★ **Inauguration: 29 July, 2008**

★ **Registered Members 1,000 plus**

★ **Regular Seminars and Workshops on Corrosion and Related Issues**

★ **Organize Corrosion Courses and AMPP Certifications**

AMPP-Jubail, is a local section of the West Asia and Africa Region Section of the National Association of Corrosion Engineers (NACE) International which is now known, as the Association for Materials Protection and Performance (AMPP) . AMPP-Jubail was established in July 2008 to promote the awareness of corrosion, and its control for industries in Al-Jubail and its extended adjoining area of Saudi Arabia. We currently have more than 1000 members from industry and academia, specializing in the field of corrosion and its control.

AMPP-J 49th TECHNICAL MEETING

"ADDRESSING CORROSION UNDER INSULATION (CUI) RISK WITH PREDICTIVE REMOTE MONITORING: MIDDLE EAST USE CASES"

AMPP™ CHAPTER JUBAIL SAUDI ARABIA

CR RADAR®

ORGANISED BY

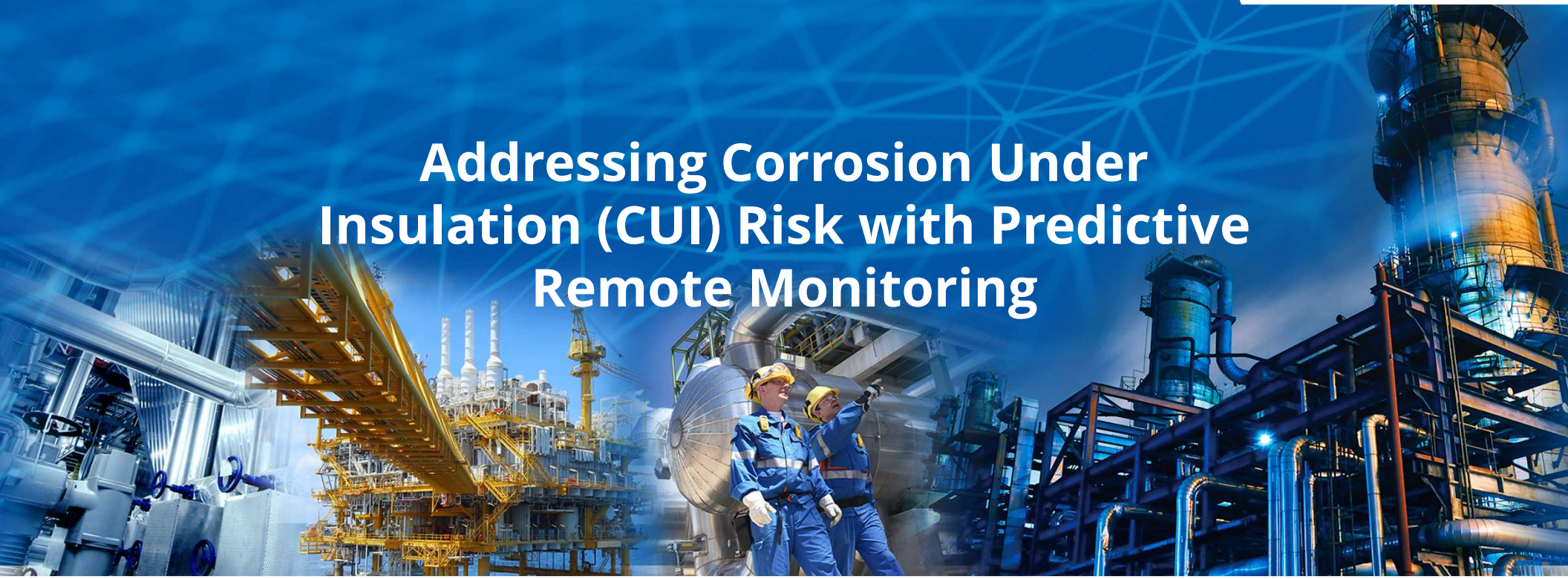
corrosion® RADAR

AMPP JUBAIL CHAPTER SAUDI ARABIA

IN PARTNERSHIP WITH

كانو للطاقة
KANOO ENERGY
A division of Kanoo Industrial & Energy

Addressing Corrosion Under Insulation (CUI) Risk with Predictive Remote Monitoring



CUSTOMERS INCLUDE:

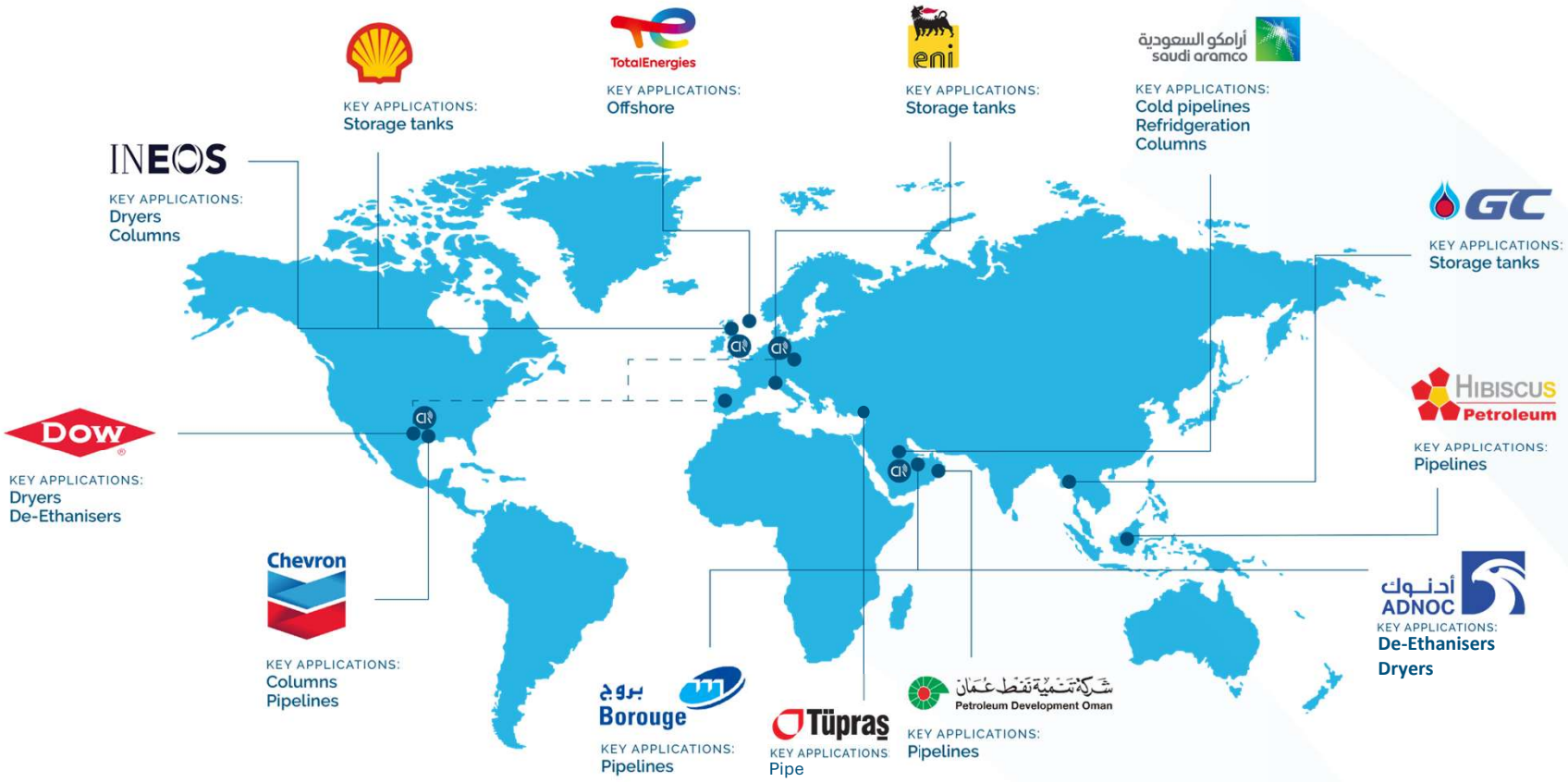
eni · aramco · ADNOC · Chevron · DOW · GC · Hibiscus Petroleum · INEOS · Petroleum Development Oman · Shell · TotalEnergies

Agenda

- Quick Introduction to CorrosionRADAR (CR)
- CUI – A global challenge
- Reactive to Predictive Inspection Approach
- Inspection Cost & TA Time Optimization
- Middle East (And Global) – Success Stories
- Live Demonstration
- Q&A

