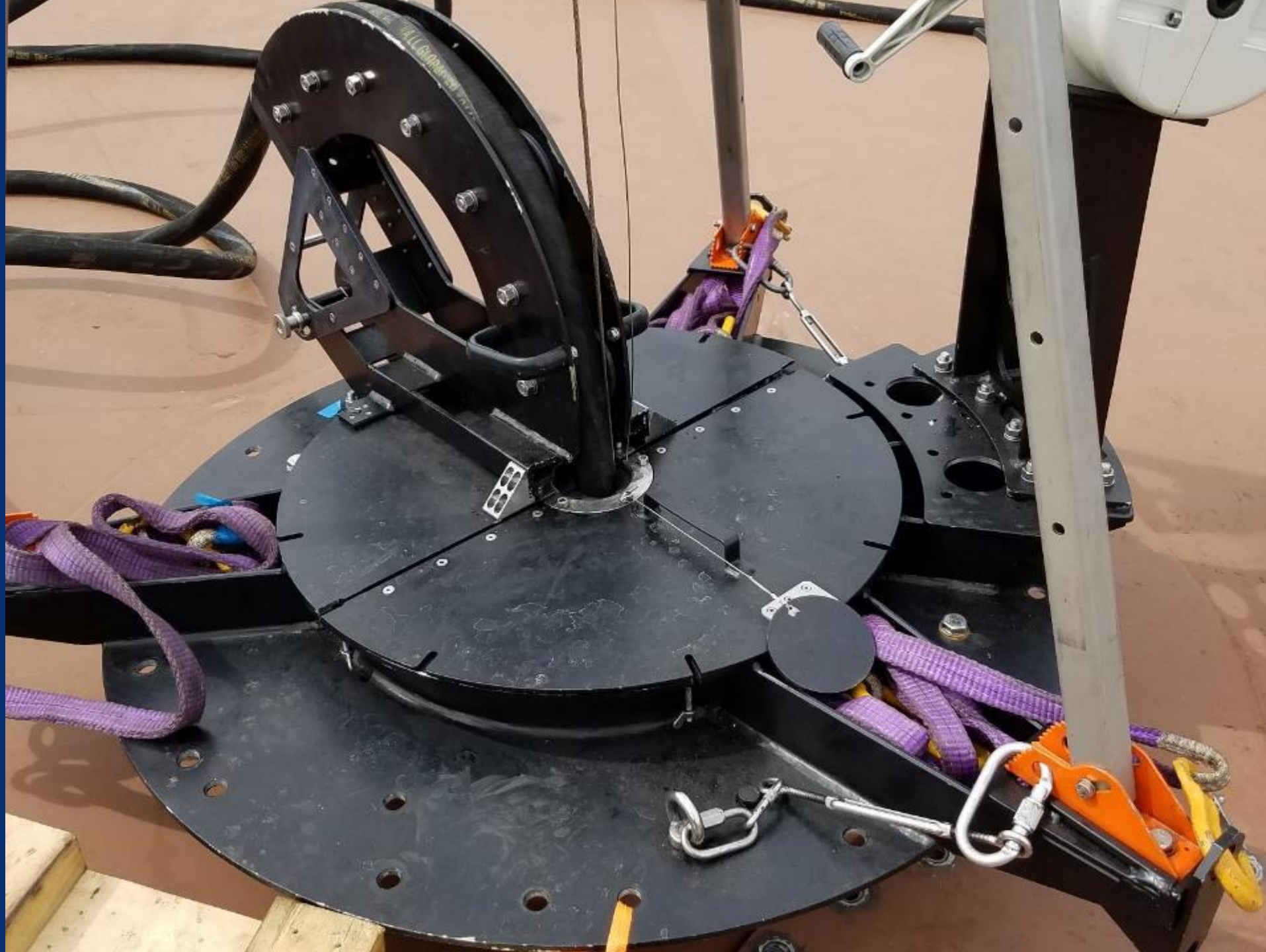
- Parked outside secondary containment, in non-hazardous area
- Robot operator and Level II NDE technician operating tool in real time
- Remote link to Diakont facility available, for connection to Level III NDE technician
- Results provided to client in complete report, along with complete report



