TCR ENGINEERING

Asset Integrity Experts

Materials Testing Lab and NDT Inspection with NABL, ISO 17025 and BIS approval

TCR – Your Asset Integrity Solution Expert

- QA Partner **from Procurement, Construction, Shutdown and Plant Run**
- **Asset Integrity Optimization** focused on reducing turn around time, increasing productivity and maximizing business returns
- Beyond NDT and Destructive Testing - Beyond Principles of RBI
  - Strong understanding of **corrosion damages, high temp and high-pressure** effects
  - Effective usage of damage specific NDT with a strong emphasis on innovative techniques including **Robotics** and Extreme Value Analysis
  - Ability to undertake **simulated research** using custom designed autoclaves
  - Strong usage of IT for stress analysis and **piping support analysis**

THE MAGIC

TCR is serving global industry leaders for over five decades

TCR ENGINEERING

50+ Years
of experience working with Global Leaders across Industries

800+
TCR Global experts and consultants currently working across 3 continents

84+
Cross Country Pipeline RT and Film Digitalization Projects

1,00,000+
Database of Microstructures specialized by Industry vertical-based solution

9,000+
Failure Analysis cases

1000+
Refinery cases

Accreditation
NABL, ISO 17025, BIS, IBR, PDO, Aramco, Qchem, RITES

For more information, visit us
www.tcreng.com

TCR ENGINEERING

TCR LEADERSHIP TEAM

V.K. Bafna

Chairman Emeritus
TCR Group of Companies

Rohit Bafna

President
TCR Global

Neelam Bafna

Managing Director
TCR Engineering

Paresh Haribhakti

Global Technical Advisor
TCR Engineering

Viren Khandwala

Director, Finance
TCR Engineering

FOCUSSED & RESPONSIVE TEAM

Lalit Surve
General Manager

Avinash Tambewagh
Head, Technical

Parul Hariya
Head, Civil

Ashwant Singh
Asst. General Manager

Manoj Singh
Head, Conv.

Seema Rajpure
Quality Control Head

Sagar Salvi
Head, Finance

Rehan Baig
Asst. Technical Head

Shemi Bhaskaran
NDT Head

Samir Choudhary
General Manager
Odisha

Atul Yadav
Head, HR

Abhijeet Darekar
Head, Customer Service

Former Plant/ Industry Veterans

Engineering Designer | Simulated Researchers

Risk Based Inspection / IOW Moderators

API 570,579,653 Inspectors

Third Party Inspectors

Fitness for Service and RLA Experts

Structural Audit | Corrosion Specialist

NDT Level III Experts

Destructive Lab Tech | Civil Lab and Field Services

Metallurgists

TCR ENGINEERING

TER ENGINEERING

SERVICES

Material Testing Lab

- Mechanical Testing
- Elevated Temp. Tensile
- NACE Corrosion Study for HIC and SSCC
- CTOD & Fracture Toughness
- Coupler & Rebar Fatigue Test
- Railtrack butt joint Fatigue
- Gully and ManHole Fatigue
- Metallurgy Evaluation
- Creep & Stress Rupture
- Welder Certification & Qualification
- Composite Testing
- Construction/Civil Testing Lab
- Chemical Analysis
- Wet Chemical
- RoHS Compliance

NDT & Inspection

- Advanced NDT
- ToFD and PaUT
- Helium Leak Detection
- High Temperature Inspection
- Intelligent Pigging Solutions
- Boiler Inspection
- Reformer Tube Inspection
- ARTiS
- Tube Inspection - Eddy Current, IRIS, RFET, MFL
- Pipeline Weld Inspection
- Cross Country Pipeline RT
- Digitalization of RT Films
- Cathodic Protection
- Robotic Storage Tank Inspection
- PWHT Heat Treatment
- Conventional NDT Services
- Metallographic Replica
- PMI-Positive Material Id
- Gamma Radiography
- Civil NDT for Concrete
- Inspection of Road & Bridges
- Third Party Inspection
- Turnaround Manpower

Asset Integrity Consulting

- AiOM - Asset Integrity Management
- Failure and Root Cause Analysis
- Pipeline Integrity
- Engineering Critical Analysis
- Stress Analysis by XRD
- Fitness for Service
- Remaining Life Assessment Study
- Boiler Audit
- Civil Structural Audit
- CAD/CAM & Stress Analysis
- Research and Development
- Plant Relocation Advisory
- Insurance & Litigation Referee
- Plant Reliability Training

TCR ENGINEERING

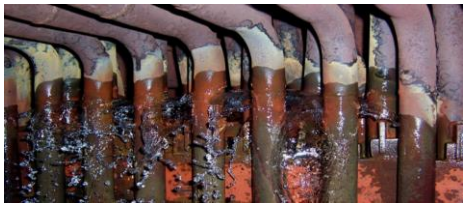
FORENSIC METALLURGICAL SOLUTIONS ON-CALL

FAILURE INVESTIGATION & RCA

Damage Mechanisms

Unravel the mysteries surrounding parts and assembly failures with Fast Turnaround time with in-depth analysis reporting.

Strong Recommendations within each report to avoid future failures.



- Corrosion due to CO2, Sour corrosion due to H2S
- Corrosion under insulation
- Stress Corrosion Cracking (Cl, NH3, caustic, CO/CO2, amine, methanol)
- Microbial Induced Corrosion on cold insulation areas
- Bimetallic joint – galvanic corrosion, Crevice corrosion

- Brittle failure due to impacting
- Environmental impurities causing pitting on turbine blades
- Erosion & Erosion Corrosion
- High Temperature Creep
- Fatigue (thermal, mechanical, pressure, vibration)
- Dusting, H2 damage/cracking

For more information, visit us www.tcreng.com

FITNESS FOR SERVICE AS PER API 579/ASME FFS-1

TCR's in-depth FFS report helps clients take decisions working with plant item in spite of presence a crack, metal loss at localized area, creep damage or mechanical damage like distortion or dents

Brittle Failure / Low Temperature

Decommissioned equipment that may be used in different services

Equipment operating in creep range and cyclic services

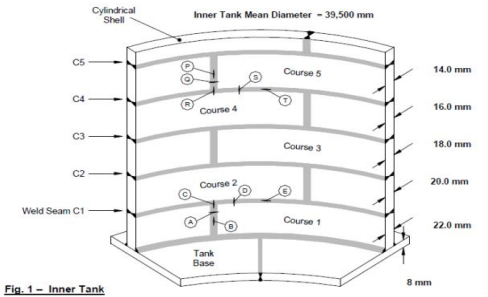


Fig. 1 – Inner Tank

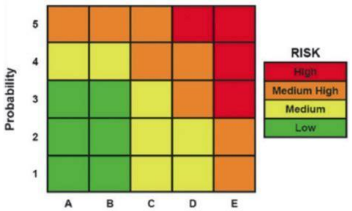
Leak before break assessment of Ammonia Storage Tank

Isomerization reactor certified by TCR with detailed FFS Study post-Fire damage

For more information, visit us www.tcreng.com

Risk Based Inspection and IOW
Effective Implementation Partner

TCR's RBI specialists have got expertise of implementation of 4000+ static assets in APM Meridium. Guidance of highly experienced metallurgists, Corrosion, NDT and mechanical integrity experts with 30+ years Oil & Gas experience. Software integration team and API certified personnel.



Step 1: Evaluate corrosion loops of the process unit. Identify all potential damage or corrosion mechanisms. Assess corrosion rates. Define the IOW limits for each damage mechanism.

Step 2: Identify the RBI components and evaluate the risk using API 580 methodology or using APM tool. Analyze recommendations and issue final inspection scope.

Step 3: Evaluation of alarms, indications, and procedures necessary to recognize exceedance of the IOW limit.

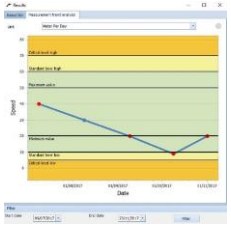
Step 4: Define the criticality of the operating limit and define the priority of the IOW limit (critical, standard or informational).

Step 5: Documentation of each IOW. Development of responses to IOW alarms and notifications.

Step 6: Training all personnel involved in the process operation in IOW implementation and timely responses to IOW indicators and alarms.

Step 7: Integrating the IOW program into the rest of the plant operations, maintenance and reliability programs, and plant data-management software.

Step 8: Revalidation of the IOWs - reviewing each IOW for effectiveness and avoidance of spurious alarms and notifications.



TCR ENGINEERING

Remaining Life Assessment of Boiler, Turbine, Heat Exchanger:

Ensuring components are used to the fullest extent for operation beyond desired useful life

Metallurgy + Engineering + NDT + Lab Destructive

Replica, EMAT, ACRT, Creep, PAUT, ABUT, RFET, Videoscopy, Oxide Scale, SEM Analysis, Mechanical, Chemical

For more information, visit us **www.tcreng.com**

Components	Dimension Checks	Thickness Measurement	Microscopic Examination Replica	Hardnes Testing	PT/MT	Ultrasonic Testing	Radiographic Testing
- economiser headers	X				X	X	
- waterwalls	X	X				X	
- boilers drums	X			X	X		
- lower waterwalls and headers						X	
- junction headers	X				X	X	
- waterwall risers		X			X	X	
- waterwall headers					X		
- superheater headers (welds)	X	X	X		X	X	
- reheater headers (welds)	X	X	X		X	X	
- desuperheaters :							
liners						X	
nozzles	X				X		
- HT superheater tubing	X	X	X	X	X	X	
- steam piping	X	X	X	X	X	X	X
- feedwater piping		X					X

Conductive

$$R_{Total} = R_1 + R_2 \qquad R_{Total} = \frac{\ln(r3/r2)}{2\prod lk1} + \frac{\ln(r2/r1)}{2\prod lk2}$$

Temperature

$$\frac{T1 - T3}{R1 - R2} = \frac{T2 - T3}{R2}$$

Thermal **Thermal** **Lateral Strain**

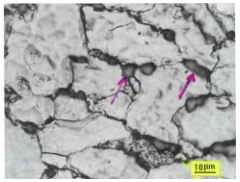
$$\sigma_t = E\alpha\Delta t \qquad \varepsilon_t = \sigma_t / E \qquad \varepsilon_x = -\nu\varepsilon_t$$

Thermal Axil

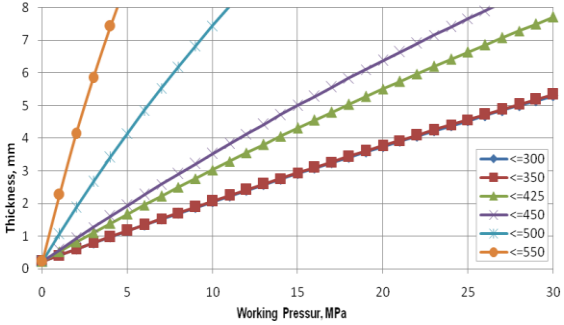
$$\sigma_x = E/(1-\nu^2) * (\varepsilon_x + \nu\varepsilon_t)$$

Von Mises Theory

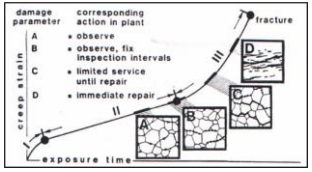
$$(\sigma_1 - \sigma_2)^2 + (\sigma_2)^2 + (\sigma_1)^2 = 2\sigma_y^2$$

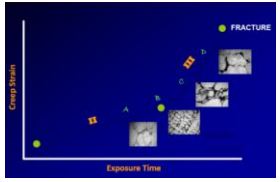


SEM of oriented creep cavitation damage of T11 super tubes – exposed to long term over heating.



Minimum required thickness at different working conditions for materials SA178-C





Larson-Miller Parameter

Creep-Stress rupture data plotted as log stress versus combination of log time and rupture

ISO 17025 Accredited LAB

Engineering Critical Assessment (ECA)

ENSURING STRUCTURAL INTEGRITY

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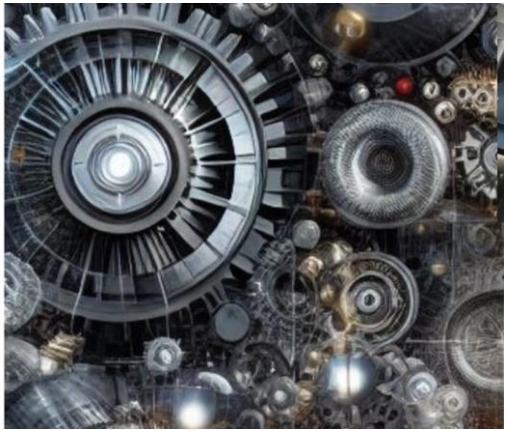

Engineering Critical Assessment (ECA) is a fracture mechanics-based methodology used to evaluate the safety and fitness-for-purpose of structures containing flaws (cracks, notches, voids).It determines whether flaws can be monitored or if repair/replacement is required.

