

## **Paper 2**

**Automated CUI Monitoring Case Studies  
by Prafull Sharma**

## Paper 2

BIO - Prafull Sharma is an Inventor and the Chief Technology Officer of Corrosion Radar with Core expertise in Industry 4.0, Industrial IOT, Predictive Analytics and Sensing Technologies.

# CUI Risk Monitoring: Status and Case Studies

Deployed by:



أرامكو السعودية  
saudi aramco



ادنوك  
ADNOC



INEOS



sitech  
services

# Corrosion Under Insulation (CUI)



CUI IS AMONG THE BIGGEST ASSET INTEGRITY THREATS

**CUI** is among top asset integrity issue in O&G and Petrochemicals

Upto **60%** of all pipeline failures are due to CUI globally

Upto **10%** of the overall plant maintenance cost in O&G globally

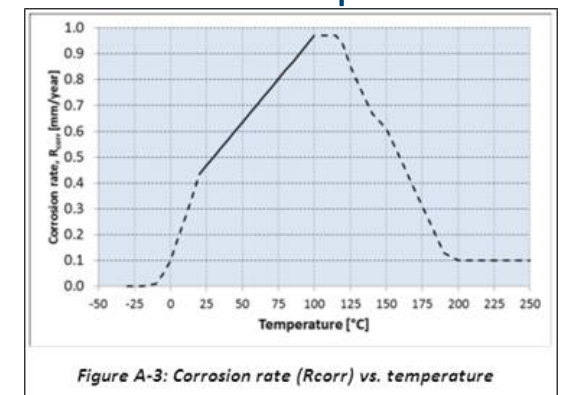
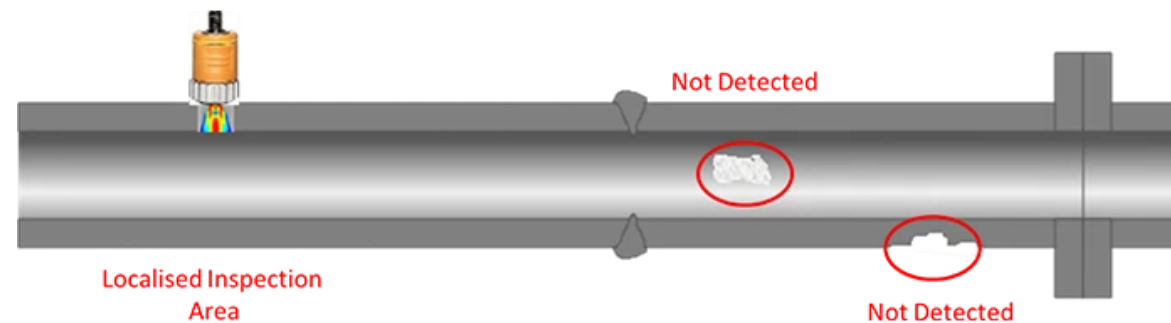
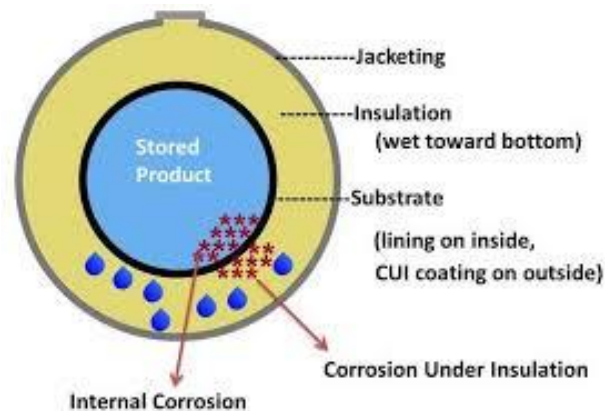


