

# **ENGINEERED COMPOSITE REPAIR AND STRENGTHENING SYSTEM**

*Restoring the Integrity of Assets*

*By*

## **LIZMONTAGENS INDIA PVT. LTD.**

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# AGENDA

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Company Overview

Case Histories

Composite Repair History

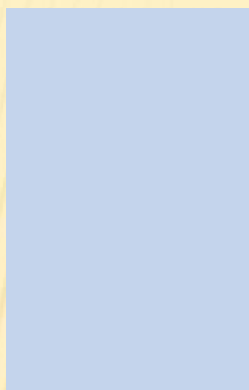
Product Solutions

Composites Overview

Engineering and Repair process

Experience List





# COMPANY OVERVIEW

## LIZMONTAGENS AND NRI-IMG



# LIZMONTAGENS GROUP HISTORY

- ❖ **Lizmontagens Group** was established In 1978 in Portugal; with a specific focus in three main areas of expertise:
  - ❖ **Refractory Linings** (Turnkey services including Detailed engineering
  - ❖ **Furnace construction** & associated structural work (Glass & Aluminium Industry)
  - ❖ **Industrial Chimney** construction and maintenance (EPC Basis)
- ❖ **Lizmontagens Group's** operations covers a wide range of industrial fields including Non Ferrous Industries, Float & Container Glass, Iron & Steel, Cement & Lime, Power Generation, Oil & Gas, Petrochemical and Fertilizer Industry.
- ❖ **Lizmontagens** has over 35 subsidiaries operating in 4 continents with a combined annual turnover of EURO 200 M





# LIZMONTAGENS INDIA

- ❖ Established in December – 2010 as 100% group subsidiary company.
- ❖ We at LIZMONTAGENS INDIA (LIPL) endeavour to provide the same service levels for which LIZMONTAGENS Group has been known globally for the past 40 years.
- ❖ LIPL is an ISO 9001:2008, OHSAS 18001: 2007, EMS ISO 14001:2004 and CRISIL certified MSE-1 organisation and are committed to provide a Top Quality Job at affordable prices in a safe working environment with “Zero Accident Tolerance”.
- ❖ We employ a highly experienced Team of Managers, Ceramic Engineers, Skilled Supervisors of over 250+. We deploy our own skilled manpower at Sites, who can execute fast track projects / shutdowns in a most professional manner.
- ❖ In just 8 years, Total Order Intake : INR 300 Cr (USD 46M).



# LIPL & NRI-IMG COMPOSITES

- ❖ In 2011 LIZMONTAGENS INDIA PVT LTD associated with IMG Composite UK as their authorised Installer for Composite Wrap solution at INDIA , Far East & Part of Middle East.
- ❖ IMG Composites Ltd founded in 2001 (formerly as IMG Offshore) is also a founder member of the Composite Repair Industry .
- ❖ In February 2018, IMG Composites was acquired by Neptune Research Incorporation (NRI) to form the world's largest conglomerate in composite repair industry.
- ❖ NRI is a solution driven, licensed engineering firm and OEM of ASME, ISO and ACI compliant composite materials.





# PIPELINE INTEGRITY ASSESSMENT



# INTEGRITY ASSESSMENT

- ❖ An Engineered composite repair system requires NDT test reports in order to detect the corrosion levels and flaws on the pipeline.
- ❖ The NDT test report enables the ECR Engineer to appropriately design the system to reinstate the integrity of the pipelines/structures.
- ❖ LIPL endeavours to provide its esteemed customers a complete solution for reinstate the integrity of the pipelines/structures which involves NDT survey, Design, Engineering and Installation of composite repair system.
- ❖ LIPL with its NDT service partners can do the Integrity assessment of pipeline by Non-Intrusive and Non-Destructive means by the following methods:



# INTEGRITY ASSESSMENT

- ❖ **External corrosion direct assessment (ECDA)** for assessing External corrosion threat in accordance with NACE International Standard Practice for External Corrosion Direct Assessment (SP-0502-2010)
- ❖ **Internal corrosion direct assessment (ICDA)** for assessing Internal corrosion threat in accordance with NACE International Standard Practice SP0208-2008 for Liquid Petroleum, SP0110-2010 for Wet Gas, and latest SP0116-2016 for Multiphase pipelines.
- ❖ **Stress corrosion cracking direct assessment (SCCDA)** for assessing Stress corrosion cracking threat in accordance with NACE International Standard Practice SP-0204-2008 recommended practice on Stress Corrosion Cracking.

# INTEGRITY ASSESSMENT

LIPL offers the following NDT Services for assessment of the pipelines.

- ❖ Detection of surface flaws
  - ✎ Visual
  - ✎ Magnetic Particle Inspection
  - ✎ Fluorescent Dye Penetrant Inspection
- ❖ Detection of internal flaws
  - ✎ Radiography
  - ✎ Ultrasonic Testing
  - ✎ Eddy current Testing



# INTEGRITY ASSESSMENT

LIPL offers the following NDT Services for assessment of the pipelines.

## ❖ Detection of surface flaws

### ✎ Magnetic Particle Inspection

A nondestructive testing method used for defect detection. Fast and relatively easy to apply and part surface preparation is not as critical as for some other NDT methods. – MPI one of the most widely utilized nondestructive testing methods

### ✎ Fluorescent Dye Penetrant Inspection

Liquid penetration inspection is a method that is used to reveal surface breaking flaws by bleed out of a colored or fluorescent dye from the flaw.

# INTEGRITY ASSESSMENT

LIPL offers the following NDT Services for assessment of the pipelines.

## ❖ Detection of internal flaws

### 📖 Radiography

Radiography involves the use of penetrating gamma- or X-radiation to examine material's and product's defects and internal features. An X-ray machine or radioactive isotope is used as a source of radiation. Radiation is directed through a part and onto film or other media. The resulting shadowgraph shows the internal features and soundness of the part. Material thickness and density changes are indicated as lighter or darker areas on the film. The darker areas in the radiograph below represent internal voids in the component.

### 📖 Ultrasonic Testing

In ultrasonic testing, high-frequency sound waves are transmitted into a material to detect imperfections or to locate changes in material properties.

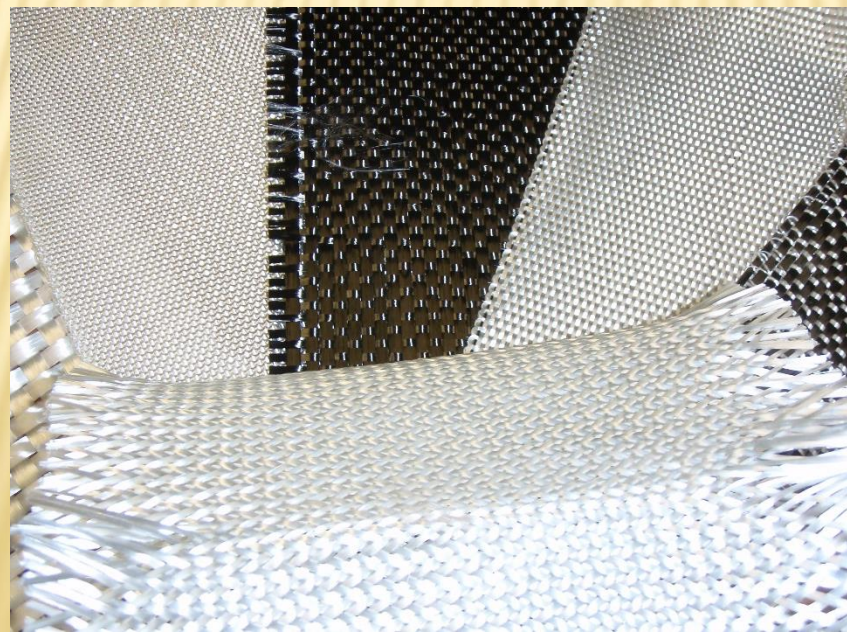
### 📖 Eddy current Testing

Electrical currents are generated in a conductive material by an induced alternating magnetic field. The electrical currents are called **eddy currents** because the flow in circles at and just below the surface of the material. Interruptions in the flow of eddy currents, caused by imperfections, dimensional changes, or changes in the material's conductive and permeability properties, can be detected with the proper equipment.





# COMPOSITES OVERVIEW





# COMPOSITES: WHAT ARE THEY?

- ❖ Combination of fabric and resin that form an extremely strong monolithic material
- ❖ Designed to share the loads & stresses with the host pipe, tank or concrete structure
- ❖ Can also be designed to neglect the strength of the host pipe, tank or structure to rehabilitate heavily corroded assets before they leak

**Fiber Reinforcement**  
(carbon, glass, or synthetic)



- High tensile strength
- High stiffness
- Low density



**Polymeric Binding Matrix**  
(epoxy, vinyl ester, urethane)



- Good shear properties
- Low density



**Composite**



- High tensile strength
- High stiffness
- Good shear properties
- Low density

ASME PCC-2-2015  
(Revision of ASME PCC-2-2011)

# Repair of Pressure Equipment and Piping

AN AMERICAN NATIONAL STANDARD



The American Society of  
Mechanical Engineers



LIZMONTAGENS INDIA

# COMPOSITE REPAIR HISTORY

INTERNATIONAL  
STANDARD

ISO  
24817

Second edition  
2017-08

**Petroleum, petrochemical and natural  
gas industries — Composite repairs  
for pipework — Qualification and  
design, installation, testing and  
inspection**

*Industries du pétrole, de la pétrochimie et du gaz naturel —  
Réparations en matériau composite pour canalisations — Conformité  
aux exigences de performance et conception, installation, essai et  
inspection*

Reference number



# ASME PCC2 & ISO 24817 Standards

**NRI**



# HISTORY

- ❖ In late 90's, a Joint Industry program of Shell and other Major Oil & Gas Companies and Composite Repair Applicator / Manufacturers was Implemented to Design an Effective Composite Repair System, for Development of Design, Qualification and Installation which led to development of ISO 24817 and ASME PCC2.

**Development of these repair standards led the foundation of  
Engineered Composite Repair System (ECR System)**

# ASME PCC-2 & ISO 24817 STANDARD

- ❖ ASME and ISO in partnership with industry experts & end users, began assembling committees who drafted the standard framework in the late 1990s
- ❖ ASME PCC-2 Article 4.1 and ISO 24817 defines a repair system as the combination of:
  - ❖ Pipe substrate
  - ❖ Surface preparation method
  - ❖ Tested repair materials
- ❖ If one of the elements is changed, then requalification is required.
- ❖ NRI tests all materials to the ASME standard including all variations of surface cleanliness in SSPC and NACE
- ❖ Trust, but verify - ALWAYS ask for validated testing!



# ACORES CERTIFICATION



**Audit Number:** ACoReS/17/001

**Date:** 19 January 2017

## Association of Composite Repair Suppliers (ACoReS) Audit Report

### Area Audited:

| Company/<br>Department                                                                    | Area                   | Hosts                                  |
|-------------------------------------------------------------------------------------------|------------------------|----------------------------------------|
| IMG Composites Ltd<br>4 Points Commercial<br>Centre, Craigshaw Road,<br>Aberdeen AB12 3AP | Aberdeen<br>Linlithgow | Ian Taylor<br>Stuart McKay<br>John Rae |

### Auditors:

| Name        | Department                                                                             |
|-------------|----------------------------------------------------------------------------------------|
| Richard Lee | ESR Technology Ltd, 22 East Central, 127 Olympic Ave, Milton Park<br>Abingdon OX14 4SA |

### Documentation Used:

| Document                                                                   | Issue   |
|----------------------------------------------------------------------------|---------|
| ASME PCC-2 Repair Standard                                                 | 2015    |
| ISO 24817                                                                  | 2015    |
| IMG Composites Internal Manuals covering Procedures, Quality, and Training | Current |
| IMG Composites Repair Design spreadsheet – Design SS (Rev 19)              | Rev 19  |

### Non-compliance's Identified:

| Summary                                                                           | No.         |
|-----------------------------------------------------------------------------------|-------------|
| Design check equation 33 (page 35) of ISO 24817. Discussed, agreed and rectified. | Observation |
|                                                                                   |             |
|                                                                                   |             |

### Observations/Summary:

|                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IMG Composites are observed to be compliant with the current ASME PCC-2 Code and ISO 24817 Standards.                                                                                                                                                                                                                           |
| IMG Composites have recently completed Type B defect revalidation pressure testing on 4" & 6" carbon steel pipe spools (Annex D) and bend, tee pipework components (Annex B) for CompoSol® FRP system.                                                                                                                          |
| IMG Composites Work packs are electronically stored and include Management of Change (MoC) procedures in the Quality Manual.                                                                                                                                                                                                    |
| All Work packs include Workscope, Safety Methods, Risk Assessments, COSHH Information, MSDS sheets, pipe repair data, repair design documents, Inspection records, Management of Change, Completion certificate, Warranty certificate, time sheets and FPAL questionnaire responses (Skills, Competence and Training Score 9.6) |
| Complaint handling and non-conformances were discussed which has resulted in a revised hold point in the PRDS document with additional sign-offs by business, technical and operations representatives witnessed.                                                                                                               |

|                         | Signed | Date      |
|-------------------------|--------|-----------|
| Auditor                 | RJ Lee | 19/1/2017 |
| Area Supervisor/Manager |        |           |

# COMPOSITES: COMMON SOLUTIONS

- ❖ Soil-to-Air Interface Corrosion
- ❖ Internal Corrosion/Erosion
- ❖ External Corrosion Under Insulation (CUI)
- ❖ Corrosion/Erosion of
  - ❖ Acid Lines
  - ❖ Flare Lines
  - ❖ Cooling Water Piping
  - ❖ Fire Water Piping
  - ❖ Waste Water Piping
- ❖ Compromised Heat-Affected (weld) Zones
- ❖ MIC issues
- ❖ Thinning Tank Walls
- ❖ Concrete Slabs, Columns, & Beams



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# ENGINEERING AND REPAIR PROCESS

NRI engineers design custom solutions for every repair

Responsible Party

■ Operator ■ Manufacturer ■ Contractor



## Repair Inquiry

What is your specific composite need?



