PRESENTERS

Internal Robotic API 653 Tank Inspections and Capabilities for Midstream Facilities

Thursday, August 29th
Time slots: 9 am CDT | 1 pm CDT

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Dir. of Business Development

Madison Hart
Business Development Manager

Webinar Agenda

- ❑ INTRODUCTIONS & WHERE IT ALL BEGAN
- ❑ MIDSTREAM MARKET & TANK CANDIDACY
- ❑ THE SQUARE PROCESS
- ❑ CASE STUDIES
- ❑ LATEST DEVELOPMENTS AT SQUARE

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2016

Founded

2018

Approved

FM

2019

Commercial Tank Inspection

2024

Tanks to Date

Midstream Market - How Square Adds Value

Safety & Environmental

- Zero confined space entry
- *Carbon Equivalent releases contained per average tank:
  - Diesel > 5 Tons
  - Gasoline > 20 Tons

*Source - Third Party Verified for 100’ diameter tank

Big Data Solutions

- Hi confidence / hi resolution data
- Big data feed/ advanced processing
  - API 653/ EEMUA 159
  - RBI / EVA / Digital Platforms
  - Similar Service

Capital Efficiency

- *$300,000 - +$2M savings per average out-of-service tank operation
- Proactive risk vs time based inspections

*Source - Solomon Associates 2018 Fuels Study

Operational Efficiency

- In- Service Inspection
- Tank utilization
- Extended out of service dates
- Extended tank life
- Predictive repair & maintenance

Tank Inspection - The Traditional Approach

- ❑ PROJECT LASTS WEEKS OR MONTHS
- ❑ DRAIN, VENT, CLEAN, WASTE DISPOSAL
- ❑ INSPECT WITH MFL or SLOFEC
- ❑ VALIDATE WITH SPOT ULTRASONIC (UT)

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Square Robot Inspection Capability

SR-3
Autonomous
Submersible
Tank Inspection Robot

Applications	
Launch/Recovery Method	Side Shell or Roof Launch
Communications	Fiber Optic Tethered
Tank Type	Fixed, External or Internal Floating Roof
Product Compatibility	Low/High Flashpoint Products
PAUT Bottom/Coating Thickness	Active
Bottom Settlement Under Load	Active
Visuals of Bottom, Shell, Internals	Active
PAUT Internal Shell Inspection	Active
PAUT Fiberglass Liner Bottoms	Active
Internal Roof Seal Inspection	In Development
Sediment Thickness Mapping	In Development

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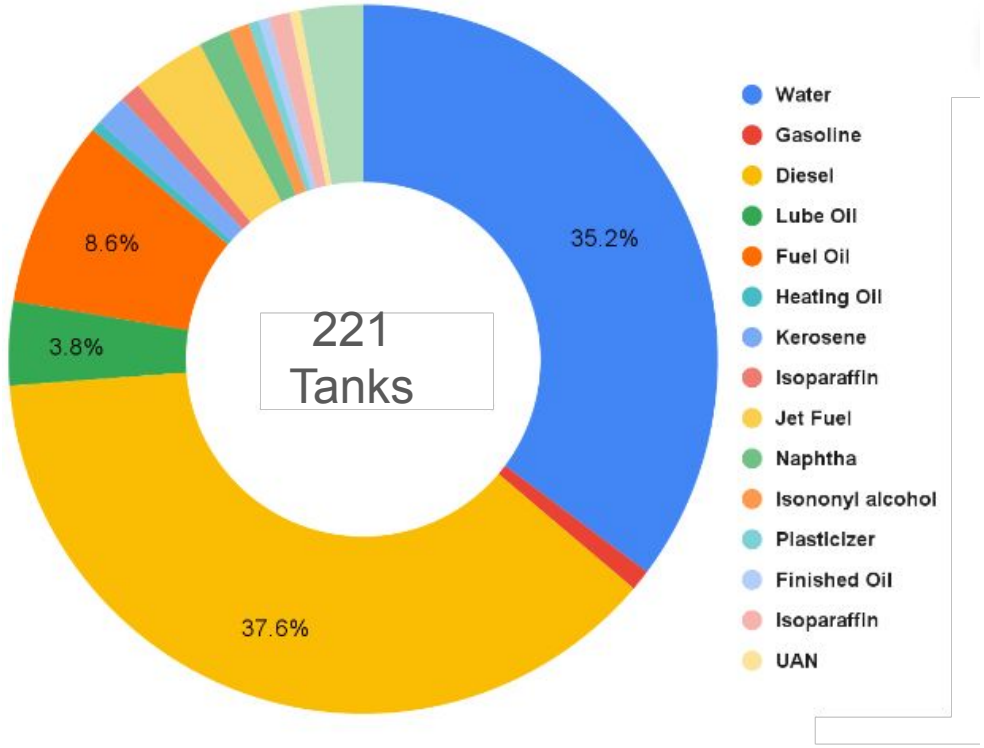
Square Robot Inspection Track Record

KPI	Count
API 653 Tanks Inspected	221
PAUT Bottom Coverage (includes obstacles)	70% average, (98% max)
Confined Space Labor Hours Saved	138,000 hours
CO2 Emissions Equivalent Contained	1.6M lbs
Cost Savings	$64 million

