OPTIMISING ASSET INTEGRITY

TCR ADVANCED

25 YEARS OF
EXCELLENCE

SERVICE PROFILE

TCR Advanced Engineering, is a global leader in Industrial Asset Integrity Management (AIM), providing comprehensive cutting edge solution for Asset Life-cycle Management, in a range of industrial sectors, including energy intensive, manufacturing, engineering and infrastructure

www.tcradvanced.com

List of Sections

5.2 Advanced NDT Services

5.3 Conventional NDT Services

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About Us

Established in 1999, TCR Advanced Engineering is a trusted partner in metallurgy, corrosion management, and engineering solutions. Our mission is to enhance asset performance, maximize productivity, and ensure safety while meeting global environmental and regulatory standards.

Headquartered in Vadodara and working closely with TCR Engineering Services, Mumbai, we bring expertise and innovation to solve complex industrial challenges. With over 9,000 investigations and 1,800 global clients, we excel in failure analysis, metallurgical consulting, advanced NDT, and corrosion assessment.

Backed by 500+ years of cumulative metallurgical expertise, our team delivers risk-mitigating, future-focused solutions that drive operational excellence worldwide. Through the EvolvebyTCR Training & Development Institute, we also empower professionals with cutting-edge knowledge and skills.

As a global leader in asset integrity and metallurgical excellence, TCR Advanced Engineering is committed to building a safer, more efficient, and sustainable industrial future.

3.5K +	150 +	180 +	350 +
Number of Clients Served	Service Offered	Total Number of Employee	Total Number of Fitness for Services
750 +	9K +	2.5L +	6L +
Total number of Remaining Life Assessment	Total Number of Investigation	Total Number of Metallography	Total Number of Sample Tested

VISION

To be a global benchmark in delivering advanced engineering solutions.

To drive operational excellence, asset integrity, and sustainable growth across industries.

To lead through continuous innovation, offering transformative, industry-leading technologies.

To set new standards in reliability, performance, and engineering excellence.

To empower professionals via world-class training, talent development, and knowledge sharing.

To foster a resilient, future-ready industrial ecosystem through trusted partnerships.

To measure success by the value co-created with every client.

MISSION

To deliver world-class, innovative, and reliable engineering solutions.

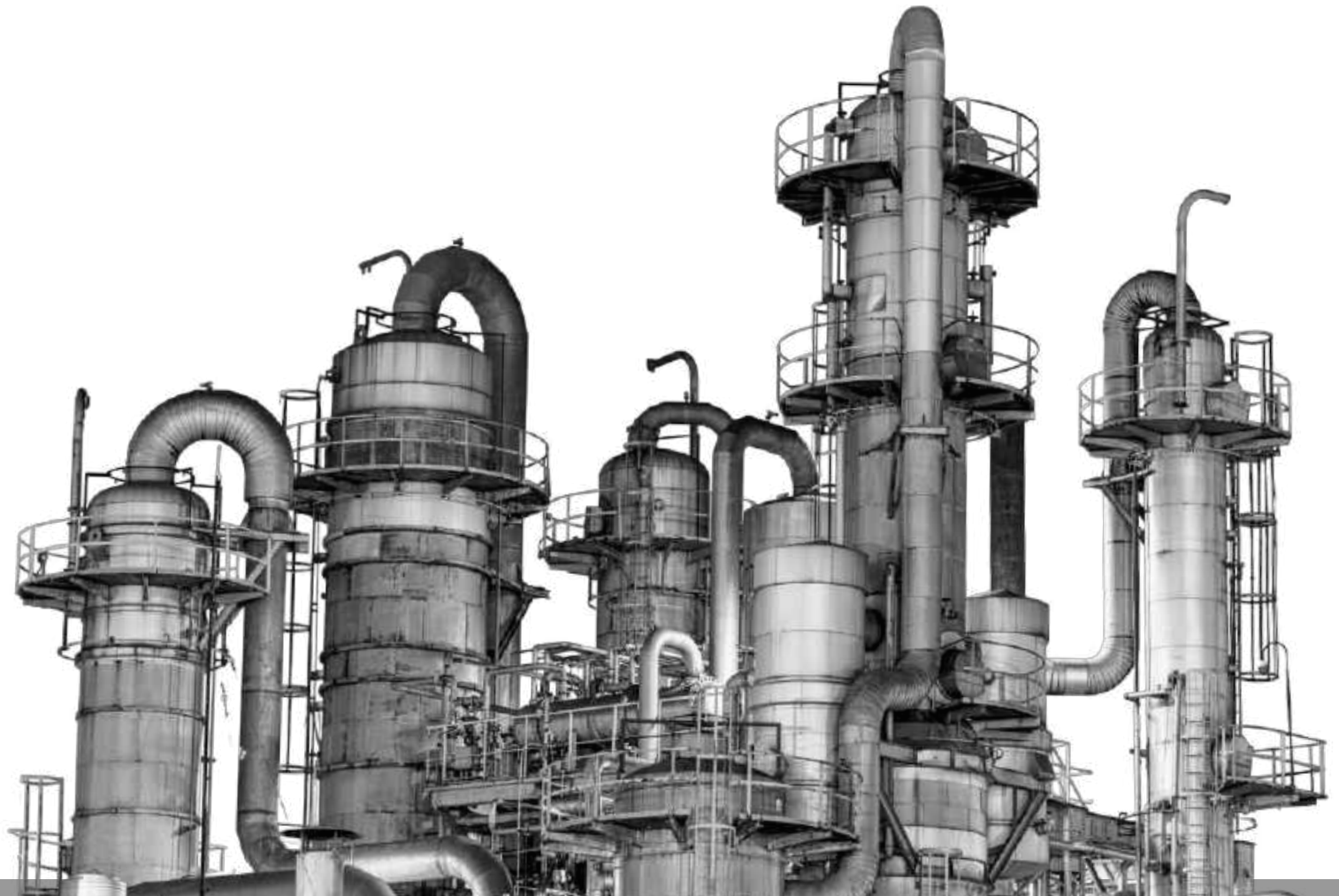
To address industry-, problem-, and equipment-specific challenges with precision.

To ensure uninterrupted asset operations, maximize productivity, and enhance operational safety.

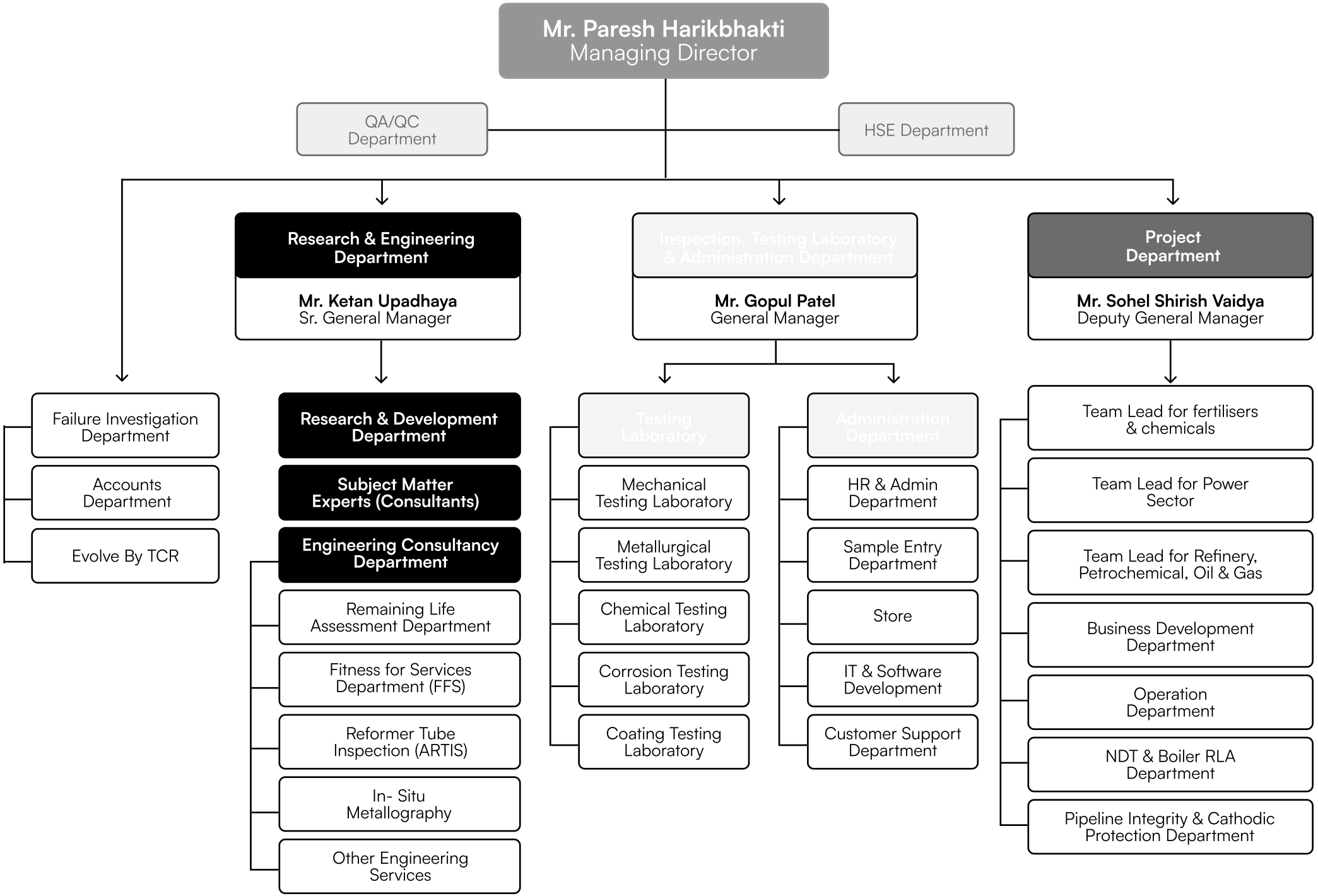
To uphold global quality and environmental standards in every engagement.

To empower clients through technical expertise and advanced technologies.

To create measurable value and drive operational excellence across industries.



ORGANIZATION CHART OF TCR ADVANCED ENGINEERING


Mr. Paresh Harikbhakti
Managing Director
QA/QC Department
HSE Department
Failure Investigation Department
Accounts Department
Evolve By TCR
Research & Engineering Department
Mr. Ketan Upadhaya
Sr. General Manager
Research & Development Department
Subject Matter Experts (Consultants)
Engineering Consultancy Department
Remaining Life Assessment Department
Fitness for Services Department (FFS)
Reformer Tube Inspection (ARTIS)
In- Situ Metallography
Other Engineering Services
Inspection, Testing Laboratory & Administration Department
Mr. Gopul Patel
General Manager
Testing Laboratory
Mechanical Testing Laboratory
Metallurgical Testing Laboratory
Chemical Testing Laboratory
Corrosion Testing Laboratory
Coating Testing Laboratory
Administration Department
HR & Admin Department
Sample Entry Department
Store
IT & Software Development
Customer Support Department
Project Department
Mr. Sohel Shirish Vaidya
Deputy General Manager
Team Lead for fertilisers & chemicals
Team Lead for Power Sector
Team Lead for Refinery, Petrochemical, Oil & Gas
Business Development Department
Operation Department
NDT & Boiler RLA Department
Pipeline Integrity & Cathodic Protection Department

MILESTONE GALLERY

1999
2025

1999-2000

- TCR Advanced was founded by the respected Bafna and Haribhakti families, starting with a used microscope and a vision for excellence in Metallography and Failure Analysis.