## Engineering Assessment Form Completion

Gathers the necessary data to perform defect analysis.



## Technical Feasibility Review

Does the proposed scenario fall within the scope of an Engineered Composite Repair (ECR) System's capabilities?



## Calculations Performed

ECR material selection, repair thickness, and length calculated based on ASME and/or ISO standards.



## Customized Proposal Delivered

A report is provided detailing the product, repair, and installation specifications.



## Installation

Installation training and onsite support to ensure ASME requirements are met.

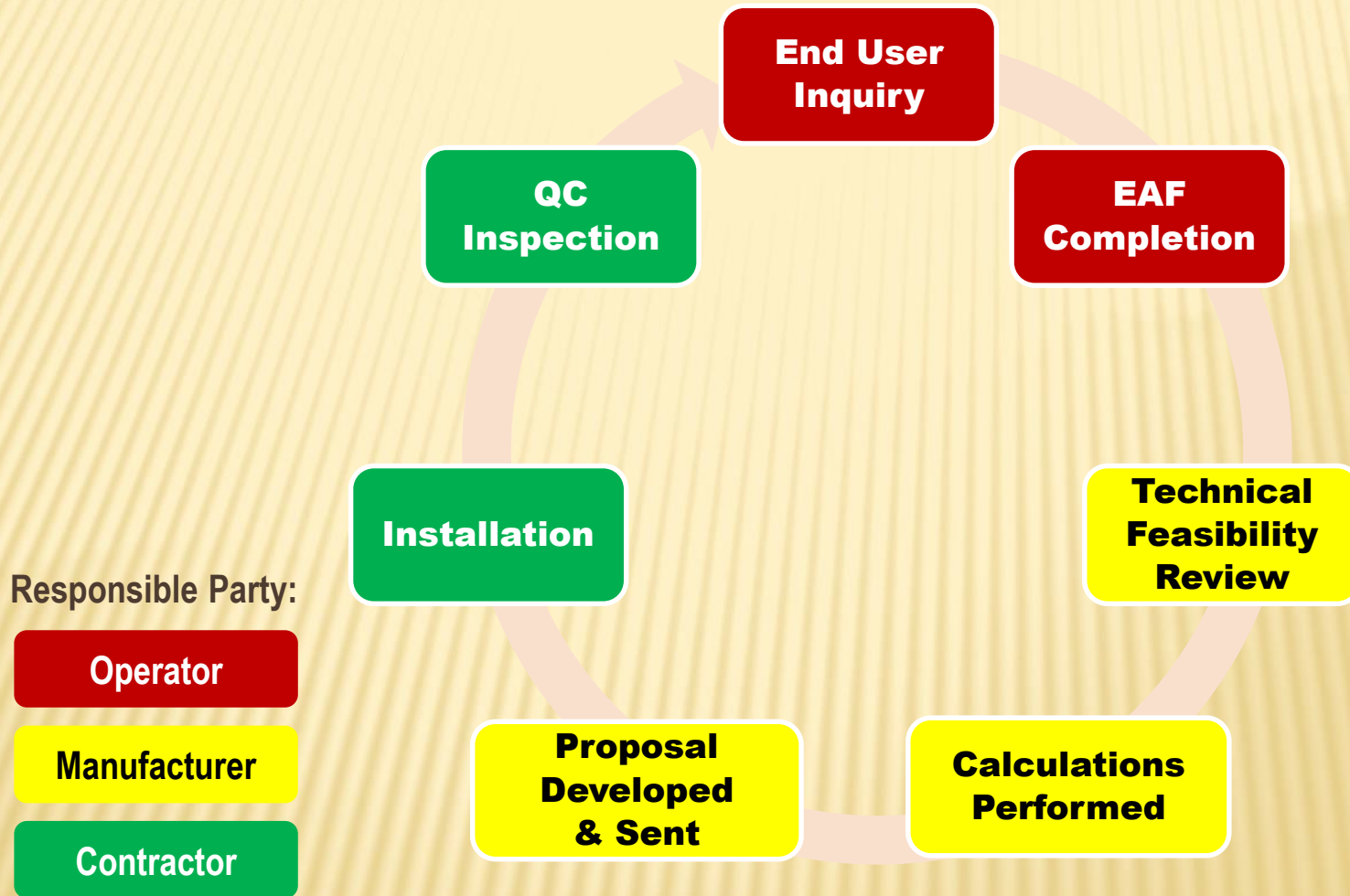


## Quality Control Inspection

Ensure that the repair and installation meet the physical criteria necessary to regain the integrity of the pipe.



# ENGINEERING & REPAIR PROCESS



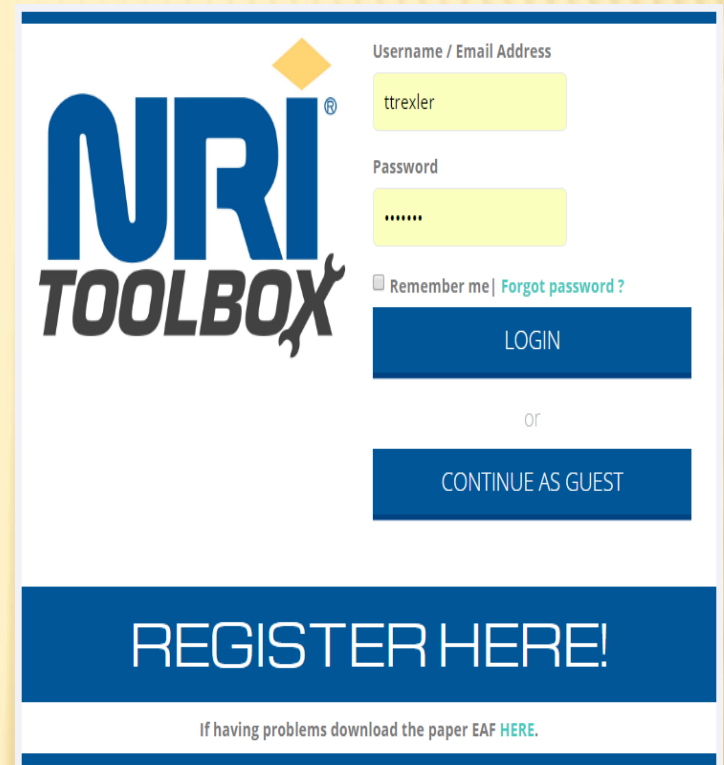


# ONLINE EAF

Online EAF ([www.nrieaf.info](http://www.nrieaf.info)) will be filled by Liz representative to submit your calculation request.

The EAF can be submitted to Liz

- ✗ Via email by downloading the Word document
- ✗ Via PRDS(Pipe Repair Datasheet) provided by Liz Representative.



The screenshot shows the NRI TOOLBOX login interface. On the left is the NRI TOOLBOX logo, featuring the text 'NRI' in large blue letters and 'TOOLBOX' in smaller black letters with a wrench icon. To the right of the logo are input fields for 'Username / Email Address' (containing 'ttrexler') and 'Password' (containing '.....'). Below these fields are checkboxes for 'Remember me' and a link for 'Forgot password?'. A blue 'LOGIN' button is positioned below the password field. Below the login button is the text 'or' and a blue 'CONTINUE AS GUEST' button. At the bottom of the page is a large blue banner with the text 'REGISTER HERE!' in white. Below this banner is a small link: 'If having problems download the paper EAF [HERE](#).'

# CONTROLLED PROCESS: OPERATOR



## Repair Inquiry

What is your specific composite need?



## Completion of an Online EAF

- ❖ Gathers the necessary data to perform
- ❖ defect analysis.
- ❖ Information requested:
  - ❖ Original piping detail
  - ❖ Operating conditions
    - ❖ Pressure and temperature
  - ❖ Defect data
    - ❖ Location and size
    - ❖ Photos
  - ❖ Inspection, walk-down reports
  - ❖ Current site conditions



*Information accuracy & detail are critical for appropriate repair design!*



UJZMOOTAGEOS IODIA



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# CONTROLLED PROCESS: NRI



## Technical Feasibility Review

- ❖ Does the proposed scenario fall within the scope of an Engineered Composite Repair (ECR) system's capabilities?



## Calculations Performed

- ❖ ECR material selection, repair thickness, and length calculated based on ASME and/or ISO standards.



## Customized Design Specification Delivered

- ❖ A report is provided detailing the product, repair calculations, installation specifications, Critical Hold and QC documentation.



# FINAL DESIGN SPECIFICATION PACKAGE

- ❖ EAF
- ❖ Details of damage/defect
- ❖ Plant drawings
- ❖ ASME/ISO calculations
- ❖ Surface prep requirements  
SSPC SP11
- ❖ Materials list for quantities  
required
- ❖ Method statement
  - ❖ Includes hold points and inspection  
procedures
- ❖ QC Documentation





CHALLENGE EVERYTHING

**SPECIFICATION FOR ENGINEERED COMPOSITE REPAIR**

|                    |                                                                |
|--------------------|----------------------------------------------------------------|
| Date               | 7/27/2016                                                      |
| Asset Owner, City  | Georgia Pacific, Brewton                                       |
| EAF Submitted by   | Service Contractor, 123.456.7890, QualifiedInstaller@Gmail.Com |
| EAF Last Edited by | N/A                                                            |
| Line ID#           | 2 Paper Machine                                                |
| NRI Report #       | E10237-                                                        |
| Design Engineer    | Bradley Whelan, BWhelan@neptuneresearch.com                    |
| Product            | Thermo-Wrap Inspectable                                        |
| # of Layers        | 6                                                              |
| Repair Length      | 300 in                                                         |

[www.neptuneresearch.com](http://www.neptuneresearch.com)





ASME PCC-2-2015  
(Revision of ASME PCC-2-2011)

# Repair of Pressure Equipment and Piping

AN AMERICAN NATIONAL STANDARD



The American Society of  
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INTERNATIONAL  
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ISO  
24817

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inspection*

Reference number



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# APPLICATION PROCEDURE



# ASME PCC2 & ISO 24817 Standards

**NRI**

# SURFACE PREPARATION

- ❖ **Critical Step** - NRI requires a 1 mil surface profile for installation of all engineered systems
  - ❖ SSPC-SP10/NACE 2 Near-White Blast Cleaning
  - ❖ SSPC-SP11 Power Tool Cleaning to Bare Metal
  - ❖ Measured with Testex film or other surface profile tooling
- ❖ Grit blast cleaning is preferred, but rarely available in a plant setting
  - ❖ NRI has tested and certified the following tools to aid in surface cleanliness



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Replica tape (Testex) surface profile testing



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# NRI TESTED & APPROVED TOOLS\*



**Safety Tools Allmet**

An Intertek EX-certified non-spark, cold filing tool



**RUST Atex Grinder**



**MBX Bristle Blaster**

Widely used in the coating industry

\* IMG Composol® systems are qualified to manual surface preparation for ST2 & ST3 surfaces.