## How CUI happens

Water ingress  
into insulation

Unpredictable location

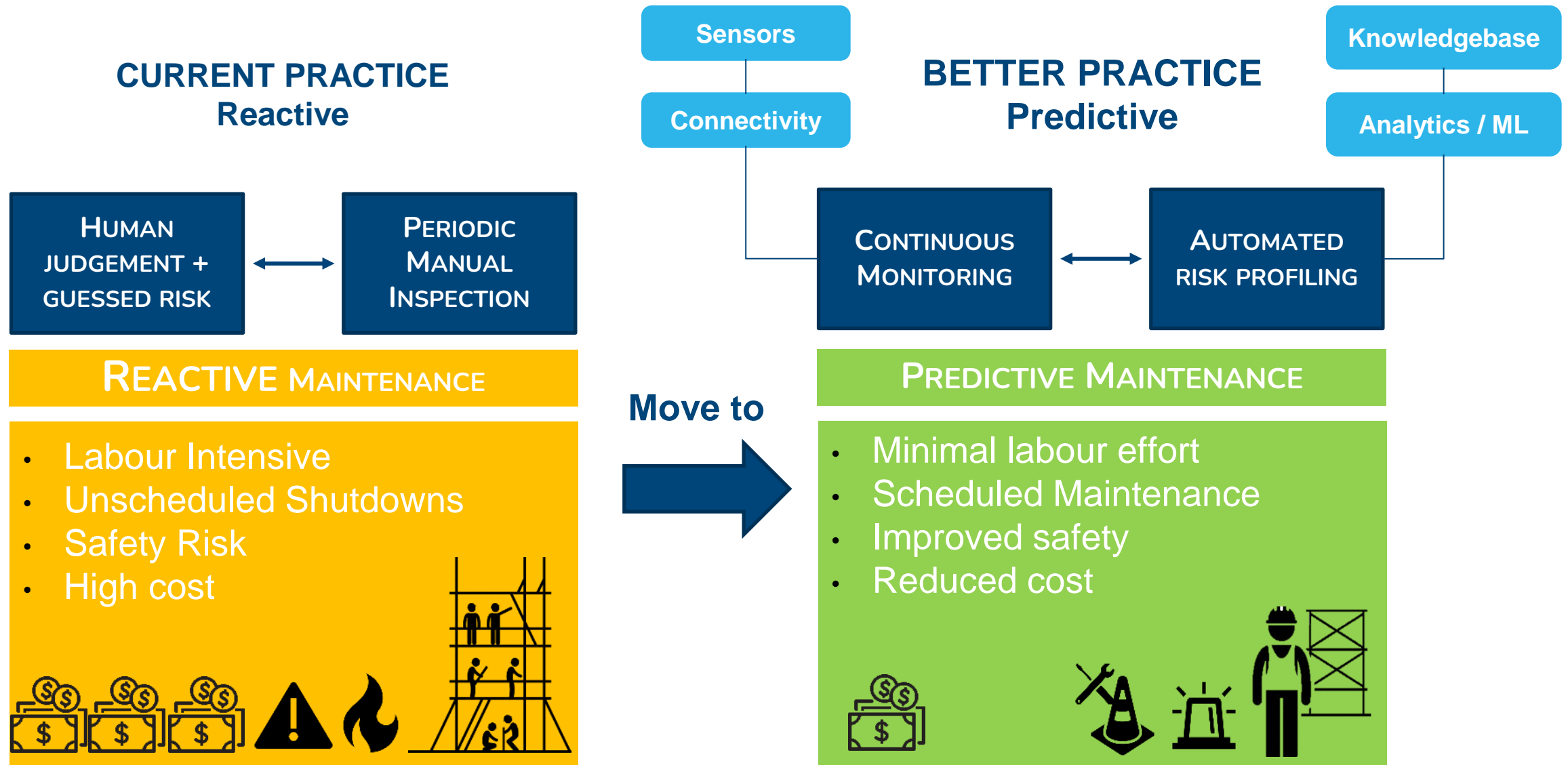
Suitable temperature



# Predictive CUI Management - Opportunity