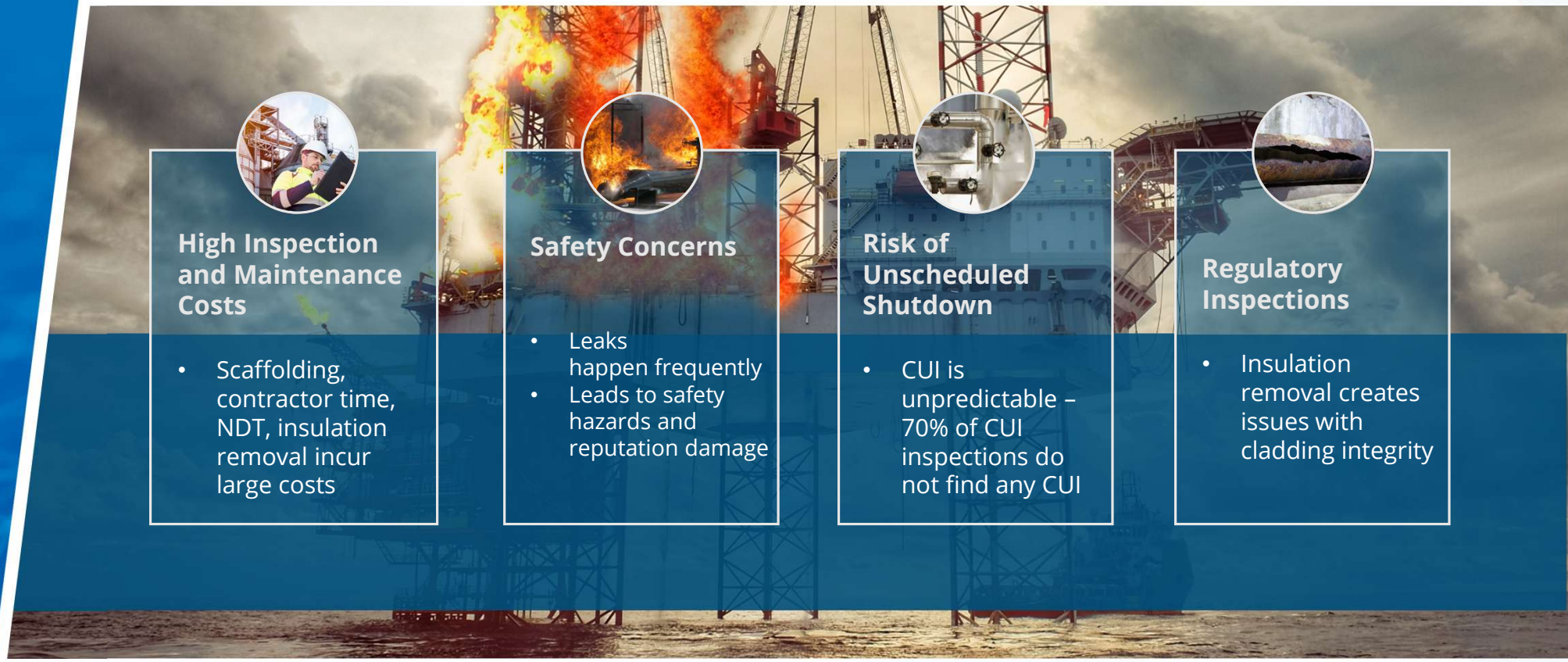
Customers Benefiting from CUI Monitoring