- Proven expertise in ECA through extensive FFS work (API 579 / ASME FFS-1)
- Skilled in API 1104 Annex A requirements
- Advanced flaw characterization and weld assessments
- Conducts CTOD & material property testing
- Performs detailed engineering calculations and flaw severity analysis

Key Considerations in ECA

- Fracture Mechanics: Predicts crack growth & failure pressure
- Material Properties: Strength, toughness, corrosion resistance
- Operating History: Past loading and service environment
- In-Service Degradation: Fatigue, corrosion, wear effects
- Threat Interaction: Combined effects of multiple flaws

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PIPELINE ASSET INTEGRITY EXPERTS

Pipeline Infrastructure

Pipeline Inspection for Anomalies

- Automated Radiographic Testing of circumferential butt welds from Internal Pipelines using Crawlers
- External X-Ray or Gamma ray radiation for detection of both surface and subsurface defects in welds
- UT shear-wave anomaly evaluation, Phased Array (PaUT) and ToFD for seam-weld scanning
- Automated Ultrasonic Testing and LRUT/Guided Wave including A/B/C-Scans as per API 1104
- Weld assessment of difficult-to-access, small diameter pipes of 1.5" up to 3.5" using palm scanner

Digitalization of RT Films as per IOCL and GAIL Spec

Material Verification Programme

- Destructive Testing Lab for PQR/Welder qualification and MOC confirmation
- Corrosion Damage Evaluation and Metallographic Replica on Weld Joints
- Positive Material Identification for Sorting

O & M Service Providers

Pipeline Asset Integrity Management with AIOM Software

Pipeline Assessment and Asset Enhancement

- Failure Analysis, Fitness for Service, Remaining Life Assessment
- Internal Corrosion and External Corrosion Direct Assessment - NACE SP 0206/NACE SP 0502
- Pipeline remaining strength and lifetime according to ASME B31G, API 579, ASME FFS
- Visual Inspection of underground pipelines using Robotic Crawlers
- Corrosion Loop Identification for RBI Study per API 580/581

Tests on Insulated Pipelines to corrosion under insulation (CUI) using PEC

In-Line Inspection using Smart Pigs for Leak detection - API 1163, API 1130, API 1175

TCR ENGINEERING

UNLOCKING VALUE OF INDIA'S NATIONAL MONETISATION PIPELINE

Design & Engineering Phase

- Material selection for main line pipe and pipe fittings
- Design & lay out of station, mainline & crossings
- Selection of proper coating system
- Designing an effective Cathodic protection (CP) system
- Ensuring appropriate safety factors during design
- Environmental Impact assessment

Construction Phase

- Proper inspection
- Adherence to approved specification and procedures
- Monitoring workmanship
- Hydrostatic test
- Records for future reference

Operation & maintenance Phase

- Line Patrolling/ROW Inspection
- Inspection of Mainline Facilities
- Online Monitoring of Pipeline Parameters through Software tools
- Leak detection systems (LDS) to detect any abnormal change in pressure and flow parameters and to locate the location of incidence

TCR's comprehensive Pipeline Asset Integrity Program

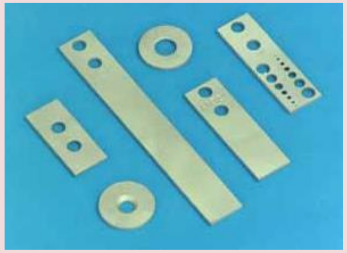
Pilferage	Corrosion (Internal/ External)	Mechanical Damage
Sabotage	Cracking	Manufacturing defects
Construction defects	Incorrect operations	Loss ground support/natural calamities

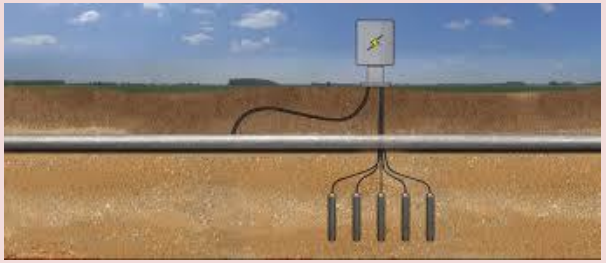
Threats to Pipeline Integrity

PIPELINE ASSET INTEGRITY SOLUTIONS BY TCR

Pipeline Monitoring

- **Internal Corrosion Rate Monitoring**
  - Advise and Installation of corrosion coupons and ER probes, electrochemical noise technique (ECN probes) or Linear polarization technique (LPR probes) & UT sensors

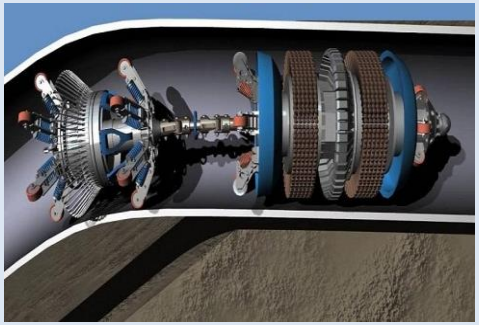




- **Cathodic Protection (CP) monitoring**
  - Monitor effectiveness of installed Permanent CP units at feeding points

Pipeline Survey

- **Intelligent Pigging In-Line**
  - Detecting corrosion, stress corrosion cracking, illegal fittings intending for pilferage and deformation anomalies including dents, gouges, grooves, Mill-Related Anomalies & weld cracks

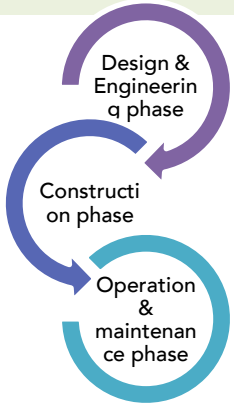


- **Coating Survey**

1. CIPL ["On" & "Off"]
2. Pearson Survey
3. CAT Survey
4. DCVG Survey
5. Coating conductance survey.
6. Casing & Carrier short surveys.

Pipeline Integrity

- **Quantitative Risk Assessment**
  - During Design Stage
- **Condition Assesment**
- **Pipeline Fitness for Service**
- **Pipeline Failure Analysis**
- **Pipeline Remaining Life**
- **Pipeline Weld Integrity**



LAB SIMULATION CORROSION STUDY AND SOFTWARE RATE OF Cor

Replicate Site Conditions Causing Pipeline Corrosion in Lab

Ability to understand influence of an individual variable on the overall corrosion. First determine the parameters influencing corrosion in the field, and then select an appropriate laboratory methodology for simulating these parameters.

ASTM G111, 'Corrosion Tests in a High Temperature or High Pressure Environment, or Both."; **ASTM G170**, "Evaluating and Qualifying Oilfield and Refinery Corrosion Inhibitors in the Laboratory"; **ASTM G102**, "Calculation of Corrosion Rates from Electrochemical Measurements"

1 **Collect Information about the Pipeline from Client:** Pipe line description, diameter, WT, grade, specification, coating etc. Operating Conditions such as Pipe line operating pressure and range, cleaning, repairs, CP, past inspection history. Fluid/Water data such as Water %, crude oil , crude oil properties, GOR and other information

2 **Investigate Failed Pipe:** Marking of historical liquid levels in pipe; Clock position verses wall thickness loss; Presence of nodules, scales, biological materials like slime, Presence of Isolated pitting; General metal loss with some deeper pits; Pitting morphology study relate to presence of certain chemical species or bacteria; Pit length verses pit width; Pit depth/diameter ratio; Metallurgical studies of pipe specimen

SOP to control minimize intrinsic (nature of corrosion and apparatus) and eliminate extrinsic causes (operator error and improper apparatus).

3 **Simulation Study:** Weight loss corrosion rate simulation in Autoclave replicating field conditions of temperature, partial pressure, Corrosive Agents and taking samples of separated water, condensate and gas composition
Electro-chemical Tests for Partial Pressure. **CO_2 Agent**: Autoclave of SS material. Maintain the partial pressure using CO_2, Nitrogen and Methane cylinders. **H_2S Agent**: Autoclave of Nickel based Alloy (C-276) with stringent safety norms

TCR will conduct at least two identical tests and determine the variation between them. If corrosion rates differ by more than 10%, two more identical tests. Mean and Standard Deviation of all four corrosion rates calculated.

4 **Software Simulation:** Cor.rate software analysis for most probable corrosion mechanisms and extent of severity to predict the current corrosion rate and life of the line
Additional Tests: Flow Behavior Analysis, Water condensation lab study for sulphate reducing bacteria, Acid producing bacteria culture studies using fluids of pipeline, scale tendency and flow regimes/phases (oil-water separation, turbulence etc.) simulation, multiple corrosion inhibitor dosage/type evaluation, topographical analysis

Ensuring Building Safety & Longevity

Comprehensive Structural Audit Services

Ensuring Building Safety, Compliance & Longevity

TCR ENGINEERING

A comprehensive health check of buildings — identifying risks, ensuring safety, and extending structural life through expert audits, NDT testing, and rehabilitation consultancy.

Purpose of Structural Audit:

- Prevent structural failures and safeguard lives
- Extend service life through corrective action
- Fulfill statutory compliance (Bye-Laws Clause 77)
- Support insurance, mortgage, and valuation needs

Building/House Audit Frequency (as per Bye-Laws)

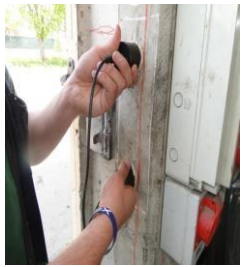
1) 15–30 years old: Every 5 years 2) Over 30 years: Every 3 years

Our Services Include:

- **Visual Inspection**: Cracks, leakages, settlement, structural framing
- **Non-Destructive Testing (NDT)**: Assess strength and quality of concrete
- **Repair & Rehabilitation**: Root cause diagnosis, cost estimates, stability certification

On-Site Field Services

Structural Audit of Buildings, Dams, Bridges, RCC structures and Warehouses



Pulse Velocity Measurement

Concrete cored and sampled specimens

Pachometer test

Services Includes:

- Visual inspection of concrete structure (Structural assessment)
- Petrographic Examination
- Crack Mapping/Crack measurement
- Cutting of Concrete Core
- Rebound Hammer Test for Hardened Concrete - IS: 13311 (Part 2)
- Ultrasonic pulse velocity - IS:13311 (Part 1)
- Concrete cover to reinforcement (Pachometer test)
- Half-cell potentiometer as per ASTM C876 – 2015
- Carbonization depth test

Column Testing

Rebound Hammer Test

Rebound Hammer Apparatus

UPV Testing

UPV Testing on column

UPV Testing

Reinforcement Testing

Half Cell Potentio Test

Field Sampling

Reverse Engineering and Design Consultancy

Engineering Design and Analysis Services

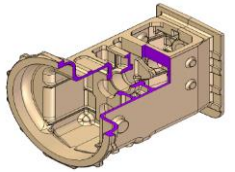
Leading Software - CATIA, Pro/ENGINEER, UniGraphics, I-DEAS, Inventor, SolidWorks, DELCAM, Ansys, CAESAR, HyperMesh, NX Nastran, Moldflow

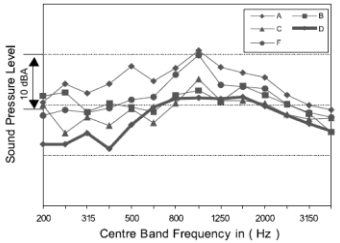
Computer Aided Designing (CAD/CAM) for 2D to 3D Conversions, Solid Modeling, Surfacing as well as Legacy Data Conversion

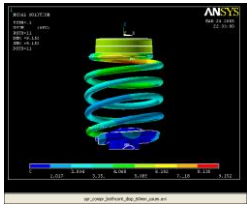
Computer Aided Engineering (CAE) including Finite Element Analysis (FEA) using Ansys

Structural Analysis including Pipe Support Analysis

Noise, Vibration, Harshness (NVH) analysis







TCR ENGINEERING

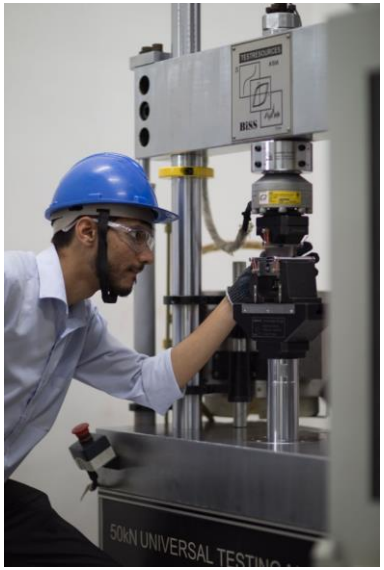
DURABILITY ANALYSES

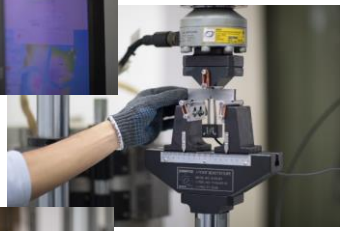
FATIGUE & FRACTURE TOUGHNESS

CTOD, K1C, J1C, S-N Curve

ASTM E606 (Low-cycle fatigue, strain-controlled Fatigue Testing) and ASTM E466 (Load-controlled Fatigue Testing – High or Low-cycle fatigue testing) widely tested. Fatigue Tests for TMT RE-BAR & COUPLERS as per IS 16172.