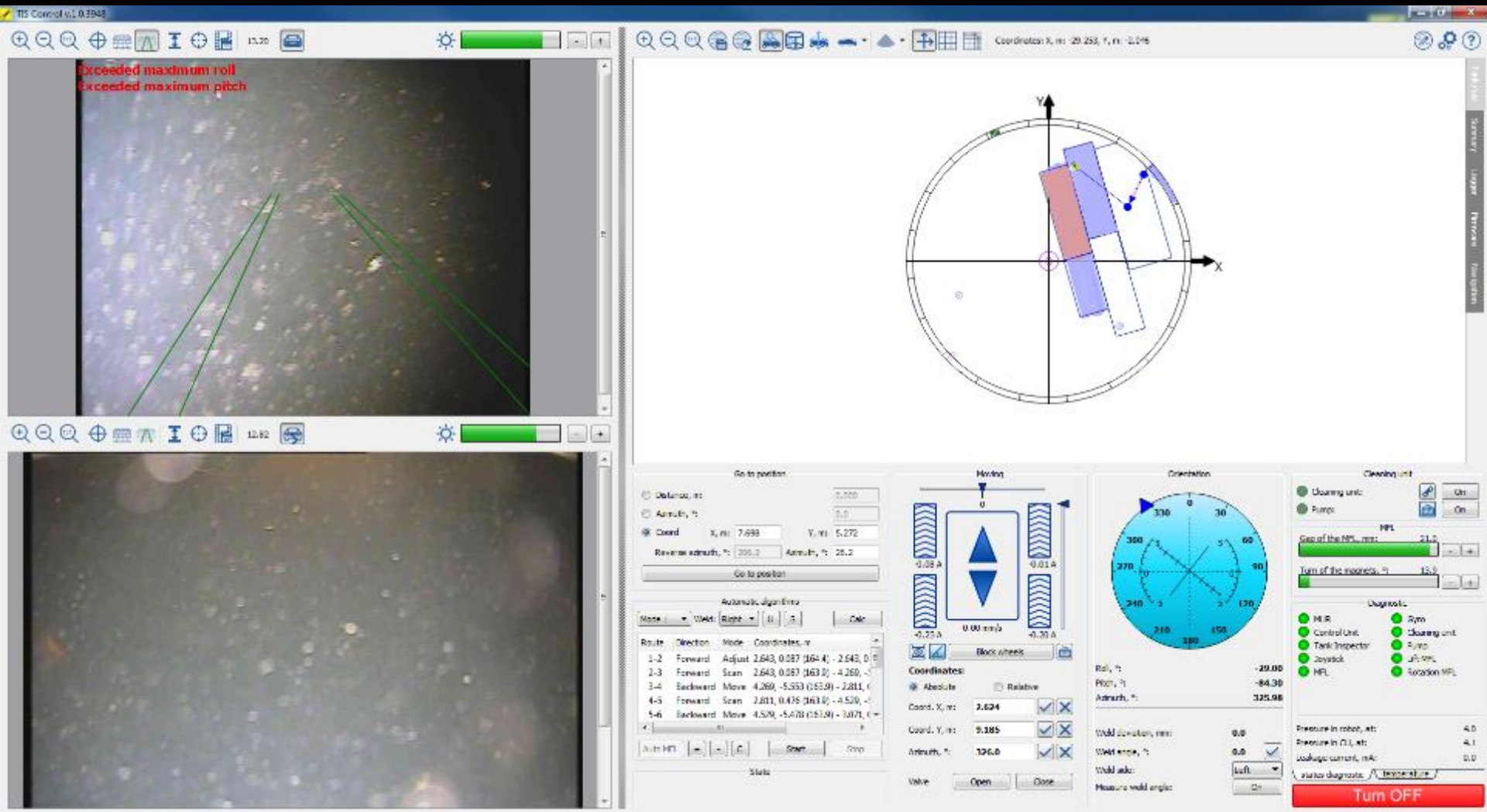


DIAKONT

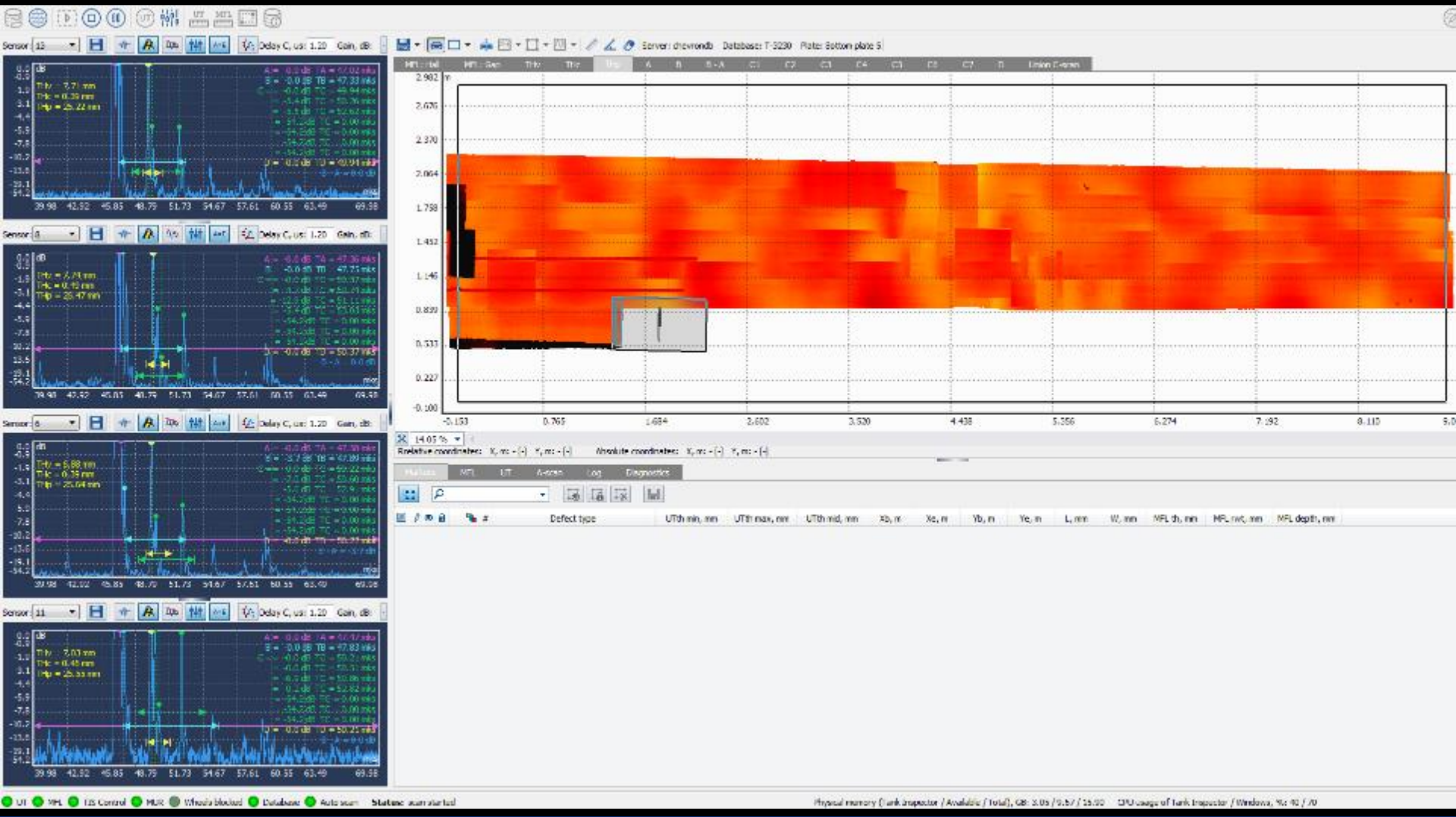