ENABLED BY MONITORING AND PREDICTIVE ANALYTICS



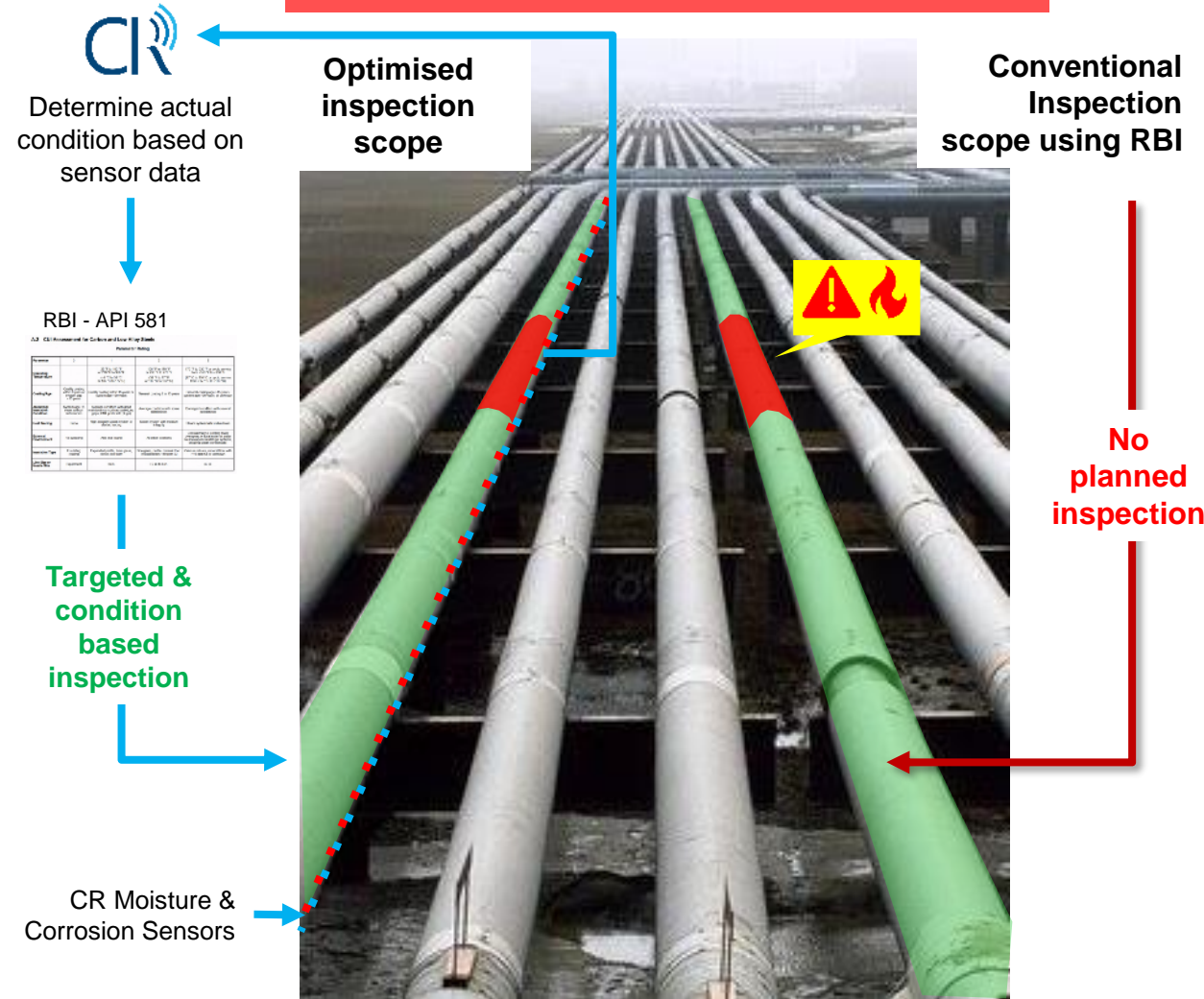
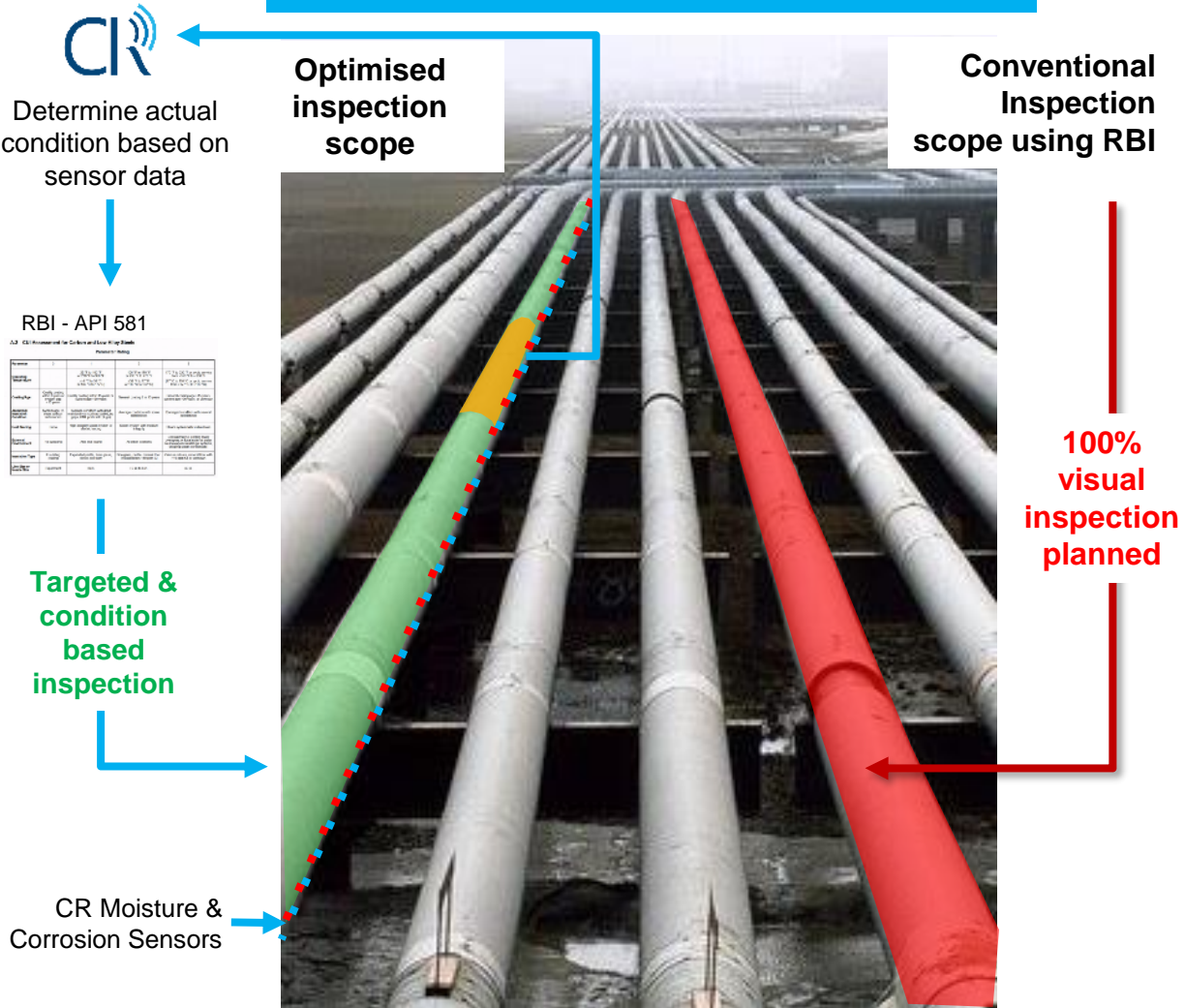
# Risk Localisation for Optimised Inspection Scope