CUI MONITORING HAS SEVERAL APPLICATIONS GLOBALLY



CUI –Hidden Threat/ Global Problem

FINANCIAL, SAFETY, OPERATIONAL, REGULATORY



High Inspection and Maintenance Costs

- Scaffolding, contractor time, NDT, insulation removal incur large costs

Safety Concerns

- Leaks happen frequently
- Leads to safety hazards and reputation damage

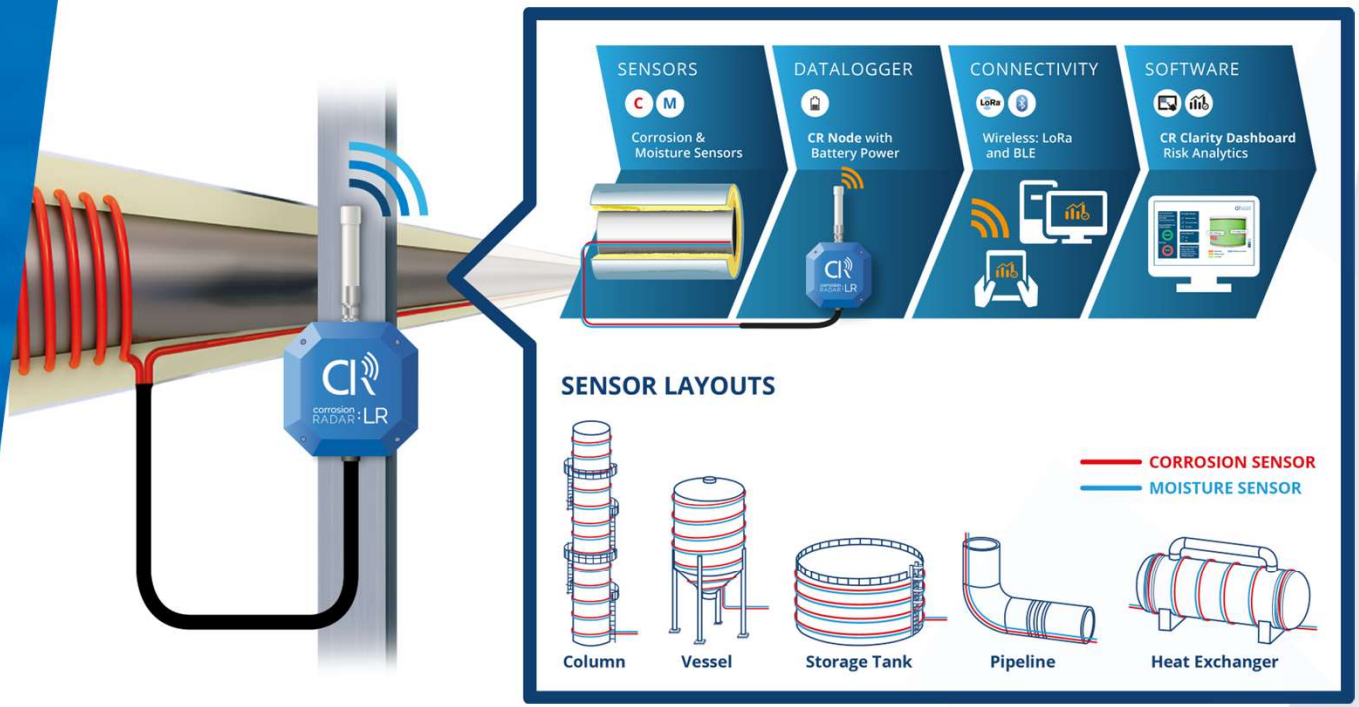
Risk of Unscheduled Shutdown

- CUI is unpredictable – 70% of CUI inspections do not find any CUI

Regulatory Inspections

- Insulation removal creates issues with cladding integrity

CUI Risk Monitoring System



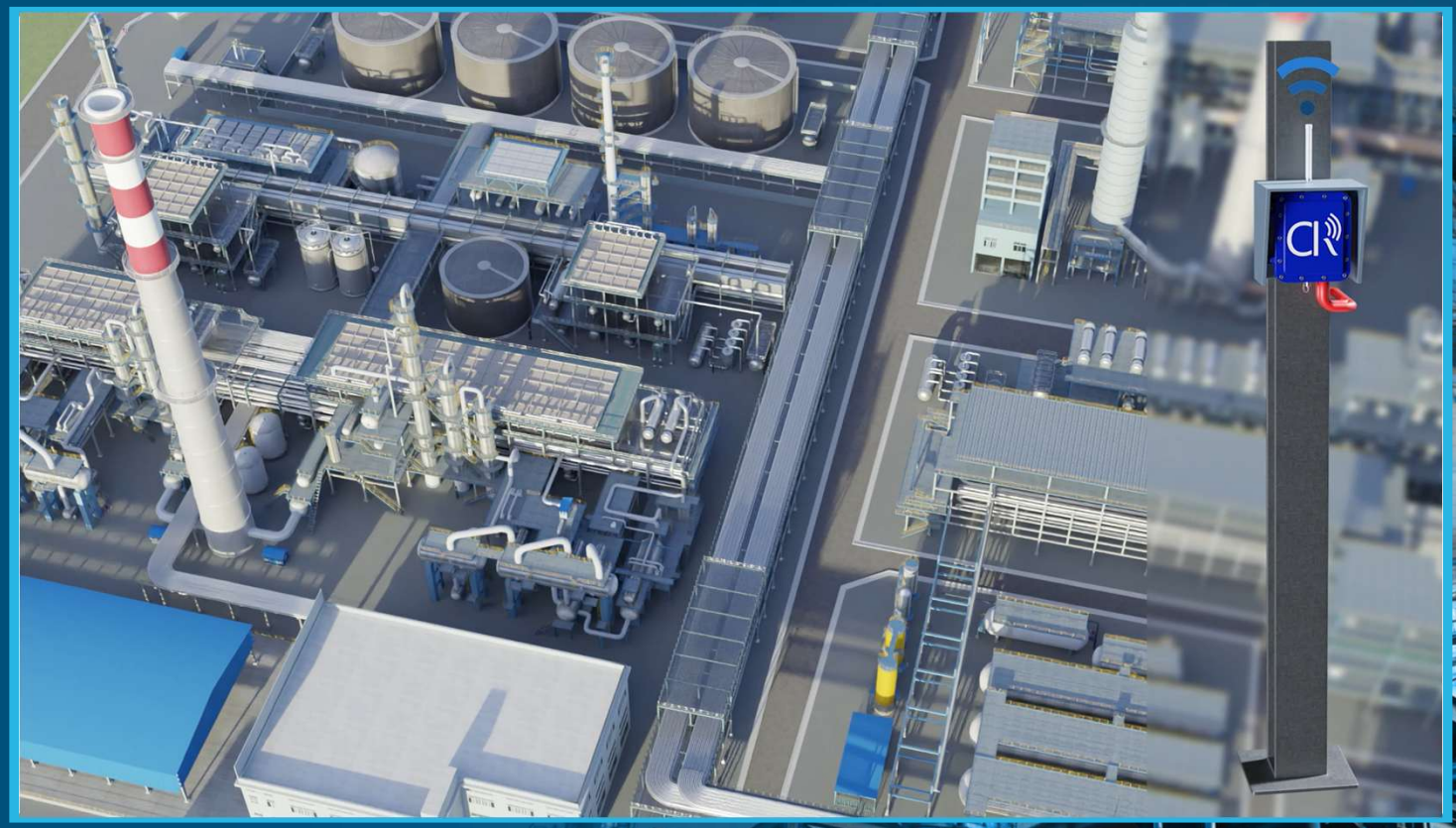
CR NODE (ELECTRONICS)

ATEX/IECEx/UL Certification	Ex – Zone 1 and Zone 2 USA – Class 1 Div 2 (C1D2)
Ingress Protection	IP66
Power Source	Battery (optional 24V DC or 110V AC)
Communications	Wireless: Cellular/WirelessHART/LoRa Manual data transfer: BLE Tablet/USB