Pipeline Before Repair



Pipeline Before Repair





Paint removal and surface preparation



REP APPLICATION



MIXING CRC & GLASS FIBER



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WRAPPING WITH GLASS FIBER



FINAL APPLICATION



# PIPING – INTERNAL CORROSION



TIHERMO WRAP™



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# PIPING – INTERNAL CORROSION



THERMO WRAP™

  
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# PIPING – INTERNAL CORROSION





# PIPING – INTERNAL CORROSION



HERMO WRAP™

  
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IMG  
COMPOSITES

  
NRI

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# PIPING – INTERNAL CORROSION





# PIPING – INTERNAL CORROSION





# PIPING – INTERNAL CORROSION



THERMO-WRAP<sup>TM</sup>



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# PIPING – INTERNAL CORROSION



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# PIPING – INTERNAL CORROSION



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# ENSURING COMPLIANCE

- ❖ Only qualified repair materials can be used on substrate and cleanliness they were tested on
- ❖ Agreed engineering and design
- ❖ Only trained, validated and licensed technicians can install repairs
  - ❖ Technicians are trained, NOT companies
- ❖ Completed QC reports by lead, trained personnel with training certification (similar to NACE)

# COMPOSITES: WHY THEY'RE USED

- ❖ Keep your assets up & running, avoiding shut downs
- ❖ Safely restore corroded, eroded & damaged pipes, tanks & vessels eliminating failures & shutdowns before they happen
- ❖ Low cost, high value repair solution
- ❖ Recognized by ASME, ISO, API 579, CSA, ACI, DOT
- ❖ Lightweight repairs adding minimal “dead weight” to already thin lines
- ❖ Repairs are close-fitting & non-geometric specific
- ❖ Fully engineered through ASME/ISO Standards
- ❖ In-house inspection programs can extend repair life



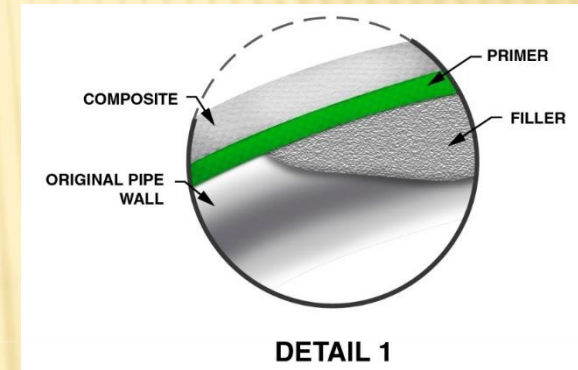


# COMPOSITES: WHAT THEY DO

Completed through two different ASME/ISO repair designs:

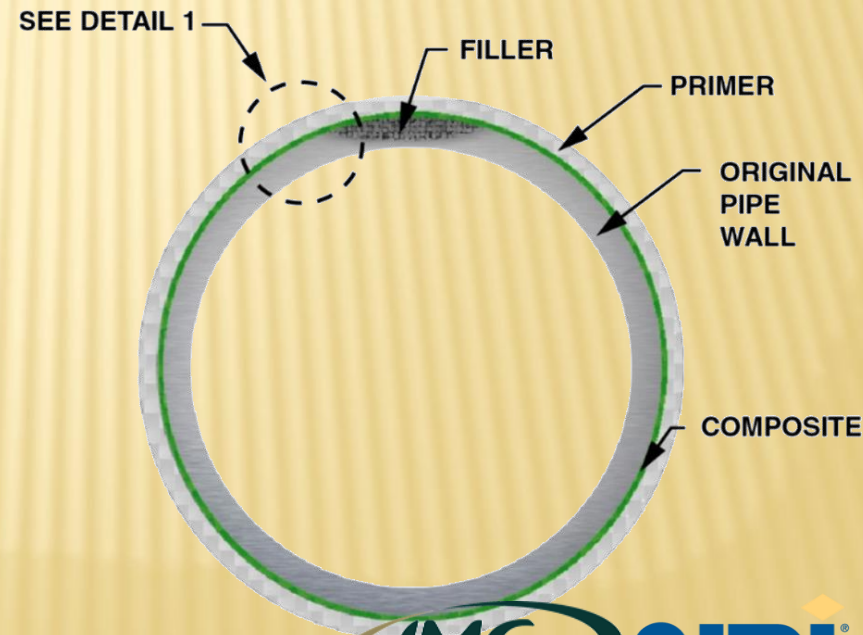
## ❖ TYPE A

- ❖ Restores hoop strength & axial load of pipe & retains pressure
- ❖ External corrosion or mechanical defect to 80% wall loss



## ❖ TYPE B

- ❖ Restores hoop strength of pipe, axial load, contains pressure and product
- ❖ Internal & External corrosion/erosion or mechanical defects to  $t_{min}$  or total wall loss



# COMPOSITES: WHAT THEY **CAN'T** DO

- ❖ Stop active leaks
  - ❖ Must be mitigated first using stop gap or other means
- ❖ Work at elevated temperatures
  - ❖ Above 500°F
  - ❖ Systems on the market have large claims and small results
  - ❖ Always ask for 3rd party testing
- ❖ Perform outside their design specification
  - ❖ Each repair is custom designed to the specific issue and parameters
- ❖ Expect to work without proper surface preparation
  - ❖ Like a coating, adhesion is a critical element to performance

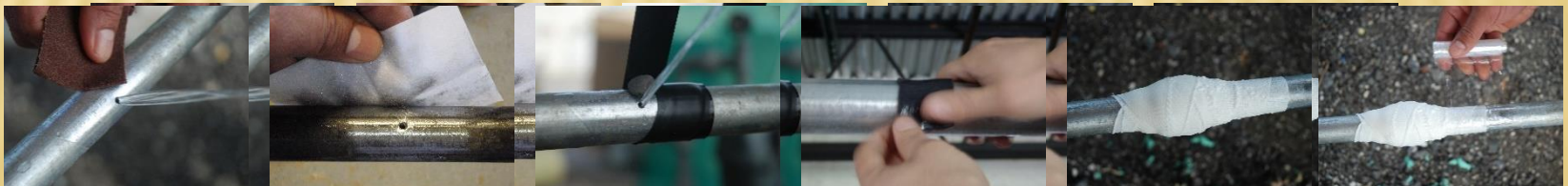


# SYNTHO-GLASS<sup>®</sup> UP & NP

## NON-ENGINEERED EMERGENCY LEAK REPAIR KITS

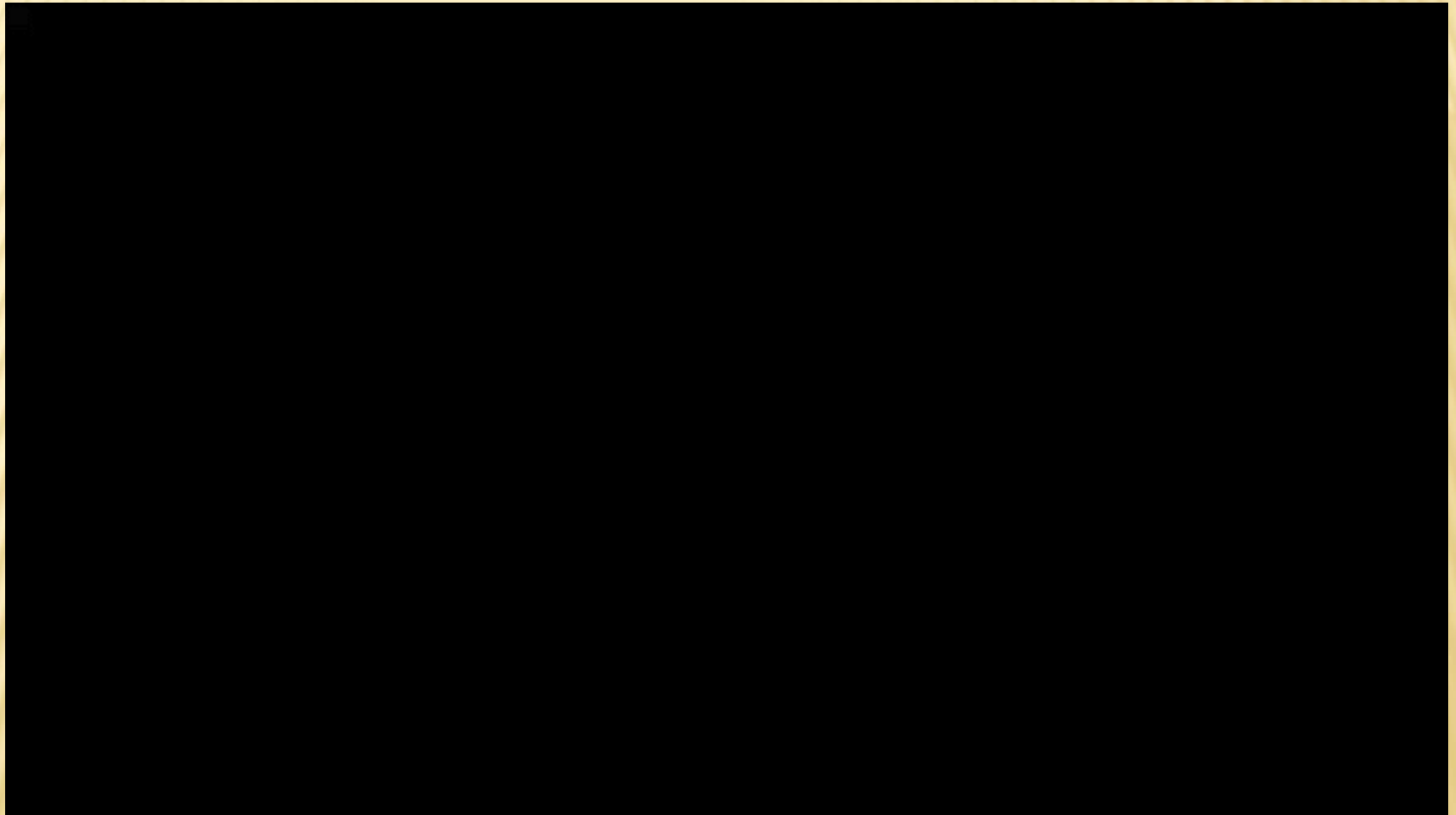
### System & Comprised Components

| Components                   |  |
|------------------------------|--|
| Step-by-Step Instructions    |  |
| Sandpaper                    |  |
| Solvent Cleaning Wipe        |  |
| Protective Gloves            |  |
| Syntho-Steel Putty           |  |
| Syntho-Glass                 |  |
| Compression Film             |  |
| Butyl Strip                  |  |
| Pressure Sealing Rubber Tape |  |



# SYNTHO◇GLASS<sup>®</sup> UP & NP

## NON-ENGINEERED EMERGENCY LEAK REPAIR KITS





# COMPOSITE CLAMP™

## NON ENGINEERED EMERGENCY LEAK REPAIR KITS

### System & Comprised Components

Made with powder coated carbon steel, supplied with an internal rubber patch for ease of leak sealing.

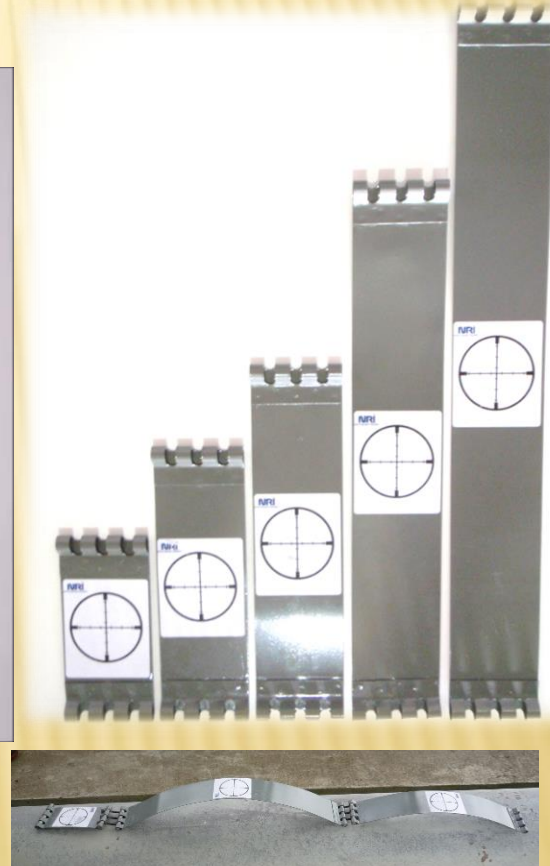
### Design Considerations / Limitations

- ◆ Temporary leak sealing for pipes from 3" up to 24"
- ◆ Connectable in order to achieve higher OD.
- ◆ Rubber patch can be changed accordingly with chemical/temperature attack
- ◆ Can be used with non-engineered or engineered system
- ◆ Used in conjunction with UP kits or engineered repairs
- ◆ Can be used by in-house maintenance or call out contractors



# COMPOSITE-CLAMP™

**NON ENGINEERED EMERGENCY LEAK REPAIR KITS**





# LEAK SEALING BY LIZMONTAGENS TEAM

**Client:** Deepak Fertilizer and Petrochemicals Ltd.

**Nozzle Size:** 20"

**Pressure:** 2 Kg/cm<sup>2</sup>

**Carrying media:** Cooling Water

**Type of defect:** 50 mm Through wall defect with cracks



## LEAK SEALING BY LIZMONTAGENS TEAM

**Client:** ONGC Hazira

**Nozzle Size:** 4"

**Pressure:** 8 Kg/cm<sup>2</sup>

**Carrying media:** Gas

**Type of defect:** Pin Holes on small bore nozzles

**No. of location:** 9 Nos.





# LEAK SEALING BY LIZMONTAGENS TEAM

**Client:** ONGC URAN

**Pipeline Size:** 36"

**Pressure:** 10 kg/cm<sup>2</sup>

**Carrying media:** Crude Oil

**Type of defect:** 100 mm through wall defect.



# LEAK SEALING BY LIZMONTAGENS TEAM

**Client:** ONGC URAN

**Pipeline Size:** 10"

**Pressure:** 80 kg/cm<sup>2</sup>

**Carrying media:** LPG

**Type of defect:** 150 mm through wall defect.

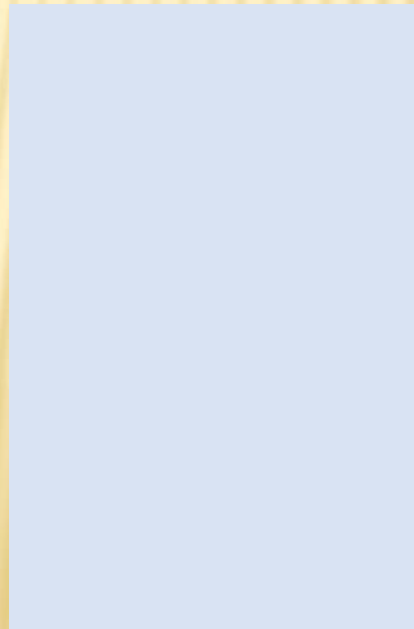






LIZMONTAGENS INDIA

# CASE STUDIES



**NRI**

# COMPOSITE INSTALLATIONS

Cooling Water Header





# LPG LINE IN SLUDGE CATCHER AREA

## INDIA ONGC, Uran



### Project Overview

- A 10" OD LPG sludge catcher was inspected and external corrosion was identified up to 70% of the original wall thickness.
- IMG's engineers designed a custom solution based on ISO 24817 requirements
- The repair was completed without shutdown, restoring the design pressure to 290 psi (20 bar) with 8 layers of CompoSol.