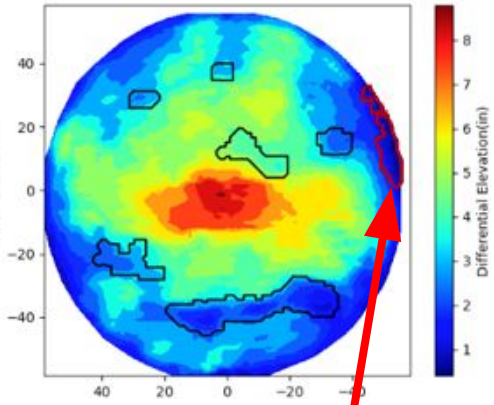


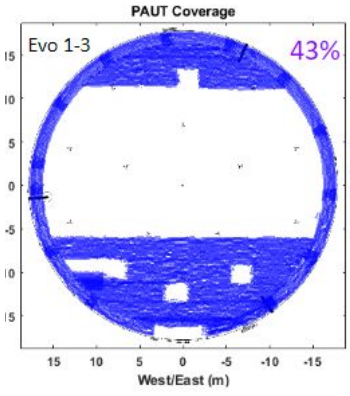
API 653 Inspection and Settlement Survey

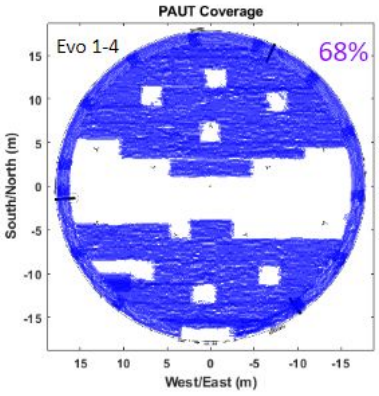
Internal tank inspection using SR-1 or SR-3

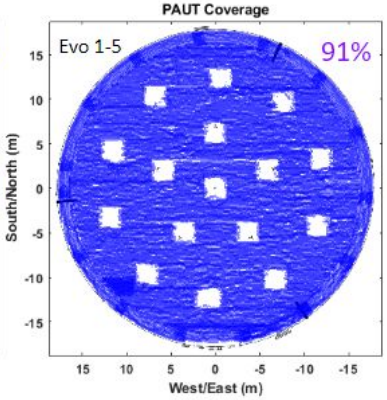
- ❑ **Tank Bottom Thickness using PAUT**
- ❑ **Differentiate Product and Soil Side Corrosion**
- ❑ **Internal Visual using 2 onboard video cameras**
- ❑ **Tank Bottom Settlement *under loaded conditions***
- ❑ **Tank Shell Thickness using PAUT**

External tank inspection simultaneously by certified inspector









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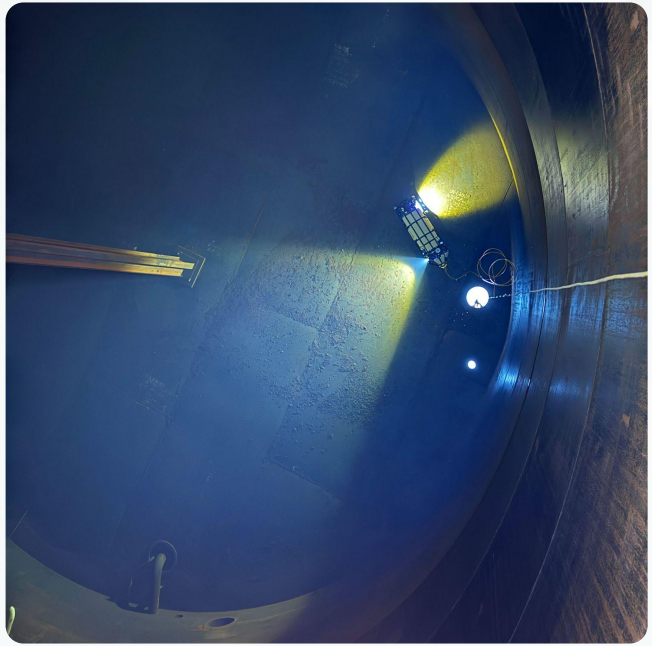
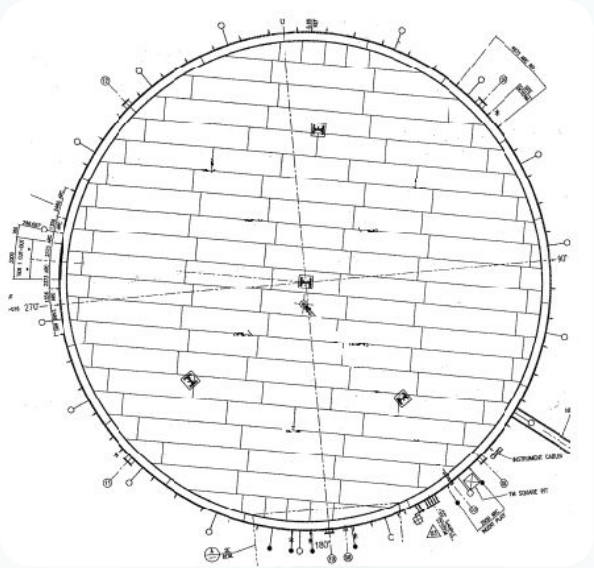
Tank Candidacy - Picking The Right Tank