Crack-Tip Opening Displacement (CTOD) - ASTM E1290, BS 7448
Strain Fracture Toughness (KIC) - ASTM E399
Fracture Toughness - ASTM E1820
Fracture Mechanics - K1c, J1c, CTOD
Force Controlled Constant Amplitude Axial Fatigue - ASTM E466
Elevated Temperature Tension - ASTM E21
Strain-Controlled Fatigue Testing - ASTM E606
Measurement of Fatigue Crack Growth Rates - ASTM E647
Room Temperature Compression Testing - ASTM E9
Creep-Fatigue Testing - ASTM E 2714
Fatigue testing by Axial-strain-controlled method - ISO 12106
Fatigue testing by Fatigue crack growth method - ISO 12108
Static Tensile, Cyclic Tensile, Slip Test, High Cycle Fatigue, S-N Curve





ISO 17025 Accredited LAB

Material Testing Laboratory for Destructive Testing

OFFSHORE ANALYSIS IN INDIA WITH RAPID RESPONSE AND DEDICATED MACHINE SHOP, EXPERT METALLURGISTS AND LAB TECHNICIANS

ARL Quantris
Optical Emissions
Spectrometer

Inductively Coupled Plasma
Spectrometer

Atomic Absorption
Spectrometer

Optical Emission
Spectrometer

Automatic
Carbon – Sulphur
Determination

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TCR ENGINEERING SERVICES PVT LTD

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

VKB HOUSE, PLOT NO. EL 182, MIDC TTC, INDUSTRIAL AREA, ELECTRONIC ZONE MAHAPE NAVI MUMBAI MAHARASHTRA, NAVI MUMBAI, , MAHARASHTRA, INDIA

in the field of

TESTING

Certificate Number: TC-6905

Issue Date: 03/03/2024 Valid Until: 02/03/2026

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity: TCR ENGINEERING SERVICES PVT. LTD.

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

Universal Tensile, Impact and Hardness Machines

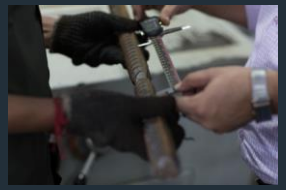
TCR ENGINEERING

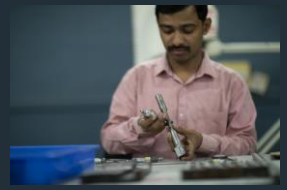
STRESS VERSUS TIME AT ELEVATED TEMP

CREEP & STRESS RUPTURE

ASTM E139 and ASTM E292

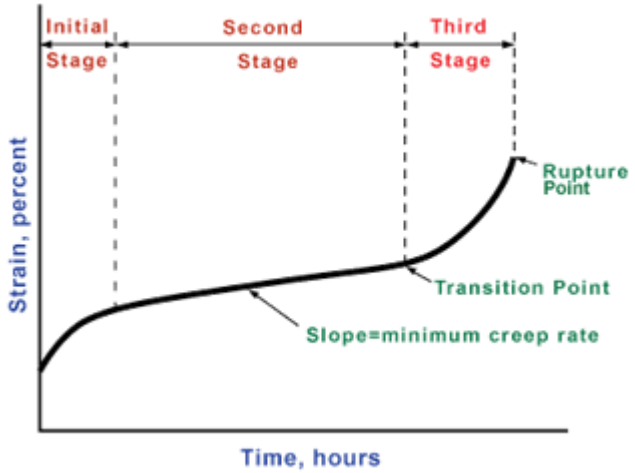
Reliable temperature control using calibrated thermocouples attached to the test specimens. The load is adjusted automatically at various time intervals for efficiency.

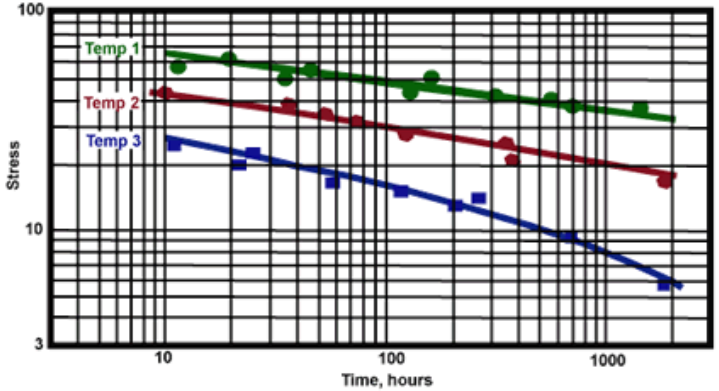




Evaluating materials for boilers, gas turbines, jet engines, ovens or any application that involves high temperatures under load.

Stress rupture test involves a tensile specimen under a constant load at a constant temperature. Stress rupture tests are employed to find out the time it takes for failure.



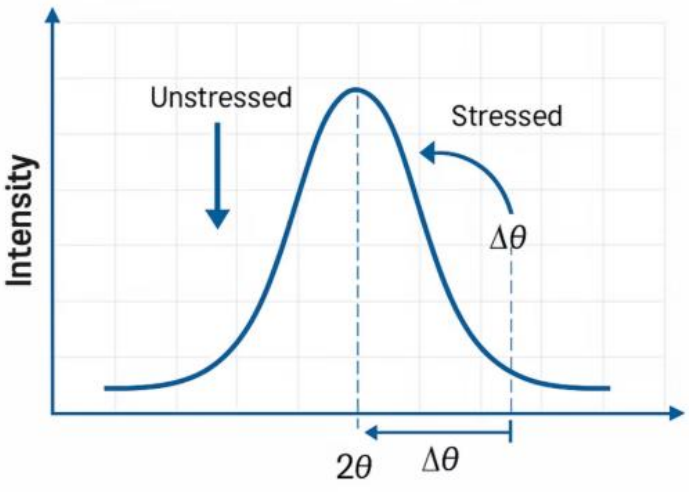


For more information, visit us www.tcreng.com

ISO 17025 Accredited
PAB

Residual Stress Measurement by X-Ray Diffraction (XRD)

TCR ENGINEERING



TCR undertakes Residual Stress Measurement by XRD — a **non-destructive, precision technique** in compliance with **ASTM E2860-20**, enhancing material integrity across industries.

Residual stresses affect:

- ✅ Fatigue life
- ✅ Crack initiation & propagation
- ✅ Corrosion resistance
- ✅ Distortion & dimensional stability

Critical for: Aerospace, Automotive, Petrochemical, Defense, Advanced Manufacturing

Key Features

- ✅ ASTM E2860-20 Compliant
- ✅ Non-destructive & accurate
- ✅ High spatial resolution (1 mm)
- ✅ Depth profiling available
- ✅ Versatile: welds, coatings, 3D printed metals & mo

TCR ENGINEERING

Metallographic Replica:

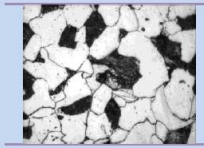
In-depth condition\life assessment of process plant components and detection of Graphitization, Degradation Of Pearlite, Creep, Thermal Fatigue, Oxidation, Grain Growth, Hydrogen Attack, Stress Corrosion Cracking, Sigma Phase

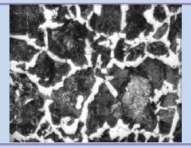
ADVANTAGE

TCR's metallurgists have a database of over 30,000 micro-structure interpretation study of various components and materials.

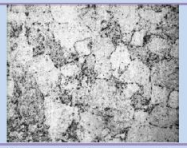
For more information, visit us **www.tcreng.com**

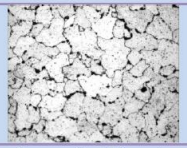
Carbon steels

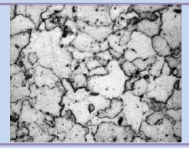

Normalized – 400X


As forged or improperly heat treated–400X

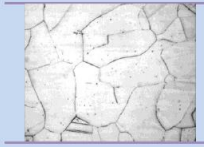

Widmanstatten ferrite and pearlite 100X

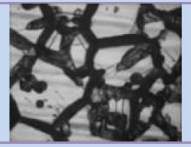

Spherodization of pearlite 400X

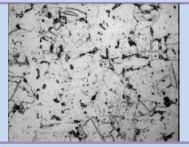

Creep voids at the grain boundaries – 400X

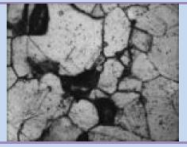

Decarburization- 400X

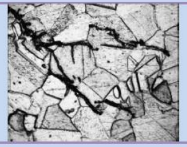
Austenitic stainless steels

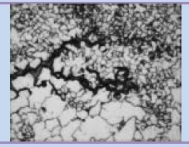

Solution annealed 400X


carbide precipitation– 400X

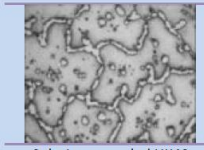

Sigma Phase 400X

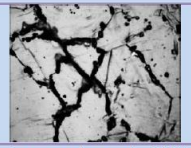

IGC 400X

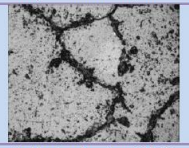

TGSCC 100X

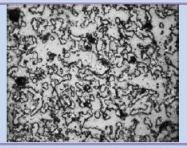

IGSCC 400X

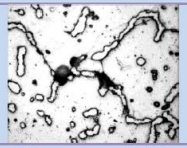
Catalytic convertors / reformer tubes / hot outlet manifolds

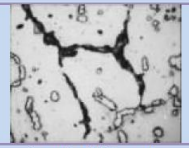

Solution annealed HK40 400X


Inter-granular crack - HK40 400X

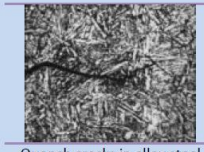

Oxidation-Incoloy 800HT 400X

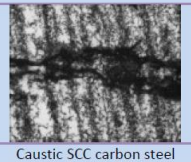

Creep damage In weld HP Mod 400X

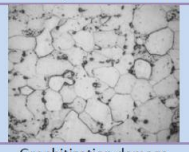

Creep damage in PM 400X

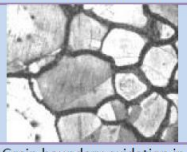

Interdendritic cracks 400X

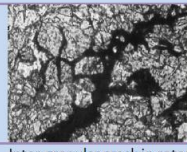
Damage mechanisms identified in the microstructure

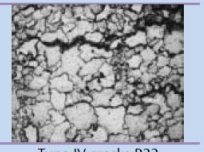

Quench cracks in alloy steel 400X


Caustic SCC carbon steel 400X


Graphitization damage low alloy steel – 400X

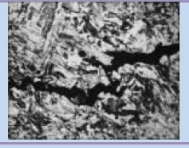

Grain boundary oxidation in CS - 100X

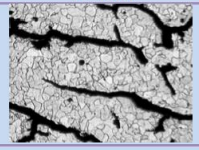

Inter-granular crack in rotor low alloy steel 400X

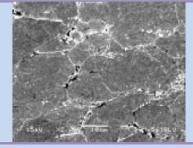

Type IV cracks P22 400X

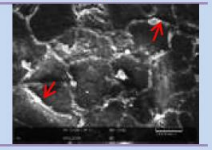

Dissimilar metal weld SS-alloy steel 200X

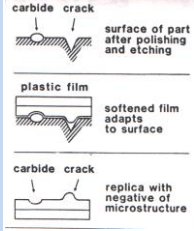

Thermal fatigue alloy steel 100X


Corrosion fatigue SS 410 400X

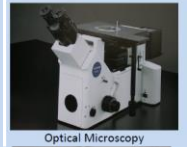

High temperature hydrogen damage C-1/2Mo. – 100X


Creep Damage in P91/T91 2000X


High temp. sulphur induced corrosion T11. – 3500X




Scanning Electron Microscopy


Optical Microscopy


Portable Microscope


In-situ Metallography by replication method.