EXAMPLE OF INTEGRATION OF CR TECHNOLOGY WITH CUI ASSESSMENT BASED ON API581

## Avoid over-inspection

## Avoid under-inspection





# Solution CUI Risk Monitoring

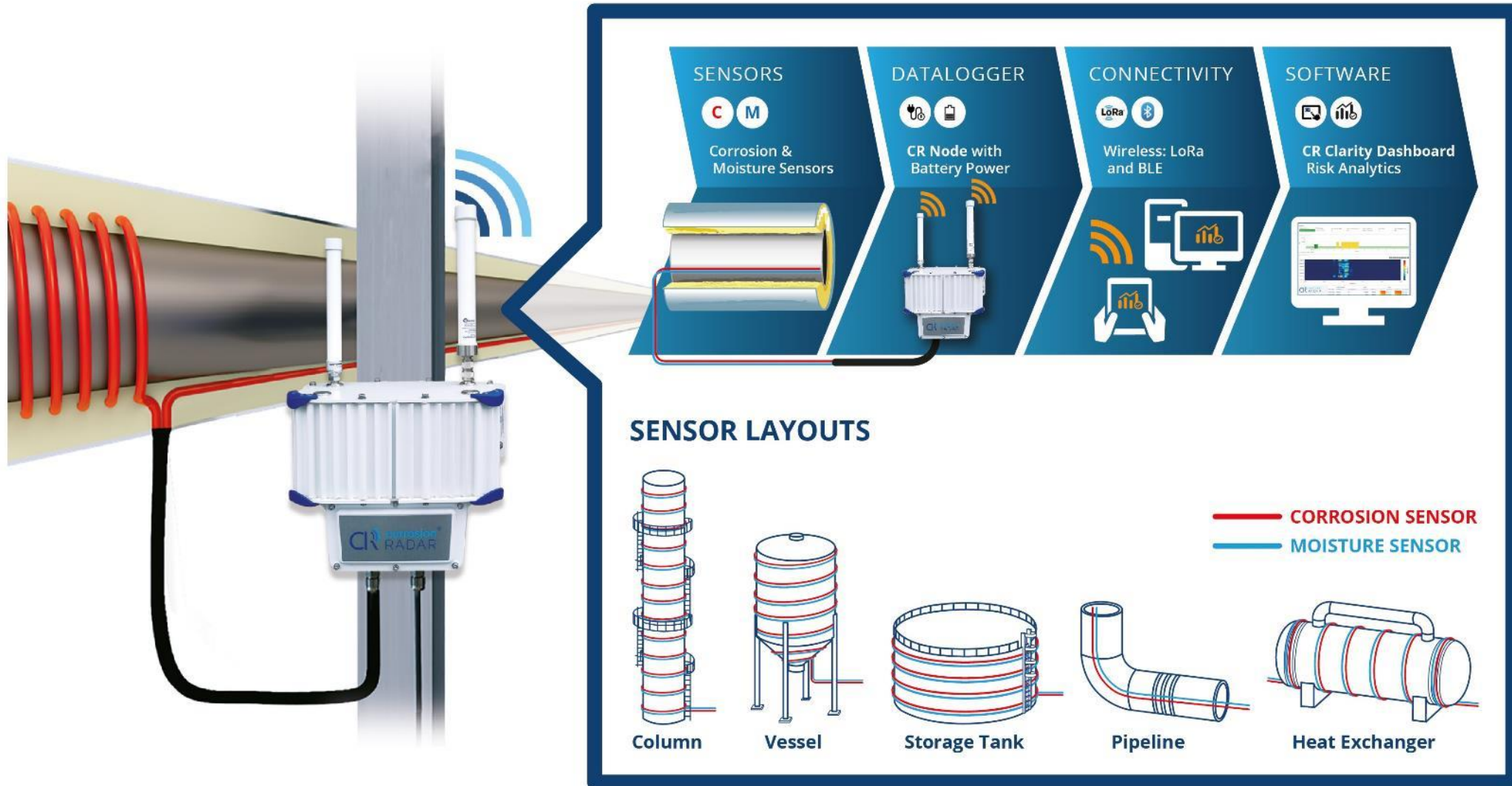


NACE Corrosion 2021  
MP Innovation of the year  
National Association of Corrosion Engineers  
International