SENSORS

Sensor Types	Moisture Corrosion
Sensor Length	Up to 100m/330ft (per node)
Temperature Range (°C)	-190 to +300 °C - 310F to 572F

CUI Monitoring at Plant Level – How it Works



Expected Value from CUI Monitoring

1 QUALITY

Insulation & Vapour Barrier Integrity

First 90 days

Compliance Enhancement

2 RELIABILITY

Predict & Prevent

Persistent moisture detection → Defect notifications raised → Insulation deficiencies rectified

1. **Minimizing operation interruptions:** With online and continuous remote monitoring, the risk of unscheduled repairs or interruptions to the operations is minimised
2. **Inspection Effectiveness:** Real-time data on corrosivity levels, measured meter by meter, enables targeted and preventive actions to rectify insulation deficiencies, enhancing inspection effectiveness
3. **Asset Life Extension:** Proactive rectification of insulation deficiencies results in reduced maintenance costs and extended asset life expectancy.

3 EFFICIENCY

T&I Scope Optimization & Prioritizing

One year before next T&I

T&I Scope-optimization:

Access to a historical database from 24/7 monitoring of CUI locations informs future inspection and shutdown decisions, optimizing T&I scopes and costs.

Next T&I cycle

65% reduction of CUI inspection costs related to scaffolding, insulation removal, and maintenance costs

Selection of Assets

RISK

H | High Consequence Assets *(Process Safety)* | High CUI Susceptibility (Severe/Serious)

Hazardous, toxic fluids or gases

Cyclic, Intermittent, Sweating, Transient zones

Asset LTCO Financial / Production | H

Production loss initiated by inspection

Assets with challenges to inspect

CG Dryers (cyclic)

Refrigeration (transient)

Columns (sweating)

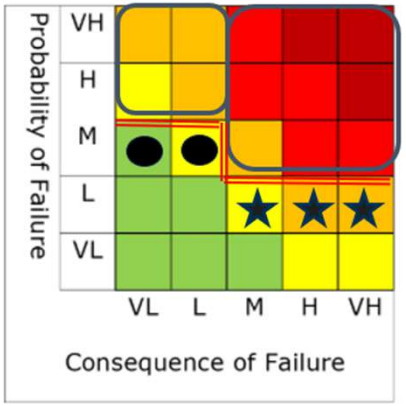
Cryogenic (protrusions)

LNG (production loss)

LPG / Propane (intermittent)

Loading Lines (accessibility)

Jetty Pipelines (accessibility)



★ High Consequence / CUI susceptibility *and cost of mitigation.*

● Asset LTCO – Repair timely.

Cold Duty Insulation – Middle East

CASE
STUDY

Value driver:
Reducing downtime and cost-efficient inspection strategy for CUI

Challenge:
Cold-insulated pipelines with intermittent operations are un-inspectable assets without disturbing operation

Outcome:
Risk Reduction in RBI (Medium to Low)

T&I scoping reduction to increase uptime

Location:
KSA

Asset type:
Loading lines with Cold duty Insulation at export Terminal

Gas Plant – Onshore – Middle East

CUI Monitoring Systems Deployed On Selected Pipelines

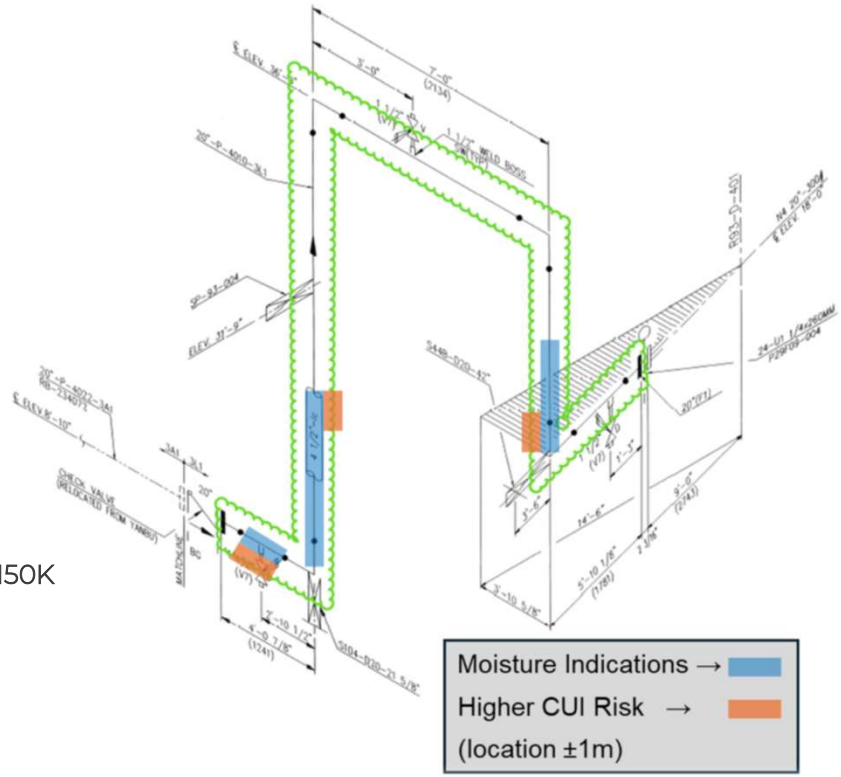
- Asset Size → 10” to 30” diameter
- Operating Temperature → -43°C to ambient
- Total Asset Length → 203m