TCR ENGINEERING

SCIENTIFIC RESEARCH LABORATORY

SOUR GAS & GENERAL CORROSION TESTING

Excellent Lab Award by NACE

Equipped with numerous high temperature/high pressure autoclaves, proving rings, salt spray chamber, Corrosion simulation in lab as well as Desktop simulation of corrosion rate with passionate corrosion scientists

Sour Gas (HIC/SSC/SOHIC) – NACE TM0284/TM0177/TM0103
Chloride Stress - ASTM G 36
SCC of Aluminum Alloy - ASTM G44/G47
Pitting/Crevice (Critical Temperature) - ASTMG48
Potentiostatic / Potentiodynamic Anodic Polarization - ASTM G5
Chloride Stress - ASTM G 36
Corrosion of Aluminum NAMLT - ASTM G67
Exfoliation of Aluminum - G66/G34
SCC of Aluminum – ASTMG103
Intergranular – ASTM A262/ DIN EN ISO 3651
Immersion Corrosion – ASTM G31
Ammonia Vapor Test – ASTM B858, Salt Spray – ASTM B117






For more information, visit us www.tcreng.com

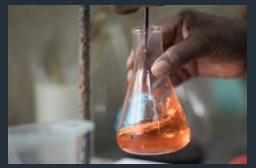
TCR ENGINEERING

GRAVIMETRY/TITRIMETRY QUANTITATIVE AND SEMI-QUANTITATIVE ANALYSES

WET CHEMICAL ANALYSIS AND SPECTROMETERS

PPM / Sub-PPM Detection Level

Identification of chemistry in Ferrous, Non-Ferrous Metals, Ceramics, Glass, Refractory, Minerals and Ferro Alloys in all forms including drillings or turnings, solid samples, and liquids.


Atomic Absorption (AA) Graphite Furnace Spectrometer
Inductively Coupled Plasma (ICP) Spectrometer
Optical Emission Spectrometer (OES)
X-Ray Diffraction Spectrometer (XRD)
Gas Analysis (Oxygen, Hydrogen, Nitrogen)
EDAX Analysis
On-Site Positive Material Identification (Portable XRF and OES)
pH Value Determination, Acid Insoluble
Sand Content, Moisture Content, Ash Content
Sulphates, Chlorides, Silicates, Carbonates, Oxides of Iron
Calcium, Magnesium, Potassium, Sodium, Iron
Solder Alloys (Tin/Lead)
Density of Powdered Metals, Particle Size Analyzer
Coating Identification, Coating Weights






For more information, visit us
www.tcreng.com

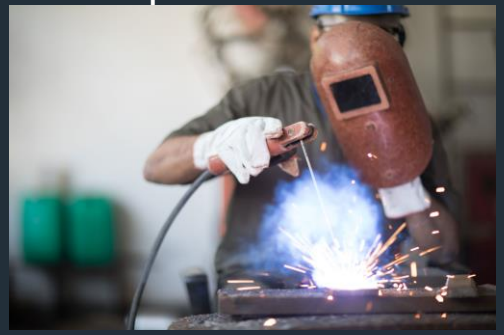
TCR ENGINEERING

WPS-PQR DEVELOPMENT

WELD EXPERTS

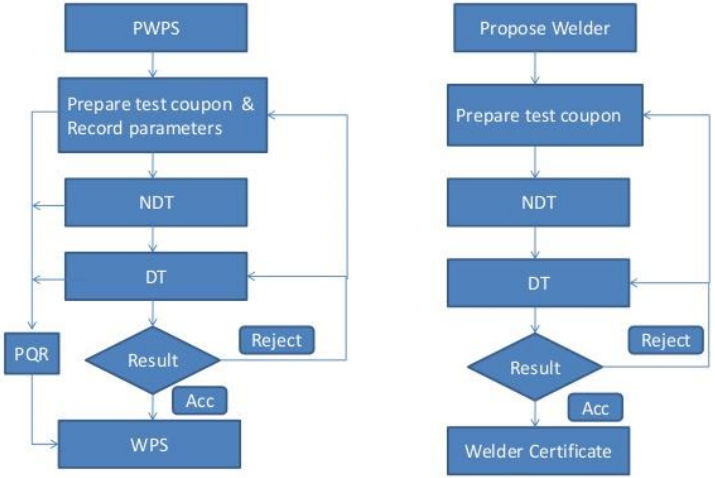
AWS D1.1, ASME IX, API 1104, EN 288

Evaluate the existing welding procedures, Perform welding quality control inspections, Supervise and inspect critical weld procedures in the field.



Complete facilities for testing welding consumable & filler material

Welding Procedure & welder qualification test



CSWIP CERTIFICATION SCHEME FOR PERSONNEL

Passionate Welding Experts

- Expert in ASME U, U2 , U3, S & R stamp qualification.
- Qualified Welding Procedures on Stamicarbon - SAFUREX; Cr-Mo-V Steels; Titanium, Zirconium, Inconel, Monel; DIROS 500
- Successfully welded 2.25Cr-1Mo item weighing 950MT
- Automatic nozzle welding using SAW
- Automatic GMAW for welding Dish ends
- Tandem Submerged Arc Welding (SAW) using up to three wires simultaneously to reduce the cycle time
- Implemented High speed Electro Slag Strip Cladding

For more information, visit us www.tcreng.com

ISO 17025 Accredited Civil LAB

Civil and Construction Material Testing

STRUCTUAL AUDITS, FIELD INSPECTIONS AND COMPLETE CIVIL TESTING LAB TECHNICIANS in association with HPL (A TCR group associate company)

TCR ENGINEERING

HPL

Material Testing Services

Technical services for testing of materials like soil / Moorum, Coarse and fine aggregates, crusher products, concrete pavement layer, cement, concrete cubes, blocks, cement concrete interlocking blocks, flooring tiles and bricks.

Cement / Pozzolanic Materials.

Standard consistency, initial & final setting time
Soundness
Fineness
Compressive strength
Chemical analysis

Coarse & fine aggregates

Sieve analysis (Gradation)
Flakiness index, Elongation index
Stripping value, Impact value, Soundness
Crushing value, Water absorption
Specific gravity, Bulk density & voids

Services include:

- Concrete Tests
- Soil Tests
- Aggregate Tests
- Field test for Soil & Concrete
- Structural assessment of concrete & Concrete delamination Survey

Fine aggregates, Natural /crusher

Sieve analysis (Gradation), Silt content,
Moisture content, Specific gravity, Bulk density

Concrete cubes/blocks/Cement

Compressive strength, RCPT
Water Permeability

Flooring Tiles

Flexural strength, Water Absorption
MOR, Drying shrinkage

All types Bricks & Blocks

Crushing strength, Water absorption, Effervescence

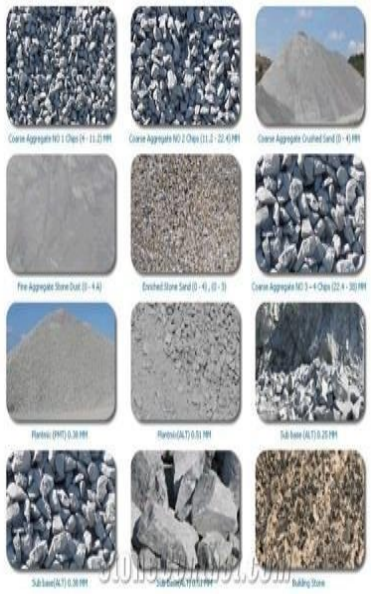
TCR ENGINEERING

SOIL TESTING AS PER IS 2720

- Particle-Size Distribution (Gradation) of Soils
- Modified/Standard Proctor Test
- Particle size distribution (Sieve Analysis)
- Liquid Limit, Plastic Limit & Plasticity Index (Casagrande)
- Specific gravity of soil using Pycnometer
- Max & Min Index Density (Relative Density)
- California Bearing Ratio (CBR)
- Moisture Content of Soil
- In-situ density tests- Sand replacement method for fine and medium grained soils
- In-situ density tests- Sand replacement method for fine, medium & coarse grained soils







In-Depth Soil Testing and Investigation

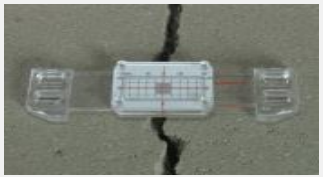
- Hydrometer analysis
- Direct shear test
- Unconfined compression test
- Chemical tests
- Dynamic Cone Penetration Test
- Cross hole seismic test
- Seismic Refraction Survey
- Electrical resistivity test (E.R.T.)
- Geological Survey & report preparation

For more information, visit us
www.tcreng.com

TCR ENGINEERING

Concrete Testing as per IS 516:

Design support for Normal concrete, Pump able concrete, High performance concrete, Early de-shuttering, Self- compacting concrete, High Fly ash concrete and Concrete pavement blocks

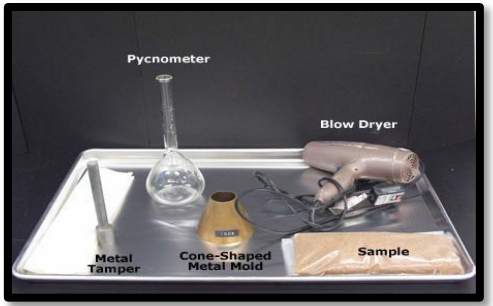


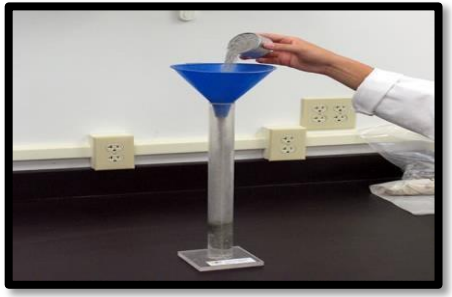
- Compressive Strength of Hydraulic Cement Mortars
- Air Content of Freshly prepared Concrete
- Bleeding test of fresh concrete
- Water absorption for Hardened concrete
- Sampling of Concrete Masonry Units/Hollow
- Determination of Dimensions, Absorption & Compressive Strength Testing of Concrete Masonry Units/Hollow Blocks
- Water absorption and Bulk Specific Gravity of dimension stones (Kerb stones, Concrete flags, Beam, etc.)
- Determination of Flexural strength test of dimension stones
- Determination of Modulus of rupture of dimension stones
- Unconfined compressive strength of intact rock core specimens
- Dimension measurement, Compressive strength and Water absorption of precast Paving Blocks
- Cutting of Concrete Core (Concrete coring on site)
- Curing, Capping, Compressive Strength & Fracture Type Analysis of Concrete Cores in Laboratory
- Compressive strength of dimension stone
- Determination of Water absorption & bulk density of dimension stone

TCR ENGINEERING

AGGREGATE TESTING

- Sampling of Aggregates
- Sieve Analysis of aggregates
- Material Finer than # 200
- Clay Lumps & Friable Particles
- Specific Gravity and Water Absorption (Particle density)
- Sand Equivalent Test
- Moisture content of aggregates (oven dry method)
- Percentage of fractured particles in coarse aggregate
- Soundness of aggregates by sodium sulphate and magnesium sulphate
- Test method for unit weight for aggregates





Hot Air Oven

Curing Tank

For more information, visit us www.tcreng.com

ISO 17025 Accredited LAB

Polymer and Rubber Testing

OFFSHORE ANALYSIS IN INDIA WITH RAPID RESPONSE AND DEDICATED MACHINE SHOP, EXPERT LAB TECHNICIANS

TCR ENGINEERING

Oil Seal Endurance Tester

The drum has a facility to mount two Oil Seal Housing Flanges, one on each side. Lab can set the test temperature, test time, test rpm & direction of rotation.

- FTIR, Chemical method : Polymer Identification.
- TGA : :% analysis of Polymer, Filler, Ash, Glass.
- DSC : Melting Point, Tg
- Heat Aging
- Flammability : Vertical, Horizontal.
- Heat Deflection Temperature (HDT)
- Softening Point (VICAT)
- Density, Moisture, Volatile and Sulphur Content
- Ozone Resistance
- Melt Flow Index
- Burst Test
- ROHS Testing
- Breakdown Voltage
- Contact Resistance
- Flash/Pour Point of Oil
- Fog testing
- Dart Impact Test
- Oil Aging
- Specific Gravity
- Dielectric Strength
- Falling dart impact
- Color, Gloss, Haze measurement

TCR ENGINEERING

PIPELINE & WELD JOINTS
RADIOGRAPHY
12 – 24" Dia Pipeline Crawler

Experienced NDT Level III expert along with dedicated team of technicians perform gamma radiography with projectors and crawlers. Computerized Radiography is available.

