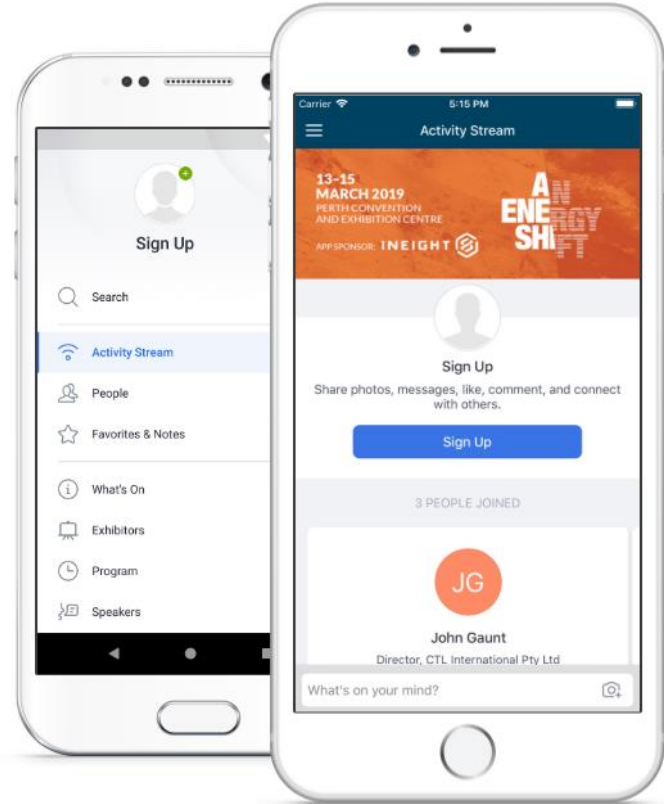
A collage of nine diamond-shaped images arranged in a grid. The images include: a NASA astronaut in space; a robotic arm with a blue light; an underwater scene with blue lighting; a large ship at sea; a wind turbine; a close-up of a robotic arm; a close-up of a pipe with a red robotic arm; a close-up of a pipe with a red robotic arm; and a close-up of a pipe with a red robotic arm.

## Quantitative Short Range (QSR): Latest technology for Inspection of Corrosion Under Pipe Supports (CUPS)

Christopher Parker

# AOG 2019 App



# Agenda

1. Industry Challenge: CUPS
2. Description of previous gaps to inspection technology
3. Oceaneering Solution - QSR Technology
4. Experience
5. Conclusions

# QSR<sup>®</sup>



# Industry Challenge: CUPS



- Typically where water collects
- Mostly hidden when in service
- Older pipes can be obscured with multiple paint layers
- Large patches can burst before there is a leak

# Industry Challenge: CUPS



- Normally direct access through lifting, is used to measure depth
- Cost of lifting, manpower, rigging, scaffolding etc.
- Increased risks undertaken, to sometimes unknown condition of remaining wall

**Limited alternative NDT options available**

# CUPS NDT Methods:

Can be split into 3 CUPS inspection Categories:

- Absence of Corrosion
- Fast Screening
- Wall Loss sizing





# Current CUPS NDT Limitations

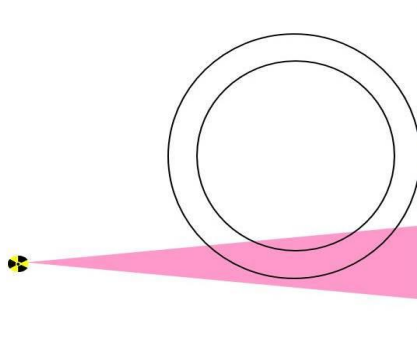


## Visual Inspection.

- Line lifts required for measurements
- Guidelines for CUPS inspection management. Not reliable due to history of false calls. (EI)



# Current CUPS NDT Limitations

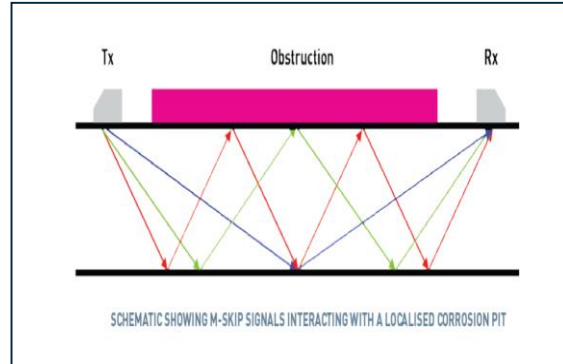


## Radiographic Methods:

- Limited to 80 mm chord length
- Generally below 8" and pipe contents can be detrimental