REALISED VALUE

- Multiple defect notifications were raised based on monitoring data
- Comprehensive inspections and rectifications were performed
- Compliance with company standard was ensured
- In three years, preventive maintenance resulted in an estimated cost saving of $150K

Continuous Monitoring & Wireless Data Collection

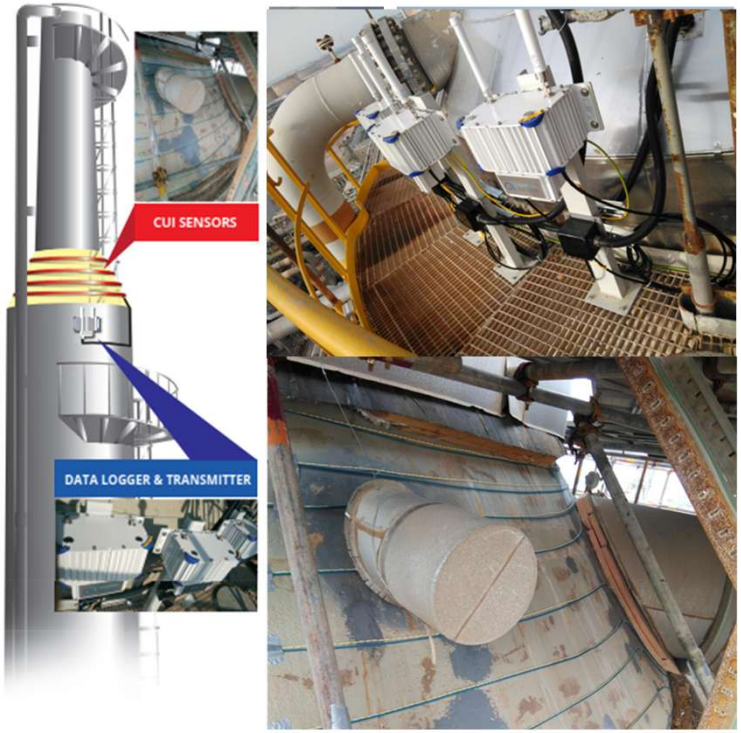
- CUI Monitoring systems collect data from the asset once a day
- The collected data is transmitted wirelessly using LoRaWAN technology
- An On-Premises Server in the Inspection Department displays the analysed data



Example of the report generated from the CUI monitoring system showing marked-up isometric of an asset with moisture and CUI risk analysis

De-Ethanizer Column – Middle East

CASE
STUDY



Value driver:
Inspection cost saving and inspection frequency optimization

Challenge:
Expensive scaffolding needed ($100k) for inspecting for CUI of a 35-meter-high column

Outcome:
Predicting the location of CUI

QA/QC of insulation workmanship

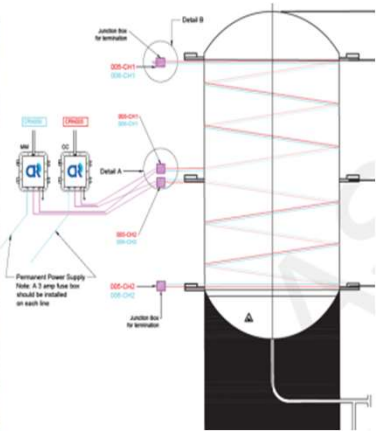
Location:
Middle East

Asset type:
De-Ethanizer Column

Dryer in Petrochemical plant

REALISED VALUE
$100K-$200K

CASE STUDY



Value driver:

Reducing the risk of CUI incidents & optimization/reduction of CUI inspections

Challenge:

Equipment with highest CUI susceptibility due to extreme Cyclic Temp-service. Several unexpected Process Safety Near Misses occurred in the past within this company.

Outcome:

- Minimized risk for unexpected equipment failure.
- Susceptible locations for CUI Inspection 100% understood.
- Cost savings up to $100k - $200k for a single Dryer inspection cycle.

Location:
Spain

Asset type:

- Dryer with a catalyst bed (30 – 40 worldwide installed within this company)
- Insulation: closed cell structure (Perlite) with a vapor barrier.
- Coating: Thermal Spray Aluminum (latest standard).