X-ray pipeline crawlers with high radiographic quality, high imaging sensitivity and low failure rate

SENTINEL 880 Delta
Gamma Projector

राष्ट्र की सेवा में परमाणु
BARC
ATOMS IN THE SERVICE OF THE NATION

Approved

For more information, visit us
www.tcreng.com

ISO 17025 Accredited LAB
Cathodic Protection Services
Corrosion Prevention & Asset Integrity

TCR ENGINEERING

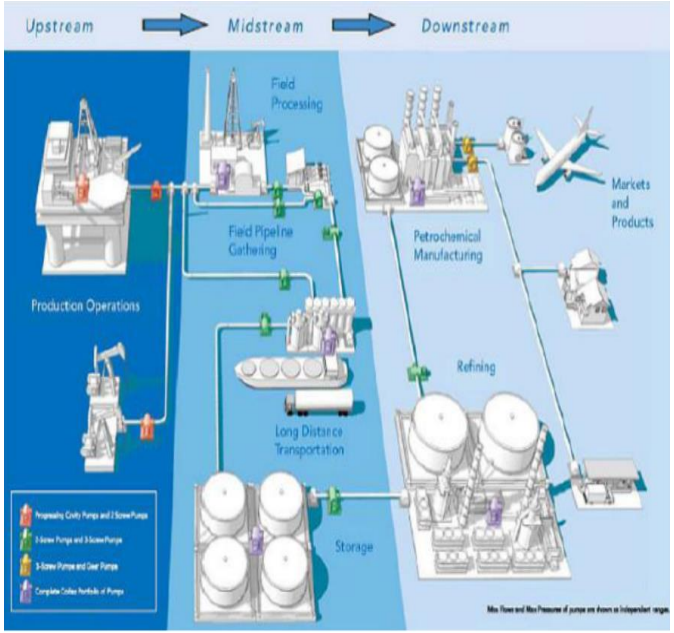
TCR Cathodic Protection Solutions offers a wide range of specialized services to ensure the integrity and longevity of assets exposed to corrosive environments. Our cathodic protection services are designed to prevent corrosion, safeguard infrastructure, and enhance operational efficiency across various industries. Some of the key services we provide include:

Services Offered:

- CP System Design & Engineering
- High-quality Anode & Equipment Supply
- Installation, Commissioning & Remote Monitori
- Corrosion Surveys: CIPS, DCVG, PCM
- System Maintenance, Retrofitting & Compliance

Industries We Serve:

- Oil & Gas (Pipelines, Tank Farms, Offshore Platf
- Power & Energy (Thermal, Hydro, and Nuclear)
- Chemical & Petrochemical Plants
- Ports, Harbors, and Marine Structures
- Infrastructure & Utilities
- Refineries and Terminals



PWHT (Post Weld Heat Treatment) Services

Preheating—reducing hardness, minimizing cold cracks, and enhancing overall weld integrity.

PWHT & Heat Treatment Services

- ❑ Localized Electric Resistance PWHT for butt welds, vessel seams
- ❑ Furnace Heat Treatment & Normalizing (permanent/temporary setups)
- ❑ Preheating to prevent cold cracking and porosity
- ❑ Refractory Dry Outs with detailed monitoring & documentation

Benefits and Precision Monitoring with PWHT:

- Relieves residual & elastic stresses
- Reduces risk of corrosion, embrittlement & brittle fracture
- Improves dimensional stability and weld microstructure
- Ensures long-term structural integrity under harsh service environments
- Multi-point thermocouples
- Real-time temperature charts
- Custom air-drying curves for refractory dry-outs

This PWHT setup uses electric resistance heating with multi-point thermocouples for precise temperature control and even heat distribution.

PIPELINE CONDITION/FAILURE ANALYSIS EXPERIENCE

Client	Type	Description of case
GAIL India Ltd., Hazira	Condition assessment	Condition assessment of 36"diameter HVJ pipeline carrying Compressed Dry Natural Gas
Indraprastha Gas Ltd.	Failure Investigation	pipeline carrying natural gas failed during hydro-test
Reliance Gas Pipelines Ltd.	Metallurgical assessment	Metallurgical assessment of pipeline material
GAIL India Ltd. (VSPL LPG)	Failure Investigation	Failure investigation of 6" x 3" reducer
Mahanagar Gas Ltd.	Failure Investigation	Failure investigation of 3" valve of gas carrying pipeline
GAIL India Ltd.,	Failure Investigation	12" API 5L X60 pipeline
Cairn Energy Ltd., Barmer	Failure Investigation	Failure investigation of 20" pipeline
Cairn Energy Ltd.,	Failure Investigation	8" Underground pipeline of Natural Gas
British Gas E&P	Failure Investigation	Failure investigation of gas pipeline
Welspun Ltd., Anjar	Failure Investigation	Failure investigation of 42" spiral welded pipes
Maharashtra Seamless Ltd.	Failure Investigation	12" pipeline ruptured during hydro-test

गेल (इंडिया) लिमिटेड
(भारत सरकार का उपक्रम - महारत्न कंपनी)
GAIL (India) Limited
(A Government of India Undertaking - A Maharatna Company)

हजीरा कम्प्रेशर स्टेशन,
इच्छापुर मगदल्ला रोड,
पी. ओ. : ओ.एन.जी.सी.,
जिला : सूरत - 394 518
HAZIRA COMPRESSOR STATION
ICCHAPORE MAGDALLA ROAD,
P.O. : O.N.G.C.,
Dist. SURAT - 394 518
फोन / PHONE : (0261) 2917304/2905734
फैक्स / FAX : (011) 26185941

LETTER OF ACCEPTANCE

TCR ADVANCED ENGINEERING
PVT. LTD. .,
250-252/9, GIDC ESTATE
NAREN HARDWARE LANE,
MAKARPURA
VADODARA-390010
Gujarat ,India
Tele No : 02652634375
Fax no.: 02652643024

LOA/WO No.: GAIL/HZR/69324/5300027093/FL-10C/17-18
Dated :01.06.2017

RFQ No. & Date: 3300069097 Dt. 01.06.2017
Your offer/Qtn.No.: EMAIL
Qtn. Dt. : 01.06.2017
E Tender No.: NIL
Vendor Type : OTHERS

Kind Attn :

Name of Work : Condition Assessment of above ground portion beneath the cold tape coating in 36" dia HVJ P/L after IJ at HAzira CS (Regulerisation WO)
Dear Sir/Madam,

With reference to your Offer against our RFQ and all subsequent correspondences (if any) till date and in continuation of our Fax/Letter of Intent (if any) we are pleased to award the subject works highlighting the following salient features:

Vendor Number: **129235**
TCR ENGINEERING SERVICES PVT. LTD.
Plot no.EL-182,MIDC-TTC,Electronic Zone
Behind Nelco,Mahape
Navi Mumbai
Maharashtra
400710
Phone: 91 22 27610921/22/23
Attention of: Mr. V.K. Bafna

Delivery To:
BG Exploration and Production India Limited
BG House, Lake Boulevard ,Hiranandani Business Park,
Hiranandani Garden, Powai, Mumbai
Maharashtra
400076
Phone: 91-22-40325000
Fax: 91-22-40058942

Invoice To:
BG Exploration and Production India Limited
BG House, Lake Boulevard Road
Hiranandani Business Park, Powai
Mumbai
400076
India

TCR ENGINEERING

RT FILM SCANNING
DIGITALIZATION
Cloud based Delivery

Bengaluru based central operations team with IT and Google Certified experts remotely co-ordinate with Pan India sites aligned with the stringent film density and resolution understanding

Google Cloud

ZOHO

For more information, visit us
www.tcreng.com

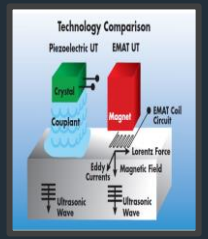
Key Benefits of NDT Film Digitizing

- Eliminates aging of films, retaining image quality
- Storage to custom Zoho Portal or Google Cloud
- Inspection reports, UT, MPI can also be archived
- Eliminates storage costs of film
- Artificial Intelligence based retrieval and compare of scans

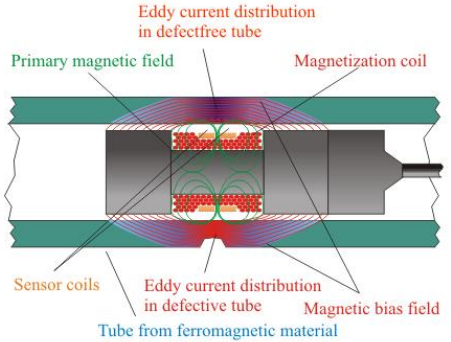
TCR ENGINEERING

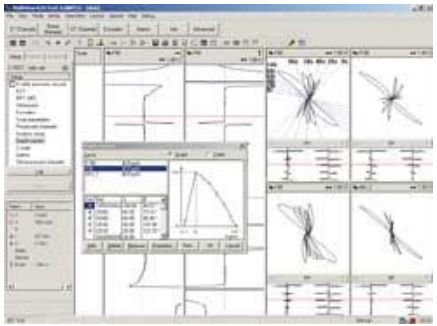
ECT, RFET, IRIS, MFL, EMAT
TUBE INSPECTION

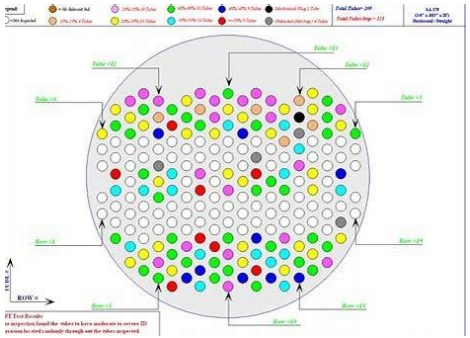
TCR's tube inspection team capable of working multiple shifts in turnaround to detect pitting, corrosion, erosion, cracking, puncture, cracks in tubes of heat exchangers, steam generators, condensers, chillers, air coolers and feedwater heaters.

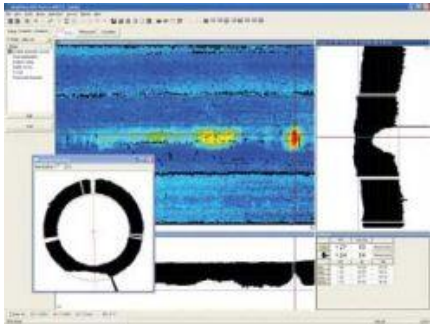


EMAT-Electromagnetic Acoustic Transducer









For more information, visit us www.tcreng.com

TCR ENGINEERING

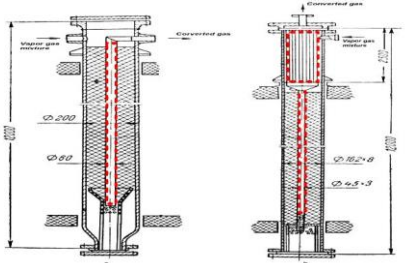
TCR INNOVATION
AUTOMATED REFORMER TUBE INSPECTION

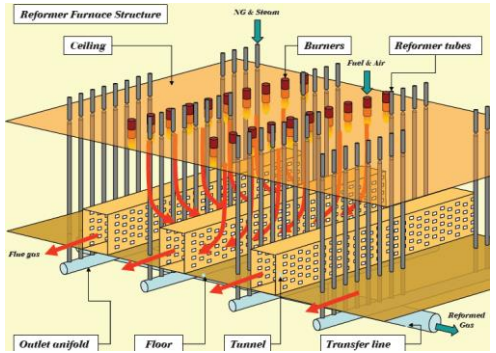
TCR's in-house developed technology solution for Automated ultrasonic scanning on reformer tubes from 105 to 190 mm outer dia.

TCR also undertakes reformer tube condition and integrity assessment & Fitness for Service (FFS) along with unique feature of "when to retire tubes"

Evaluation of damage mechanisms including creep, fissure detection, microstructure degradation, thickness loss and internal carburization

- Inspecting from an external surface without removing the catalyst
- Detection of micro level sub surface and mid-wall creep fissures
- Creep strain and bowing angle estimate at a resolution of 0.1meter
- Eliminate erection of scaffolding





As stated by NACE

Eddy current examination is not reliable in the detection of early damage (i.e. less than 30% through-wall).