# CorrosionRADAR: LR



CUI Risk Monitoring System with Corrosion and Moisture Sensing





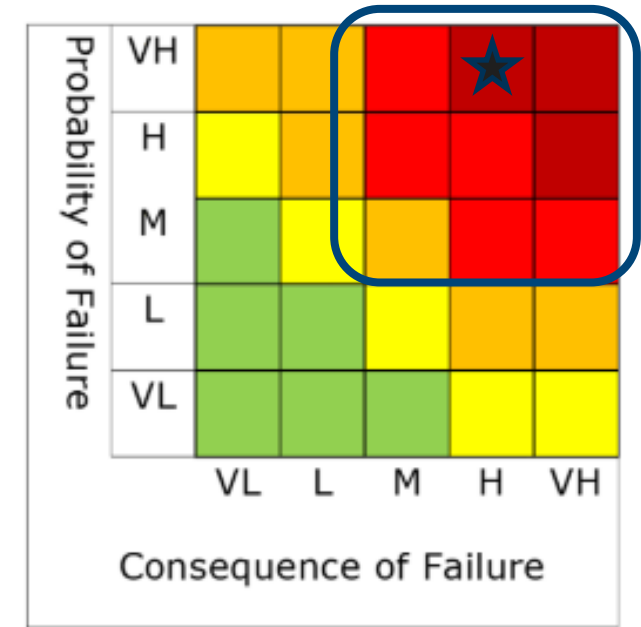
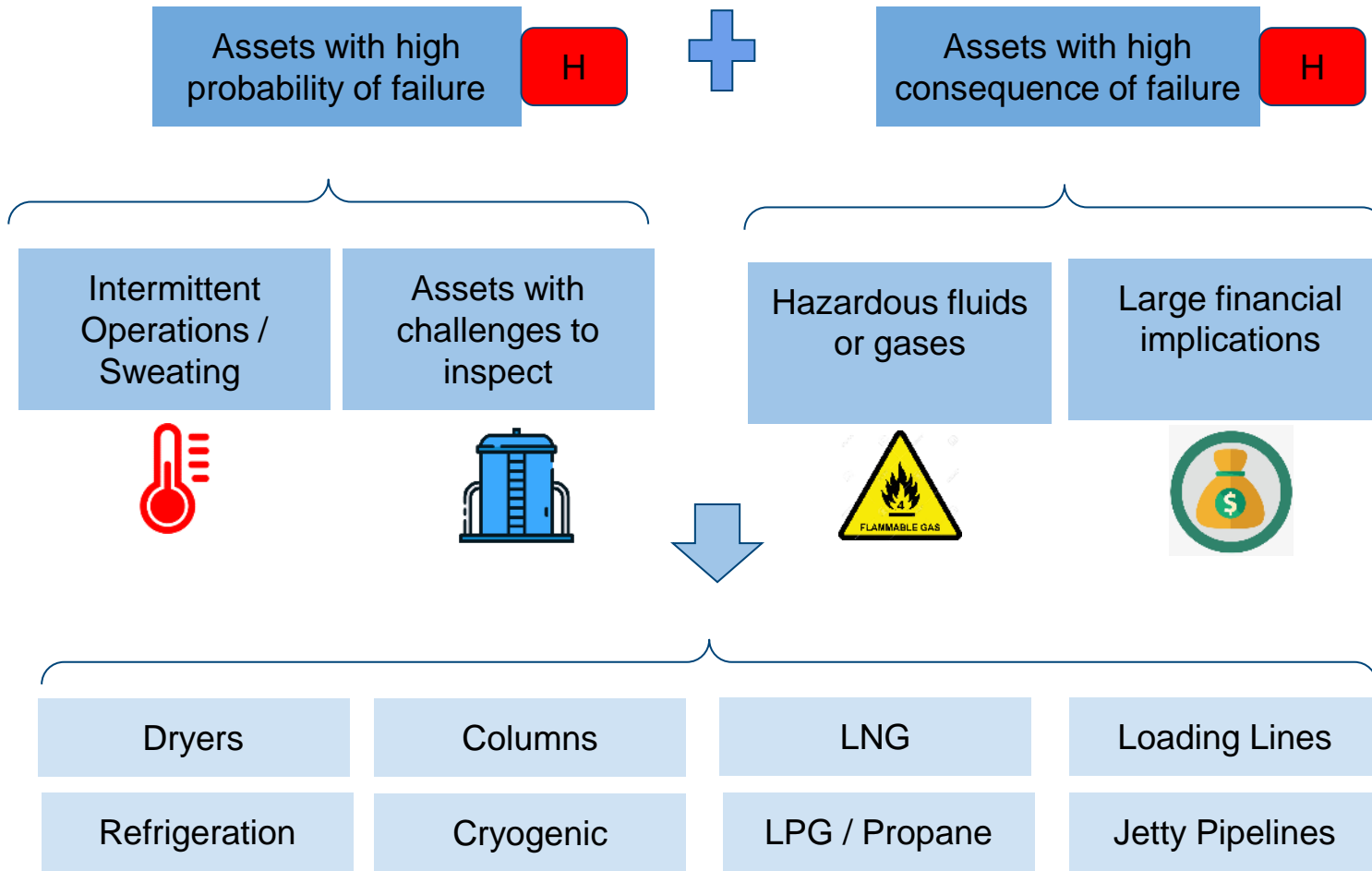