Savings with CorrosionRADAR

- Results in requirement to perform targeted inspection

Activity	Cost (€) (Without monitoring)	Cost (€) (With Monitoring)
Scaffolding	38,500	7,000
Insulation	77,000	14,000
Visual Inspection	550	500
NDT	13,750	2,500
TOTAL	**129,800**	**24,000**

- Cost of inspection savings with CR: (€)105,800 per inspection cycle
- Savings increases with additional inspection interval/postponement
- Savings does not include probability/consequence of failure reduction

Dryer in Petrochemical plant

CASE
STUDY

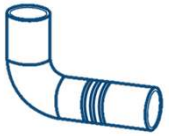
Value driver:
Reducing the risk of CUI incidents & optimization/reduction of CUI inspections and cost's

Challenge:
Health & Safety risk and reputational risk of a CUI incident

Outcome:
Requirement on vessels & piping circuits at severe risk of CUI
Recommended on piping/vessels at severe risk of CUI

Location:
USA

Asset type:
Piping and Pressure Vessels



Savings with CorrosionRADAR

- Results in requirement to perform targeted inspection

Activity	Cost ($) (Without monitoring)	Cost ($) (With monitoring)
Scaffolding	3000	0
Insulation	2000	200
Visual Inspection	600	60
NDT	6,000	560
TOTAL	**11,600.00**	**820.00**

- No requirement for scaffold/insulation strip, radiography of 2 x supports, UT of 6 x bend welds
- Cost of inspection savings with CR: $10,780 per inspection cycle
- Savings increases with additional inspection interval/postponement
- Savings does not include probability/consequence of failure reduction

Savings with CorrosionRADAR

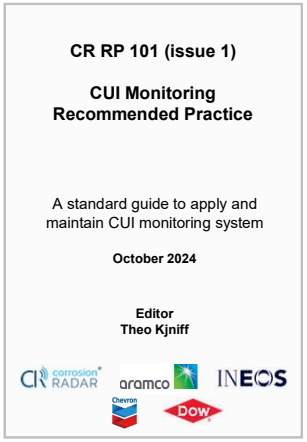
- Lack of detections on corrosion sensor could justify inspection deferment.

Activity	**Cost ($)**(Without Monitoring)	**Cost ($)** (With monitoring)
Scaffolding	6000	0
Insulation	2000	0
Visual Inspection	1,000	0
NDT	9,000	0
TOTAL	**18,000.00**	**00**

- No requirement for scaffold/insulation strip, radiography of 2 x supports, UT of 10 welds
- Cost of inspection savings with CR : $18,000 per inspection cycle
- Savings increases with additional inspection interval/postponement
- Savings does not include probability/consequence of failure reduction

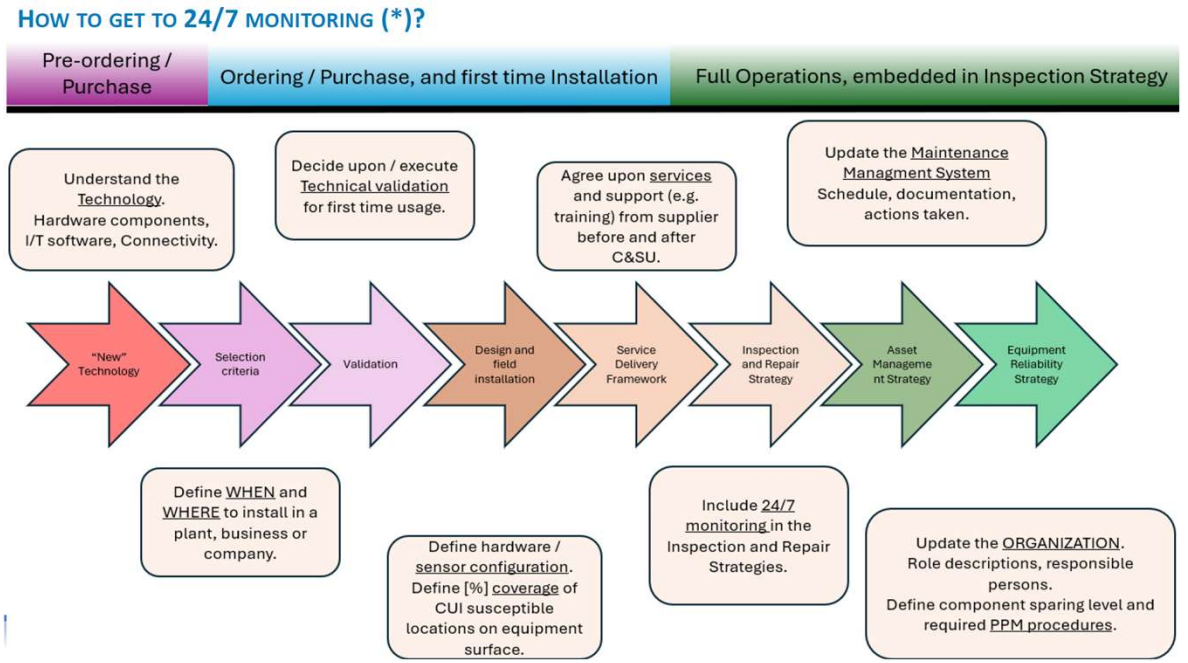
CUI Monitoring Recommended Practice CUI RP 101

CUI Monitoring Recommended Practice



December 2024

Core contents



https://www.onestopndt.com/ndt-news/best-practices-for-corrosion-under-insulation-monitoring-released

Customer Feedback

aramco

"The Ju'aymah NGL Fractionation now features the Corrosion Under Insulation (CUI) monitoring solution by CorrosionRADAR, highlighting our commitment to rapid and impactful digital transformation. This successful implementation marks a significant milestone, and we aim to leverage it to enhance value across all our facilities."