Ultrasonic Examination

The primary ultrasonic technique utilized for the detection and estimation of creep damage is through transmission ultrasonic attenuation. Recent validations have again found that ultrasonic is more reliable at the detection and quantification of creep damage, particularly in its early stages.[2]

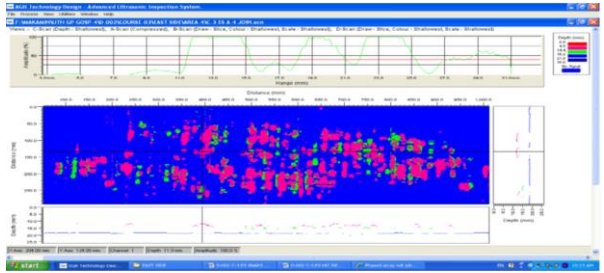
For more information, visit us
www.tcreng.com

TCR ENGINEERING

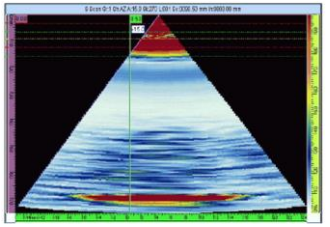
ON-LINE INSPECTION AND HIGH TEMP NDT

HTHA AND SWC

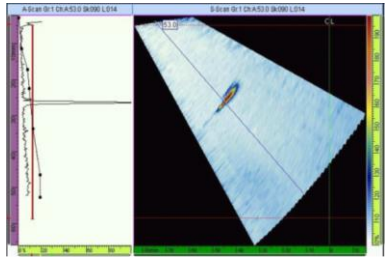
TCR Detects and Monitor's Corrosion Growth Rate/Wall Thinning and In-service defects of Plant piping, Vessels & Tanks operating at elevated temperatures up to 700° F (350° C).



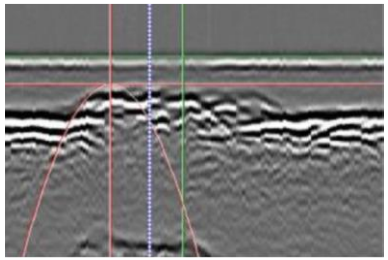
Wall thickness mapping of the area, before making hottaps



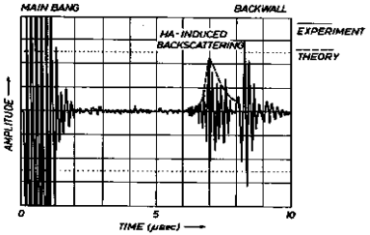
HTHA confirmation using PAUT



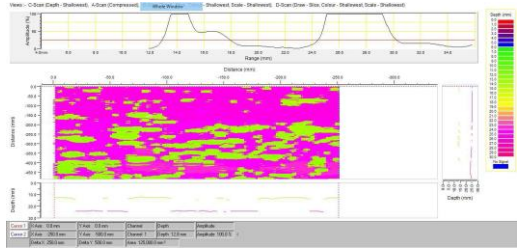
Phased Array Inspection of on-line repaired areas



Time of Flight (ToFD) inspection of heavy wall vessels or welds



HTHA using ABUT-L



HIC/SWC/Inclusion/Lamination detection

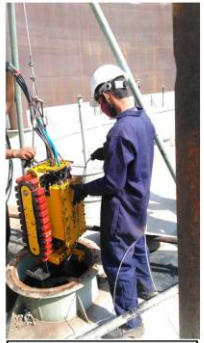
For more information, visit us www.tcreng.com

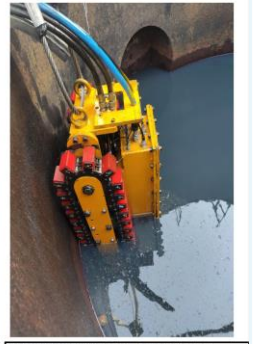
ROBOTIC &
VISUAL INSPECTION

ENGINEERING

In-Service Hydrocarbon Tank

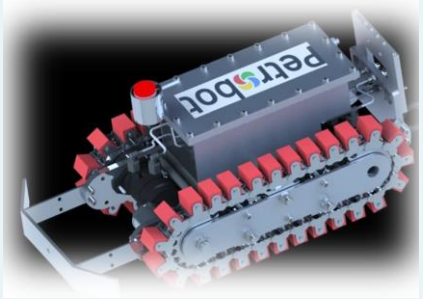
Thru 19.5" Dia. Manhole – Vertical Cone Roof Tank


Thru 24" Dia Manhole -Single Deck Floating Roof Tank


PetroBot ITIS Rover – In HSD Tank

ATEX Certified

PESO Approved



Custom Robotic Solutions


Tank Shell UT Scanning_ Vertical Movement


Boiler Tube Inspection


Underground Pipeline


Jetty Pile Casing or Pipe Rack Inspection


Horizontal Vessel External Shell Inspection


UG Tank Internal Inspection

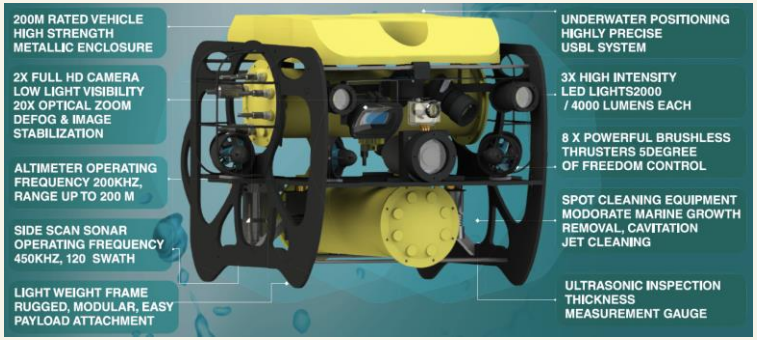

Conveyor Super Structure Inspection


High Rise Pipe Rack Inspection

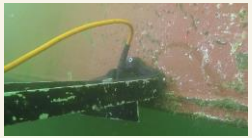

Offshore Riser Pipe Inspection

ROBOTIC & VISUAL INSPECTION

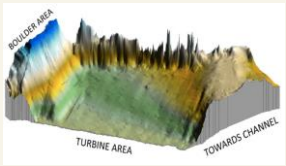
UNDERWATER



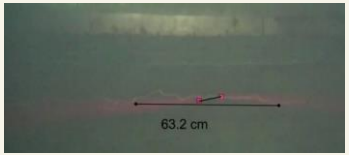
HD live video



Thickness Measurement



SONAR/Bathymetric Surveys



LASER defect quantification

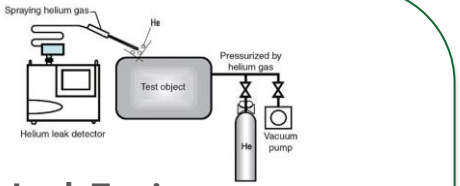
Spot Cleaning of Marine Growth

UNDERGROUND & ABOVE

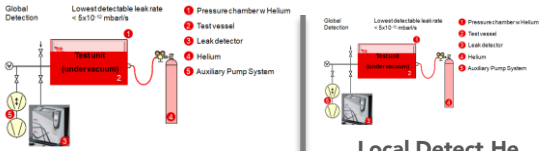
Robotic Crawler based pan tilt zoom camera for inspection of pipelines of 20"+ diameter upto 200 meter length to ensure the lines are free from defects and foreign particles.

Key Differentiator

Beyond Material Composition and Crack Length, TCR provides meaningful insights that drives plant efficiency



Helium Leak Testing (Pressure Method)

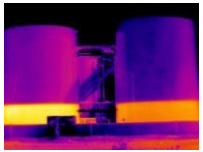


Global Detect He Outside
(Vacuum Method)

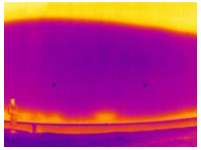
Local Detect He
(Vacuum Method)

Locating the smallest leaks in pressure, vacuum, condenser, heat exchanger, steam turbine generator

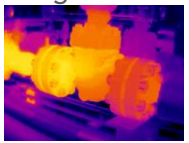
Thermography



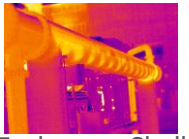
Storage Tank Level



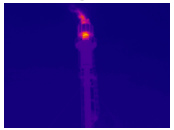
Paraffin/Sludge Level



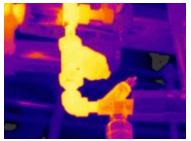
Valve



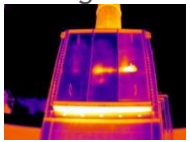
Exchanger Shell



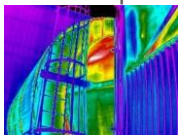
Flare Tip



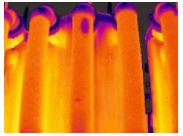
Steam Trap



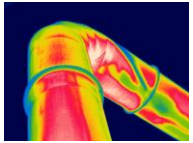
Boiler Economizer



Outlet

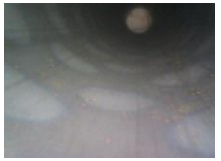


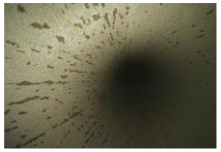
Pipe Delamination



Material Buildup

Videoscopy





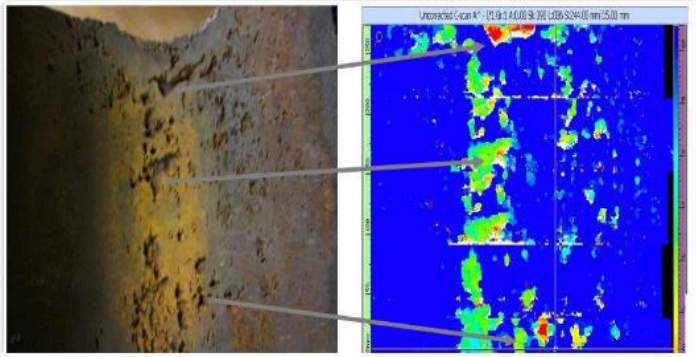
Visual Inspection at unapproachable locations

PLANT SURVEY & CORROSION MAPPING

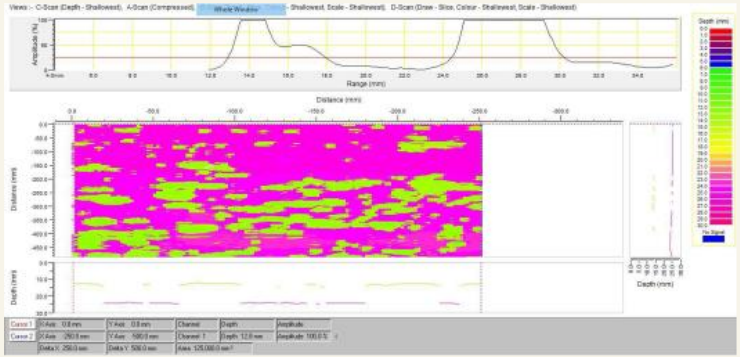
TCR ENGINEERING

Step-wise Cracking & HTHA

Sample evidence of corroded areas detected with ultrasonic corrosion mapping



ToFD, AUT P-Scan, PAUT, AUBT-L, AUBT-S

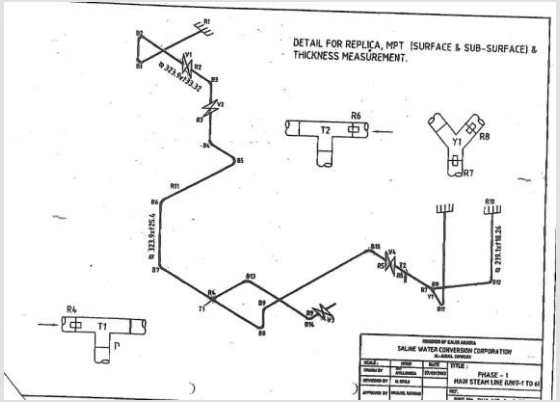


C-Scan showing Step-wise Crack

Corrosion Thickness Survey

Segregate the given lines as per Corrosion Loops

- Create Isometric drawings for all the loops
- Mark the Thickness Measurement Locations (TML) on loops as well as at Site as per isometric drawing
- Identification of inspection requirement including scaffolding, insulation removal and high temperature measurement
- Review of all thickness reports



TCR will create isometric sketches of all test points surveyed

Percent of wall loss determination

The nominal thickness is the thickness of a fitting or piping that corresponds with A.S.A. Pipe Schedule Manufactures Chart. There is a 12.5% mill tolerance (higher or lower) from the chart.