2001-2005

- Launched Testing Division and began offering NDT services.
- Secured first major domestic/international project (OGS, Iraq).
- Debuted in industrial exhibitions.
- Developed MIC software for metallurgical analysis.

2006-2010

- Set up Corrosion & Chemical Testing facilities.
- Completed key projects at Reliance (fire damage) and Godrej (plant assessment).
- Achieved NABL accreditation across four domains.
- Surpassed 1,000 failure investigations.

2011-2015

- Developed ARTIS robotic crawler.
- Became Gujarat's first NABL-accredited NDT lab.
- Installed India's first private-sector SEM.
- Moved HQ to Makarpura, Vadodara.
- Recognized as a "Well-Known Laboratory" by Central Boilers Board.

2016-2020

- Delivered testing for Statue of Unity project.
- Launched "Evolve by TCR" training arm.
- Developed AiOM software for asset management.
- Received key contracts from BPCL and HPCL.
- Boiler Tube Failure book published by ASM International.

2021-2025

- Expanded with new divisions in Engineering, NDT & Research.
- Opened Bharuch and Bhubaneswar branches.
- Won major international projects in Kuwait (NBTC) and Abu Dhabi (EM Steel).
- Launched Pipeline Integrity & Cathodic Protection services.

OUR SERVICES

5.1 Engineering Consultancy Services

1. Failure Analysis

TCR Advanced provides reliable, unbiased, and accurate root cause analysis (RCA) that is accepted across various industries, including oil & gas, refinery, petrochemical, fertilizers, power, engineering, defence, aviation and insurance. With over 9000 investigations completed, TCR offers exceptional expertise in metallurgical failure analysis. Their assessments of both static and rotary equipment are trusted globally for critical evaluations. As recognized industry leaders, TCR's findings contribute to safer and more informed operational decisions.

A) Metallic Components

We provide expert failure analysis of metallic components to identify the root causes behind premature failures. Using advanced techniques such as Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDS), fractographic analysis with use of advanced metallography including colour metallography, we investigate cracks, corrosion, wear, brittle and fatigue failures. Our approach includes material characterization, mechanical property evaluation, and a detailed review of service history and design parameters and FEA. Each analysis concludes with a root cause identification and tailored corrective action plan. We help clients reduce recurring failures, improve reliability, and ensure compliance with standards. Reports are supported by evidence and recommendations for material upgrades or process modifications. This service supports both failure prevention and litigation or insurance investigations.

B) Non-Metallic Components

Our failure analysis for non-metallic components covers polymers, composites, ceramics, rubber, and FRP/GRP systems. These materials often degrade due to UV exposure, chemical attack, thermal aging, or improper design. We use a combination of mechanical testing, spectroscopy, microscopy, and thermal analysis to understand the cause of failure. Case studies often include pipeline linings, seals, tanks, insulators, and gaskets. Our team evaluates the interaction of service environment and material limitations to recommend improvements. We also assess processing or manufacturing flaws, such as incomplete curing or contamination. Findings help reduce downtime, enhance performance, and avoid future reliability risks. This service is critical for industries using advanced

2. Remaining Life Assessment of Process Plant Components

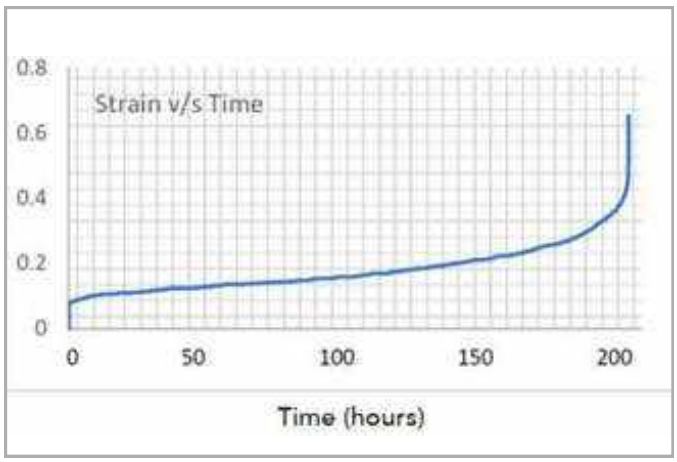
Our RLA services evaluate the structural and metallurgical condition of critical components/equipment in service to estimate their remaining useful life. Using advanced non-destructive testing (NDT), creep and fatigue damage assessment, and metallographic analysis, we determine the integrity of vessels, heat exchangers, piping, and rotating equipment. We incorporate operating history, design conditions, and degradation mechanisms to develop a life estimation model. This proactive approach supports asset management, turnaround planning, and safety assurance. Our RLA methodology aligns with industry standards and regulatory codes such as ASTM, API and IBR guidelines. With a focus on minimizing unplanned shutdowns, we help plants operate efficiently while avoiding catastrophic failures.

3. Remaining Life Assessment of Boilers (IBR and international guidelines)

Our boiler RLA services help plant operators assess the condition of boiler pressure parts and estimate remaining safe service life. We evaluate superheaters, reheaters, water walls, and headers using ultrasonic testing, oxide scale thickness measurement, hardness profiling, and metallographic replication. Creep and fatigue evaluations are conducted for high-temperature areas prone to damage. Our approach includes review of design data, operating parameters, and historical maintenance records. We identify damage mechanisms such as creep, corrosion, erosion, and thermal fatigue. This service allows for cost-effective maintenance scheduling, component replacement planning, and safe operation extension. Final reports include recommendations for repair, inspection intervals, and life extension strategies. Our assessments conform to national and international standards such as IBR and ASME.

4. Life Assessment Based on Omega Method (ACRT)

Our Life Assessment service using the Omega Method offers a premier, data-driven approach to predict the remaining creep life of components operating in high-temperature environments. This advanced technique relies on Accelerated Creep Rupture Testing (ACRT) performed on representative samples taken directly from in-service equipment, such as boiler waterwall or superheater tubes and components from refinery heaters. The resulting creep strain data is then analysed using the sophisticated Omega model to accurately forecast material degradation and predict the remaining time to rupture. This provides a more precise and reliable life assessment than conventional calculations, empowering clients with the critical insights needed for optimised maintenance planning, safe operational life extension, and prevention of catastrophic failures

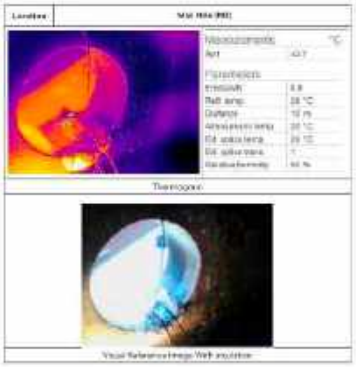


5. Knowledge-Based Audit for Power Plants

In the current era of challenging operational philosophies aimed at integrating renewable energy generation into the grid, the reliability of boilers and associated piping systems remains the cornerstone of coal-fired power plant performance. However, boiler tube failures (BTFs) continue to be the leading cause of forced outages, unplanned downtime, and efficiency losses. TCR Advanced Engineering's proprietary Knowledge-Based Audit (KBA) methodology; is the foundational activity preceding RLA provides a conceptual framework for damage mechanism—based diagnostics, demonstrating that boiler efficiency losses are not solely thermodynamic in nature but are intrinsically linked to metallurgical degradation of materials. Leveraging insights from over 1,500 boiler tube failure investigations and 500+ remaining life assessments (RLAs), this approach integrates metallurgical evaluations with operational and NDT data to proactively identify and mitigate high-risk failure mechanisms in both sub-critical and super-critical boilers

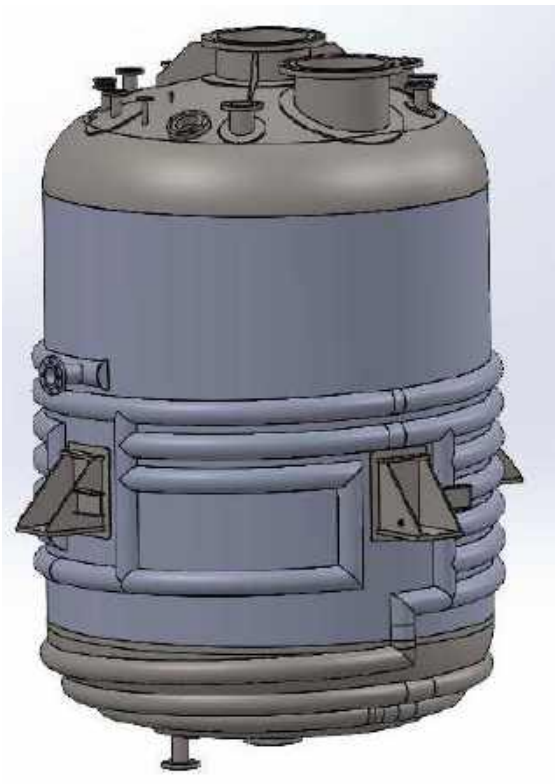
6. Remaining Life Assessment of FRP/GRP Tanks

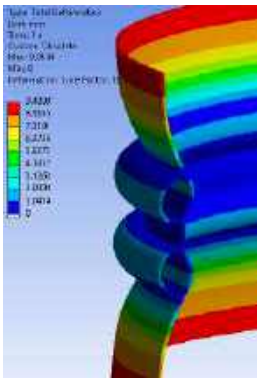
We offer specialized RLA services for FRP (Fibre Reinforced Plastic) and GRP (Glass Reinforced Plastic) tanks and piping systems. These composite structures are prone to aging, chemical degradation, delamination, and mechanical failure over time. Our evaluation involves visual inspection, ultrasonic testing, thermal analysis, laminate thickness verification, and structural stress analysis. We assess resin integrity, fiber damage, and compatibility with stored chemicals. Our approach helps identify early signs of failure and potential risks to operations or the environment. We deliver accurate predictions on remaining service life, with practical recommendations for repair, maintenance, or replacement. Our assessments support compliance with environmental and industry regulations, ensuring safe, long-term use of composite storage systems.