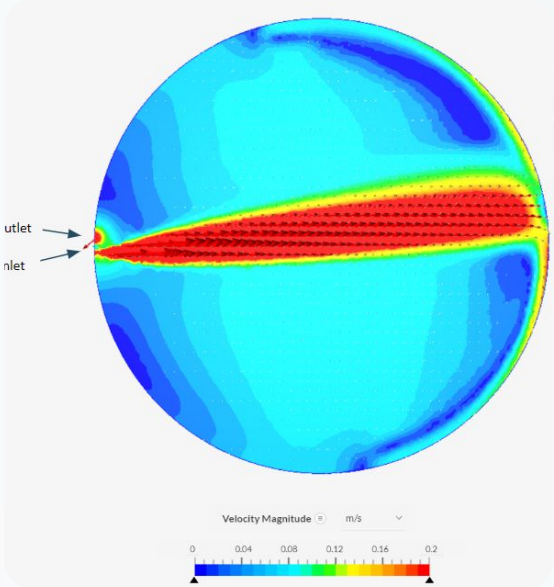
- ❏ Minimum 24” manway size
- ❏
- ❏ Product compatibility
  - ❏ Temperature (< 104F/40C)
  - ❏ Product height (< 15 FT)
  - ❏ Viscosity (< 45 cSt)
- ❏ Minimal sediment/sludge profile
- ❏
- ❏ Good Actors vs Bad Actors



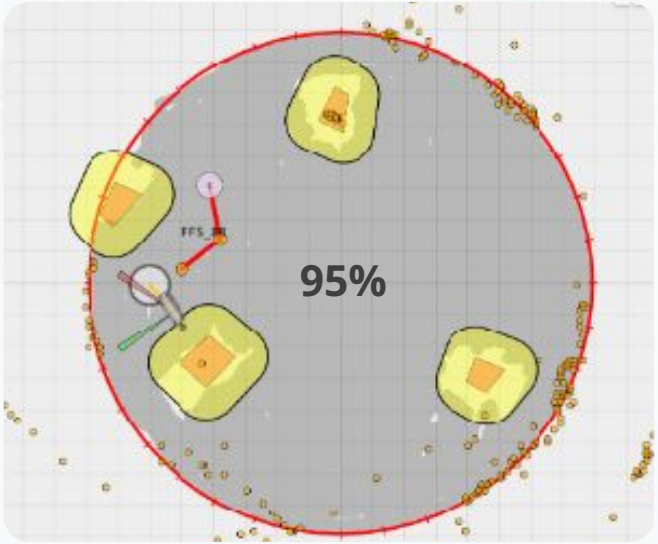
The Square Process - Pre-Job Planning



Tank Drawing Package Review



Flow Velocity Analysis
(if needed)



Max Accessible Bottom Area Estimate

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Mobilization Options

Operations Van
Operations Control Center,
7KW Diesel Power Generator

Air Freight
Robot(s), Support Gear, Batteries

Small Logistics Footprint Improves Efficiency and Lowers Logistics Cost

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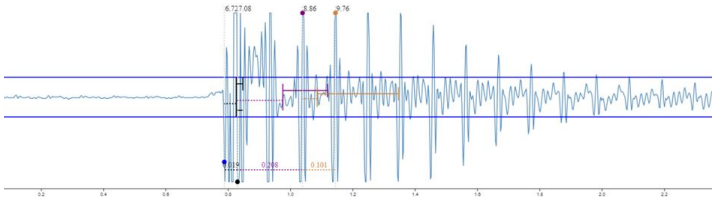
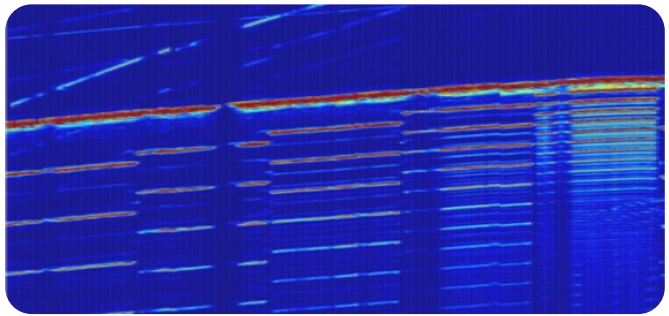
PAUT Calibration/ Function Testing

- Standardization Block is 15-inches (381-mm) in length and 3.5-inches (88.9-mm) in width encompassing all the transducers.
- Stainless steel block and A36 Steel used for the functional test.
- 5 steps measuring with each thickness having a +0.004/-0.004inch tolerance.

1. 0.100-inch / 2.54-mm
2. 0.200-inch / 5.08-mm
3. 0.300-inch / 7.62-mm
4. 0.400-inch / 10.16-mm
5. 0.500-inch / 12.70-mm





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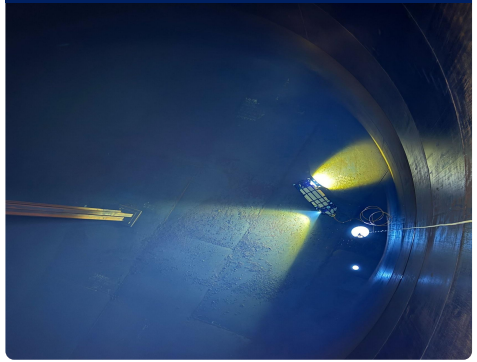
The Square Process Roof Launch