Demonstration Results



Demonstration Results



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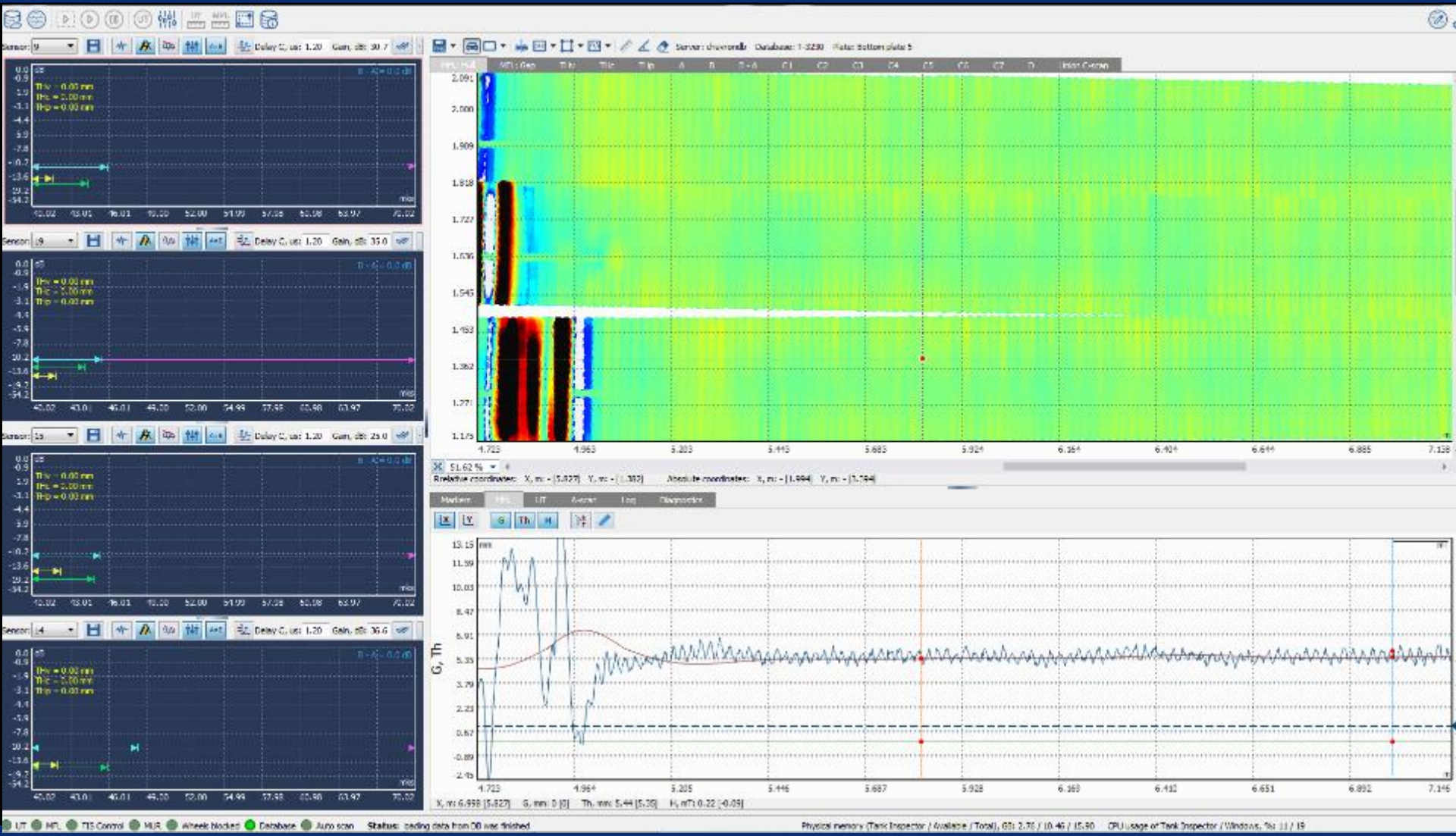
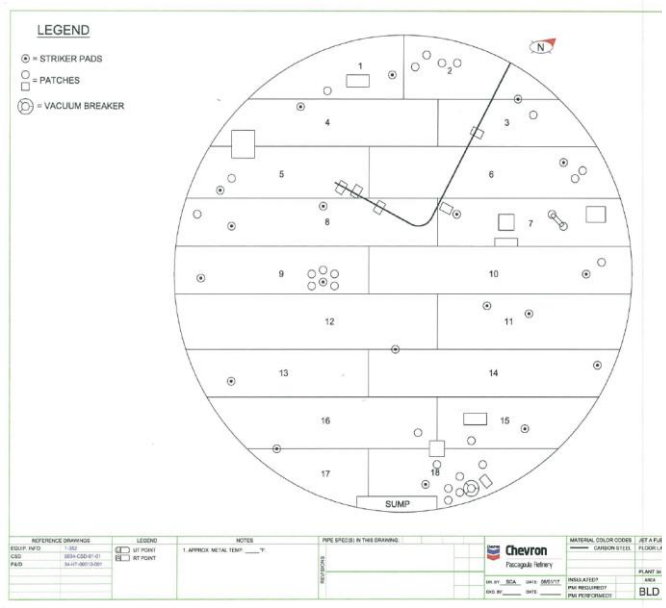
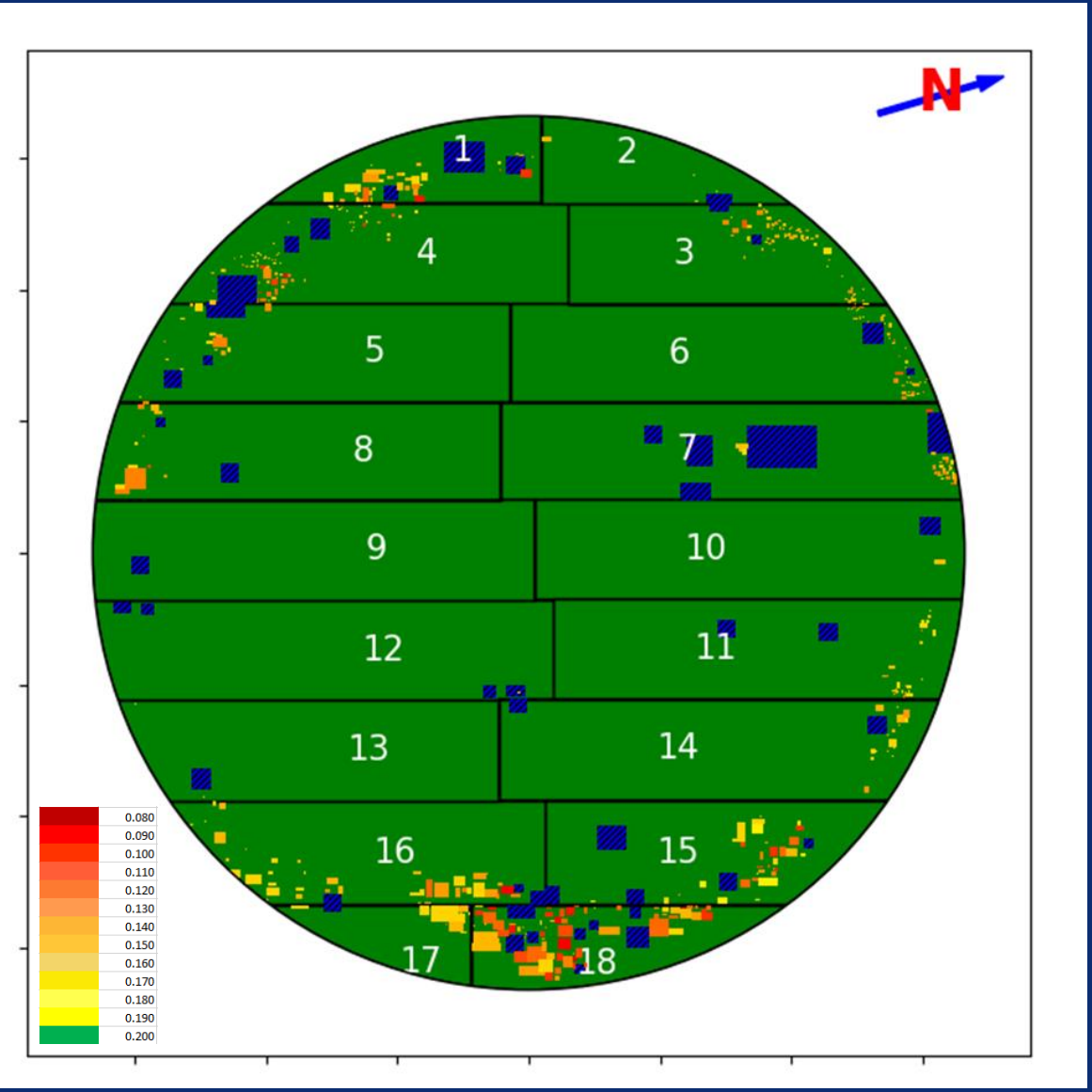