# CRUDE OIL SUCTION LINE INDIA ONGC



## Project Overview

- A 30" OD intermediate pump suction line operating at 1.55kg/cm<sup>2</sup> of pressure was inspected & severe external corrosion was identified over 164ft (261m) of pipe works.
- IMG's engineers designed a custom solution based on ISO 24817 requirements
- The repair was completed without shutdown restoring the design pressure of the crude oil line using CompoSol .







## **Project Overview**

- Severe external corrosion was identified on this 36" OD LP OIL line with (5) 14" OD LP connectors operating at 71 psi (5Kg/Cm2)
- IMG's engineers designed a custom solution based on ISO 24817 requirements
- 1,107 ft (337m) of 36" OD & 444 ft (135.5 m) of 14" OD pipe were repaired without shutdown, fully restoring the design pressure of the crude oil line using CompoSol

## 16" OD COOLING WATER LINE POLAND, 2015

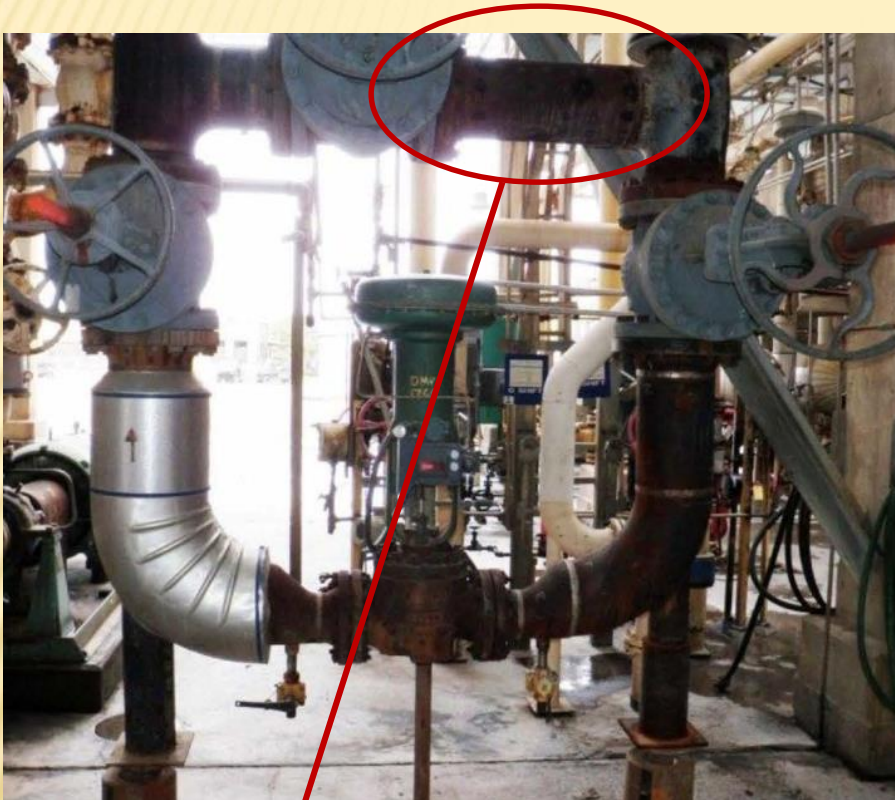


### SYNTHO-GLASS<sup>®</sup> XT Project Overview

- 16" OD with an active leak due to internal corrosion
- A stop-gap was used to stop the leak and Syntho-Glass<sup>®</sup> XT fully restored the integrity of the line
- NRI materials fixed the pipe that otherwise could have taken days with a traditional isolate, cut-and-replace
- The fertilizer plant is now operating at full capacity



# 10" PROCESS PIPING REHAB USA, 2010



## THERMO-WRAP™ Project Overview

- 10" kerosene pipe with accelerated wall thinning due to internal corrosion
- Repair was needed to reinforce thinned areas, prevent failure & keep the system in working order
- NRI designed a Thermo-Wrap repair for the 435 psi (30 bar) pressure rating & operating temp of 255°F with spikes up to 300°F (124 & 149°C respectively)
- In only a few hours, the pipe was restored

# 144" OD KNOCK OUT FLARE DRUM USA, 2014



## THERMO-WRAP™ Project Overview

- Severe internal corrosion on a 144" OD Flare line knock-out drum
- Repair required a 2-year life until the next shutdown
- Completed while in service eliminating down time
- By utilizing NRI's Thermo-Wrap system, the plant saved an estimated \$3 million that would have resulted from an unexpected shutdown & replacement of the vessel



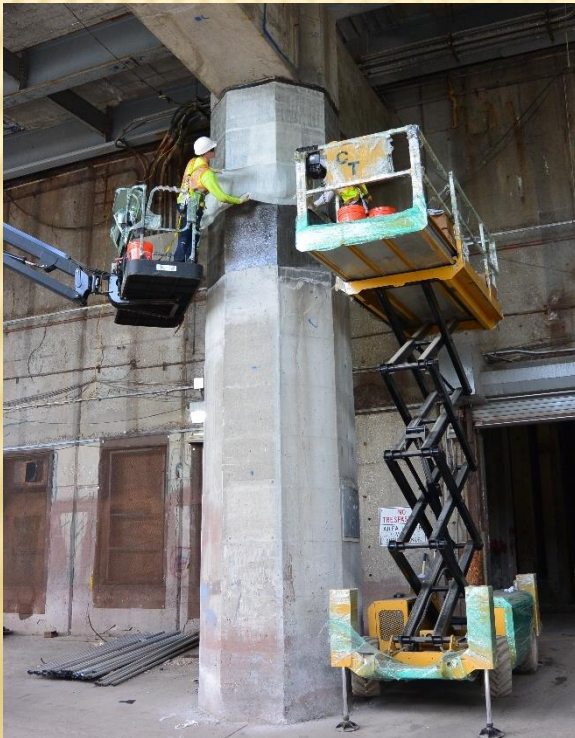
# FLARE LINE REHABILITATION BRAZIL, 2013



## THERMO-WRAP™ Project Overview

- Internal corrosion caused several defects along a 50ft (15m) section of flare line
- The difficult geometries posed no problem for NRI's Thermo-Wrap ECR system
- NRI's materials extended the life of the line until it could be replaced during the next scheduled shutdown 2 years away.

# CONCRETE DECK STRUCTURAL / CIVIL REHAB USA, 2013

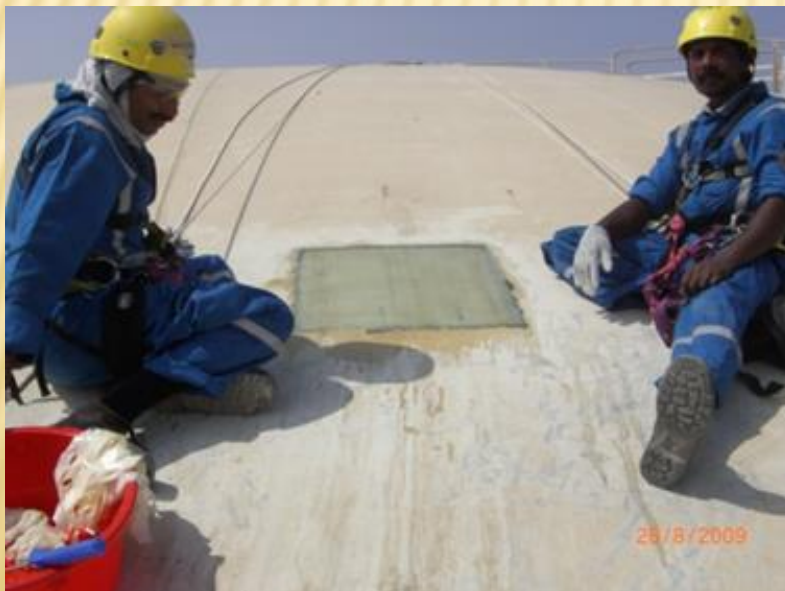


## TITAN® 118 MCU

### Project Overview

- Moisture intrusion from the roof deck caused deterioration so severe that holes were bored to drain the standing water
- NRI's engineers designed a custom solution based on ACI & ICRI requirements
- Titan-118 was applied in a "U wrap" along the beam lengths & overlapping strips on the underside of flat concrete deck
- Titan-118 was also used to restore integrity to damaged columns





## Project Overview

- Inspection identified severe external corrosion in and around the weld seam of the dome tank roof.
- IMG's engineers designed a custom solution based on ISO 24817 requirements
- The repair was completed without shutdown of the tank.

## SOME PICS CONTINUED





## SOME PICS CONTINUED



## SOME PICS CONTINUED





## SOME PICS CONTINUED



## SOME PICS CONTINUED





# SOME OTHER OVERSEAS PROJECTS



PEMEX REFINACIÓN  
REFINERÍA "LAZARO CARDENAS"  
MINATITLAN, VER.



**LM Promotora Industrial, S.A.deC.V.**

**CONTRATO: PXR-OP-RMIN-SP-GMIN-A-39-14**

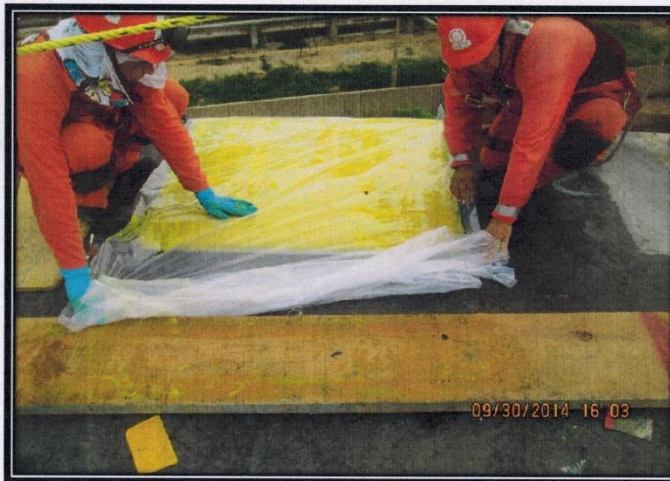
CONTRATISTA

LM PROMOTORA INDUSTRIAL, S.A. DE C.V.

DESCRIPCION DE LA OBRA

"SELLADO DE FRACTURAS EN UNIÓN ENVOLVENTE-CÚPULA Y PERFORACIONES EN CÚPULA A BASE DE FIBRA TERMO WRAP, SYNTHO POXY HC Y ACERO PLÁSTICO PUTY STICKS SS07 DE NRI, DE LOS TANQUES ATMOSFÉRICOS TV-5, TV-6, TV-408, TV-506, TV-507, TV-508, TV-509 Y TV-512, UBICADOS EN EL SECTOR 6, EN EL INTERIOR DE LA REFINERÍA "GRAL. LAZARO CÁRDENAS", EN MINATITLÁN, VER."

**FOTOS DE TRABAJOS TERMINADOS DEL TV-509**





## SOME OTHER OVERSEAS PROJECTS



**PEMEX**  
REFINACION

PEMEX REFINACIÓN  
REFINERÍA "LAZARO CÁRDENAS"  
MINATITLÁN, VER.



**LM Promotora Industrial, S.A.deC.V.**

**CONTRATO: PXR-OP-RMIN-SP-GMIN-A-39-14**

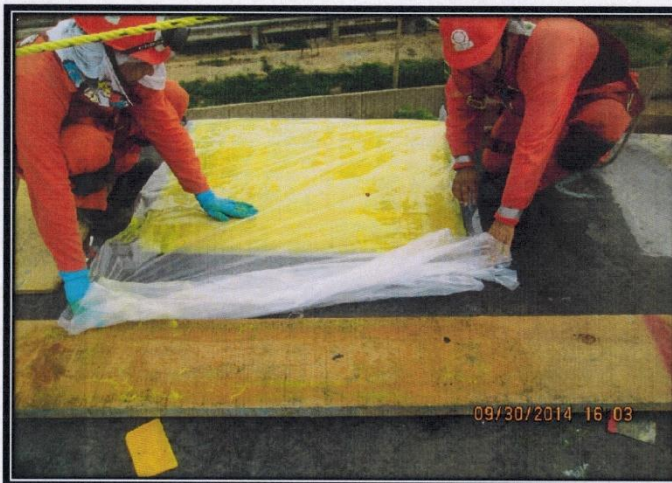
CONTRATISTA

LM PROMOTORA INDUSTRIAL, S.A. DE C.V.