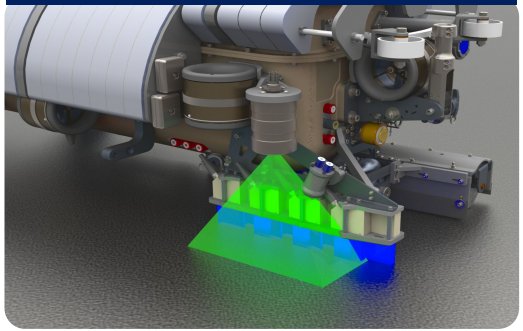
1. Mobilize

2. Lift

3. Submersion

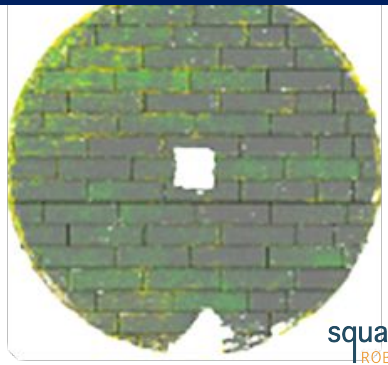


4. Inspection

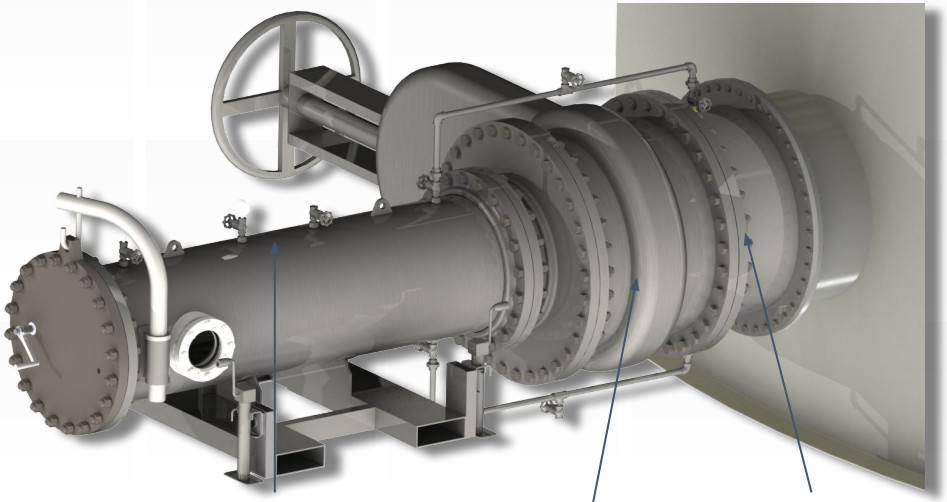


5. Recover

6. Report



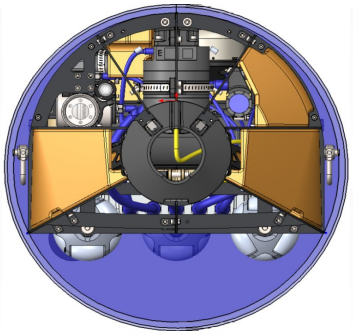
SR-3 Side Launcher System



Vehicle Chamber

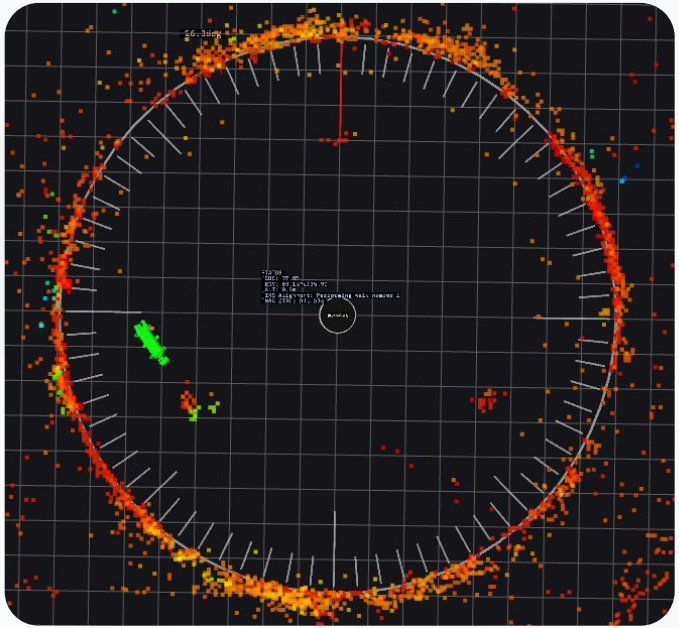
24” Gate Valve

Manway Adapter

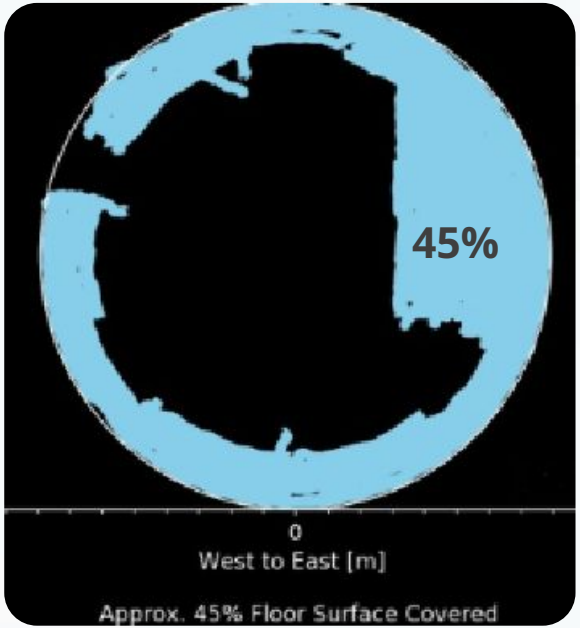


SR-3 Shell Launch Approach

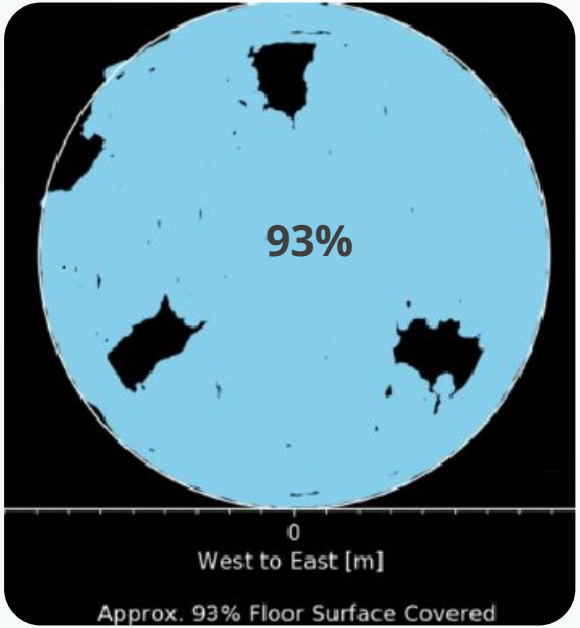
Squared Process - Job Execution



Initial Internal Layout Verification

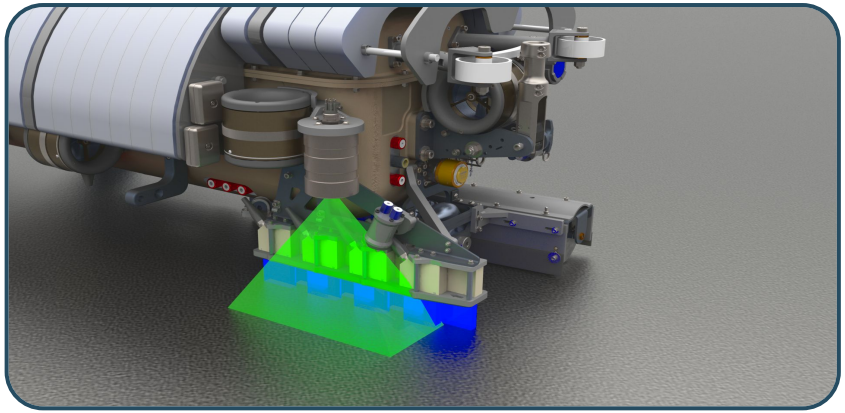


Estimated Coverage Update



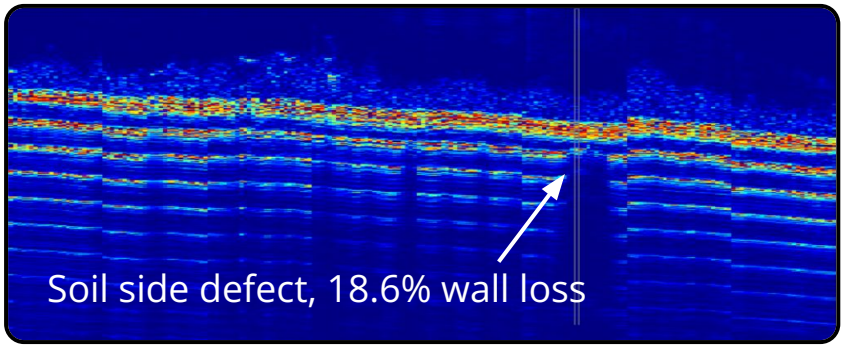