## M-Skip, MrGWT, and other UT Methods

- M-Skip: Quantitative from thicker schedule pipes 12 mm +
- A mix of quantitative, qualitative and screening methods



# System Requirements

A system that can tackle the inspection challenges presented by CUPS must be:

- Quantitative for thin wall pipe
- Reliable
- Easy to use
- Diameter Range of 8" +
- Repeatable
- Accurate
- Indirect

## Solution?

# QSR1® - “Quantitative Short Range” Scanning

GUL developed system to quantitatively measure corrosion at support locations.



- Scans the pipe along the top under its own power
- Does not require couplant
- Inspection is possible through thin coatings

# QSR<sup>®</sup>



8" to 24" (200 mm-610 mm)  
Diameter Pipe



Interchangeable  
Frames



6 mm to 13.5 mm  
Nominal thickness



LAN or USB Cable  
Connection



Horizontal Pipe and  
Simple beam supports



Smooth Surface  
Coating Thickness <1 mm

# WaveProQSR™ Software



Multiple Connection Interfaces



Semi-Automated Analysis Routines



Expect Software Updates



Cloud Computing

\*Cloud based analysis, machine learning and remote auditing assists with providing the best possible service

# Support Types

- Simple Supports
- Pipes resting on beams

Not yet covered:

- Saddle Supports
- Circumferential Grooves
- Clamp U-Bolt
- Welded Supports



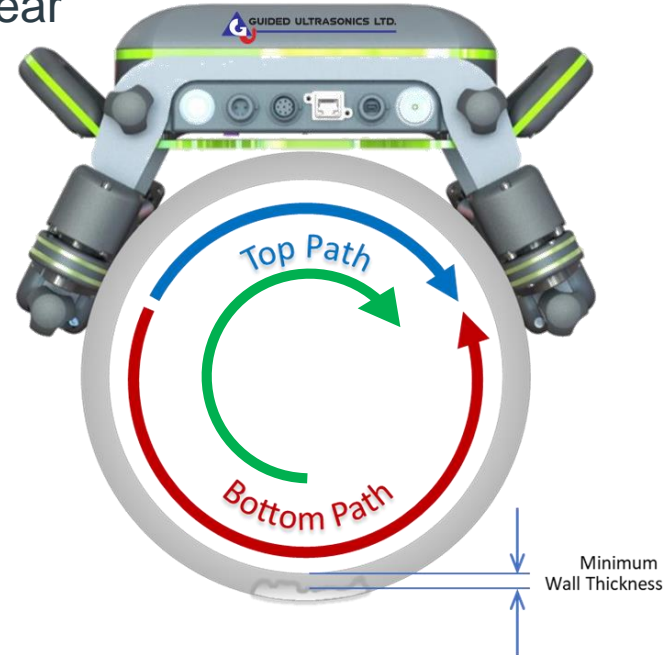


# QSR Technology

The Innovative Solution

Using both **Dispersive and non-Dispersive** Shear Horizontal wave modes, QSR1® can automatically measure at each location:

- Pipe Diameter
- Top & Bottom Path Wall Thickness
- Bottom Path **Minimum Wall Thickness**
- **Quantitative** up to 50% wall loss
- **Qualitative** at greater than 50% wall loss