DESCRIPCION DE LA OBRA

"SELLADO DE FRACTURAS EN UNIÓN ENVOLVENTE-CÚPULA Y PERFORACIONES EN CÚPULA A BASE DE FIBRA TERMO WRAP, SYNTHO POXY HC Y ACERO PLÁSTICO PUTY STICKS SS07 DE NRI, DE LOS TANQUES ATMOSFÉRICOS TV-5, TV-6, TV-408, TV-506, TV-507, TV-508, TV-509 Y TV-512, UBICADOS EN EL SECTOR 6, EN EL INTERIOR DE LA REFINERÍA "GRAL. LÁZARO CÁRDENAS", EN MINATITLÁN, VER."

### FOTOS DE TRABAJOS TERMINADOS DEL TV-509





# SOME OTHER OVERSEAS PROJECTS



PEMEX REFINACIÓN  
REFINERÍA "LAZARO CARDENAS"  
MINATITLAN, VER.



**LM Promotora Industrial, S.A.deC.V.**

**CONTRATO: PXR-OP-RMIN-SP-GMIN-A-39-14**

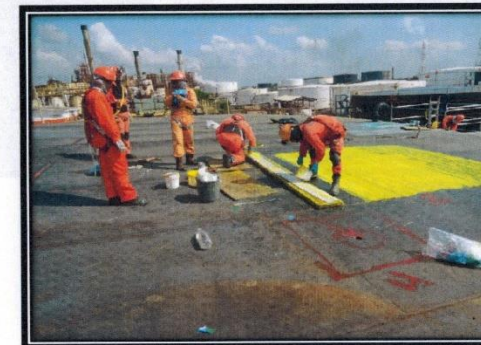
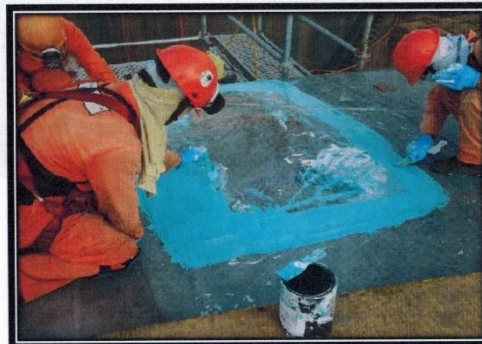
CONTRATISTA

LM PROMOTORA INDUSTRIAL, S.A. DE C.V.

DESCRIPCION DE LA OBRA

"SELLADO DE FRACTURAS EN UNIÓN ENVOLVENTE-CÚPULA Y PERFORACIONES EN CÚPULA A BASE DE FIBRA TERMO WRAP, SYNTHO POXY HC Y ACERO PLÁSTICO PUTY STICKS SS07 DE NRI, DE LOS TANQUES ATMOSFÉRICOS TV-5, TV-6, TV-408, TV-506, TV-507, TV-508, TV-509 Y TV-512, UBICADOS EN EL SECTOR 6, EN EL INTERIOR DE LA REFINERÍA "GRAL. LAZARO CÁRDENAS", EN MINATITLÁN, VER."

FOTOS DE PROCESO DE LOS TRABAJOS  
DE TV-6





## SOME OTHER OVERSEAS PROJECTS



**PEMEX**  
REFINACION

PEMEX REFINACIÓN  
REFINERÍA "LAZARO CARDENAS"  
MINATITLAN, VER.



**LM Promotora Industrial, S.A.deC.V.**

**CONTRATO: PXR-OP-RMIN-SP-GMIN-A-39-14**

CONTRATISTA

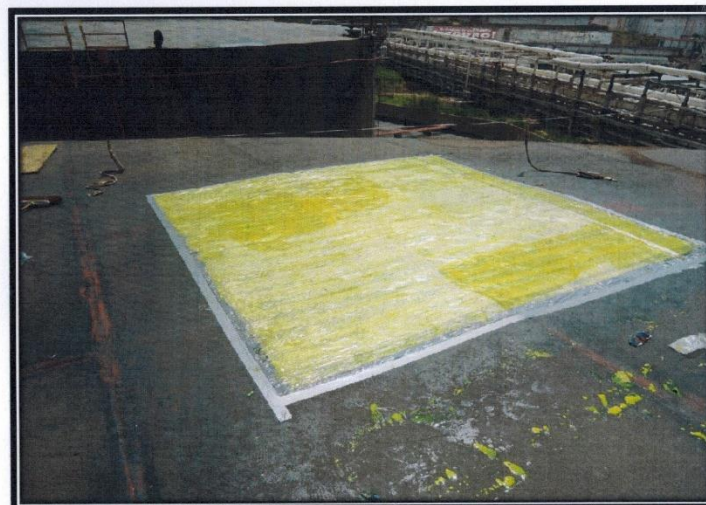
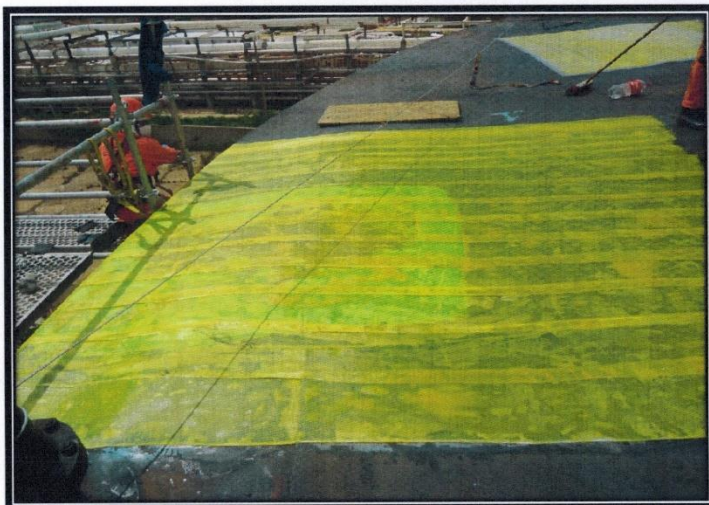
LM PROMOTORA INDUSTRIAL, S.A. DE C.V.

DESCRIPCION DE LA OBRA

"SELLADO DE FRACTURAS EN UNIÓN ENVOLVENTE-CÚPULA Y PERFORACIONES EN CÚPULA A BASE DE FIBRA TERMO WRAP, SYNTHO POXY HC Y ACERO PLÁSTICO PUTY STICKS SS07 DE NRI, DE LOS TANQUES ATMOSFÉRICOS TV-5, TV-6, TV-408, TV-506, TV-507, TV-508, TV-509 Y TV-512, UBICADOS EN EL SECTOR 6, EN EL INTERIOR DE LA REFINERÍA "GRAL. LAZARO CÁRDENAS", EN MINATITLÁN, VER."

### FOTOS DE TRABAJOS TERMINADOS DEL TV-6

FOTOS DE INICIO DE LOS TRABAJOS DE TV-508





# FLARE HEADER INDIA ONGC



## Project Overview

- Inspection identified severe external corrosion along 1,312ft (400m) of 36" OD and 1,148ft (350m) of 48" OD flare headers
- IMG's engineers designed a custom solution based on ISO 24817 requirements
- The repair was completed without shutdown at a height of 72ft (22m) from scaffolding, restoring the design pressure of the crude oil line using CompoSol

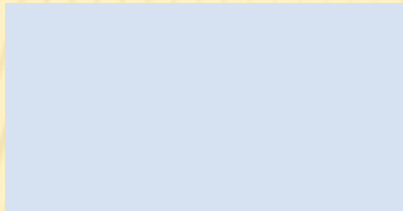
# WHY CHOOSE COMPOSITE REPAIRS?

- ❖ To extend the service life of a system until the next shutdown
- ❖ To eliminate downtime
- ❖ Can be applied while pipe is in service
- ❖ Engineered to ASME, ISO and ACI standards
- ❖ They are an extremely cost effective alternative to clamps, cladding or replacement
- ❖ Composites can be applied on long or short runs of pipe, tanks and vessels as well as flat laminates on tanks

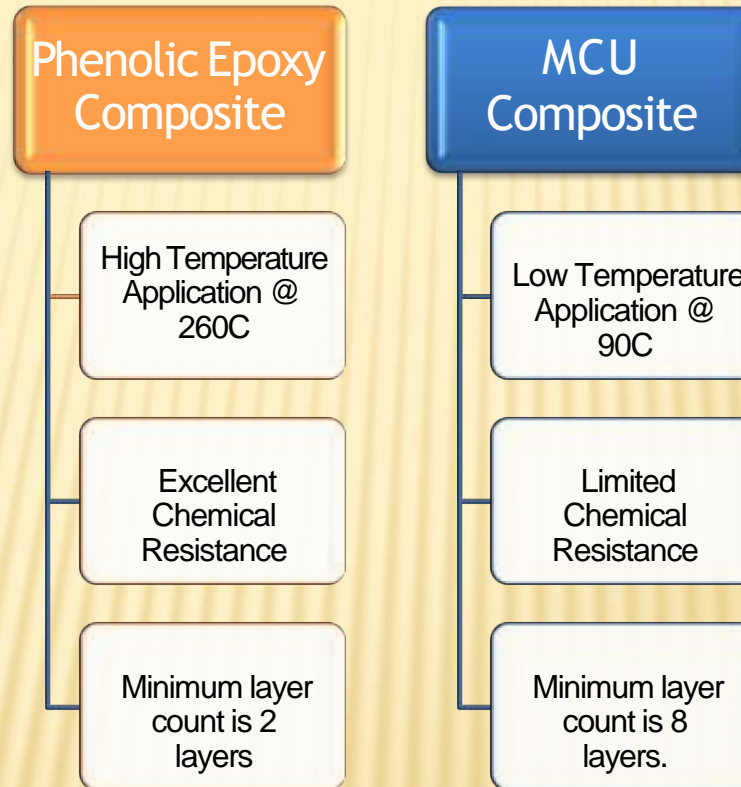




# PRODUCT SOLUTIONS



# ENGINEERED COMPOSITE REPAIR





## Description

CompoSol Pipeline is engineered & designed composite pressure retaining repair system. Designed with ISO 24817, ASME PCC-2 & ACoReS Audit requirements.



## Typical Applications

- ❖ Used on pipes & piping systems, including bends, tees, reducers & other complex geometries suffering from wall thinning (including through-wall defects) caused by internal & external corrosion or mechanical damage.

## Benefits

- ❖ Can be applied to surfaces prepared to ST2 standard
- ❖ Resistant to a wide range of chemicals encountered in petrochemical industry
- ❖ Can be applied under cold permit to work
- ❖ Fire Rated to BS 476 Parts 6 and 7

# STRUCTURAL STRENGTHENING



## Description

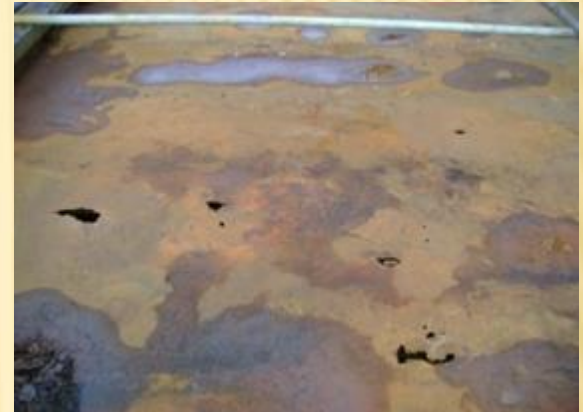
CompoSol® Structure is a composite repair system for reinforcing worn & holed structural members including, but not limited to beams, columns, hollow sections & piles. CompoSol Structure is applicable to both steel and concrete.

## Typical Applications

- ❖ Restore or upgrade the load capacity of the structural member.

## Benefits

- ❖ IMG Composites' engineers design the composite reinforcement using a combination of engineering first principles, design standards & the latest research papers.
- ❖ All designs are verified using Finite Element Analysis





# THERMO-WRAP<sup>TM</sup> 500

## Description

Factory-saturated, custom engineered composite repair system compatible with temperatures reaching 500°F (260°C).