- Any (TML) from 12.5% thru 19% lower is light wall loss.
- Any (TML) from 20% thru 39% lower is moderate wall loss.
- Any thickness readings found to be 40% or greater is severe wall loss and recommended to be replaced and reported

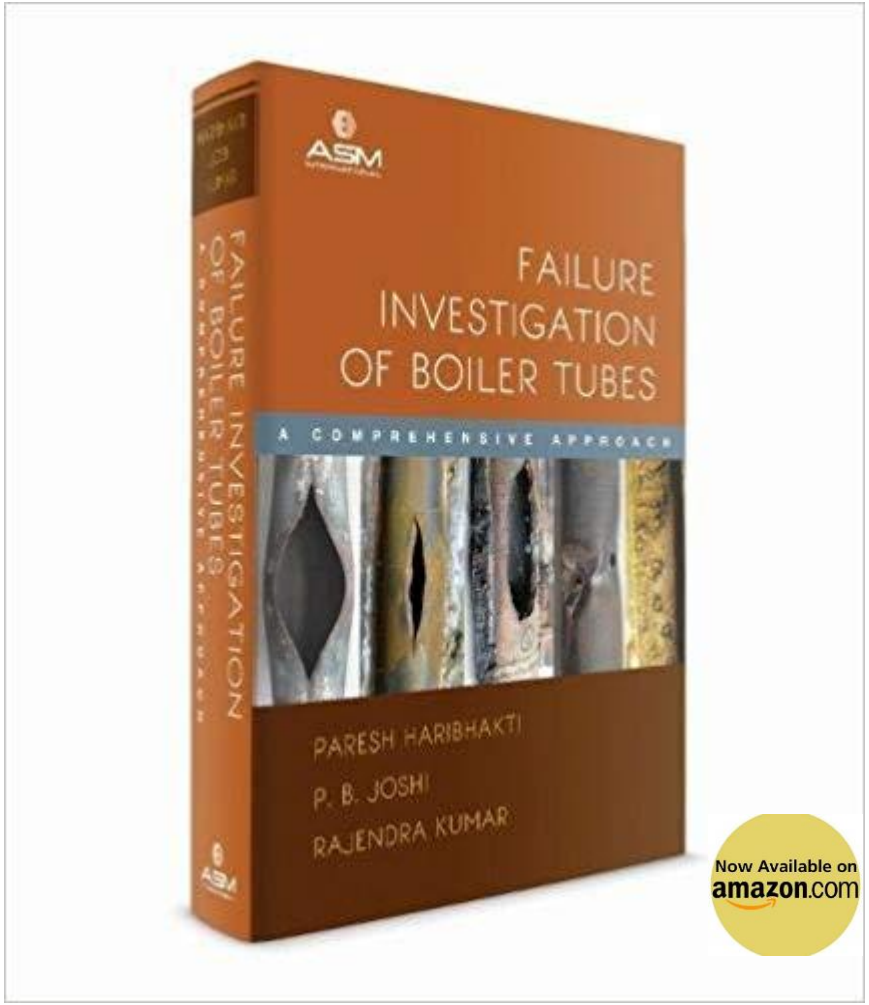
TCR ENGINEERING

BOOK ON BOILER TUBE FAILURES

INDUSTRY CONTRIBUTION

TCR's Managing Director and Chief Metallurgist Paresh Haribhakti has written an award winning book on Boiler Tube Failures and associated damage mechanisms with detailed case studies

Published by ASM International (USA) and available at various university library and engineering companies as reference study material.



For more information, visit us www.tcreng.com

Global Group Focused on Inspection

TER ENGINEERING
Navi Mumbai

TER
Dubai (UAE)

TER ARABIA
Dammam, Jubail and Yanbu (Saudi Arabia)

TER U-SONIX
Offshore and Sub-Sea

EVOLVE
Vadodara (India) and Virtual

TER ADVANCED
Vadodara (India)

TER QATAR
Doha

TER KUWAIT
Faheel

TER OMAN
Muscat

TCR ENGINEERING

FOUNDING VISION: PRINCIPLES OF PRECISION, TRANSPARENCY AND RELIABILITY

TCR LEGACY

TCR has a growing global presence and is rooted in behaving ethically in all their interactions-with their employees, partners and their customers.

Historical Milestones

TCR Engineering Services was incorporated in 1973

It was the vision of Mr. V. K. Bafna, the founder, a keen metallurgist to provide real, sustainable solutions to companies that would drive progress for them. He infused the principles of precision, transparency and reliability in all actions due to which,

TCR today is a trusted service provider for top-notch companies across the globe and has many 'firsts' to its credit. It has become a thought leader in the industry because of its pioneering work.

Our journey started as a disruptor for end to end inspection services to a being global leader

.

2018
TCR Qatar is established, Civil Lab starts

2010
TCR establishes an alliance - Malaysia

2007
TCR Engineering enters into a JV in Saudi Arabia to establish **TCR Arabia** in Dammam

2006
TCR Engineering opens **TCR Kuwait**, its first international office in Kuwait

1999
TCR Engineering establishes **TCR Advanced** in Vadodara to offer research and consulting solutions for plant management

1980
First to add a chemical analysis spectrometer in India

1975
First to install 100T Tensile Machine in India

1973
TCR Engineering Services Company Founded in Mumbai

VIRENDRA KUMAR BAFNA
Founder & Visionary TCR Engineering Services Pvt. Ltd.

TCR CREDIBILITY: ACCREDITATION & APPROVALS

TCR ENGINEERING

TCR is among the few leading & independent laboratories that meet the international standards of quality, accredited by reputed global agencies

CERTIFICATIONS

- Bureau of Indian Standards
- IBR Approved
- ISO 17025 Accredited Laboratory

INDUSTRY/UNIVERSITY PARTNERSHIPS

- Bombay Chamber of Commerce & Industry
- EEPCINDIA – Engineering the Future
- Indian Institute of Technology Madras
- Make in India

CORPORATE PARTNERSHIPS

- Chugai Technos
- Petrobot
- PLANYS Technologies
- CIA Inspection Inc.

ASSOCIATIONS

- NACE – The Worldwide Corrosion Authority
- ASM
- ASNT Corporate Partner
- Indian Society for Non-Destructive Testing (ISNT)

TCR ENGINEERING

INDUSTRIAL TRAININGS
EVOLVE BY TCR

Highly effective coaching for plant operations, inspections and maintenance personnel with experienced Teachers and practical knowledge.

www.evolvetcr.com

- ASNT Level II programs in UT, DP, MP, RT, VT, ECT, IR
- Boiler tube failure-mechanisms and mitigation
- REAC Reactors in Refinery
- Selection of NDT for effective end result
- Intensive course on "fracture mechanics, fracture toughness and fatigue testing"
- Introduction to Corrosion and NDT
- Metallography for Non Metallurgists
- Study of different coatings for protection against corrosion under insulation/fire proofing
- Application methods for Paint Coatings and Inspection Of Painted Panels
- Corrosion in Petrochemical Process Plants
- Corrosion Under Insulation For Pipelines
- Failure of 9% Nickel steel during extended cryogenic service
- Failures and Protection methods for Above Ground Storage Tanks
- Beyond RBI: Striving for zero loss of containment
- API 510, 579, 653 Training programs

For more information, visit us
www.tcreng.com

PRIDE OF INDIAN METALLURGISTS

GLOBAL RECOGNITION

TCR ENGINEERING

NACE INTERNATIONAL INDIA SECTION

305-A, Galleria, Hiranandani Gardens, Powai, Mumbai – 400076.

NACE International India Section

Presents

CORROSION AWARENESS AWARD - 2007

(Sponsored by NIIS)

To

TCR Engineering Services Pvt. Ltd.

Award for excellent Laboratories in Private Sector

In recognition of their contributions in the field of Corrosion Sciences

Dr. Baldev Raj
Chairman Awards Committee

A M Uplenchwar
Chairman India Section

Appreciation Award by Vikram Sarabhai Space Center for Contribution in the launch of space shuttle ASLV-D3

Appreciation from ISNT

Memento from NACE

American Society of Metals (ASM) acknowledged Mr. Paresh Haribhakti at International Conference on 'Material Testing & Characterization'

Recognized by KNPC, Kuwait for contributions to the 'Plant Integrity Solutions Workshop'

KK Award presented to Mr. Paresh Haribhakti, MD, TCR Advanced in the Category of Professional Field for the Year 2015 by Indian Institute of Metals (Baroda)

CUSTOMERS ACROSS INDUSTRIES

MAJOR CLIENTS

ENGINEERING

KEY INDIA CLIENTS

KEY GLOBAL CUSTOMERS

TCR ENGINEERING

COMPLETE QUALITY ASSURANCE PARTNER

FOR OPTIMUM PLANT HEALTH

Key Highlights

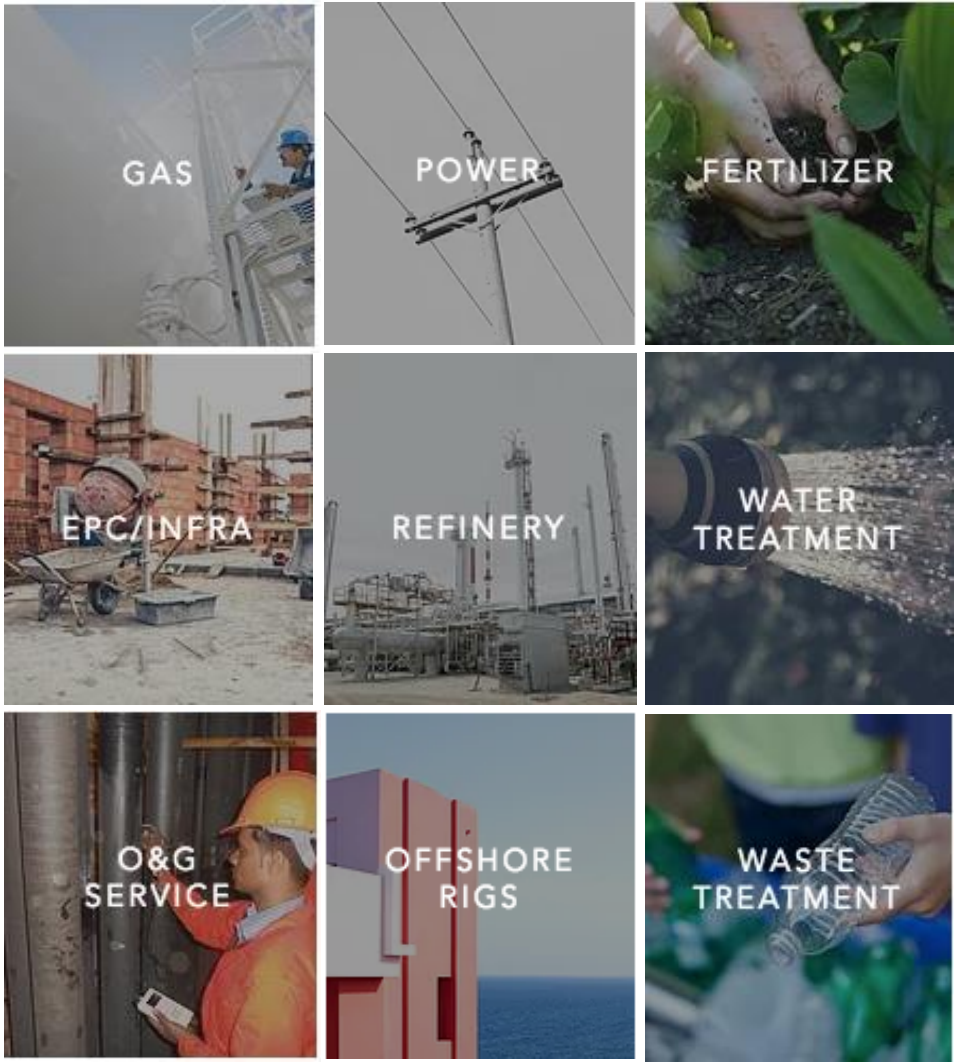
With over 50 years of experience, TCR has built a proprietary model of managing end to end inspection and advisory services and validate results as per ASTM, BS, IS and other international standards.

TCR ENGINEERING

OUR SOLUTIONS ARE TAILOR MADE FOR YOUR INDUSTRY VERTICALS

TCR offers an unparalleled perspective and extraordinary solutions that are relevant to the needs of the client. Staying away from the cookie cutter approach, TCR ensures that its offerings by comprehensive, actionable and bring about the necessary transformation for their customers.