Pascagoula T-352 Floor Plan & Diakont Results

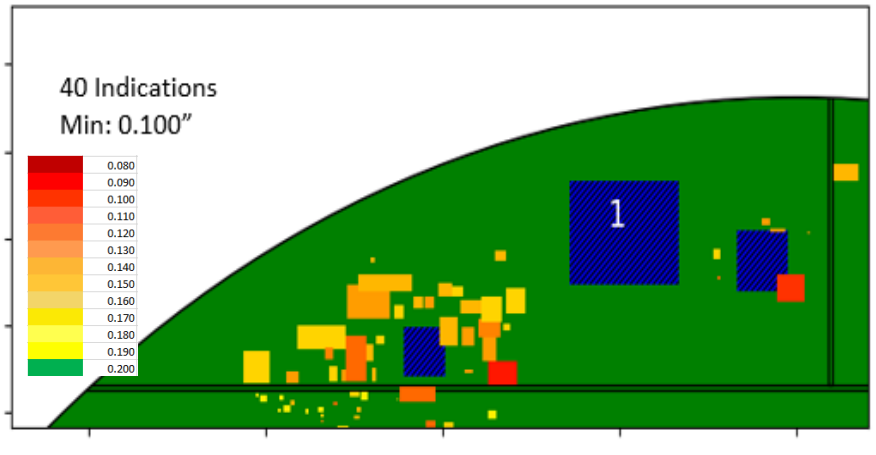


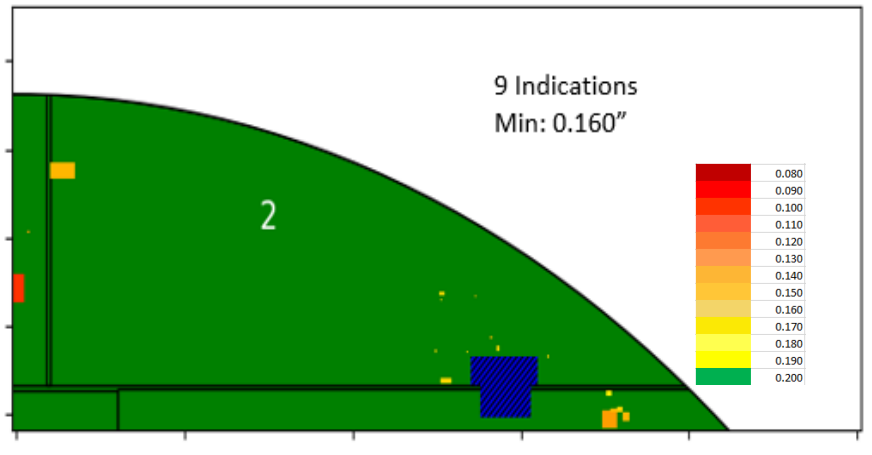
Diakont:
Inspection work:
July & October 2017