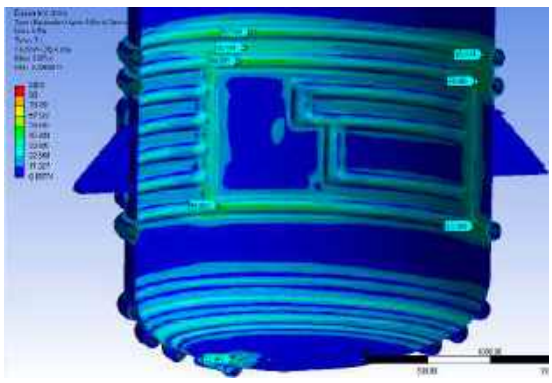


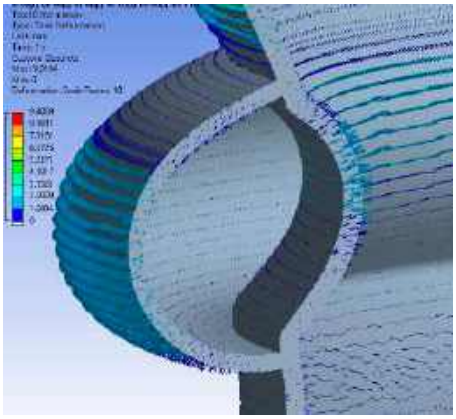
7. Fitness For Service (FFS) Assessment

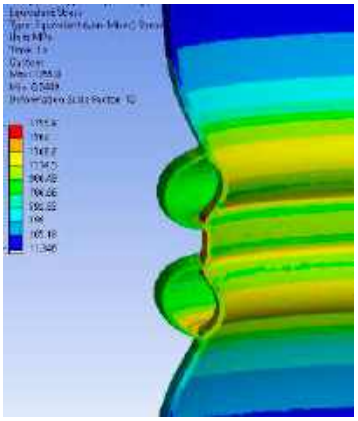
FFS assessments are critical for evaluating damaged or aged equipment to determine if it can safely continue in service. We follow API 579-1/ASME FFS-1 standards to assess flaws such as corrosion, dents, cracks, deformation, and other anomalies. Our multidisciplinary evaluation includes stress analysis, material degradation assessment, and fracture mechanics. We offer all three levels of FFS assessments—Level 1 (screening), Level 2 (simplified engineering), and Level 3 (detailed analysis)—based on the complexity and criticality of the equipment. We consider operational conditions, past repairs, and inspection data to deliver a precise and reliable fitness evaluation. Whether it's pressure vessels, tanks, or piping systems, our FFS service supports informed decisions on repair, continued operation, or replacement. This service helps avoid unnecessary shutdowns and enhances safety, reliability, and regulatory compliance. Final reports include detailed engineering analysis, risk categorization, and actionable recommendations. TCR Advanced has successfully completed more than 700 FFS studies across refinery, petrochemical, fertilizer, power, and other process industries.











8. Fire Damage Assessment

Post-fire evaluations are essential to determine the structural integrity and usability of affected equipment and structures. We conduct a comprehensive assessment including temperature exposure mapping, hardness testing, metallographic examination, and deformation analysis. Our experts identify the extent of thermal damage and material degradation due to high heat and oxidation. We evaluate tanks, piping, support structures, and machinery to assess their fitness for continued service or need for replacement. The report includes clear recommendations, damage classification, and suggestions for repair or reconstruction. This service is essential for insurance claims, regulatory compliance, and rapid restoration of operations after a fire event. Our methodology adheres to standards such as API 579-1/ASME FFS-1 (Part 11).

9. Engineering Critical Analysis (ECA) as per API-1104

ECA is a fracture mechanics-based technique used to evaluate flaws and defects in pressure-retaining components. It determines whether a defect, such as a crack or corrosion pit, poses a risk to the structural integrity of equipment. We apply finite element analysis (FEA), material toughness data like CTOD, and operating stress calculations to assess the acceptability of flaws. ECA is used for pipelines welds. Our analysis helps avoid unnecessary repairs and supports safe operation by quantifying failure risk. ECA is often integrated with inspection programs to prioritize repairs and plan maintenance. It ensures safety and compliance without compromising efficiency.

10. Structural Stability Assessment & Certification

We conduct structural stability assessments of industrial structures, buildings, chimneys, stacks, equipment supports, walkways, and platforms. Our evaluations include on-site inspection, load testing, stress-strain analysis, and review of structural drawings. We identify potential issues like corrosion, settlement, fatigue, and overloading. Our engineers provide recommendations for repairs, retrofitting, or reinforcement, ensuring structural integrity under operational and environmental loads. We also offer certification of stability as per regulatory requirements and codes such as IS, ASME. This service ensures safety of personnel, operational continuity, and regulatory compliance. Reports are detailed, including CAD-based structural models, load assessments, and risk mitigation strategies.

11. Engineering Design Review

Our engineering design review services focus on verifying structural soundness, functionality, safety, and compliance of designs before construction or fabrication. We perform detailed checks on design calculations, material selections, load paths, and code compliance across mechanical, structural, and piping systems. Our multidisciplinary team identifies inconsistencies, overdesigns, and potential failure points, helping avoid costly rework or operational issues. We also validate drawings, P&IDs, and stress analysis reports, ensuring they meet both client specifications and international standards such as ASME Section VIII Div. 1 & 2, ASME B31.1/B31.3 and API 650/620, standards. The review process is consultative, promoting better design practices and enhancing constructability and maintainability. Our design validation adds an extra layer of assurance for critical projects, especially in oil & gas, power, and process industries. This service supports safer execution, better risk management, and lifecycle cost optimization

12. Risk-Based Inspection (RBI) Assessment — API 580/581

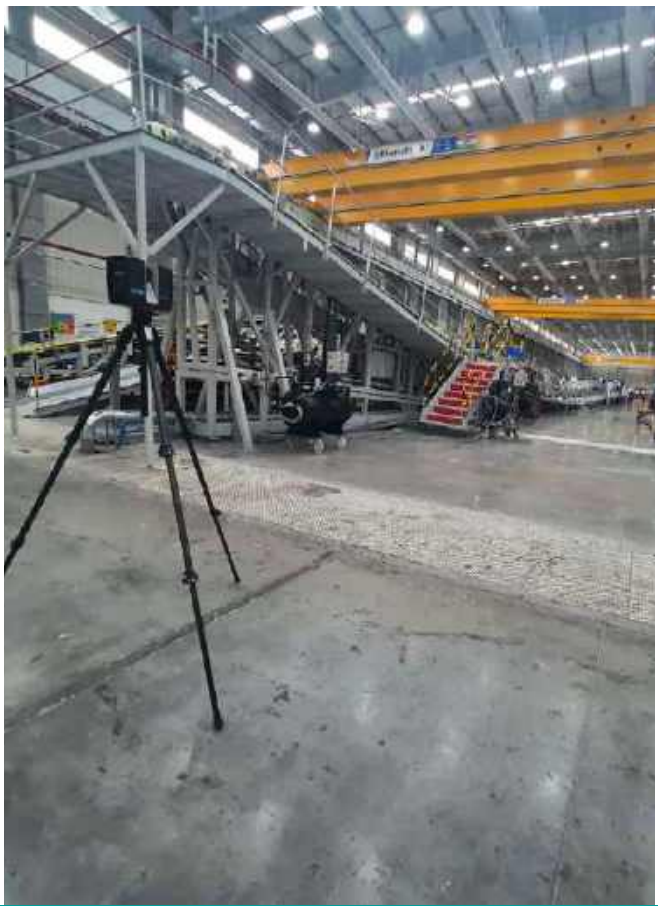
We provide Risk-Based Inspection (RBI) assessments based on API 580/581 to optimize inspection plans by prioritizing assets with higher risk profiles. Our approach involves detailed evaluation of degradation mechanisms, failure probabilities, and potential consequences. This data-driven method reduces unnecessary inspections while focusing resources where they matter most. We assess static and rotating equipment, storage tanks, piping systems, and pressure vessels. Our RBI software tools and customized algorithms generate inspection intervals and risk matrices, enhancing decision-making and compliance. The outcome is a cost-effective, safety-driven inspection plan that aligns with reliability goals. RBI implementation also aids in asset integrity management, prolonging equipment life and ensuring regulatory alignment.

13. Asset Integrity Management (AiOM Tool)

We offer a comprehensive Asset Integrity Management (AIM) solution using our proprietary AiOM tool. This software-based framework integrates inspection, maintenance, corrosion monitoring, risk assessment, and documentation into a centralized platform. Our approach ensures that all critical assets operate safely and efficiently throughout their lifecycle. AiOM supports real-time tracking of inspection schedules, failure modes, and health indices of equipment. We also provide training and implementation support to align AIM strategies with plant goals. The tool enables data-driven decision-making, improves operational planning, and helps maintain compliance with industry standards. Our solution is scalable for process plants, refineries, utilities, and offshore installations. Ultimately, our AIM service reduces downtime, enhances safety, and protects long-term asset value.

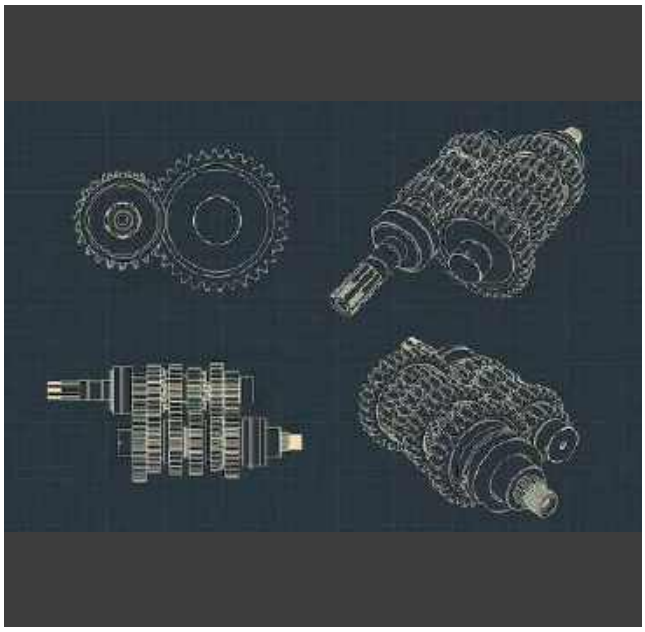
14. 3D Laser Scanning & Digital Documentation

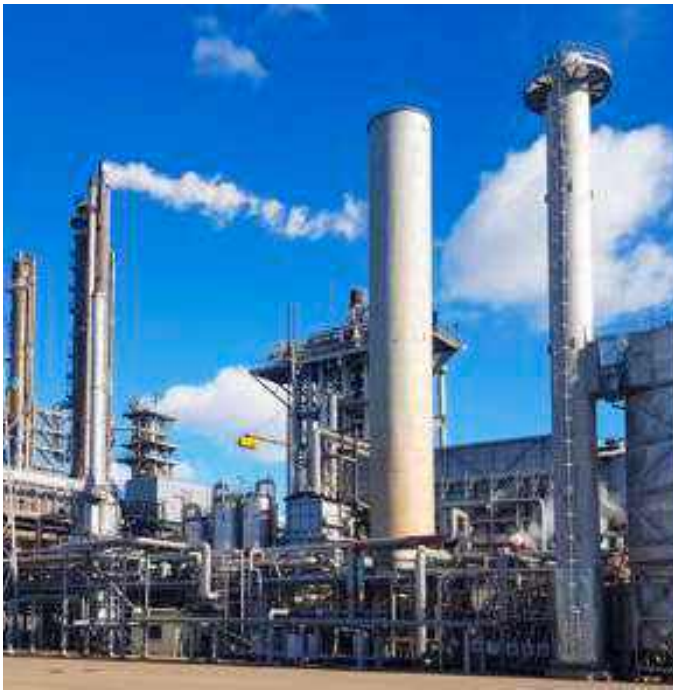
Our 3D laser scanning services provide highly accurate digital capture of existing facilities and equipment. Using advanced LiDAR technology, we create point clouds and 3D models for as-built documentation, revamp planning, and reverse engineering. These models help visualize complex structures, identify clashes, and streamline retrofit or modification projects. We also offer integration with CAD/BIM platforms, enabling precise dimensional analysis and design validation. The digital documentation supports efficient planning, faster approvals, and fewer errors during execution. It's ideal for brownfield projects, maintenance planning, and heritage documentation. Our scanning services reduce manual measurement errors, improve safety, and deliver cost savings by minimizing rework. The output includes 3D models, drawings, and walkthroughs tailored to client needs.