## Typical Applications

Repair external / internal corrosion on steam piping, flare, blow down & chemical processing lines

## Benefits

- ❖ Qualified at extreme temperatures
- ❖ Factory-saturated, no mixing required
- ❖ Design conforms to ASME PCC-2, ASME B31, ISO 24817, DOT, API, & CSA Z662 standards for nonmetallic reinforcing & repair



# THERMO-WRAP<sup>™</sup> INSPECTABLE

## Description

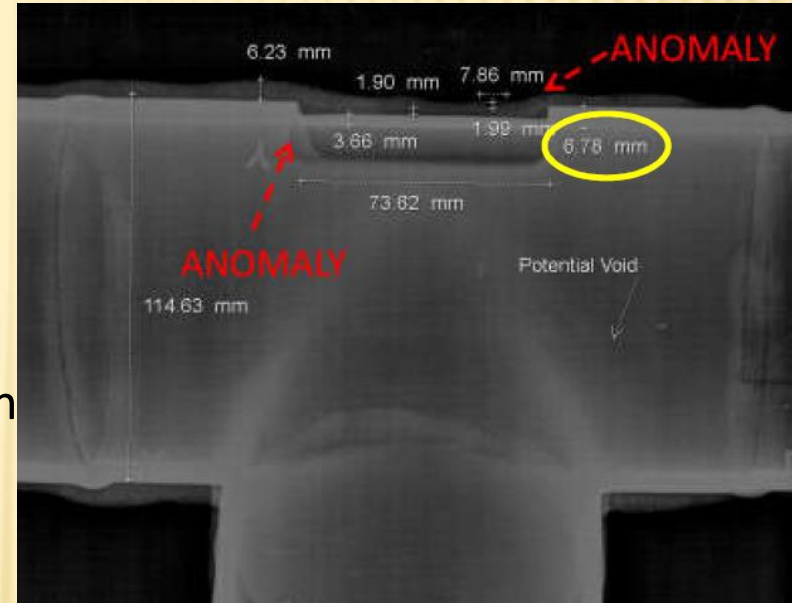
Field saturated , mid-temperature, high chemical compatibility inspectable composite system

## Typical Applications

- ❖ Repair external / internal corrosion
- ❖ Process lines, Flare lines, Hydrocarbon lines, water lines

## Benefits

- ❖ Inspectable with standard radiography providing sharper imaging to detect defects
- ❖ Used for repairs with harsh chemical services & elevated temperatures
- ❖ Design conforms to ASME PCC-2,
- ❖ ASME B31, ISO 24817, DOT, API, &
- ❖ CSA Z662 standards





## Description

Custom engineered composite repair system designed to repair corroded or damaged piping with harsh chemical services such as sulfuric acid to 98%.

## Typical Applications

- ❖ Repair external / internal corrosion on flare, blow down & chemical processing lines

## Benefits

- ❖ Compatible with 1% to 98% sulfuric acid
- ❖ Conformable for repairing elbow, tees, nozzles, welds & headers
- ❖ Design conforms to ASME PCC-2, ASME B31, ISO 24817, DOT, API & CSA Z662 standards for nonmetallic reinforcing & repair
- ❖ Ambient-cured epoxy



# SYNTHO ♦ GLASS<sup>®</sup> XT

## Description

Unique pre-preg, bi-directional composite used to repair and reinforce internal and/or external corrosion on pipelines or structures

## Typical Applications

Repair external / internal corrosion on  
product lines: oil, gas, chemicals, fire water  
lines, cooling water, dock/terminal  
lines, underwater/splash zone repairs,  
ground to air  
interface repairs

## Benefits

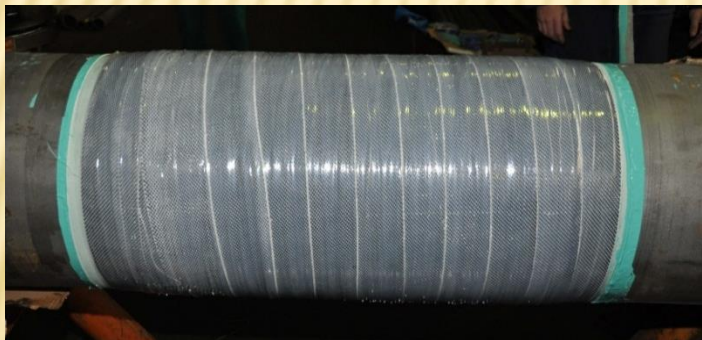
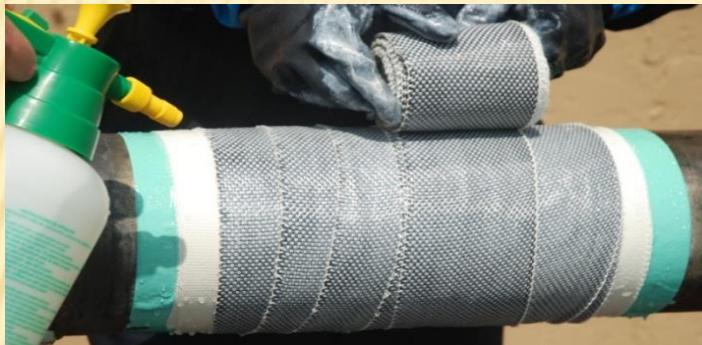
- ❖ Water-activated, factory-saturated, no mixing required
- ❖ Design conforms to ASME PCC-2, ASME B31, ISO 24817, DOT, API, & CSA Z662 standards for nonmetallic reinforcing & repair





# VIPER-SKIN™ THERMO-WRAP™ CF

Bi-axial hybrid carbon and glass fiber versions of Syntho-Glass XT and Thermo-Wrap





## Description

Unique, uni-directional carbon fiber fabric, saturated with SteelWrap Epoxy & primer system.

## Typical Applications

- ❖ Dents, gouges, wrinkle bends, cracks
- ❖ Deterioration & damage including CUI, metal loss, pitting, cracking
- ❖ Regulatory changes including classification factor change, road crossing reinforcement, casing alternative
- ❖ Repair / reinforce structural steel members; stiffening / load capacity increase; weight reduction
- ❖ **Benefits**
- ❖ Stiffer & stronger than steel = lower design thickness
- ❖ No post-curing necessary
- ❖ Highest strain reduction available
- ❖ Design conforms to ASME PCC-2, ASME B31, ISO 24817, DOT, API, & CSA Z662 standards for nonmetallic reinforcing & repair



LIZMONTAGENS INDIA



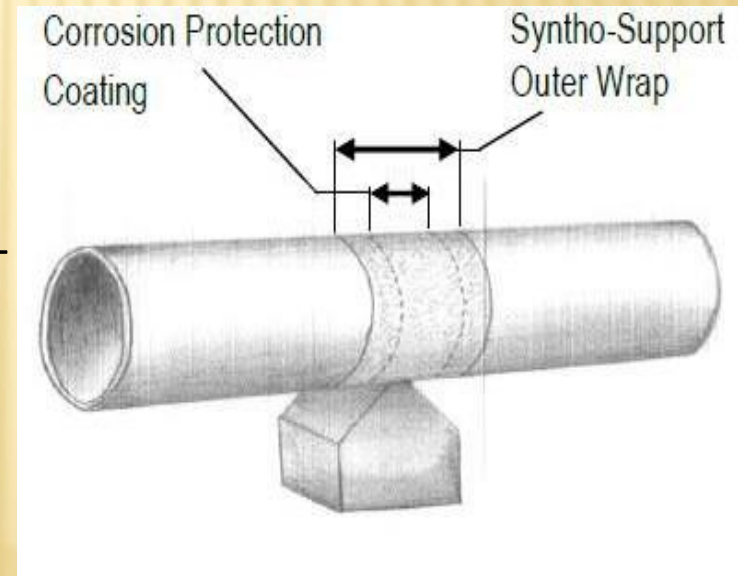
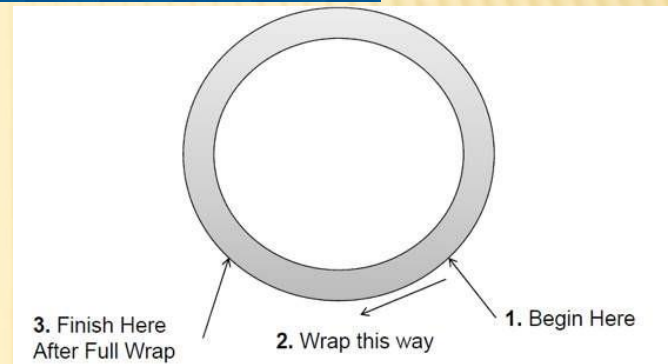
CHALLENGE EVERYTHING  
+1.561.683.6992 NEPTUNERESEARCH.COM



# SYNTHO-SUPPORT™

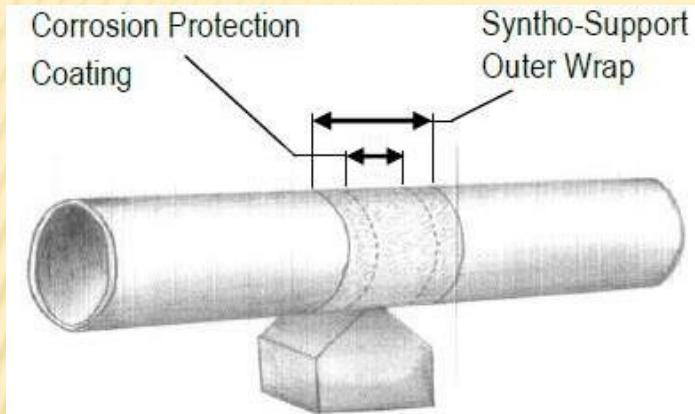
## SUPERIOR PROTECTION FOR PIPES AT SUPPORTS

**Syntho-Support** has been specifically designed to be a superior wrapping system for pipe support areas to prevent future corrosion and abrasion due to crevice corrosion, galvanic corrosion, heat affected zone corrosion, and vibration abrasion. This system, when used with a corrosion coating of your choice, provides exceptional mechanical and impact protection on steel (CS & SS), galvanized, concrete, FRP, iron, and PVC. Syntho-Support can be used underwater, underground or above ground. Syntho-Support is used for corrosion/abrasion prevention only



# SYNTHO-SUPPORT™

SUPERIOR PROTECTION FOR PIPES AT SUPPORTS





# COMPOSITES FOR CIVIL USE

- ❖ Design conforms to ACI 440
- ❖ Rehab existing columns, beams and slabs that have experienced spalling or corrosion in the plant
- ❖ Adds structural strength
- ❖ Can be used as a non-engineered, safety repair to stop falling debris



# STRUCTURAL STRENGTHENING

## Description

CompoSol® Structure is a composite repair system for reinforcing worn & holed structural members including, but not limited to beams, columns, hollow sections & piles. CompoSol Structure is applicable to both steel and concrete.

## Typical Applications

- ✗ Restore or upgrade the load capacity of the structural member.
- ✗ Tank Roof

## Benefits

- ✗ IMG Composites' engineers design the composite reinforcement using a combination of engineering first principles, design standards & the latest research papers.
- ✗ All designs are verified using Finite Element Analysis





# COMPOSOL® RANGE

- CompoSol – [Pipework](#)
- CompoSol - [Pipeline](#)
- CompoSol - [Vessel](#)
- CompoSol - [Encap](#)
- CompoSol – [Structure](#)
- Composol Subsea
- Composol X-Protect
- CompoSol – GF Liner
- Composol Caisson



### Annex D: ISO 24817 – Pressure Test Report

|                                                                                                                                           |                             |                                             |                                    |                |           |
|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------|------------------------------------|----------------|-----------|
| Location:                                                                                                                                 | ONGC ,Hazira Gas Plant      | Tested by:                                  | Chetan Sawant/Lizmont agents       | Date:          | 15 Jun 17 |
| Test Piece Description:                                                                                                                   |                             | ¾" x Sch 80 pipe spool of thickness 3.91 mm |                                    |                |           |
| Defect:                                                                                                                                   | hole                        | Defect Diameter:                            | 3 mm                               |                |           |
| Repair Description:                                                                                                                       | Thickness                   | Approx. 4mm                                 | Number of Layers                   | 6              |           |
|                                                                                                                                           | Fibre                       | Glass Reinforced Fabric                     | CompoSol® CRC:                     | Tropical Grade |           |
| Repair applied by:                                                                                                                        | Chetan Sawant               | Witnessed By:                               | M.K. Mishra – ONGC<br>Palkar- ONGC |                |           |
| Application Temp:                                                                                                                         | 32 deg C                    | Application Date:                           | 14 Jun 17                          |                |           |
| CompoSol® REP Batch No:                                                                                                                   | Part B 160365 /Part A160366 | CompoSol® CRC Batch No:                     | Part B160363 / Part A160364        |                |           |
| Repair procedure followed: Seal of hole with REP with build up and followed by 6 layers of Glass Fabric saturated with CRC Tropical Grade |                             |                                             |                                    |                |           |
| Shore D Hardness                                                                                                                          | 70                          | Prep Standard:                              | ST2 – Manual surface prep          |                |           |

| Testing Procedure             |                                                                          |                         |            |               |  |
|-------------------------------|--------------------------------------------------------------------------|-------------------------|------------|---------------|--|
| Ambient Temperature           |                                                                          | Min. 30 deg C           |            | Max. 32 deg C |  |
| Test Increments:              | 10 bar                                                                   | Burst / Final Pressure: | 100 bar    |               |  |
| Time between repair and test: | 16 hours                                                                 | Failure Mode:           | No failure |               |  |
| Test started at:              | 11.00 am                                                                 | Test completed at:      | 11.30 am   |               |  |
| Notes:                        | Passed the requirement of contract No. HZR/OPS/GT/ CompositeRepair /2017 |                         |            |               |  |

Witness signed

1) .....  
2) .....