**Case  
Studies**

# Assets for CUI monitoring



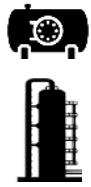
## Selection of High Risk Assets



# Key Global Customers



CUI MONITORING HAVE SEVERAL APPLICATIONS GLOBALLY



**Key Applications:**  
Reactors, Dryers,  
Columns

**INEOS**



**Key Applications:**  
Storage Tanks

**Key Applications:**  
Offshore



**Key Applications:**  
Storage Tanks



**Key Applications:**  
Columns  
Dryers  
Pipelines

أرامكو السعودية  
**saudi aramco**



**Key Applications:**  
Cold Pipelines  
Refrigeration  
Columns



**Key Applications:**  
Dryers  
De-Ethanisers

Roadmap of 50+  
Dryers



**Key Applications:**  
De-Ethaniser  
Columns



**PETRONAS**

**Key Applications:**  
Pipelines



**Key Applications:**  
Pipelines

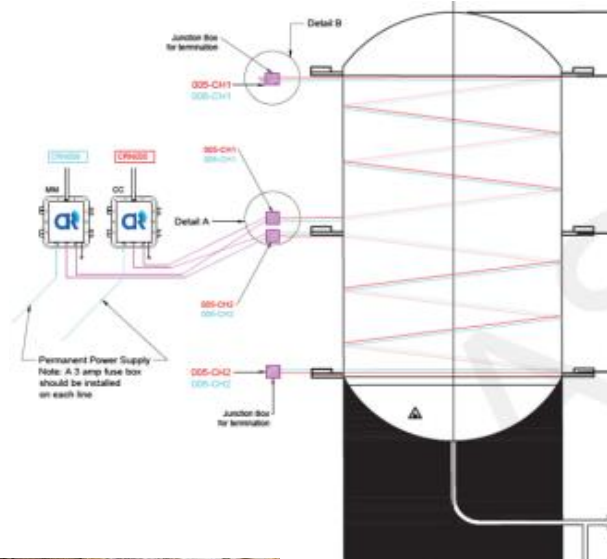


# Dryer Monitoring – Risk Reduction

INTERMITTENT TEMPERATURE SERVICE



## Dryer (Molecular Sleeve absorption)



**Problem** – High CUI risk in Dryers in a petrochemical plant leading to proactive inspection costs

### Asset Type

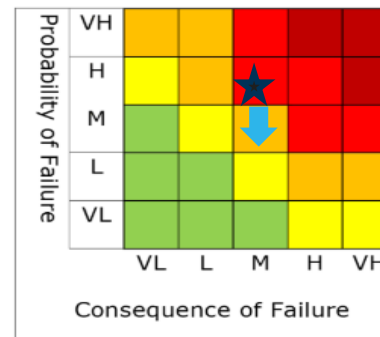
- Molecular Sleeve Dryer
- Cyclical temperatures (-15 DegC to 180 DegC)
- Foamglas insulation

### Solution

- 2 units of CUI monitoring system

### Outcome and Benefits

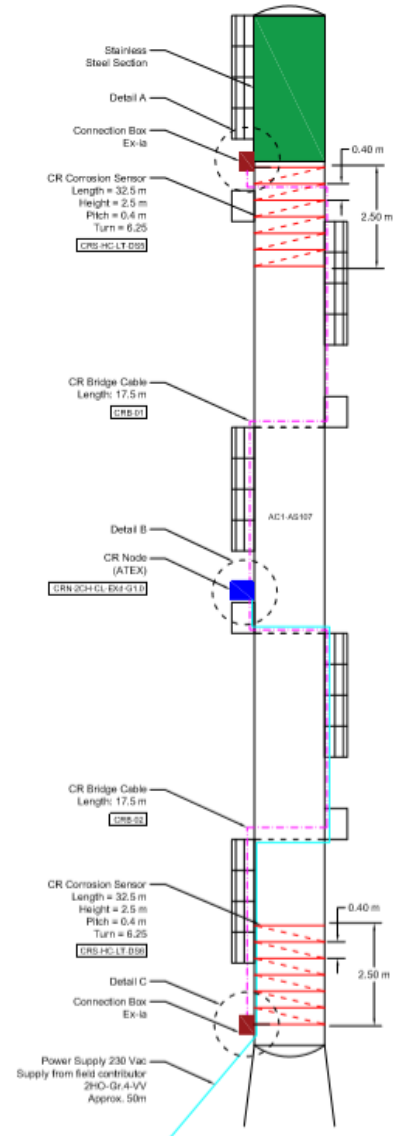
- Risk Reduction in RBI (High to Medium)
- Inspection frequency increase from 5 yrs to 10 yrs
- Cost saving of \$100k in an inspection cycle