15. Technical Support for Indigenization / Localization

We support industries in reducing import dependency through comprehensive technical assistance in indigenization and localization of critical components. Our services include reverse engineering, design validation, performance benchmarking, and material compatibility assessment. We help identify capable local vendors, assist in prototype development, and ensure compliance with functional and safety standards. By collaborating closely with clients and manufacturers, we enable cost-effective sourcing without compromising quality. Our team also performs life cycle analysis and quality audits to ensure successful integration of localized components into existing systems. This initiative is crucial for defence, aerospace, power, and heavy industry sectors seeking to enhance self-reliance.





16. Material Selection & Vendor Audit

We assist clients in selecting appropriate materials based on operating environments, mechanical requirements, corrosion exposure, and industry standards. Our expertise spans ferrous and non-ferrous alloys, polymers, composites, and advanced coatings. Material selection is guided by service conditions such as temperature, pressure, and chemical exposure. We also offer vendor audits to ensure suppliers meet quality, specification, and manufacturing standards. This includes reviewing raw material sources, quality systems, process capabilities, and previous performance. Our audits help prevent failures due to poor material quality or inadequate fabrication. Clients benefit from improved supply chain reliability, reduced procurement risk, and enhanced product performance. This service is vital during project execution, equipment replacement, and localization efforts.

17. Electrochemical Studies for Material Selection & Corrosion Behaviour

Electrochemical studies are critical for understanding material behaviour in corrosive environments. We perform potentiodynamic polarization, electrochemical impedance spectroscopy (EIS), and cyclic voltammetry to evaluate corrosion rates and mechanisms. These tests help predict long-term performance and support material selection for aggressive conditions, including sour service, marine exposure, and high-chloride environments. We simulate actual service conditions to offer realistic data for selecting metals, alloys, and protective coatings. Our results guide design modifications and preventive strategies to minimize corrosion-related failures. Industries such as oil & gas, chemical, and marine greatly benefit from our insights. We also assist in failure analysis and R&D for new material development. The outcome: informed, cost-effective, and durable material solutions.

18. Cathodic Protection

We design and implement Cathodic Protection (CP) systems to safeguard metallic structures from corrosion. This includes both Sacrificial Anode and Impressed Current CP systems, tailored for pipelines, storage tanks, marine structures, and underground assets. Our services begin with soil resistivity surveys and corrosion potential mapping, followed by system design and installation. We also perform regular monitoring and troubleshooting of existing systems to ensure optimal performance. CP is often used in conjunction with coatings for extended protection. Our team ensures systems meet standards such as NACE, DNV, and ISO. This preventive approach significantly extends asset life, reduces maintenance costs, and ensures regulatory compliance. It's a critical solution for long-term corrosion control in harsh environments.

19. Advanced SEM & EDS

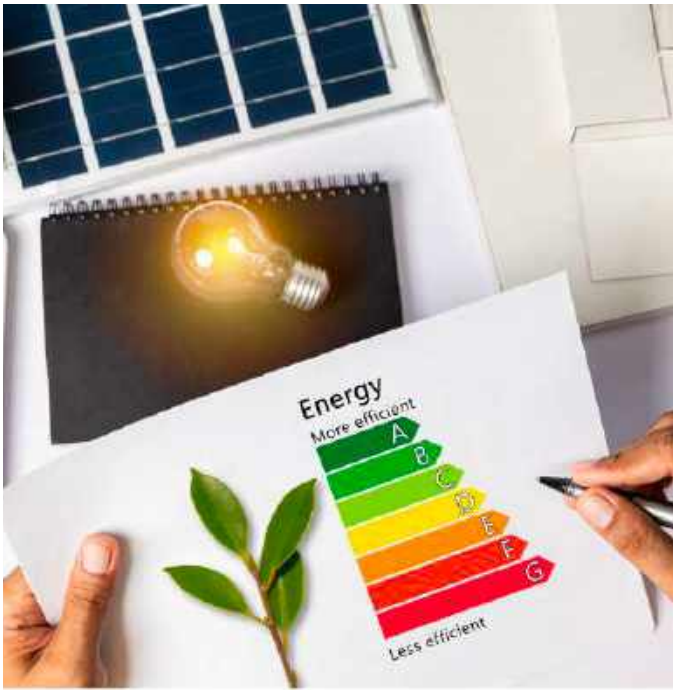
Our advanced Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS) services offer high-resolution imaging and elemental analysis at the micro and nano scale. These tools are essential in material characterization, failure analysis, and quality assurance. SEM reveals surface morphology, fracture patterns, and microstructural features such as grain boundaries and inclusions. EDS identifies elemental composition, enabling the detection of contaminants, corrosion products, and material deviations. We analyse metals, alloys, ceramics, coatings, and non-metallics to support industries ranging from aerospace to electronics. The precision and depth of these analyses lead to accurate root cause identification and improved product reliability. Our lab capabilities ensure high-quality data that support critical decisions in design, manufacturing, and R&D.

20. Critical Weld Solutions & Repair Methodology

Our Critical Weld Solutions and Repair Methodology service provides engineered, code-compliant procedures as per ASME Sec IX. This service can also integrate to core services of failure analysis, metallurgical evaluation, and Fitness-For-Service (FFS) assessment to develop a robust repair strategy. A help in preparing detailed Weld Procedure Specification (WPS) based on coupon tests and welder qualifications, that covers material selection, pre- and post-weld heat treatments, and welding techniques tailored to the specific application. All repairs are subsequently validated using advanced NDT methods to ensure they meet stringent industry standards such as ASME and API. This service offers a cost-effective alternative to component replacement, safely extends asset life, and ensures the continued reliability of critical equipment like pressure vessels, piping, and reactors.

21. Specialized Metallography

Our specialized metallography services offer detailed microstructural analysis to support failure investigations, material characterization, and quality control. We examine grain structures, phase distribution, inclusions, heat treatment effects, and weld zones using optical and electron microscopy. Techniques include macro-etching, micro-etching, and sample preparation for both ferrous and non-ferrous materials. We assess structural degradation such as creep cavitation, carbide precipitation, corrosion attack, and phase transformations. This analysis plays a vital role in determining root causes of failure, verifying material conformity, and predicting component behavior under service conditions. Our metallographic evaluations are aligned with ASTM and ISO standards. We also support R&D and material development through customized studies. This service ensures a deeper understanding of material integrity, guiding decisions on repair, replacement, or continued use.



22. Energy Audit

We conduct comprehensive energy audits for industrial plants, utilities, and commercial facilities to identify energy losses and recommend efficiency improvements. Our audits cover electrical systems, thermal processes, HVAC, lighting, and compressed air systems. We assess equipment performance, load distribution, energy consumption trends, and heat recovery opportunities. Using advanced tools and data analytics, we pinpoint inefficiencies and quantify potential energy savings. Recommendations include retrofits, process optimization, and integration of renewable energy sources. The outcome is reduced operational costs, improved energy intensity, and enhanced sustainability. Our reports support green certification, regulatory compliance, and ESG goals. Energy audits also help in benchmarking and achieving government or industry energy-saving mandates.

23. Plant Life Extension

Our Plant Life Extension (PLE) services help facilities operate safely and efficiently beyond their original design life. We assess the condition of critical equipment and systems using a combination of mechanical, metallurgical, and operational data. This includes stress analysis, creep/fatigue evaluations, corrosion mapping, and structural inspections. We identify aging-related degradation mechanisms and develop strategies to manage them. Our multidisciplinary team delivers detailed life extension plans covering upgrades, replacements, inspection intervals, and risk mitigation. We ensure compliance with industry standards and regulatory guidelines while minimizing downtime and cost. The service is ideal for power plants, refineries, chemical plants, and manufacturing units looking to maximize asset value. Our goal: safe, reliable, and extended plant operation with optimized lifecycle costs.

II. Advanced NDT

24. Advanced Robotic Solution.

TCR Advanced delivers cutting-edge Advanced Robotic Solutions that enhance industrial inspections with automation, precision, and safety. Engineered for extreme conditions, our robots reduce human exposure, minimize downtime, and provide accurate, real-time data. With advanced sensors and analytics, they're ideal for petrochemical, power, and heavy industries. Trust TCR for efficient, standards-compliant, and reliable robotic inspections.

24.1 Automated Reformer Tube Inspection System (ARTiS).

TCR's indigenously developed Automated Reformer Tube Inspection System (ARTiS) is a robotic crawler that revolutionizes ultrasonic inspection of reformer tubes by eliminating the need for scaffolding and manual access. Capable of climbing up to 14 meters, ARTiS performs high-resolution data capture. ARTiS (Automated Reformer Tube Inspection System), is an innovative combination of inspection methodologies designed to precisely evaluate the remaining creep life of reformer and cracker tubes used in heater applications across refinery, petrochemical, and fertilizer sectors.

Our expert team conducts comprehensive tube inspections and metallurgical evaluations, which enabled accurate marking of tubes to be recommended for replacement and allowing tubes fit for service to continue in operation even after their original design life. This proactive approach ensures uninterrupted plant operations until the next scheduled shutdown, avoiding costly unplanned breakdowns.

Key highlights of ARTiS services:

- Precise detection and evaluation of creep damage in reformer and heater tubes.
- Assessment tailored for diverse metallurgy including high-performance nickel-chromium alloys.
- Support for life extension decisions critical to plant safety and reliability.
- Means to optimize maintenance planning and reduce operational risks.