*W. Mishra*  
*15/06/2017*  
*15/6/17*  
*R.H. Palkar*  
*S Ecm*

M. K. Mishra  
Deputy General Manager (P)  
ONGC Hazira, Surat-394518.



# EXPERIENCE LIST

| PROJECTS EXECUTED TILL DATE |                                           |                      |                  |                     |                 |                                                                                                                   |
|-----------------------------|-------------------------------------------|----------------------|------------------|---------------------|-----------------|-------------------------------------------------------------------------------------------------------------------|
| Sr.No.                      | Client                                    | Owner / Consultant   | Project Duration | Location            | Status          | Job Description                                                                                                   |
| 1                           | Balmer Lawrie & Co. Ltd.                  | BPCL                 | 2012             | Mahul, Mumbai       | Completed       | Application of Composite repair of corroded piping (various Pipes from 1/2" to 24").                              |
| 2                           | Balmer Lawrie & Co. Ltd.                  | IOCL                 | 2012             | Haldia, WB          | Completed       | Application of Composite repair of corroded piping (various Pipes from 1/2" to 36").                              |
| 3                           | Bharat Petroleum Corpn. Ltd.              | BPCL                 | 2013             | Mahul, Mumbai       | Completed       | Application of Composite repair of corroded piping (Pipe dia 24").                                                |
| 4                           | Balmer Lawrie & Co. Ltd.                  | IOCL                 | 2013             | Haldia, West Bengal | Completed       | Application of Composite repair of corroded piping (various Pipes from 1/2" to 36").                              |
| 5                           | Oil & Natural Gas Corporation Ltd.        | ONGC                 | 2014             | Uran, Navi Mumbai   | Completed       | S&A of Composite Repair on Flare Header / Oil lines (Various Pipe of 8" & 10")                                    |
| 6                           | Oil & Natural Gas Corporation Ltd.        | ONGC                 | 2015             | Uran, Navi Mumbai   | Completed       | S&A of Composite Repair on Flare Header / Oil lines (Various Pipe of 30", 36" & 48")                              |
| 7                           | Bin Son Refinery / IMG                    | BSR                  | 2015             | Danag, Vietnam      | Completed       | S&A of Composite Repair on Pipe lines (Pipe dia 10" LPG / PP Lines)                                               |
| 8                           | Shekharian Part Ltd.                      | SPL                  | 2015             | Tehran, Iran        | Completed       | S&A of Composite Repair on Flare Header / Oil lines (Various Pipe of 40" & 48")                                   |
| 9                           | Mumbai Port Trust                         | MbPT                 | 2015             | Mumbai, Maharashtra | Completed       | S&A of Composite Repair on Flare Header / Oil lines (Various Pipe of 8" & 36")                                    |
| 10                          | Oil & Natural Gas Corporation Ltd.        | ONGC                 | 2016             | Uran, Navi Mumbai   | Completed       | Strengthening & Life enhancement of Crude Oil pipelines of the plant through Composite application in accord area |
| 12                          | Oil & Natural Gas Corporation Ltd.        | ONGC                 | 2017             | Hazira, Surat       | Completed       | Strengthening of small bore point in pipeline at gas terminal                                                     |
| 13                          | Mangalore Refinery & Petrochemicals Ltd.  | MRPL                 | 2017             | MRPL                | Completed       | On-line pipe rehabilitation & pipe leak arresting for 54" Flare Line                                              |
| 14                          | Gujarat Gas Ltd.                          | GGL                  | 2017             | GGL                 | Completed       | Composite repair of 18" pipeline                                                                                  |
| 15                          | Rashtriya Chemicals & Fertilizers Limited | RCF                  | 2017             | Trombay, Mumbai     | Completed       | Composite Repairs of 8" & 3" inch pipeline                                                                        |
| 16                          | Oil & Natural Gas Corporation Ltd.        | ONGC                 | 2017             | Uran, Navi Mumbai   | Under Execution | Composite Repairs for cooling water supply & return lines                                                         |
| 17                          | Vedanta Ltd. (CAIRN)                      | Vedanta Ltd. (CAIRN) | 2017             | Rajasthan           | Under Execution | Composite Repairs for DSS Feed Water & Crude Pipeline                                                             |
| 18                          | Indian Oil Corporation Ltd.               | IOCL                 | 2017             | Vadodara, Gujarat   | Under Execution | Composite Repair for 10" H2 gas Pipeline at VGO-HDT Unit                                                          |
| 19                          | Deepak Fertilizer                         | DFPCL                | 2018             | Taloja, Mumbai      | Under Execution | Composite Repair for strengthening of 28" water pipeline                                                          |
| 20                          | Mahanagar Gas Ltd.                        | MGL                  | 2018             | Mumbai              | Under Execution | AMC for Repair of Corroded Steel Pipeline Surface with Composite Repair Sleeve                                    |
| 21                          | Municipal Corporation of Greater Mumbai   | MCGM                 | 2018             | Sakinaka            | Under Execution | Strengthening of Sewage pipeline                                                                                  |
| 22                          | Oil & Natural Gas Corporation Ltd.        | ONGC                 | 2018             | Uran, Navi Mumbai   | To be started   | Repair & strengthening of Roof of Slop Tank & IM Tank through Composite Application                               |
| 23                          | Vedanta Ltd. (CAIRN)                      | Vedanta Ltd. (CAIRN) | 2018             | Rajasthan           | To be started   | Provision of Composite Repair in Inplant and Intrafield Pipelines at Rajasthan                                    |



LIZMONTAGENS INDIA

# THANK YOU







**Scar-Guard**  
Protect Your Mainline Pipecoating, Avoid Re-Pull

A large yellow pipe is being installed at a construction site. Several workers in white protective suits and hard hats are visible. The background shows a large pile of dirt and some construction equipment.

# Index

- Who is Shawcor?
- HDD & Common Coatings
- Coating Damages
- Scar Guard System
- Advantages Vs Other Systems Vs Re-Pull
- Summary & Conclusion







# Who is Shawcor?



# Shawcor is a global integrated supplier of pipeline solutions to the oil and gas industry

## World-wide organisation and capability

### Pipeline Performance



- Bredero Shaw
- Socotherm
- Canusa-CPS
- Dhatec

### Composite Production Systems



- Flexpipe Systems

### Integrity Management



- SPS
- Desert NDT
- Zedi
- Vintri
- Lake Superior

### Oilfield Asset Management



- Guardian
- CSI

### Connectivity



- ShawFlex
- DSG-Canusa
- PFT Systems & Connectors

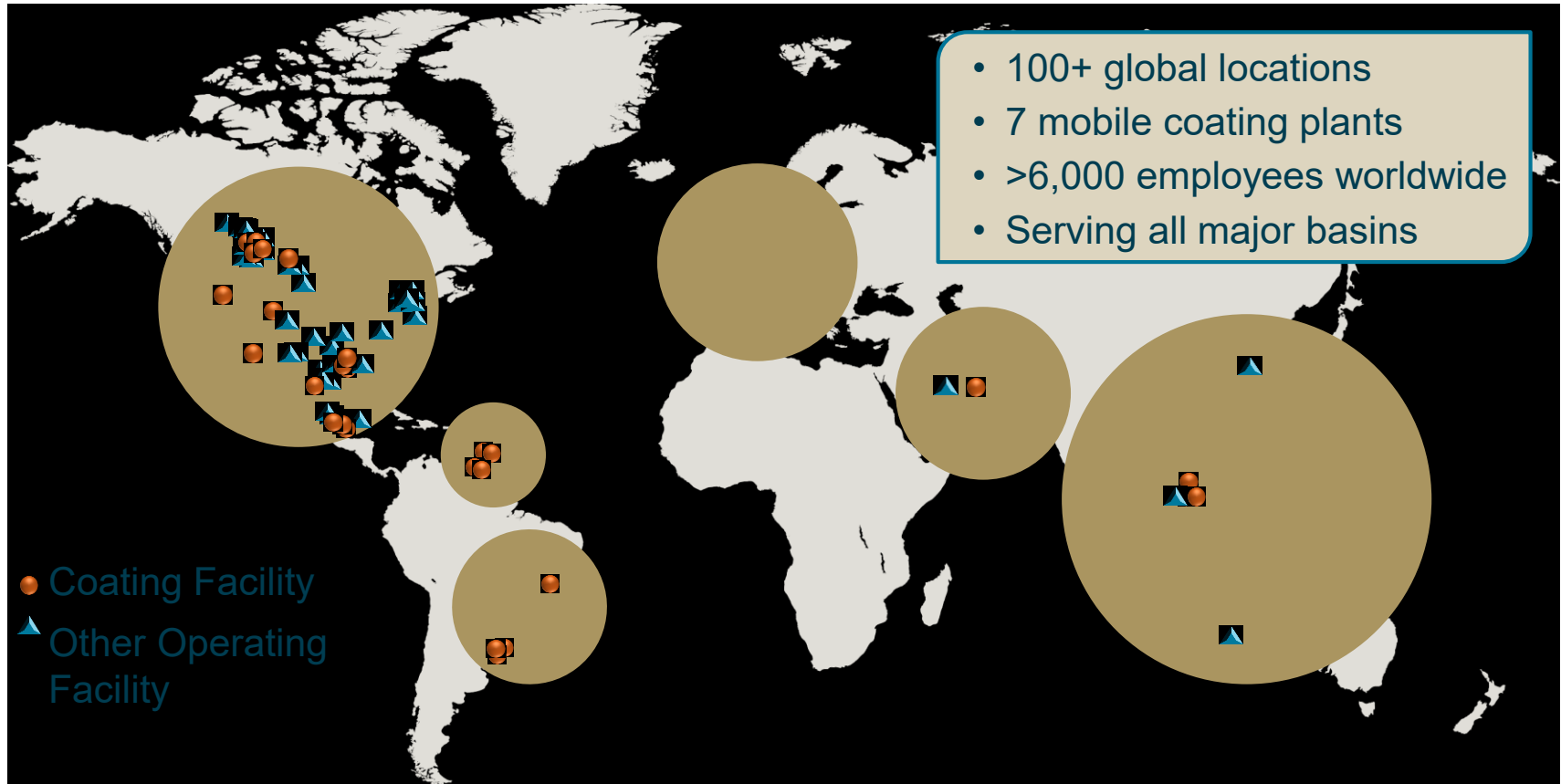
Technology

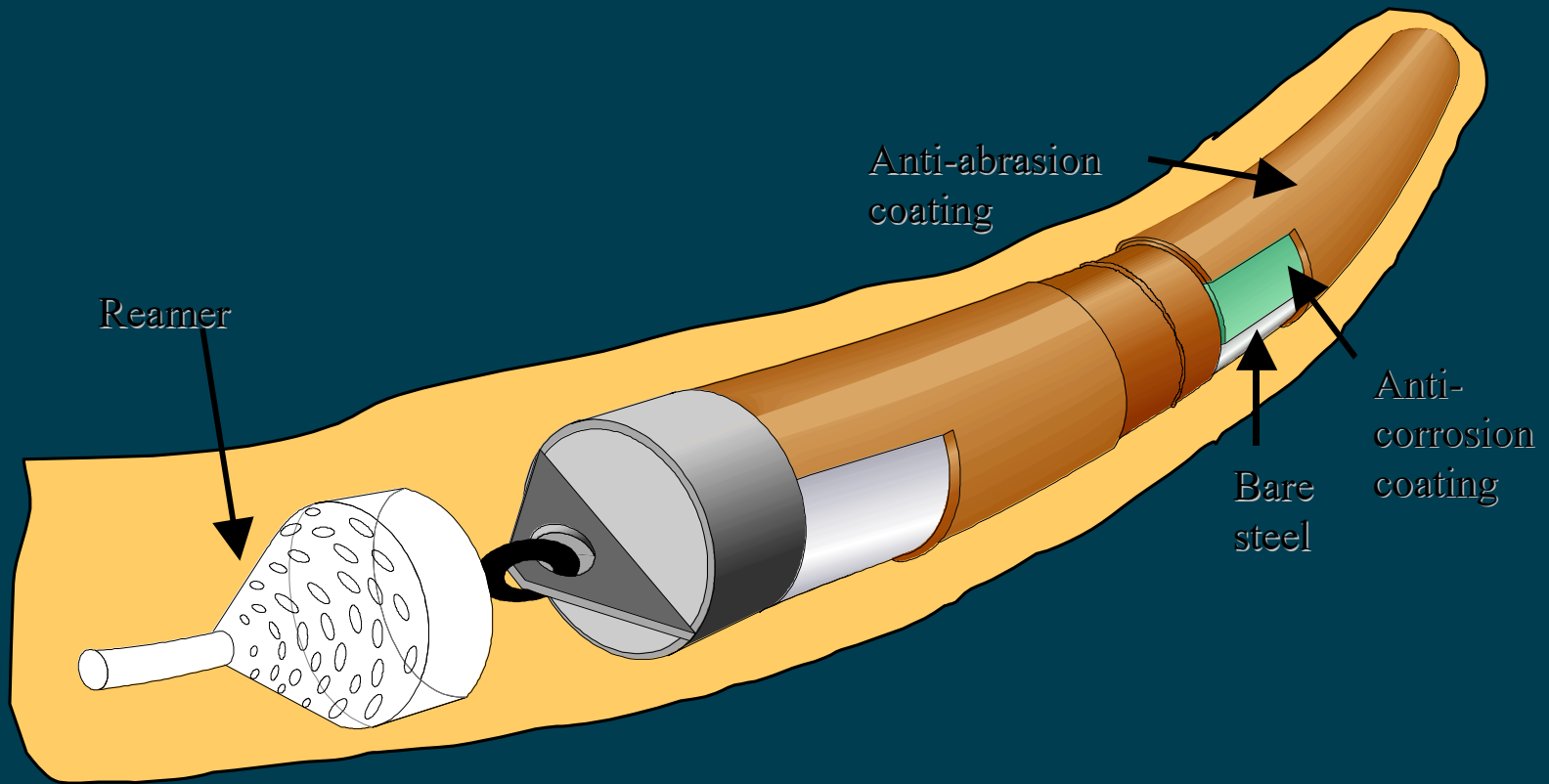
Execution

Integrity



# Unmatched scale, diversity and global reach





## HDD – Horizontal Directional Drilling



## NO EXCAVATION PROCESS

- Trenchless technology for laying pipelines
- Inaccessible area for trenching
  - Structure, geographical, population impact
- Used at river crossings, under roadways, railroad tracks, etc.
- Most of the areas are what is known as HCAs (high consequence areas)