**ROI  
60% Savings**

# Column Monitoring – Inspection optimisation

PRODUCTION COLUMN CORROSION MONITORING TO INSPECTION WHEN AND WHERE NECESSARY



**Problem** – High scaffolding costs of >\$0.5M due to proactive inspection cycles of 6 years but most often CUI is localised

## Asset Type

- Production Column
- CUI temperature range zones (90 DegC to 180 DegC)
- Hot insulation and no coating

## Solution

- 2 units of CUI monitoring systems

## Outcome and Benefits

- Risk Reduction in RBI (Very High to High)
- Inspection optimisation to zones only with risks
- Scaffolding to rope access leading to cost savings

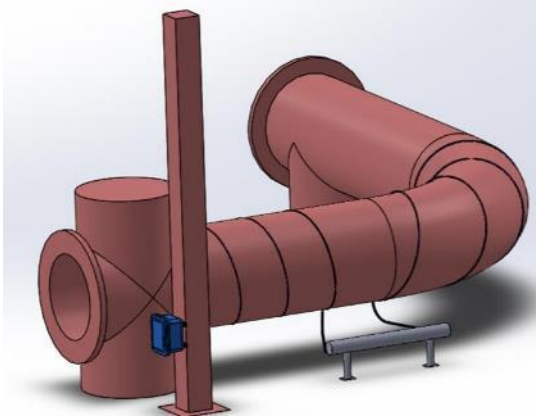
Probability of Failure	VH	Orange	Yellow	Red	Red	Red
	H	Yellow	Orange	Red	Red	Red
	M	Green	Yellow	Orange	Red	Red
	L	Green	Green	Yellow	Orange	Orange
	VL	Green	Green	Green	Yellow	Yellow
		VL	L	M	H	VH
		Consequence of Failure				

**ROI  
60% Savings**

# Jetty Loading Lines Cold Insulation – Turnaround Scoping



INTERMITTENT OPERATIONS WITH FOAMGLAS INSULATION IN SAUDI ARABIA



**Problem** – Cold insulation pipes can only be inspected during a turnaround thereby increasing T&I scope decreasing uptime

## Asset Type

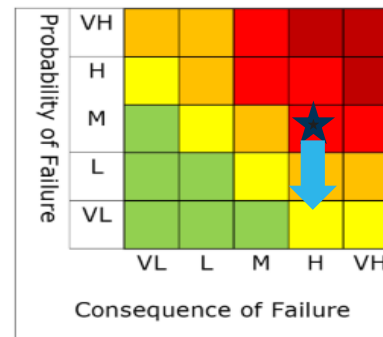
- Cold insulation pipes with Propane for export lines
- Sub zero temperature but intermittent operations
- Foamglas insulation

## Solution

- 1 units of CUI monitoring systems per 100 meters

## Outcome and Benefits

- Risk Reduction in RBI (Medium to Low)
- T&I scoping reduction to increase uptime
- 1 day saving ~ \$2M saving



**ROI  
72% Savings**

# Propane Refrigeration Unit in NGLF Plant



PROPANE REFRIGERATION UNIT WITH FOAMGLAS INSULATION IN SAUDI ARABIA



## Problem

- Cold insulation pipes can only be inspected during a turnaround thereby increasing T&I scope -> decreasing uptime

## Asset Type

- Cold insulation pipes in refrigeration units and export lines
- Sub-zero temperature but intermittent operations
- Foamglas insulation + vapour barriers

## Solution

- 1 unit of CUI monitoring systems per 100 meters

## Outcome and Benefits

- Risk Reduction in RBI (Medium to Low)
- T&I scoping reduction to increase uptime due to availability of condition data
- Per day saving ~ \$MM saving

2022-10-10T00:00:00+00:00

Description  
Q&H node deployed

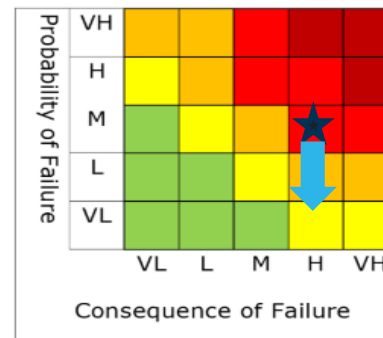
Risk	CoF
S&E	M
Business	M

Asset Config

Variable	Value
config_version	2
creation_date	2022-10-10 00:00:00
next_inspection_history	No_NDT_finding_0_to_2_years_ago_high_pof
rotation_name	Shower Jack 30 stream