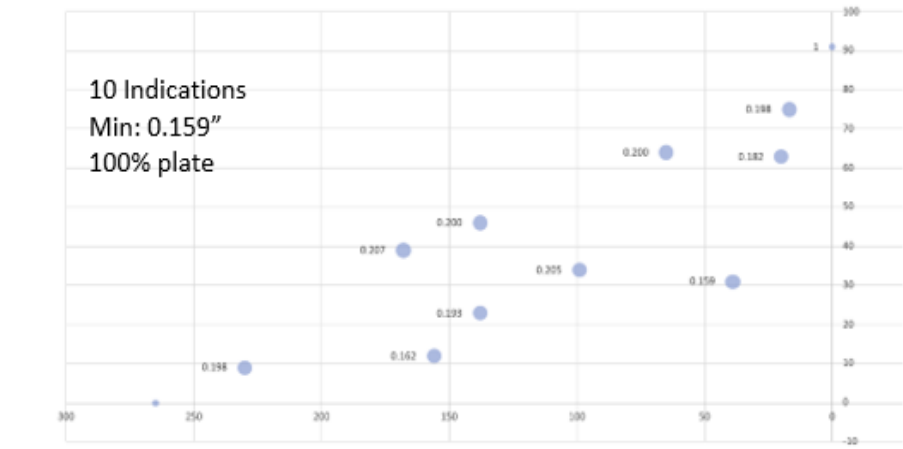
AIS Inspection:
June 2017

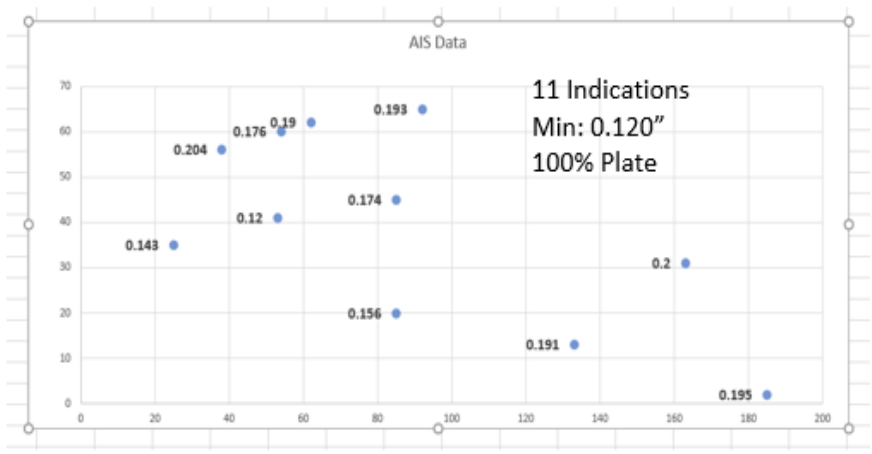


Some Plates Comparisons with Conventional MFL/UT



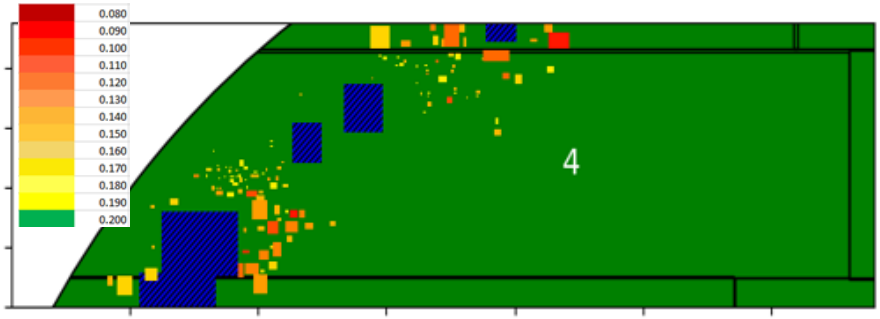




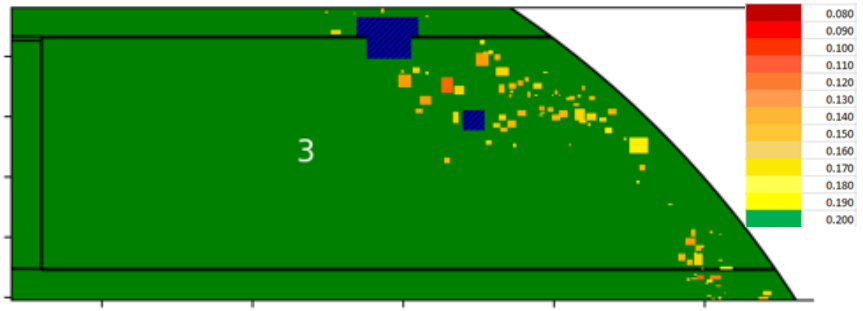


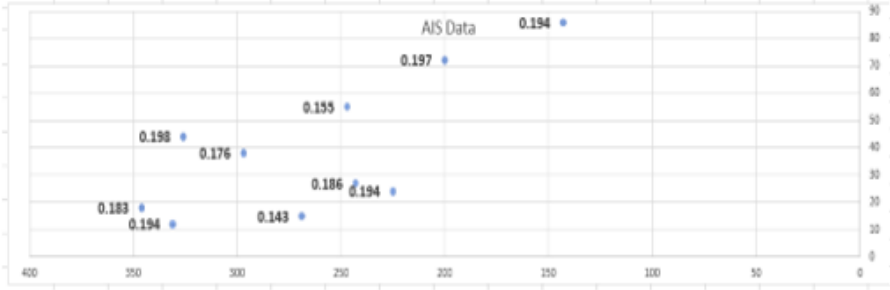
T-352; Plates 3 & 4

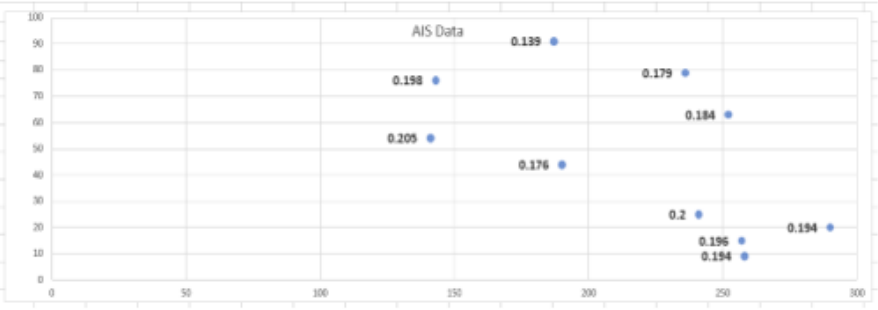
10 Indications
Min: 0.100”