Final Estimated Coverage Update

High Resolution Sensors and Navigation

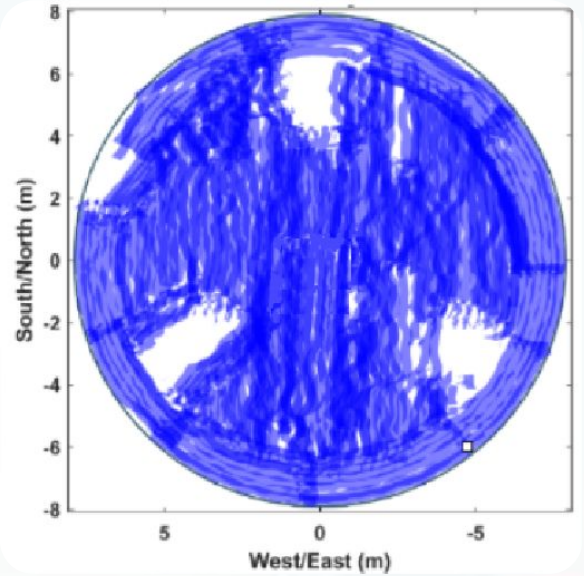


PAUT A, B, C-Scan for Plate Thickness

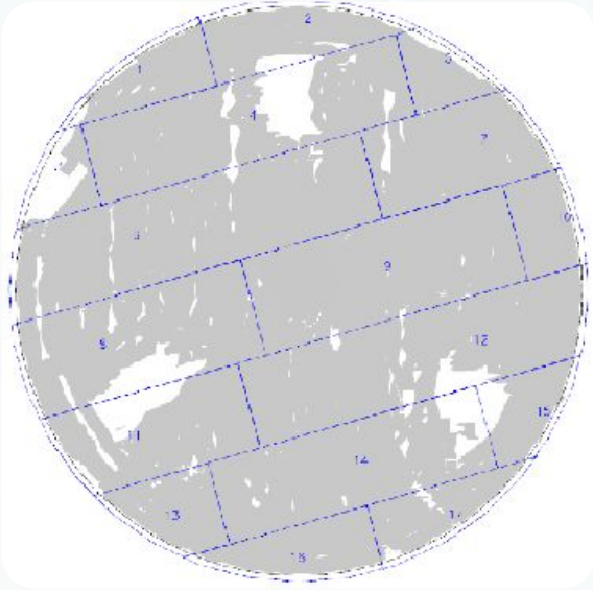
Access to Critical Zone



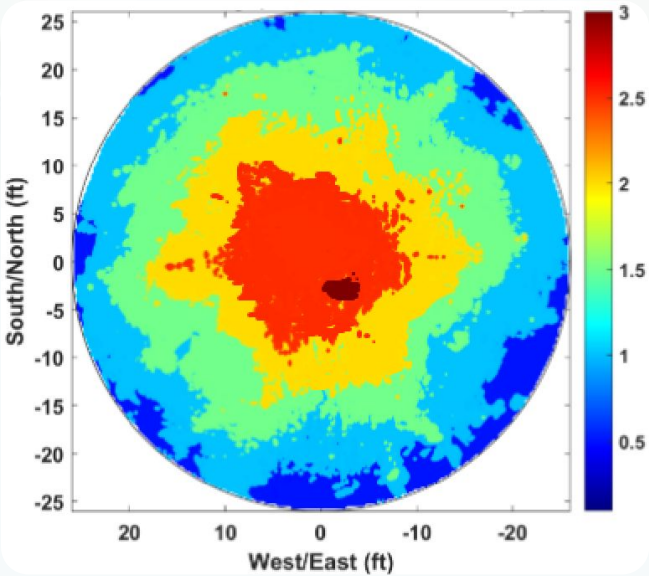
The Square Process - Post Job Data Processing



Processed Robot Tracklines



Processed PAUT Coverage



Processed Bottom Settlement

The Square Process - Final Report Delivery

Bottom Findings Layout

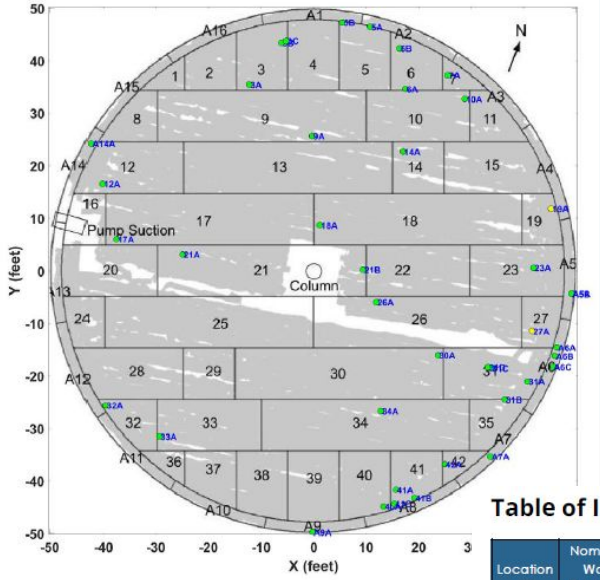


Figure 8 - Findings Map

Inspection Intervals

External Inspection Intervals	
External Visual Inspection	January 2027
Shell Ultrasonic Thickness Survey	January 2037
Regular Plates	