24.2 Robotic Inspection of Tanks

TCR Advanced's robotic tank inspection services deliver safe, efficient, and comprehensive evaluations of storage tanks without the need for human entry. Utilizing magnetic crawler robots equipped with ultrasonic testing and high-definition cameras, we inspect tank floors, walls, and roofs. These systems navigate vertical and horizontal surfaces and operate in wet or sludge-filled environments. Our solutions eliminate the need for scaffolding, entry permits, and confined space risks. Data collected includes corrosion mapping, weld integrity, and wall thickness analysis. The inspection is digitized, with 3D modelling and cloud-based reporting for instant review. Robots operate in flammable and hazardous atmospheres including fuel / diesel tanks with ATEX / IEC / PESO certified explosion-proof ratings. Downtime is significantly reduced.

24.3 Robotic Inspection of Boiler tubes

Robotic boiler tube inspections by TCR Advanced are engineered for safe, accurate, and fast assessment of internal boiler tube conditions, especially in ambient-temperature and limited-accessibility. Using tracked crawler robots with pan-tilt cameras and ultrasonic sensors, the system detects erosion, pitting and wall thinning. Robots are capable of navigating straight tube paths across the water walls. Inspections are non-invasive and can often be performed during shutdown. Real-time defect visualization and mapping enhance decision-making and maintenance planning. TCR Advanced ensures reliability through precision robotics.

25. Advanced Visual Inspection

TCR Advanced offers Advanced Visual Inspection solutions that combine high-definition imaging with intelligent analytics to deliver precise assessments of critical assets. These techniques enhance visibility into hard-to-reach areas, reduce inspection time, and improve safety of plant Assets. Ideal for various industrial environments, they support proactive maintenance and ensure compliance with Industrial standards.

25.1 Videoscopy

TCR Advanced utilizes cutting-edge videoscopy technology to inspect confined and complex internal areas with precision and clarity—even in the most challenging industrial environments. Our fleet of 18 high-resolution video borescope units, operated by expert technicians, works round the clock to support critical industries such as power, oil & gas, petrochemicals, and fertilizers.This minimally invasive inspection technique enables real-time, high-definition visual assessments of critical components like heat exchangers, turbines, boiler tubes, and piping systems, all without requiring costly disassembly. It is instrumental in the early detection of corrosion, cracks, weld flaws, and foreign object damage, helping plants avoid unplanned shutdowns and extend equipment life.

25.2 Drone Inspection

Our drone inspection service provides aerial access to tall, large, or hazardous structures such as stacks, tanks, and flare systems. Equipped with HD and thermal cameras, drones capture detailed visuals quickly and safely. This eliminates scaffolding, reduces downtime, and enables real-time condition monitoring in high-risk zones.

25.3 Thermography

Thermographic inspection uses advanced infrared cameras to detect temperature anomalies across equipment surfaces, identifying issues like overheating, insulation failures, and electrical faults. TCR's thermal imaging technology supports preventive maintenance by capturing real-time heat signatures, even in live operational environments, ensuring safer and more efficient asset performance.

26. Advanced Ultrasonic Based NDT Inspection

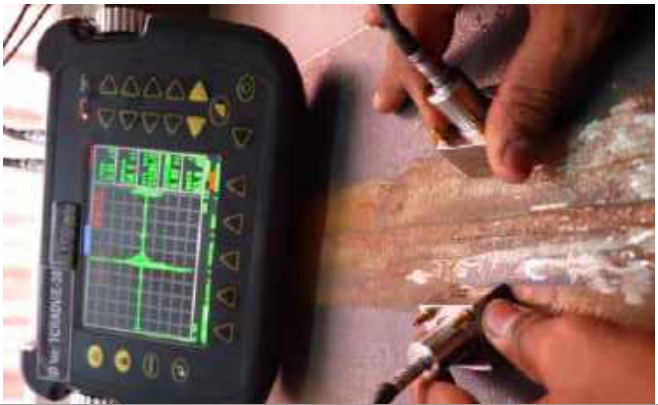
TCR Advanced provides a comprehensive suite of Advanced Ultrasonic NDT services, leveraging state-of-the-art technology to perform highly accurate volumetric inspections. These methods go beyond conventional ultrasonic testing by utilizing sophisticated techniques like multi-element probes, digital signal processing, and specialized wave physics to enhance the detection and characterization of internal flaws. From high-resolution weld inspections using Phased Array (PAUT) and Time of Flight Diffraction (TOFD) to the long-range screening of pipelines with LRUT and assessing non-metallic materials with MAUT, our services provide a detailed, three-dimensional view of a component's integrity. This allows for precise defect sizing and reliable data, which are essential for making critical fitness-for-service and remaining life decisions.

26.1 Matrix Array Ultrasonic Testing (MAUT)

Matrix Array Ultrasonic Testing (MAUT) is an advanced non-destructive testing technique offered by TCR Advanced, specifically suited for the inspection of non-metallic materials such as FRP, GRP, carbon fibre and other composite structures. Utilizing a two-dimensional matrix of ultrasonic elements, MAUT enables high-resolution imaging and accurate detection of internal flaws, delaminations, voids, and discontinuities within complex laminate structures. Its ability to scan irregular surfaces and deliver volumetric data in real time makes it an ideal solution for assessing the structural integrity of non-metallic components used in critical applications. TCR's capability in deploying MAUT ensures reliable diagnostics and comprehensive reporting, supporting enhanced asset integrity and preventive maintenance strategies across industries such as aerospace, chemical, and renewable energy.

26.2 Time of Flight Diffraction (TOFD)

TOFD is a high-resolution ultrasonic technique used to detect and size internal cracks with exceptional accuracy. Utilizing diffracted waves instead of reflected ones, TOFD delivers precise flaw depth and length measurements. It's especially effective in weld inspections and critical component evaluations.



26.3 Phased Array Ultrasonic Testing (PAUT)

PAUT uses multiple ultrasonic beams steered electronically to inspect complex structures and welds with high-speed, detailed imaging. It allows for real-time scanning, defect sizing, and visualization of internal flaws, significantly improving the accuracy and efficiency of inspections.

26.4 TOFD & PAUT as combined Inspection

Restrictions on the use of industrial radiography has increased in recent times due to health hazards, hence the need for alternative weld inspection methods and techniques such as Time of Flight Diffraction (TOFD) and Phased Array Ultrasonic Testing (PAUT) have become indispensable. NDE has become more relevant in recent times due to its ability to assess the flaws accurately. Along with sizing of flaw, characterization of flaw is also very important. Hence, the combination of TOFD and phased array techniques have become a need.

When PAUT and TOFD techniques are judiciously performed together, the quality of testing increases when compared with radiography, i.e. the integrity of weld joints inspected with TOFD or PAUT is higher than those inspected using radiography. At times the combined inspection cost for PAUT + TOFD may seem higher than conventional radiography testing but since these advanced ultrasonic methods do not involve any radiation hazards and other jobs can be carried out in the vicinity of such testing, leading to a direct saving associated beside time saved in production/fabrication. The speeds of PAUT + TOFD inspection in one scan shortens the overall inspection time and eliminates the time-loss associated with RT. Similar to radiography, the records with raw data can be preserved forever. Our TOFD & PAUT combined inspection is confirming to the code section ASME BPVC Section-V Article 4 Ultrasonic Examination Methods for Welds.

26.5 Long Range Ultrasonic Testing (LRUT)

TCR Advanced offers Long Range Ultrasonic Testing (LRUT) as an efficient solution for the inspection of metallic pipelines, particularly those that are underground, insulated, or otherwise difficult to access. This technique uses guided ultrasonic waves to scan long lengths of piping from a single test point, enabling the detection of corrosion, wall thinning, and other discontinuities without requiring full exposure of the line i.e. without removal of hot or cold insulations as well as for without excavation of underground buried pipelines. LRUT is especially valuable for rapid screening during baseline assessments and periodic monitoring, allowing asset owners to prioritize areas for detailed inspection or maintenance. With TCR's technical proficiency and field experience, LRUT enhances the overall integrity management process by combining speed, safety, and accuracy in pipeline evaluation. Our LRUT inspection is confirming to the code section ASME BPVC Section-V Article 19 Guided Wave Examination Method for Piping.

26.6 Short Range Ultrasonic Testing (SRUT)

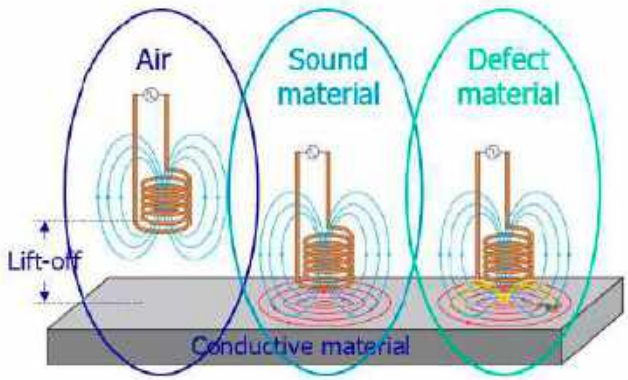
TCR Advanced utilizes Short Range Ultrasonic Testing (SRUT) as a targeted inspection method to evaluate areas of piping that are typically inaccessible, such as sections under pipe supports, clamps, or other contact points. SRUT employs low-frequency ultrasonic waves that travel along the surface of the component, effectively detecting corrosion, pitting, and material loss in these high-risk zones without requiring complete lifting or removal of supports. This technique significantly reduces inspection time and associated downtime while improving the reliability of integrity assessments. With TCR's expertise in advanced NDT techniques, SRUT plays a critical role in preventive maintenance strategies and ensures continued plant safety and performance.

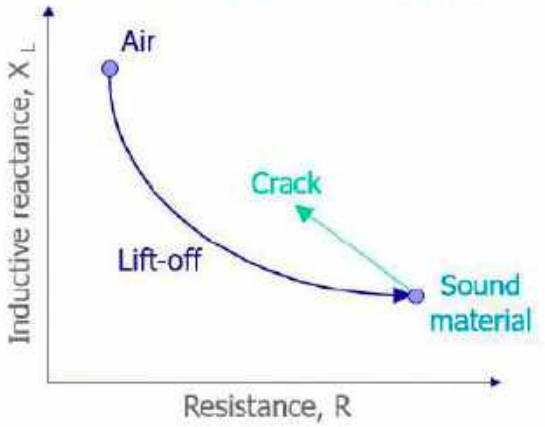
26.7 High Temperature Ultrasonic Testing (HTUT)

HTUT allows accurate thickness measurements and flaw detection in components operating at elevated temperatures —up to 200°C—without shutting down equipment. TCR Advanced uses specialized probes and couplants to ensure reliability, supporting real-time asset monitoring during operation.