77 Indications
Min: 0.120”





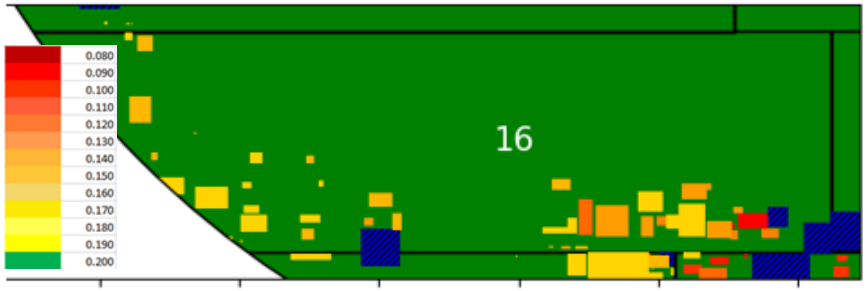


10 Indications
Min: 0.143”
1x1; Half Plate

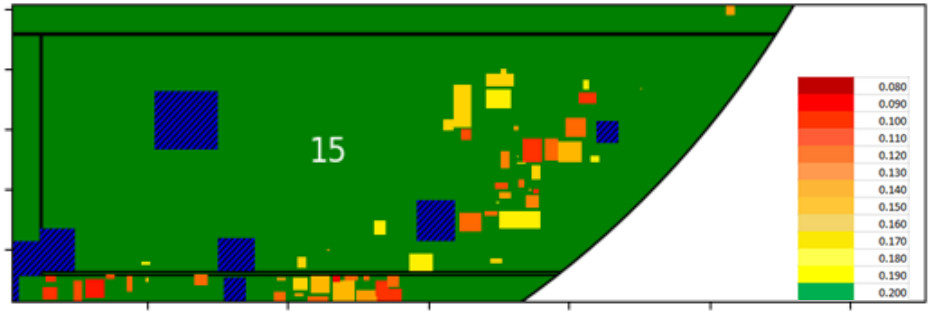
10 Indications
Min: 0.139”
Half Plate

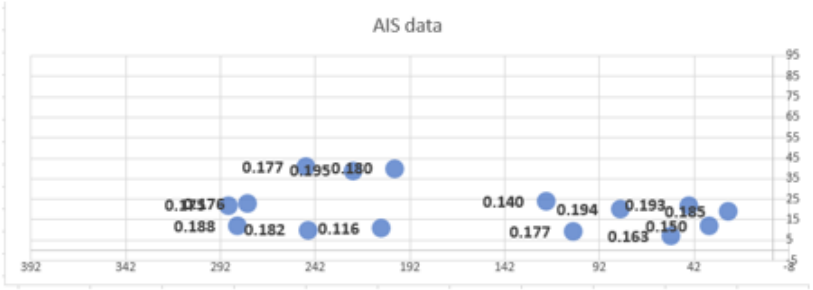
T-352; Plates 15 & 16

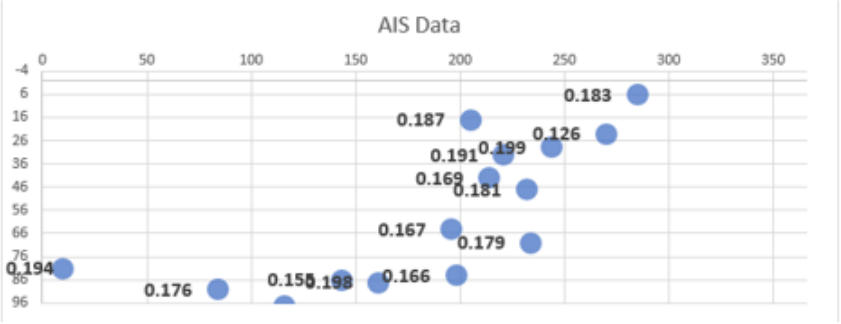
50 Indications
Min: 0.090”



41 Indications
Min: 0.110”





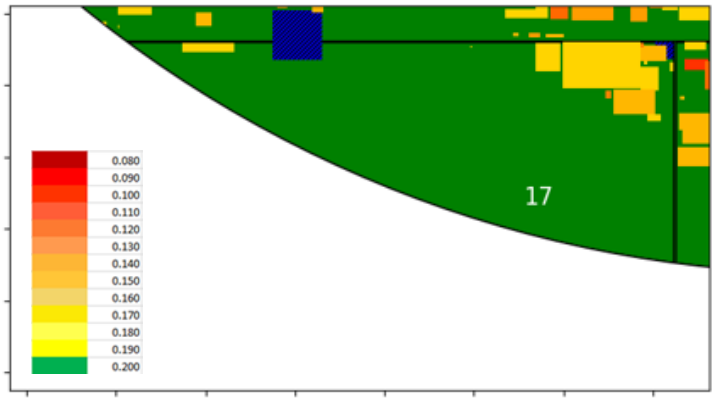


15 Indications
Min: 0.150”
100% Plate

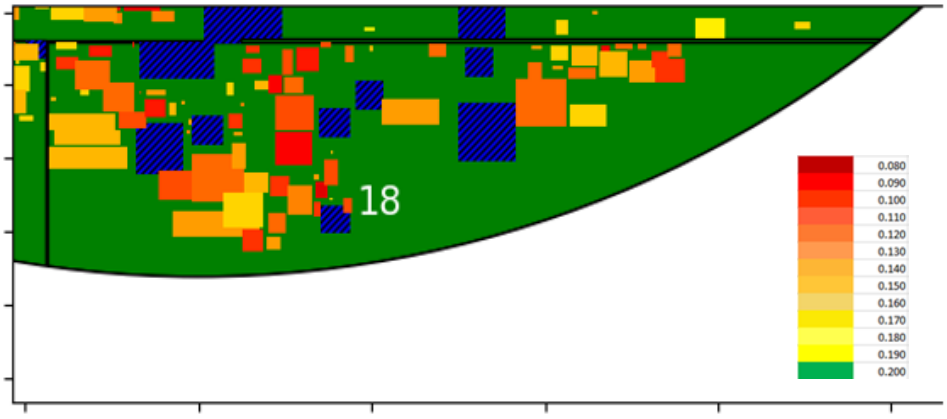