TCR creates NDT techniques that target individual corrosion damages with the assistance of its expert team members that comprise of metallurgists, API plant inspectors, corrosion scientists, NDT level III and professionals from process, maintenance, and inspection department of plants.



For more information, visit us
www.tcreng.com

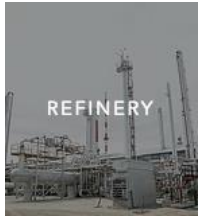
TCR ENGINEERING

INDUSTRY VERTICALS

REFINERY

Many among TCR's professionals are ex-employees of these global majors and have developed the competence to assess failures and fire damages in CDU/VDU, FCCU, hydrogen manufacturing, storage tanks, REAC, reactors, and their internals.

TCR's NDT and in-situ metallographic replica teams have undertaken several studies detecting metallurgical degradation, detachments/ fastener failures, creep, stress corrosion cracking, pitting, erosion, reheat cracking and fatigue-related damage mechanisms.



MARQUEE CLIENTS

Industry: Refinery

Reliance Industries Limited
Saudi Aramco
HMEL
IndianOil
Sasol
reaching new frontiers
ONGC
PETRONAS
Gulf Petrochem
Towards New Horizons
HP
BHARAT OMAN REFINERIES LIMITED
PEMEX
Bharat Petroleum
OPaL
CPCL

"The knowledge of the crew deployed at site, the quality of the replica's and the zeal and enthusiasm with which the crew completed the work is commendable and highly satisfactory."

U Anand, Vice President
RELIANCE INDUSTRIES LIMITED

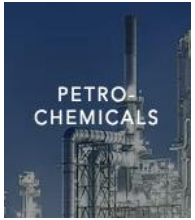
TCR ENGINEERING

INDUSTRY VERTICALS

PETRO-CHEMICALS

Qchem and Sabic depend on TCR to provide expertise in evaluating leaks, process upsets and failures that can occur in reactors, storage tanks & high-temperature transfer lines/acid.

TCR can gauge transfer line leaks, tank floor/bottom, creep, pitting, SCC, Erosion-corrosion, IGC, and fatigue-related damage mechanisms.



MARQUEE CLIENTS

Industry: Petro Chemicals

Reliance Industries Limited

سابك sabic

HALDIA PETROCHEMICALS LTD

المتقدمة Advanced
الشركة المتقدمة للبتروكيماويات
Advanced Petrochemical Company

BASF
We create chemistry

Qchem
شركة قطر للكيماويات المحدودة
QATAR CHEMICAL COMPANY LTD.

الصحراء للبتروكيماويات
sahara petrochemicals

TASNEE التصنيع

GUJARAT FLUOROCHEMICALS LIMITED

> **TCR also provided services on Remaining life Assessment of aged components by destructive analysis. We have got benefited by the getting Repair Weld Procedures of aged Incloly 800H header joints by TCR. We appreciate the enthusiasm and dedication of TCR Team members towards accepting such challenging assignments and provided us satisfactory services.**
>
> *B K Gupta, Vice President*
> **GODREJ INDUSTRIES LIMITED**

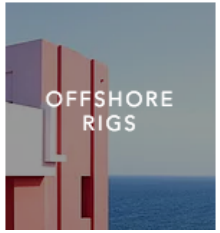
For more information, visit us
www.tcreng.com

TCR ENGINEERING

INDUSTRY VERTICALS

OFFSHORE RIGS

TCR can appraise tubing failures, fasteners, fatigue, seawater splashing, corrosion fatigue, pitting, crevice corrosion and cavitation corrosion related damage mechanisms.



MARQUEE CLIENTS

Industry: offshore Rigs

ऑयल इंडिया लिमिटेड
(भारत सरकार का उद्यम)
Oil India Limited
(A Government of India Enterprise)

ओएनजीसी
ONGC

ارامكو السعودية
Saudi Aramco

TCR has competence in evaluating failures that can occur in well bore piping, chain links, pumps/rotary equipment, and drilling rigs.

For more information, visit us
www.tcreng.com

TCR ENGINEERING

INDUSTRY VERTICALS

GAS

TCR aims at providing QGas assistance in evaluating Leaks/Failures and Catastrophic explosion that can occur in Storage spheres, terminal, jetty, and LT transfer lines.

TCR has conducted several studies across fastener failures and detection of corrosion under insulation, pitting, SCC and IGC related damage mechanisms.

MARQUEE CLIENTS

Industry: Gas

Hazira LNG & Port

BG GROUP

INDRAPRASTHA GAS LIMITED

PETRONET LNG LIMITED

"We appreciate the enthusiasm, quality of service and response to our queries, professional approach & dedication of TCR team members towards the assignment and provide is satisfactory services."

Pratapsing Parmar, Area Manager (TG Dept)
ESSAR PROJECTS

TCR ENGINEERING

INDUSTRY VERTICALS

O&G SERVICE

TCR has worked with clients like Halliburton, Schlumberger, Weatherford, enabling it to evaluate leaks, accidents, and failures that can occur in online tapping, drilling (tubes & beads) and manufacturing of tubes.

MARQUEE CLIENTS

Industry: O&G Service

HALLIBURTON

Weatherford®

Schlumberger

TCR can analyze tubing failures, drill line tooling failures, fatigue, corrosion fatigue, pitting and crevice corrosion related damage mechanisms.

TCR ENGINEERING

INDUSTRY VERTICALS
EPC/INFRA

Clients like L&T depend on TCR to evaluate the composition and WPS/PQR's weld strength using destructive testing including chemical analysis, CTOD and high/low temperature tensile and impact.

TCR has expertise in evaluating the mixing of materials, improper MTC/identifications, weld joint failures and improper PWHT that can occur in material inventory, welding consumables, tank bottoms, and truss. TCR conducts several studies across fasteners, lifting lugs, weld failures/cracking, MIC-microbiological influenced corrosion, reheat cracking and SCC related damage mechanisms.

MARQUEE CLIENTS
Industry: EPC/Infra

EIL · L&T · Nasser S. Al-Hajri Corp. · GAIL · Tekfen Construction · TATA · Linde · Technip · Bombardier · AFCONS Infrastructure Limited · Rasandik Passion For Excellence · ISGEC Heavy Engineering Ltd. · CCC · Godrej

> **Quality of Services, response to our queries, professional approach and experience of TCR's manpower deserves great appreciation.**
>
> *Aman Shah, Site Manager (Infra)*
> **Adani Projects**

For more information, visit us
www.tcreng.com

TCR ENGINEERING

INDUSTRY VERTICALS

POWER

TCR's Paresh Haribhakti has authored a book published by ASM on Boiler Failures. With in-depth knowledge of boiler tubes, outlet headers, main steam line, and turbine.

TCR undertakes in-line helium leak and hydrogen leak testing of condensers and generators.

TCR can undertake metallurgical and failure studies including FFS & RLA to evaluate BTL (boiler tube leaks), metallurgical degradation, creep, erosion, pitting, general corrosion, high-a hydrogen attack, and fatigue related damage mechanisms.

TCR's clients include MEW, SEC, GE, Alstom, Siemens among others.

MARQUEE CLIENTS

Industry: Power

torrent POWER

CGPL Coastal Gujarat Power Limited

الشركة السعودية للكهرباء Saudi Electricity Company

ALSTOM

SIEMENS

adani

THERMAX

एन एच पी सी NHPC

NAYARA ENERGY

> **The Management & Technical Team at the site appreciates the valuable & prompt services provided by the TCR Advanced technical team at site. We expect the same from your company for all our future projects.**
>
> *Abdul Hannan, QA/QC Manager*
> **GE ELECTRIC INTERNATIONAL, INC**

For more information, visit us www.tcreng.com

TCR ENGINEERING

INDUSTRY VERTICALS

WATER TREATMENT

TCR has proficiency in evaluating leaks and failures that can occur in pumping stations and transfer lines.

TCR can gauge transfer line leaks, tank floor/bottom, MIC, pitting, SCC, CUI, erosion, corrosion, and crevice corrosion related damage mechanisms.

MARQUEE CLIENTS

Industry: Water Treatment

METITO

Commitment to a Cleaner Environment

MINISTRY OF ELECTRICITY & WATER
STATE OF KUWAIT

المؤسسة العامة لتحلية المياه المالحة
Saline Water Converstion Corporation

Kirloskar

"TCR provided failure analysis services to Metito. Thank you very much for your support all the time."

Saifulla Ahmed, Senior Application Engineer
METITO OVERSEAS QATAR W.L.L.

For more information, visit us
www.tcreng.com

TCR ENGINEERING

INDUSTRY VERTICALS

FERTILIZER

Since 2012, TCR has provided metallurgical & engineering consulting to QAFCO for effectively assessing failure damages that occur in the reformer section, ammonia converter, ISR (isothermal shift reactor) and RGC (reform gas cooler).

TCR has undertaken several studies across failure in reforming section (reformer tubes) and has expertise in damage specific NDT to discover corrosion, erosion corrosion, cavitation, pitting, creep, IGC related damage mechanisms present in the plant.

MARQUEE CLIENTS

Industry: Fertilizer

GNFC

Oman India Fertiliser Co.

QAFCO
QATAR FERTILISER COMPANY

GUJARAT STATE FERTILIZERS & CHEMICALS LTD.

Zuari Agro Chemicals LTD

IFFCO

MCF
Mangalore Chemicals & Fertilizers Limited

Rashtriya Chemicals and Fertilizers Limited

INDORAMA
ELEME FERTILIZER & CHEMICALS

> **We sincerely thank TCR team for carrying out failure analysis in a very detail, systematic, methodical and scientific manner. The analysis not only highlights mode and various reasons of failure, but it also throws light on the operational aspects, which might have played an important role in the initiation and which might have been the main cause of the failure. This aspect will help us in taking preventive actions for future.**
>
> *M Y Joshi, Manager*
> **GUJARAT NARMADA VALLY FERTILIZERS COMPANY**

TCR ENGINEERING

INDUSTRY VERTICALS

WASTE TREATMENT

TCR is proficient in evaluating leaks and environmental hazards that can occur in Incinerator boilers and their tubing, transfer lines, scrubbers.

TCR can assess boiler shell plate failures, boiler tube failures, suction line failures, SCC, H2S corrosion, pitting, and cavitation corrosion-related damage mechanisms

Future of Quality Assurance

TCR is leading the new way of Quality Assurance by defining the future

TCR ENGINEERING

At TCR, we are continuously working towards improving our offerings to provide a better and a more efficient Quality Assurance for your Optimum Plant Health

Industry-specific Solution

- Plant and industry veterans with understanding of process/operations challenges
- Aware of the business risk versus failure probability
- Keeping abreast on new materials and plant items

Equipment-specific Solution

- Researching new techniques for inspection
- Constantly buying probes and accessories to ensure no downtime at site
- Train-the-trainer approach to spread knowledge

Problem-specific Solution

- Corrosion damage evaluation is a specialty
- Metallurgy is the core of all investigation
- Look at a problem through multiple angles

TCR ENGINEERING

OUR GLOBAL LOCATIONS

INDIA

TCR ENGINEERING SERVICES
EL–182 MIDC–TTC, Electronic Zone,
Mahape, Navi Mumbai–400710
Tel : +91-22-67380900
www.tcreng.com

TCR ADVANCED ENGINEERING
250-252/9, GIDC Estate, Makarpura,
Vadodara-390010, Gujarat, India
Tel: +91-265- 2657233, 2643024
www.tcradvanced.com

KSA

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P.O. Box-2899, Gas Gardens,
King Abdulaziz Seaport Facility,
Dammam-32211, KSA
Tel: +966-3-8475784
www.tcr-arabia.com

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Tel: +971-50-7858901
uae@tcreng.com

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#3, Al Emadi Building, Ras Bu Aboud
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T: +974 44354768
E: Qatar@tcreng.com
www.tcr-qatar.com

KUWAIT

TCR KUWAIT
kuwait@tcreng.com
www.tcr-kuwait.com

MALAYSIA

TCR MALAYSIA
C/O Approved Group International
No 6 Jalan DBP 3,
Dolomite Business Park,
68100 Batu Caves
Selangor, Malaysia
TEL: +603-6188 6311

TCR ENGINEERING

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MAIL US

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@TCRENG.COM

CALL US

+91.93233 97295

TO GET A QUOTE

MEET US

TCR ENGINEERING SERVICES
PLOT NO. EL-182, MIDC-TTC, ELECTRONIC ZONE, BEHIND NELCO, MHAPE, NAVI MUMBAI-400 710 MAHARASHTRA, INDIA

VISIT US

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ENGINEERING
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For questions, mail us at sales@tcreng.com
WWW.TCRENG.COM