27. Heat Exchanger Tube Inspection Testing

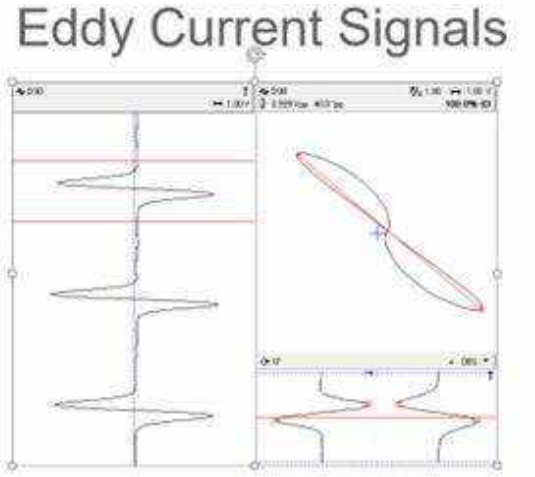
TCR Advanced offers a complete suite of Heat Exchanger Tube Inspection techniques to assess tube integrity, identify internal/external flaws, and prevent failure in critical process equipment. Our advanced non-destructive testing methods cover a wide range of materials and tube configurations, enabling precise detection of corrosion, erosion, pitting, and cracks. These inspections are non-invasive, fast, and minimize operational downtime. Techniques are applicable to both ferrous and non-ferrous tubes across power plants, refineries, and chemical processing industries. Each method provides high-resolution data and supports condition-based maintenance strategies. Our specialized probes and systems are designed for complex geometries. Real-time data analysis and digital reporting improve decision-making. All inspections are performed in compliance with global NDT standards. TCR ensures safety, performance, and reliability of critical heat exchanger assets.

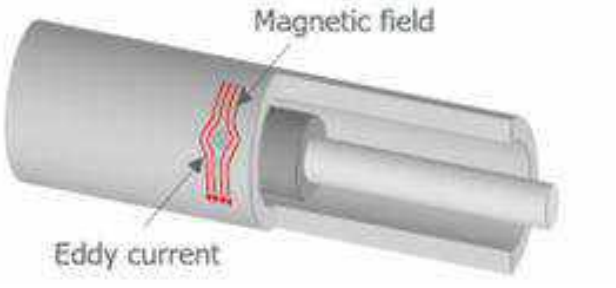




27.1 Eddy Current Testing (ECT)

Eddy Current Testing (ECT) is a fast, non-contact technique used to inspect non-ferromagnetic heat exchanger tubes for surface and near-surface flaws. It is ideal for detecting cracks, wall loss, and pitting in a wide range of tubing materials. ECT provides real-time results and high sensitivity to small defects. The system supports rapid scanning with minimal preparation. It is highly effective in air-cooled heat exchangers and chillers. The method does not require couplant, ensuring clean and efficient inspections. Custom probes can navigate tight bends and varying tube diameters. Automated signal analysis enables accurate flaw characterization. ECT complies with ASME BPVC Section-V Article 8 Eddy Current Examination. It is a go-to solution for high-speed, high-volume tube screening.





27.2 Remote Field Eddy Current Testing (RFET)

RFET is specifically designed for inspecting ferromagnetic tubes such as carbon steel, commonly found in boilers and heat exchangers. It uses low-frequency electromagnetic fields to detect both internal and external flaws through the tube wall. RFET is sensitive to wall loss, corrosion, and pitting. The technique offers excellent depth penetration and accurate defect sizing. Inspection can be performed with minimal cleaning. Probe design allows for long-range scanning through bends and support plates. Data is acquired in real-time and can be reviewed with automated analysis tools. RFET is suitable for in-service inspection, reducing downtime. It ensures comprehensive coverage of thick-walled or magnetically responsive tubes. TCR provides reliable results in high-density exchanger environments. RFET complies with ASME BPVC Section-V Article 17 Remote Field Testing (Rft) Examination Method.

27.3 Near Field Testing (NFT)

Near Field Testing (NFT) is optimized for detecting internal corrosion and localized wall loss in finned carbon steel tubes. Unlike RFET, NFT uses a different coil arrangement that focuses inspection on the near-surface region. It's ideal for tubes with support plate wear, under-deposit corrosion, and scale build-up. The technique is fast and does not require tube cleaning. NFT is effective in high-speed scanning of large volumes of tubes. The system can identify wall thinning, pits, and localized erosion. It performs well in noisy signal environments with minimal interference. TCR uses customized probes to match tube size and configuration. This method is especially suited for air-cooled exchangers. It supports preventive maintenance through reliable degradation mapping.

27.4 Surface Eddy Current Testing (SECT)

Surface Eddy Current Testing (SECT) is a powerful method for detecting surface and sub-surface cracks in non-ferromagnetic metallic components, especially on external surfaces of heat exchanger tubes. It provides high-resolution defect imaging without requiring direct access to internal surfaces. SECT is ideal for detecting stress corrosion cracking, fatigue cracks, and grinding burns. The technique is fast, clean, and doesn't require liquid couplants. TCR employs portable and automated SECT systems for field or workshop inspections. Signal analysis allows accurate sizing and depth estimation of surface flaws. SECT is applicable to a wide range of alloys and curved surfaces. This method supports early-stage defect detection and life extension strategies. It is widely used in aerospace, nuclear, and petrochemical sectors.

FIG. 3.10. A typical surface probe.

27.5 Internal Rotary Inspection System (IRIS)

IRIS is an ultrasonic technique used for accurate wall thickness measurement and defect detection inside heat exchanger tubes, especially where eddy current methods may fall short. It operates by rotating an ultrasonic probe inside water-filled tubes, providing detailed cross-sectional imaging. IRIS is capable of detecting internal and external corrosion, erosion, and pitting. The method works on both ferrous and non-ferrous tubes. It delivers high-resolution results for defect sizing and wall thickness profiling. IRIS requires tube cleaning and water coupling but offers unmatched accuracy. It is well-suited for post-cleaning inspections and QA validation. IRIS may be used to validate ECT/RFET results, offering a comprehensive inspection scope. It's a reliable solution for high-precision analysis in critical systems.

27.6 Eddy Current Array (ECA)

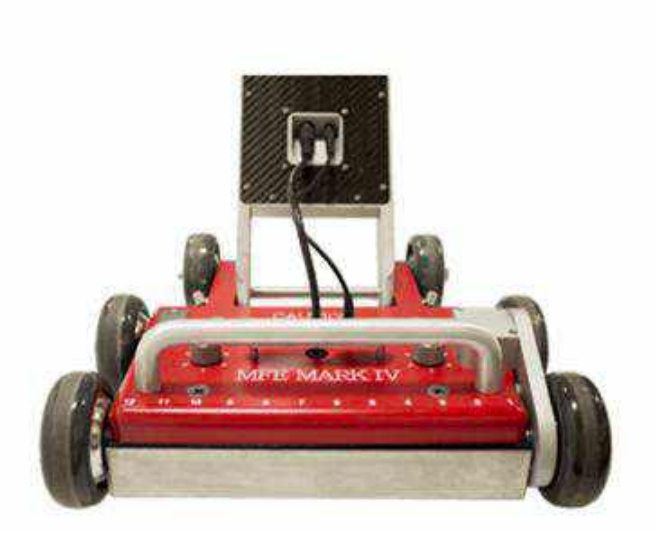
Eddy Current Array (ECA) - Advanced Inspection for Precision Reliability Eddy Current Array (ECA) technology offers a highly sensitive, non-destructive method for detecting surface and near-surface defects in conductive materials. Utilizing a multi-coil probe configuration, ECA allows for rapid scanning over large surface areas with superior accuracy and resolution. It is ideal for applications across aerospace, automotive, rail, oil & gas, and energy sectors, where precision and reliability are critical. With real-time imaging, no need for couplants, and adaptability to complex geometries, Surface ECA ensures efficient inspections with minimal downtime. Empower your inspection capabilities with advanced technology trusted by leading industries worldwide.

28. Tank Inspection

TCR Advanced provides reliable and high-precision tank inspection services to evaluate the structural integrity and operational safety of storage tanks. Our inspection portfolio includes advanced and conventional techniques suited for aboveground and in-service tanks. We assess corrosion, pitting, weld quality, and leaks using innovative tools and standards-compliant methods. Magnetic Flux Leakage (MFL) enables fast, large-area scanning of floor plates for corrosion. Acoustic Emission Testing provides floor profiling without internal access. Vacuum Box Testing detects weld leaks with high sensitivity. All services minimize downtime and support preventive maintenance. Our inspections ensure compliance with API 653 and other international standards. Real-time reporting and data visualization improve decision-making. TCR safeguards asset life and environmental safety.

28.1 Bottom Floor Inspection by Magnetic Flux Leakage (MFL)

MFL is an invasive technique for scanning tank bottom plates to detect corrosion and pitting under coatings or linings. It uses a strong magnetic field to reveal metal loss anomalies through changes in flux leakage. The method covers large areas quickly. MFL is highly sensitive to volumetric defects and can detect corrosion before it becomes critical. TCR employs advanced scanners with encoded mapping capabilities. Data is digitally recorded for analysis and trending. Minimal surface prep is required. It ensures reliable inspection. MFL helps maintain regulatory compliance and prevent costly failures. Our MFL inspection is confirming to the code section ASME BPVC Section-V Article 16 Magnetic Flux Leakage (MFL) Examination.



28.2 Bottom Floor Profile by Acoustic Emission Testing

Acoustic Emission Testing (AET) is a passive technique used to monitor active defect growth in tank floors under normal operating pressure. It detects transient elastic waves emitted from sources like crack growth or corrosion. AET helps prioritize areas for detailed inspection by mapping high-risk zones. The technique is non-invasive, suitable for large tanks, and performed without product removal. It provides real-time assessment and floor profiling. Sensors are installed on tank walls and the signal data is triangulated. AET supports condition-based inspection and maintenance strategies. TCR's AET capabilities enhance operational efficiency and long-term tank integrity, suggesting monitoring period / inspection interval. Our AET inspection is conforming to the code section ASME BPVC Article 11, 12, 13 Acoustic Emission Examination Of Metallic Vessels During Pressure Testing.

28.3 Vacuum Box Testing

Vacuum Box Testing is a simple yet effective method for detecting through-leaks in tank floor welds and lap joints. A vacuum is applied over the test area using a sealed box while a soap solution reveals leaks as bubbles. The method is ideal for new construction and repair validation. It is applicable to flat, curved, and irregular surfaces. TCR follows strict procedural controls to ensure test reliability. It is fast, cost-effective, and complies with API 650/653. Vacuum box testing complements other floor inspection methods.