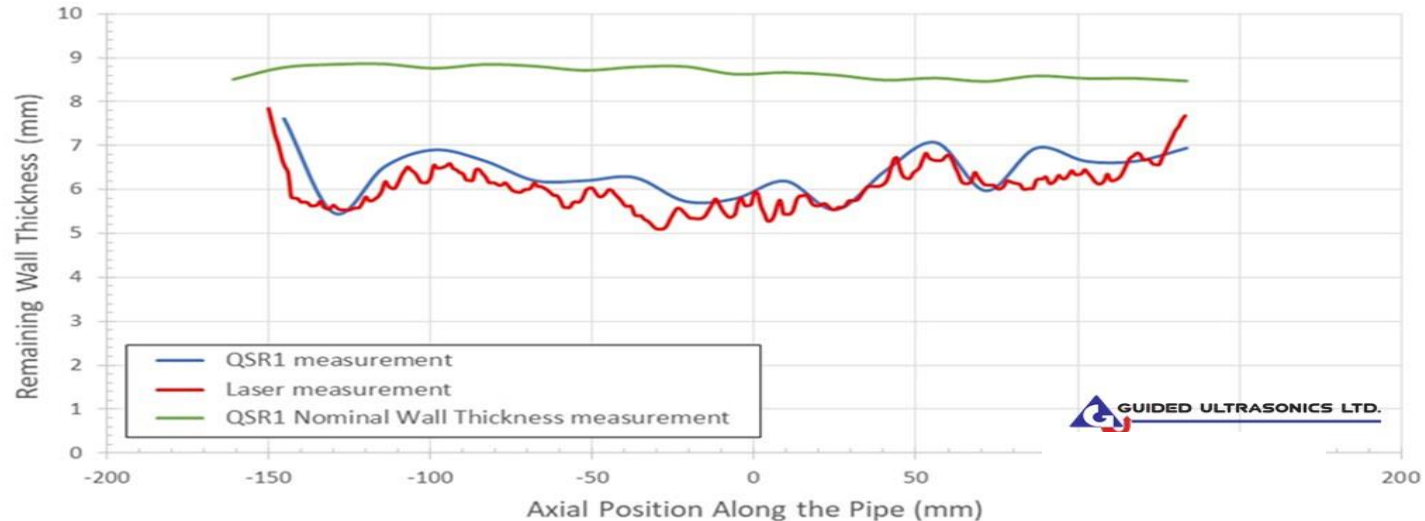
# Verification: Laboratory Test

- Ex-service 12-inch pipe
- Hidden Corrosion Under Pipe Support (CUPS) type defect
- Scanned with QSR1® in order to obtain the corrosion profile
- Defect was then visually examined and laser scanned
- QSR1® scan was compared with the reference laser scan



# Verification: Laboratory Test

Very good agreement was achieved between the laser scan of the defected area (red line) and the QSR1® measurements (blue line).



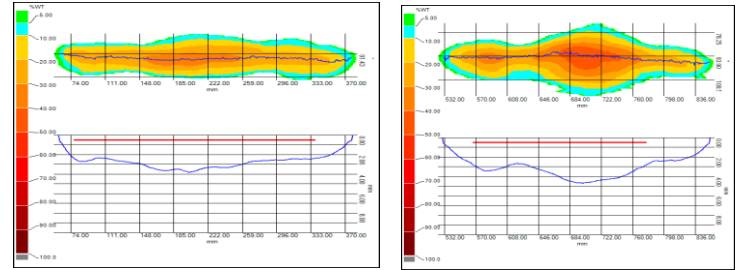
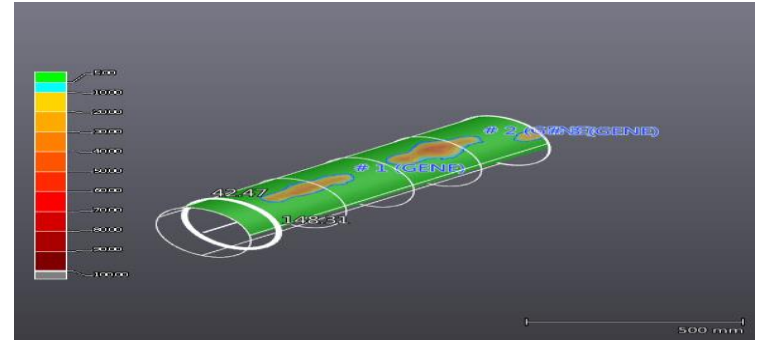
# Verification: Sample Test