# DIRECTIONAL DRILL





# COMMON COATINGS

## Main line Coatings:

- FBE
- 3LPE & 3LPP

## Field Joint Coatings:

- Field Applied FBE
- 2 part liquid Epoxy Systems
- Hot or Cold Applied Tapes
- Heat Shrink Sleeves

Lack of codes for ARO systems

**CURRENT PRACTICE IN HDD: 3LPE COATED MAINLINE PIPE & HEAT SHRINK SLEEVE WITH FIBER REINFORCED IN PE BACKING**

# COATING DAMAGES

## Main Factors

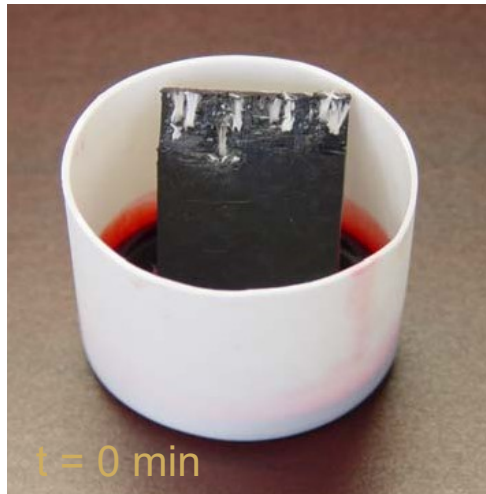
- ◆ Installation
- ◆ Abrasion
- ◆ Impact & Gouge
- ◆ Bending load
- ◆ Jobsite hazards





# Suitability of purpose?

## FIBREGLASS ABSORBS WATER



Guaranteed water absorption = Guaranteed decrease in tensile strength\*\*\*

\*\*\*Kouadio, Kouassi Serge P. "Durability of fiberglass composite sheet piles in water", McGill University, Copyright 2001

# SCAR-GUARD SYSTEM

## Proven Abrasion Resistance Overlay System

- A hard top sacrificial composite wrapping system for protection of the main corrosion coating of the pipeline section undergoing a trenchless construction.
- Scar-guard is available in 2 different forms:

- **Scar-Guard E:** A high performance Epoxy site impregnated bidirectional fiberglass wraps

| Impact Resistance | Abrasion Resistance | Gouge Resistance |
|-------------------|---------------------|------------------|
| 21.7J (192 in-lb) | 3,333               | Pass             |

- **Scar-Guard MCU:** PU Pre-impregnated Bidirectional fiberglass wraps.

| Impact Resistance  | Abrasion Resistance | Gouge Resistance |
|--------------------|---------------------|------------------|
| 47.6 J (421 in-lb) | 1,667               | Pass             |





# ADVANTAGES -

- On site application with domestic tools
- Fast installation, curing, and turn into service
- Protect the mainline coating from abrasion
- Sacrificial behavior in case of any possible damage while anticorrosion coating is intact.
- 2 grades for harsh and harsher terrain.
- Big saving against re-pull and casing requirement.
- Big project references

# Case History – 24” Diameter pipe in HDD

## ARO IN KSA

Saudi Aramco needed to protect hundreds of feet of new 24” pipeline during the HDD pull back which would pass through aggressively rocky terrain that could possibly damage the pipe’s coated surface and cause premature coating failure.

The owners turned to Scar-Guard to protect the pipeline, not only during the pull and the installation process wasn’t the only harsh condition on the job work was mainly performed at night when temperatures typically only reached 110°F (43°C). Mobile tents were also erected to protect the freshly coated and wrapped pipes from the dust and sand blown by the heavy desert winds.

- pipe’s surface was prepped with a sweep blast.
- The joint welds were grit blasted to to SA2.5 and coated with Syntho-Poxy HC, a two-component, anti-corrosion epoxy filler.
- Then the primer-coat of Scar-Guard Epoxy
- Scar-Guard composite system in a clockwise manner and quickly covered with compression film.
- After curing, the film was removed and thickness and hardness tests performed.

Approximately 12 hours after the composite system application, the pipe was ready for pull back. The new pipeline was successfully installed without scarring and is now protected, thanks to Scar-Guard.





# CASE HISTORY: OMAN

## PROJECT: EPC WORKS FOR MODIFICATION OF SOHAR & NEW IBRI GSS

| Product                     | Description                                                        |
|-----------------------------|--------------------------------------------------------------------|
|                             | ‘Canusa-CPS’ Scar Guard E                                          |
|                             | 31 Style 24oz 10’’ x 300’ composite Fiberglass Cloth               |
|                             | Thermo-Poxy                                                        |
|                             | Comp Film Blue 12’’ x 700’                                         |
|                             | Resinator 2-12’’ combo welded aluminum design                      |
|                             | Resinator mixing tray <12’’ for use with welded aluminum resinator |
| Pipe Size                   | 28’’ Diameter & 12’’ Diameter                                      |
| Pipe Length                 | 28’’ = 48, 24 & 24 meters & 12’’ =32 meters                        |
| Type of Coating             | 3 Layer Polyethylene                                               |
| Type of Field Joint Coating | Heat Shrink Sleeves                                                |

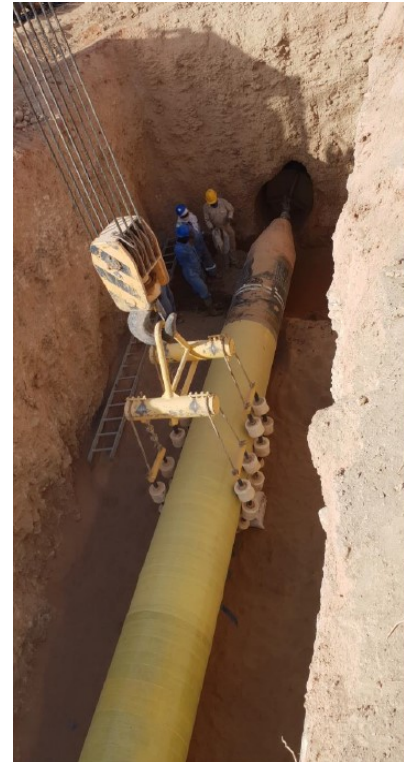




# CASE HISTORY: OMAN

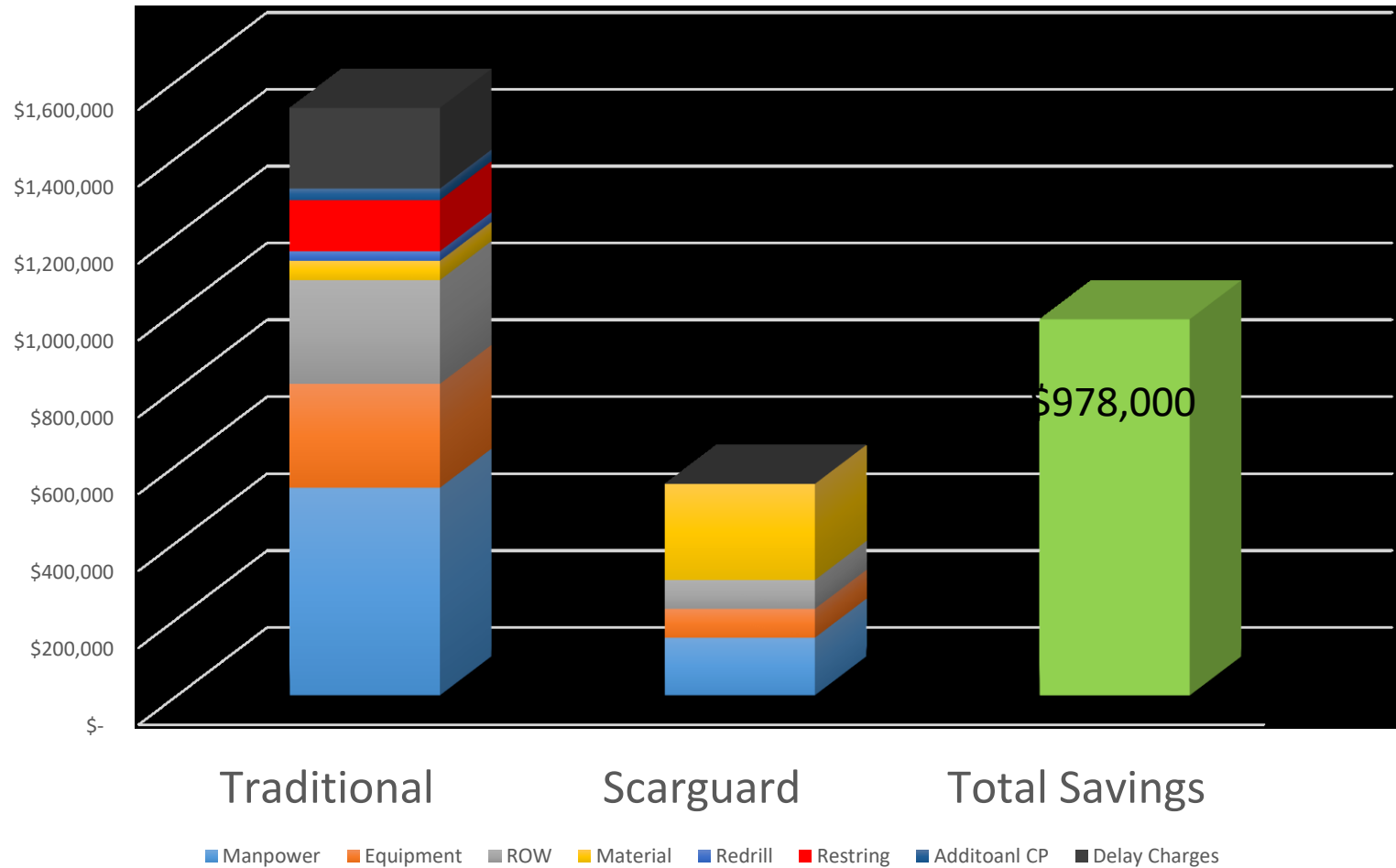
## PROJECT: LIPIC-EPC4 NGL PIPELINE AND OGC/ORPIC 32” GAS LOOPLINE

| Product                     | Description                                                       |
|-----------------------------|-------------------------------------------------------------------|
|                             | ‘Canusa-CPS’ ScaSubjectr Guard E                                  |
|                             | 31 Style 24oz 10” x 300’ composite Fiberglass Cloth               |
|                             | Thermo-Poxy                                                       |
|                             | Comp Film Blue 12” x 700’                                         |
|                             | Resinator 2-12” combo welded aluminum design                      |
|                             | Resinator mixing tray <12” for use with welded aluminum resinator |
| Pipe Size                   | 32” Diameter                                                      |
| Pipe Length                 | 1800 Sqmtr                                                        |
| Type of Coating             | 3 Layer Polyethylene                                              |
|                             |                                                                   |
| Type of Field Joint Coating | Heat Shrink Sleeves                                               |





# Cost of a 1160 meters Re-Pull 20" OD Pipe



# SUMMARY

- HDD installations are numerous and vary greatly in type, size, and conditions
- Ordinary pipeline coatings do not hold up well to HDD installations, must use special system
- Selection of coating dependent upon specific HDD project
- Coating failures are **expected** so CP systems must be adequate to protect pipe
- Accurate assessment of coating condition after installation is difficult
- HDD installations are now commonplace and are part of every major pipeline



# CONCLUSION

- ◆ When aggressive soil conditions are expected – wrap your pipe.
- ◆ It's like insurance; increased layers equals increased protection

SCAR◆GUARD™

**MANY THANKS FOR YOUR TIME.**

**ANY FURTHER QUESTIONS?**