Internal Inspection Interval with Coating per API 653	
Next Out-of-Service Interval	January 2042
Bottom Repair Threshold	0.272-inch (27% wall loss)
Internal Inspection Interval without Coating Per API 653	
Next Out-of-Service Interval	January 2042
Bottom Repair Threshold	0.315-inch (16% wall loss)

Table of Indications

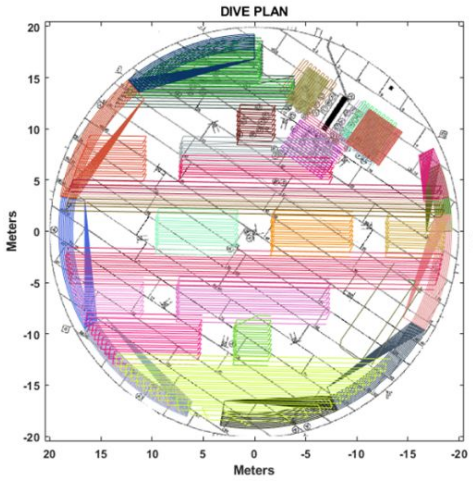
Location ID	Nominal Wall Thickness (in.)	Lowest Measure Wall Thickness (in.)	Wall Loss % Deviation from Nominal Wall	X (in.)	Y (in.)	Corrosion Type	Critical Zone	Ref. Corner
3	0.375	0.347	7.5	30	13	SS		BL
3	0.375	0.347	7.5	104	108	SS		BL
3	0.375	0.343	8.5	115	113	SS		BL
5	0.375	0.336	10.4	70	145	SS		BL