29. Leak Testing

TCR Advanced delivers precise leak testing services to detect and locate even the smallest leaks in pressure-retaining systems and critical equipment. Our methods are designed for high sensitivity, reliability, and applicability across a wide range of industries including oil & gas, power, and pharmaceuticals. Helium Leak Detection offers superior sensitivity for vacuum and pressure systems. Airborne Ultrasonic Leak Detection identifies leaks in pressurized gas or steam systems during operations, hence this technique is non-invasive and does not disrupt operations. Digital reporting and mapping ensure effective data use. Realtime leak testing enhances equipment reliability and safety compliance. Our Leak Testing inspection is confirming to the code section ASME BPVC Article 10 Leak Testing.

29.1 Helium Leak Testing

Helium Leak Testing is a high-sensitivity technique used to identify leaks in sealed systems, heat exchangers, condensers, and vacuum equipment. Helium is used as a tracer gas due to its small atomic size and inert nature. Detection is done via mass spectrometry, allowing identification of even micro-leaks. The technique is suitable for both pressure and vacuum modes. TCR uses portable which can be carried inside the confined space as well as fixed systems depending on the application. Leak rates can be quantified precisely. The method is ideal for critical systems where leakage is not at all acceptable. It ensures integrity and regulatory compliance in sensitive environments.

29.2 Airborne Leak Detection

Airborne Ultrasonic Leak Detection uses high-frequency sound waves emitted by pressurized gases escaping through leaks. Ultrasonic detectors convert these into audible signals, allowing fast and accurate leak pinpointing. It is ideal for compressed air, steam, and gas systems. The method is non-contact and suitable for noisy environments. No tracer gas or system shutdown is required. TCR uses advanced sensors with noise filters and digital display units. The system can also be used for electrical discharge and bearing inspection. This method supports energy audits and efficiency improvements. It's fast, flexible, and cost-effective.

30. In-Situ Metallography (Replica Testing) & Hardness Testing

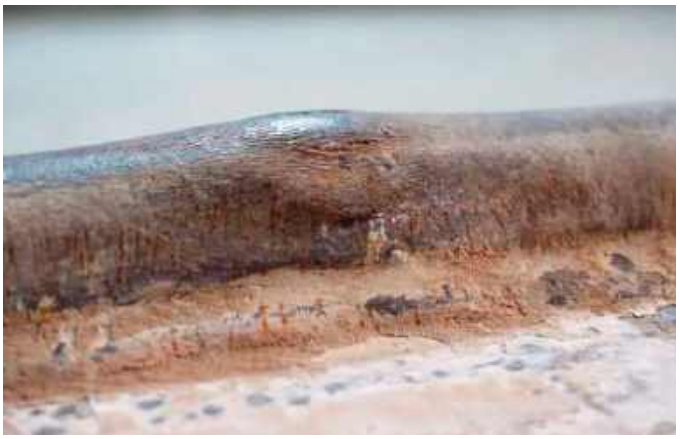
TCR Advanced offers In-Situ Metallography (Replica Testing) and Hardness Testing to assess the microstructural condition and mechanical strength of critical components without disassembly. Replica testing uses a high-fidelity impression of the metal surface to examine grain structure, creep, phase changes, and identify active damage mechanisms. The portability of the equipment allows on field inspection and interpretation at the same instance. Hardness testing is performed using portable devices for on-site evaluation of material strength and degradation. These methods are vital for life assessment, failure analysis, and fitness-for-service evaluations. TCR's expert metallurgists analyse and interpret results with precision. The process is non-destructive, efficient, and requires minimal surface preparation. It supports plant reliability and long-term maintenance planning.

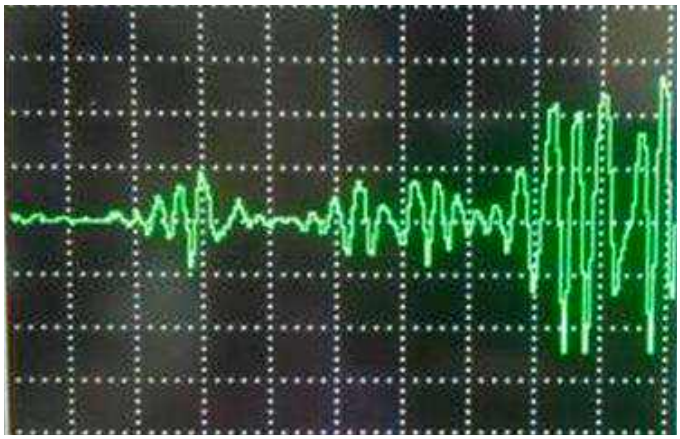
31. Specialized Advanced NDT Techniques (Damage-Specific)

TCR Advanced provides damage-specific NDT solutions tailored to detect critical degradation mechanisms in high-temperature and high-pressure environments. Techniques such as HTHA detection, carburization analysis, HIC assessment, and oxide scale measurement are designed to identify early-stage material damage. These methods rely on specialized ultrasonic, metallographic, and electromagnetic tools to ensure accuracy. They support remaining life assessments, root cause analysis, and plant risk management. All testing complies with API, NACE, and ASME guidelines. TCR helps clients make informed decisions for shutdown planning and asset integrity management.

31.1 HTHA Detection

High-Temperature Hydrogen Attack (HTHA) inspection at TCR Advanced utilizes advanced ultrasonic techniques to detect internal fissures, micro-cracking, and decarburization in steel components operating above 200 °C in hydrogen-rich environments. Our methods allow inspection from outside surface, eliminating the need to open equipment or remove catalysts. TCR's expertise enables accurate assessment of damage severity and estimation of attack depth. These inspections are ideal for large-area screening and are critical for ensuring equipment reliability and preventing unexpected failures. While early-stage degradation may remain undetectable, our skilled analysts provide reliable evaluations to support asset integrity decisions complying to API 941 including code cases. Accurate, non-invasive, and standards-compliant, TCR delivers trusted HTHA inspection solutions and remaining life assessments.





31.2 Carburization Detection

Carburization detection at TCR Advanced is performed using Phased Array Ultrasonic Testing (PAUT) to identify hardness variations and structural changes in components exposed to carbon-rich, high-temperature environments. This degradation leads to wall loss (metal dusting) embrittlement and loss of ductility, posing a risk to equipment like reformers and furnace tubes. PAUT enables non-invasive, high-resolution scanning to detect depth and extent of carburized zones especially in low alloy steels (grades P5, P9, P91) during equipment shutdown. If access available it can be complemented by selective hardness mapping and metallographic evaluation. Our inspection services provide the accurate, real-time insights for condition monitoring and life assessment. TCR's unique carburization detection methodologies ensure operational safety, support predictive maintenance and complies with industry standards (API 571).

31.3 HIC Damage Assessment

Hydrogen-Induced Cracking (HIC) is a critical damage mechanism in carbon steel equipment exposed to wet H_2S environments. TCR Advanced conducts HIC detection using Phased Array Ultrasonic Testing (PAUT) to accurately locate, size, and map internal cracks across vessel and pipeline walls. This high-resolution technique enables rapid, non-intrusive evaluation of large areas, providing clear insight into crack orientation and severity. Our inspections are further supported by metallurgical analysis for a complete assessment of material degradation. Early identification of HIC is essential to prevent leakage, unplanned shutdowns, and safety incidents. TCR's approach depending upon the selection of right probes ensures reliable detection, compliance with industry standards, and proactive maintenance planning.

31.4 Internal Oxide Scale Measurement

Internal Oxide Scale Measurement, a specialized non-destructive technique essential for the life assessment of boiler tubes operating at high temperatures. The thickness of the oxide scale formed on the internal surface of a tube is a direct indicator of its average metal temperature and is a critical input for calculating remaining creep life. Using high frequency, advanced ultrasonic testing (UT) methods, our technicians can accurately measure the scale thickness from OD side of the tube, eliminating the need for destructive sampling. This proactive inspection provides valuable data to identify tubes experiencing overheating, predict potential failures, remaining life, and support targeted maintenance and replacement strategies, thereby ensuring boiler reliability and preventing costly forced outages.

32. Electro Magnetic Acoustic Transducer Testing (EMAT) — Up to 600°C

TCR Advanced offers Electromagnetic Acoustic Transducer (EMAT) technology as a cutting-edge solution for thickness measurement up to 600°C, particularly where conventional ultrasonic testing may face limitations. EMAT enables non-contact measurement by generating ultrasonic waves directly within the material using electromagnetic principles, eliminating the need for couplants. This makes it highly suitable for high-temperature components, rough or scaled surfaces, and materials with limited surface access. EMAT is ideal for in-service inspection of ferrous metals, pipelines, and boiler tubes, especially where consistent and accurate thickness monitoring is critical. Application of automated crawlers coupled with EMAT probes allow wider coverage for corrosion mapping. With advanced sensors and precise data capture, TCR ensures reliable assessment even in the most challenging environments, supporting clients in maintaining asset integrity and minimising downtime.

33. Magnetic Permeability Measurement

TCR Advanced offers magnetic permeability measurement as a reliable technique to evaluate the condition and integrity of reformer tubes, inlet and outlet pigtails, headers which are having non ferromagnetic properties and operating in high-temperature hydrogen-rich environments. Over time, exposure to such conditions can lead to material degradation, including carburization, which may alter the tube's magnetic response. By measuring magnetic permeability, TCR can detect these microstructural changes non-destructively, helping assess susceptibility to carburization and other metallurgical risks. This technique provides valuable insights into the remaining life and fitness-for-service of reformer tubes, enabling proactive maintenance planning and minimizing unplanned shutdowns.

III. Conventional NDT

TCR Advanced offers a complete range of NABL-approved Conventional Non-Destructive Testing (NDT) services to evaluate material and weld integrity without affecting component usability. Our services include PMI, surface roughness, ferrite content, de-magnetization, DPT, MPT, UT, and RT. These methods are essential for detecting surface and subsurface flaws, material misidentification, and magnetic property assessment. All testing is performed as per ASME, ASTM, ISO, and EN standards. We support both in-house and on-site inspection requirements with portable and fixed systems. TCR's skilled NDT technicians and Level II/III professionals ensure accurate detection, interpretation, and documentation. Our NDT services are critical for quality control, in-service inspection, and failure prevention across multiple industries. Real-time reporting, digital imaging, and certified procedures ensure dependable outcomes.

TCR Advanced conducts tests based on the following standards

ASME SEC V | ASTM E 797 | ASME SEC XI | ASTM A 609 | ASTM A 435 | ASTM A 388 | ASTM E 709

34. Positive Material Identification (PMI)

TCR Advanced provides Positive Material Identification (PMI) using XRF and OES analysers to verify the chemical composition of metals and alloys. This technique is essential for quality assurance, material traceability, and ensuring compliance with specifications during fabrication and maintenance. PMI helps prevent material mix-ups that could lead to catastrophic failures. Our handheld and mobile analysers allow rapid on-site testing of pipes, fittings, valves, and structural components. TCR ensures results are delivered in real time with minimal surface preparation. PMI support both in-process and final product verification.