Ex-Service 10" QSR data compared to  
Creaform Laser scanner

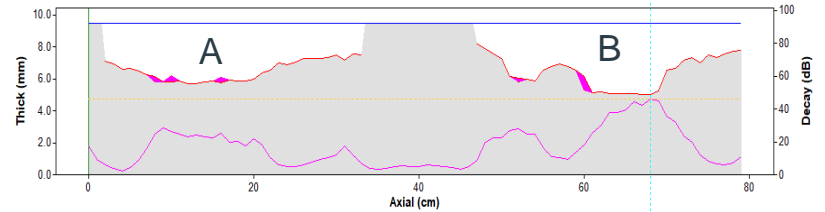
SAMPLE ON DISPLAY AT THE OYSTER BAR

Area	QSR (loss from meas.)	Creaform (loss)
A	3.8 mm	3.81 mm
B	4.5 mm	4.68 mm

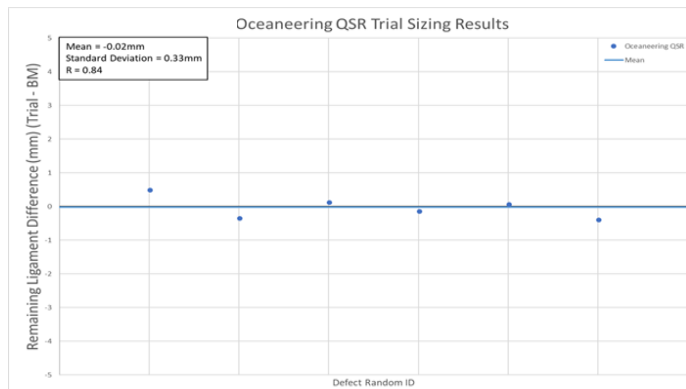
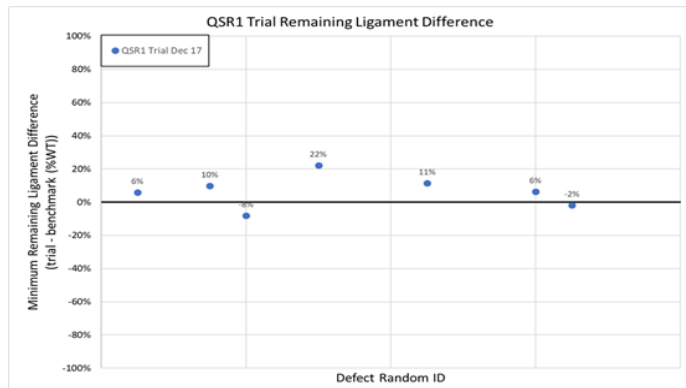
Creaform



QSR



# Verification: QSR1® 3<sup>rd</sup> Party Trials



- **No False Calls**
- QSR1 Showed the **most positive** results from other CUPS technologies used in the trial
- Samples and defects **correctly** indicated as >50%

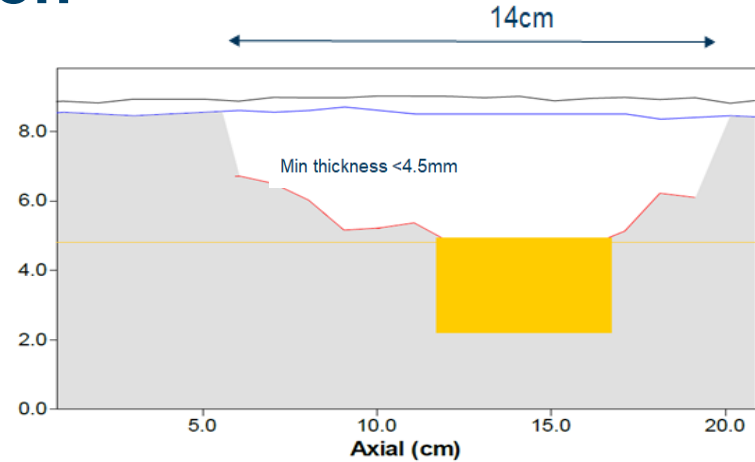
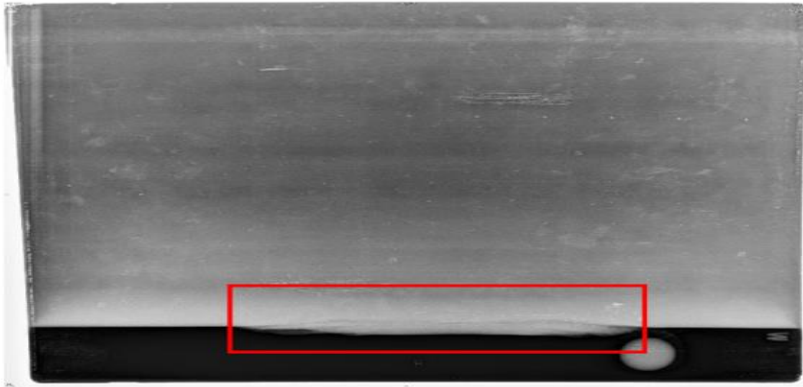
Latest trial Accuracy result:

- **±5% WT (±1σ)**
- Max difference of 0.5 mm
- St.Dev: -0.33 mm
- Mean: -0.02 mm

# Verification: On-Site Inspection

## 12" In-service pipe support.

- QSR: Remaining thickness < 4.5 mm
- Rad: Estimate 4-5 mm (After pipe support removal and re-siting)



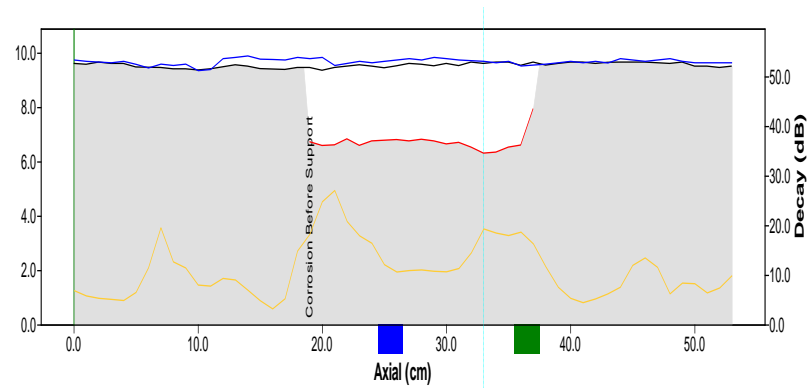
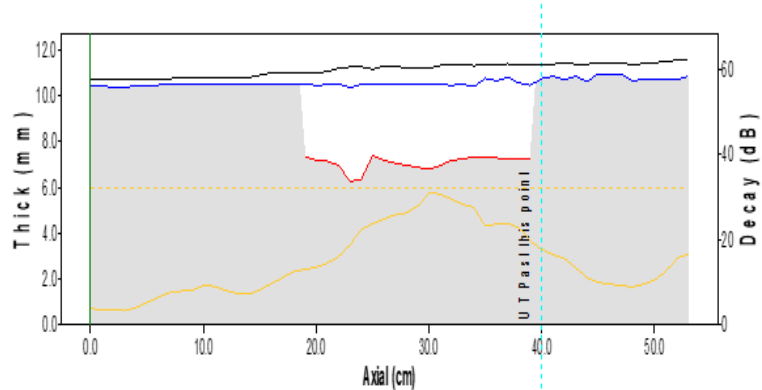


# Introduction to Australia

- Wide deployment to our Australian clients
- Incorporated into CUPS inspection management programs
- Oceaneering tried and test procedures
- First to introduce and utilise the innovative technology in Australia
- The only experienced and fully certified QSR operators in Australia
- QSR cloud based analysis, machine learning and remote auditing



# Australian Site Examples



# Industry Conclusions

- Reduces the risk associated with line lifts and avoids the use of radiation, **costs savings evident**
- Go to method for simple support inspection
- Reliable results obtained through thin layers of corrosion product and paint
- The equipment can cope with real site conditions



# QSR® Technology Looking Ahead

## Since Initial Release:

### QSR1 First Gen unit:

- Increased pipe diameter range from 16" to 24"
- Maximum nominal thickness increased to 13.5 mm
- Fully automated collection parameter settings

### In the Pipeline...

- Increase thickness range up to 25 mm (1") nominal thickness (estimated Q2, 2019)
- Increased application for support types
- Second unit generation that scans circumferentially instead of axially like the QSR1 unit

# Thank you for your attention!

Please visit [oceaneering.com](https://oceaneering.com) for more information



Connecting What's Needed with What's Next™

## Come Visit us at The Oyster Bar!