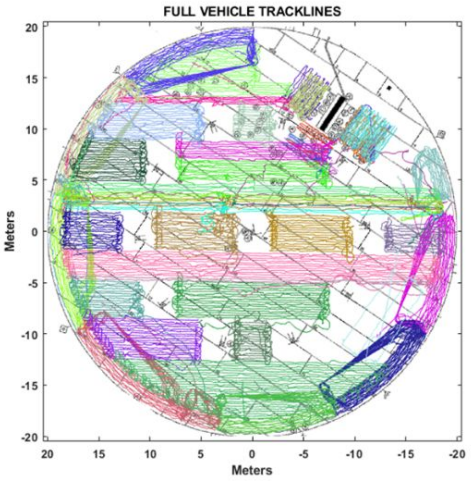
Visual Inspection Images

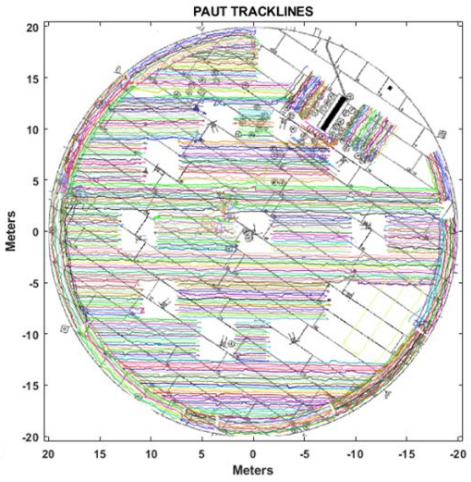
Case Study: 131’ Diameter Diesel Tank

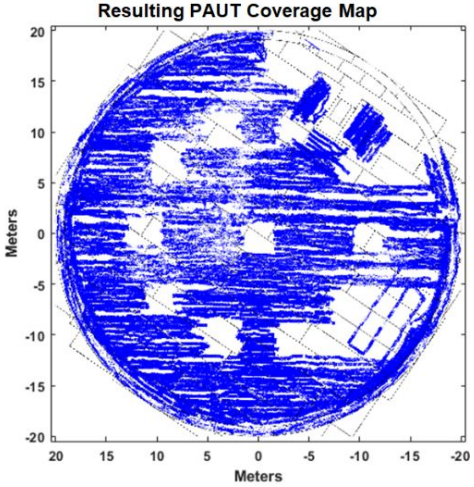
Risk Based Inspection:

- Prioritize critical zone
- Maximum floor coverage within allotted 5 day inspection time time
- Extended out of service date 15-20 years









Case Study: 92’ Diameter Diesel Tank

- Inspection Time: 3 DAYS
- UT Tank Bottom Coverage: 78%
- UT Plate Coverage: 29/31 plates
- Confidence Level: High

Similar tanks nearby suggest internal tank bottom repairs required

- Proactively manage risk ahead of 2025 API inspection date
- Obtain API 653 compliant report
- Gain clear understanding of expected repairs
- Budget for repairs and project timeline in 2025