Khalid S. Al-Ghamdi
Senior Vice President, Eastern Region Manufacturing

INEOS

"We have had a highly positive experience with CorrosionRADAR's technology. Following the success of this deployment, we are now actively exploring opportunities to scale up the technology across our operations. We are confident that with the help of CorrosionRADAR and our team's expertise, we can continue to improve the safety, efficiency, and sustainability of our processes."

Philip Enegela
Integrity Team Leader at INEOS

Chevron

"Since installing CorrosionRADAR's CUI monitoring solution, we now have predictive insights that guide our inspection planning. It's helped us focus our resources where they're most needed, improving both the efficiency and effectiveness of our inspection strategy."

CUI Program Manager

DOW®

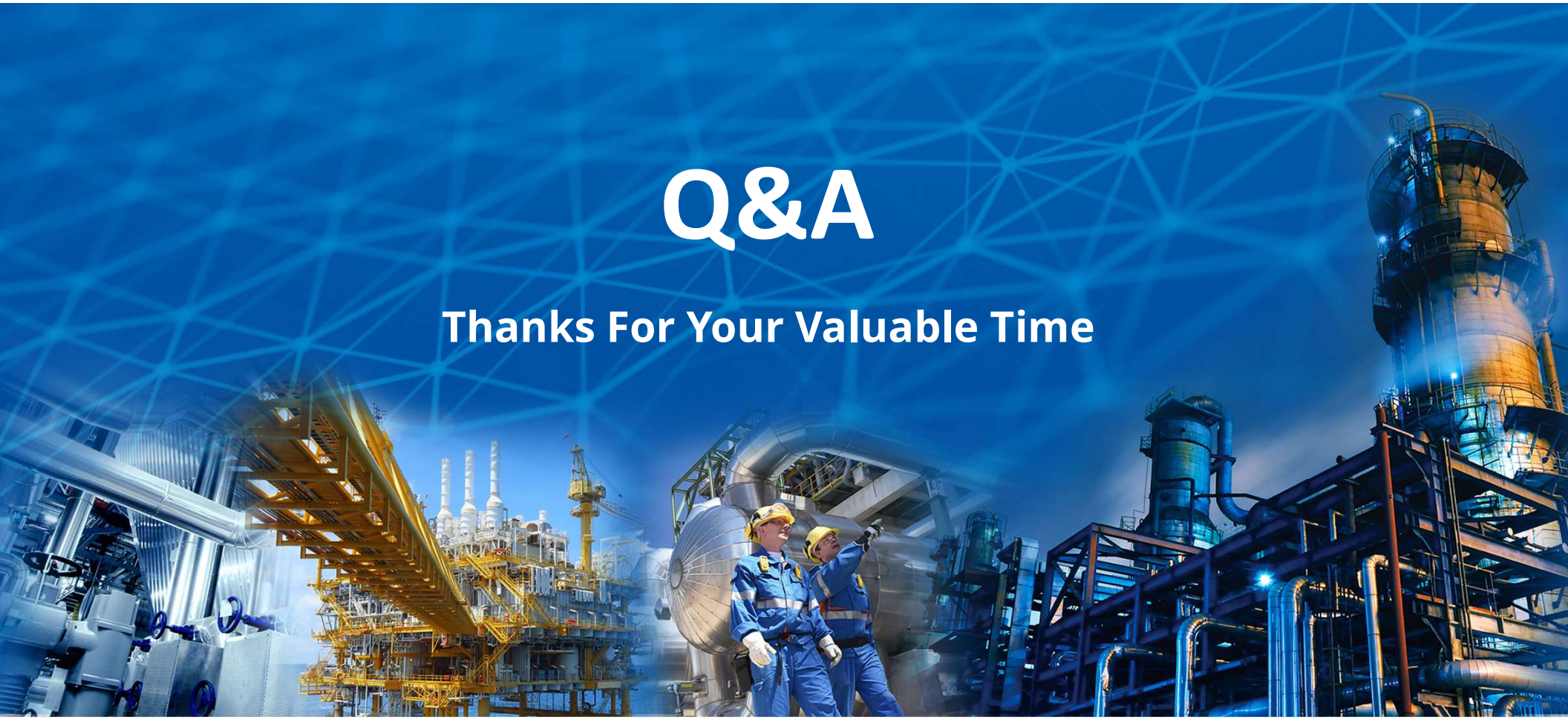
"Within 6 months we confirmed that the corrosion sensor was doing what it should do, the moisture sensor was doing what it should do"

Senior Asset Integrity Expert

Time For Live Demonstration

Click on link below:

https://youtu.be/_v-fmxLZ6Fk?si=W3m6VZzB3Eyy7mH-



Q&A

Thanks For Your Valuable Time

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Cambridge Science Technology AWARDS