DWVGL-RP-G109 - 5 Level Risk Matrix

Very Low		Low		Medium		High		Very High		
Moisture sensors										
Sensor ID	Online	Availability (7d)	Availability (all)	Detections	S&E	Business	CUI PoF	Coating PoF	Material PoF	Water PoF
qs32node2-c12	Yes	98.43%	93.12%	Not detected	L	L	L	H	VH	VL
Corrosion sensors										
Sensor ID	Online	Availability (7d)	Availability (all)	Detections						
qs32node2-c11	Yes	95.43%	96.55%	Not detected						



**ROI  
60% Savings**

# Other Installation examples

A wide range of applications

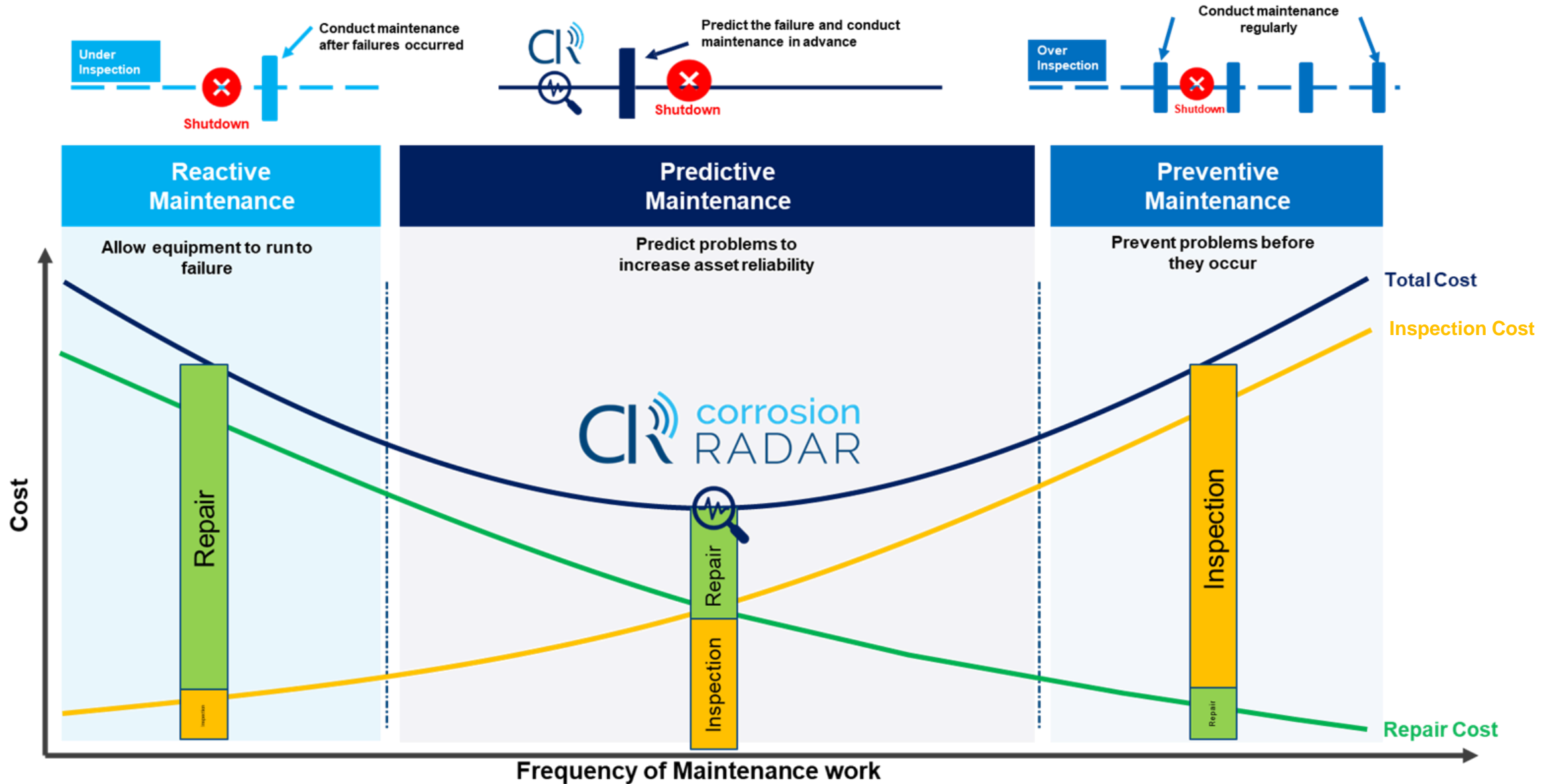




# Benefit - Optimise inspections (reduce cost and risk)



OPTIMISATION OF INSPECTION AND MAINTENANCE





# Enabling Smarter Assets

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