15 Indications
Min: 0.126
100% Plate

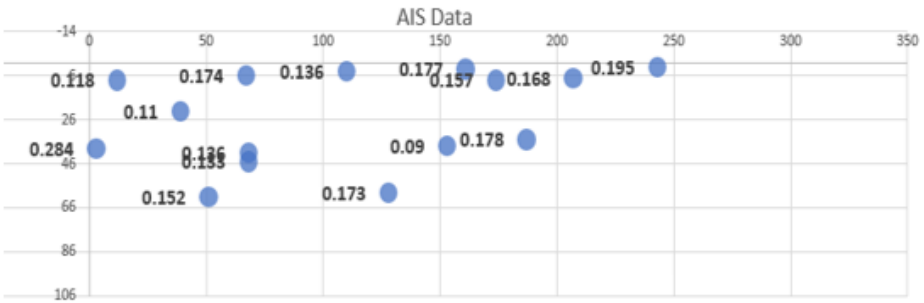
T-352; Plates 17 & 18

12 Indications
Min: 0.140”



80 Indications
Min: 0.080”





18 Indications
Min: 0.116”
100% Plate

15 Indications
Min: 0.090”
100% Plate

Comments and Conclusions

- We will continue exploring robotic solutions.
- We are looking for companies that are willing to work with us to develop solutions for inspection and maintenance for oil facilities both on-shore and off-shore.