Savings: In-Service Robotic vs Traditional Inspection

>$400k temporary storage, prep, inspection cost

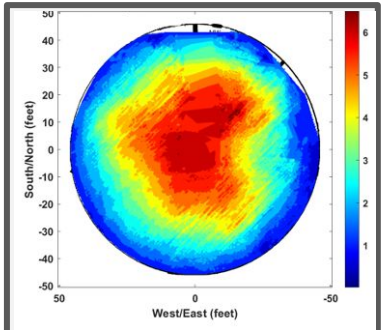
+ 27 days of out of service time

+ Contained > 5 tons of CO2 emissions

+ Eliminated 550 confined space **labor hours**

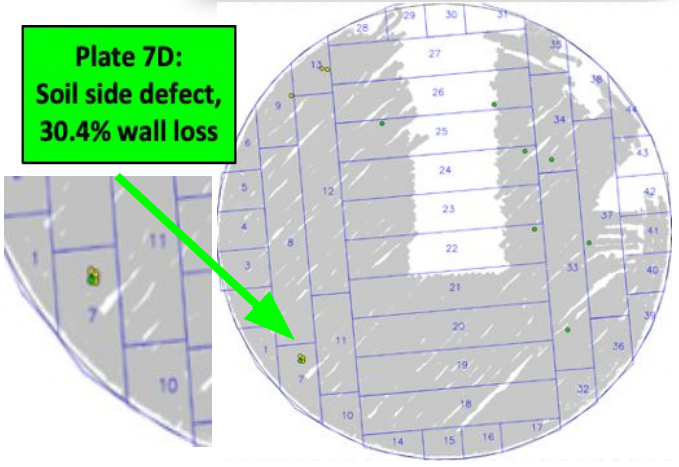
+ Higher density/Higher confidence data

+ Extended API 653 compliance > 20 years



Tank Bottom Settlement Heat Map

Plate 7D: Soil side defect, 30.4% wall loss



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New Capabilities

Advanced Robotics

State of the Art Sensors

High Density Data Acquisition

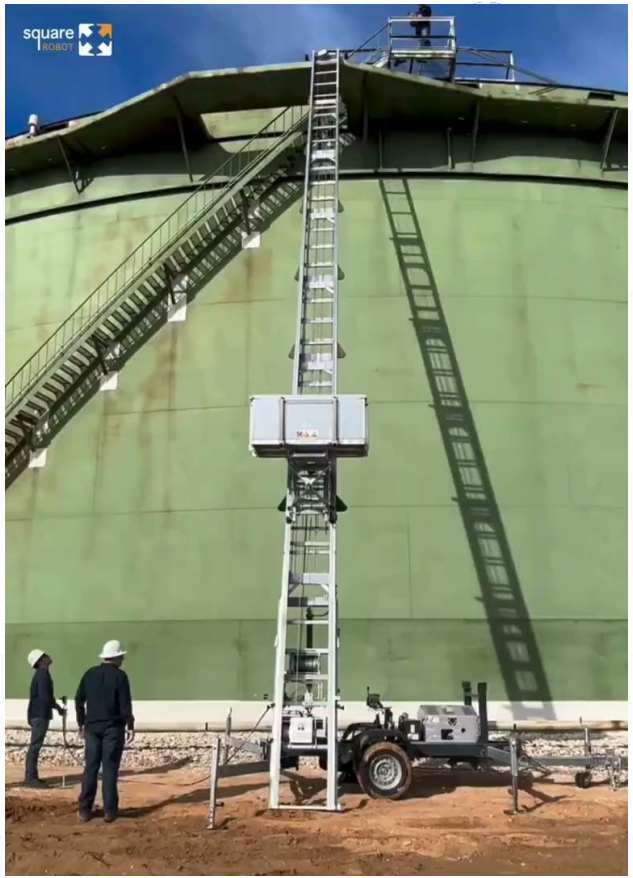
Square Robot Training and Service Center

- Houston Training and Service Center
  - Training - 10 week “Boot Camp” completed
  - Square Robot and Partner Training
  - Robot repair and maintenance
- 25’ Diameter Tank
  - Training
  - New Product Development
  - Customer Demonstrations and Testing
  - Probability of Detection Studies

Square Robot's Bocker Lift System

Square Robot offers further safety and efficiency to its inspection robot roof launch and recovery process using the Böcker incline lift system.

- Eliminates overhead lifts
- Reduced rigging and complex lift plans
- Reduced cost
- Eliminates ground prep typical for cranes
- Self-contained, small footprint
- Maneuverability on site
- Enhanced mobility and road versatility



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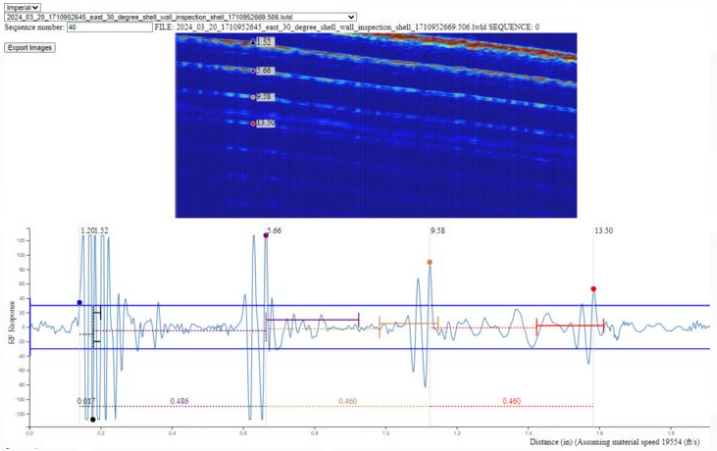
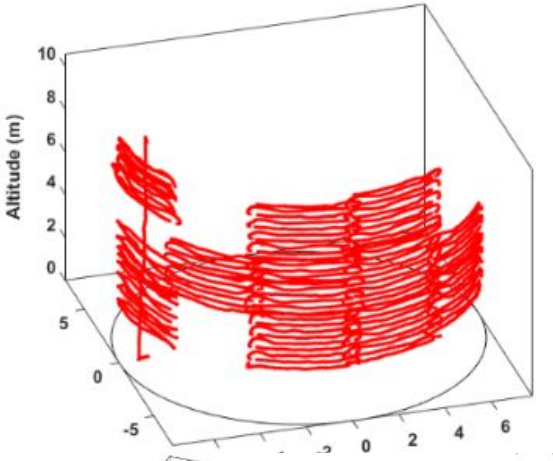
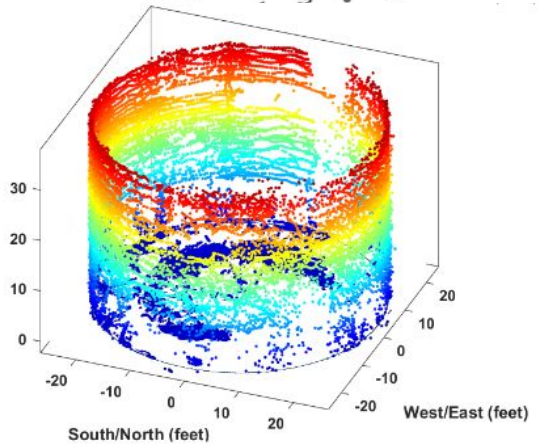
SR-3 Internal Shell PAUT Inspection

- Improved internal shell coverage and access versus external point UT
- Insulated tanks
- Reorient PAUT to face shell
- High quality data and coverage results
- Next step to internal seal inspection with camera - orient camera toward roof seal







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Q & A

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State of the Art Sensors

High Density Data Acquisition