35. Surface Roughness

Surface roughness testing at TCR Advanced measures the texture and finish quality of machined, welded, or coated surfaces. Using portable profilometers and advanced digital systems, we provide precise Ra, Rz, and other surface parameter readings.

36. Ferrite Content

TCR Advanced conducts ferrite content measurement using portable, non-destructive magnetic induction or eddy current instruments to determine the ferrite percentage in stainless steel welds and base materials. Accurate ferrite balance is crucial to prevent cracking, ensure corrosion resistance, and maintain weld quality in austenitic and duplex stainless steels. Results are instantly available and recorded. TCR's ferrite testing ensures reliability in critical pressure components and piping systems.

37. De-Magnetization

TCR Advanced offers de-magnetization services to remove residual magnetism from ferromagnetic components post-fabrication, machining, or inspection. Magnetic fields can interfere with welding, machining accuracy, and product performance. Our de-magnetization techniques include AC coil, yoke, and waveform decay methods. Testing is conducted using calibrated gauss meters to ensure residual field levels are within acceptable limits. This service is critical for rotating equipment, shafts, valve parts, and precision instruments.

38. Dye Penetrant Testing (DPT) / Liquid Penetrant Testing (LPT)

Dye Penetrant Testing (DPT) at TCR Advanced is a reliable surface inspection method used to detect cracks, porosity, and laps in non-porous materials. We use both fluorescent and visible dye systems in accordance with ASTM E165 and ASME Section V. DPT is suitable for welds, castings, forgings, and machined parts in stainless steel, aluminium, and other non-ferrous alloys. It is easy to apply, cost-effective, and ideal for large-area scanning. TCR provides both on-site and lab-based DPT services for easy interpretation. TCR's skilled NDT technicians and Level II/III professionals ensure accurate detection and comprehensive reporting.

39. Magnetic Particle Testing (MPT)

TCR Advanced provides Magnetic Particle Testing (MPT) for detecting surface and slightly subsurface discontinuities in ferromagnetic materials. The method uses dry or wet fluorescent particles under visible or UV light, depending on application sensitivity. MPT is widely used for inspecting welds, fasteners, shafts, and structural components. Our services follow ASTM E709 and ASME Section V standards. We use yokes, coils, and bench units for various part sizes and geometries. MPT enables fast and reliable flaw detection without affecting the part's usability. TCR's skilled NDT technicians and Level II/III professionals ensures high inspection accuracy, clear documentation, and expert evaluation.

40. Ultrasonic Testing (UT) / Ultrasonic Flaw Detection (UFD)

Ultrasonic Testing (UT) at TCR Advanced involves high-frequency sound waves to detect internal defects, measure wall thickness, and assess material properties. We perform both straight beam and angle beam testing using advanced flaw detectors. UT is highly effective for weld inspection, lamination checks, and corrosion mapping. Our procedures align with ASME, AWS, and ISO standards, ensuring consistent and repeatable results. TCR's skilled NDT technicians and Level II/III professionals deliver in-depth flaw characterization and detailed documentation. UT is a versatile, non-destructive, and cost-efficient solution for in-service and new fabrication components.

41. Radiographic Testing (RT)

Radiographic Testing (RT) is a powerful volumetric inspection technique offered by TCR Advanced to reveal internal flaws such as porosity, inclusions, and incomplete fusion in welds and castings. Using X-ray and gamma-ray sources, we provide both film-based and digital radiography services as per ASME Section V, ASTM E94, and ISO 17636. RT produces permanent, interpretable records with high sensitivity to discontinuities. TCR's skilled NDT technicians and Level II/III professionals ensures strict radiation safety compliance and provides accurate evaluations through skilled radiographers. RT is widely used in critical pressure equipment, pipelines, and structural welds where defect tolerance is minimal.

IV. Material Testing

TCR Advanced offers a comprehensive suite of NABL Accredited Material Testing services as per ISO — IEC 17025, ensuring reliable and standards-compliant analysis of metals, alloys, polymers, and construction materials. Our state-of-the-art laboratories are equipped to perform chemical, mechanical, corrosion, rubber/plastic, civil material testing and metallurgical testing with precision and traceability. These tests support material verification, quality control, failure investigation, and product development across industries. All procedures follow national and international standards (ASTM, IS, ISO, DIN, etc.). Backed by expert metallurgists and material scientists, our testing ensures structural integrity, compliance, and safety of critical components. TCR delivers quick turnaround, detailed reporting, and unmatched technical expertise. Our lab infrastructure is supported by robust quality systems. TCR is the trusted partner for accurate, NABL-certified material testing solutions.

42. Chemical Testing

TCR Advanced offers accurate chemical composition analysis of metals, alloys, and non-metallic materials through advanced techniques like Optical Emission Spectroscopy (OES), ICP-OES, XRF, and wet chemistry. These tests ensure raw material verification, grade confirmation, and product quality control. We evaluate elements including C, S, P, N, and trace constituents to ensure compliance with customer and international specifications. Our chemical testing supports PMI, alloy identification, heat treatment verification, and failure analysis. All testing is conducted under strict quality protocols and traceability. With fast turnaround and certified results, TCR's chemical analysis service is vital for material validation across sectors like oil & gas, Refinery, power plants, fertiliser plants, automotive, aerospace, and construction.

TCR Advanced conducts tests based on the following standards: ASTM E 1251, ASTM E415, IS 8811, ASTM E 1086, IS 9879

43. Mechanical Testing

TCR Advanced provides mechanical testing services to evaluate the strength, toughness, and durability of metals and materials under different loading conditions. Our capabilities include tensile, compression, bend, impact (Charpy), hardness (Brinell, Rockwell, Vickers), and proof load testing. These tests are essential for product development, process validation, and compliance with material standards. TCR have modern universal testing machines, impact testers, and hardness testers which are accredited through interlaboratory test and NABL. Mechanical tests are conducted as per ASTM, IS, and ISO standards, with detailed reporting and acceptance. We provide services for welding procedure qualifications, material certification, and component reliability assessments. The fleet of instruments and machines available at TCR ensures reliable insights into material behaviour under real-world conditions.

TCR Advanced conducts tests based on the following standards: ASTM A 370, ASTM E 8, IS 1608, IS 1599, ASTM E 190, ASTM E 290, ASTM E 10, IS 1500, IS 1501, IS 1586, ASTM E 18, ASTM E 384, ASTM E 23, ISO 148-2, EN 10002, EN 910

44. Corrosion Testing

TCR Advanced offers corrosion testing services to evaluate material resistance under various environmental and chemical conditions. Our lab performs Salt Spray Testing, Intergranular Corrosion (IGC), Pitting & Crevice Corrosion Tests, Sulphide Stress Cracking (SSC), and Hydrogen-Induced Cracking (HIC) as per NACE, ASTM, and ISO standards. These tests are crucial for selecting suitable materials in corrosive service and for validating protective coatings or treatments. TCR simulates real-world exposure to predict service life and optimize material selection. Our corrosion testing lab is equipped with autoclaves, humidity chambers, potentio-dynamic electrochemical study and advanced microscopy for post-test analysis. The service supports industries such as petrochemical, marine, power, and infrastructure.

TCR Advanced conducts tests based on the following standards: ASTM A 262, ASTM G 48, ASTM A 923, ASTM B117

45. Rubber & Plastic Testing

TCR Advanced conducts rubber and plastic testing to evaluate physical, thermal, and mechanical properties of polymers used in industrial applications. Our testing covers tensile strength, elongation, hardness (Shore A/D), compression set, specific gravity, flammability, and aging. We ensure compliance with IS, ASTM, and ISO standards, supporting product validation and R&D. These tests help assess material suitability for sealing, insulation, lining, and packaging applications. TCR also evaluates chemical resistance and performance under thermal cycling. All tests are conducted under controlled conditions with precision instrumentation. Our expertise supports industries such as automotive, chemical, pharmaceuticals, and consumer goods.

46. Civil Material Testing

TCR Advanced offers comprehensive civil material testing services to evaluate the quality and compliance of construction materials such as cement, concrete, aggregates, bricks, steel, and soil. Our laboratory conducts tests including compressive strength, mix design, slump test, gradation, water absorption, and specific gravity as per IS and ASTM standards. We specialize in advanced assessments like Ultrasonic Pulse Velocity, Rebound Hammer, Core Compression, Carbonation Depth, and Chemical Analysis. Our services also include Ground Penetrating Radar and Half-Cell Potential tests for evaluating reinforcement and corrosion risks. TCR provides field sampling, on-site testing, and third-party validation, supporting contractors, developers, and consultants with accurate reporting and technical expertise to ensure structural safety and project compliance.

47. Metallurgical Testing

TCR Advanced offers comprehensive metallurgical testing services to evaluate the microstructural characteristics and metallurgical integrity of metals and alloys. Our lab performs microstructure analysis, grain size measurement, phase identification, inclusion rating, intergranular corrosion (IGC), carbide sizing and distribution analysis, gamma and gamma prime particle size measurement, identification of complex precipitates, micro level elemental distribution map, etc. using advanced optical and scanning electron microscopy (SEM/EDS). These tests are vital for assessing material performance, weld quality, heat treatment effectiveness, and root cause analysis of failures. TCR's metallurgists provide expert interpretation aligned with standards. We also offer replica metallography for in-situ component assessments. Our services support industries like oil & gas, petrochemical, process plants, fertilizers, paints, Pharmacuaticals, aerospace, automotive, and power generation as well as concerned fabrication shops. With NABL-accredited protocols, rapid turnaround, and expert insights, TCR delivers actionable metallurgical evaluations to ensure quality and reliability.

TCR Advanced conducts tests based on the following standards: ASTM B 487, ASTM E 112, ASTM E 407, ASTM E 340, ASTM E 1077, IS 6396, ASTM E 562, IS 7754, IS 6416, ASTM E 45

48. Coating Evaluation Services:

TCR Advanced provides comprehensive Coating Evaluation Services to verify the quality, integrity, and long-term performance of protective coatings on underground lines. Since protective layer is important, our services are designed to ensure these coatings meet the required specifications and stringent industry standards. Our evaluation covers a range of crucial parameters including adhesion strength, coating thickness, visual condition check and the detection of defects such as pinholes (holidays). We are equipped to assess various coating systems—from galvanized zinc and multi-layer paints to epoxy and bituminous coatings. Our detailed analysis provides clients with the assurance that their assets are properly protected against corrosion, enhancing reliability and extending service life.

TCR Advanced conducts tests based on the following standards: ASTM A 262, ASTM G 48, ASTM A 923, ASTM B117

The evaluation of protective coatings is essential to ensure their long-term performance, durability, and suitability for specific environmental and operational conditions. Various types of coatings—such as zinc-rich coatings (e.g., galvanizing), epoxy coatings, conventional paints, and bituminous coatings—can be subjected to laboratory testing to assess their adhesion strength, coating quality, and thickness uniformity.

(A) Adhesion Testing

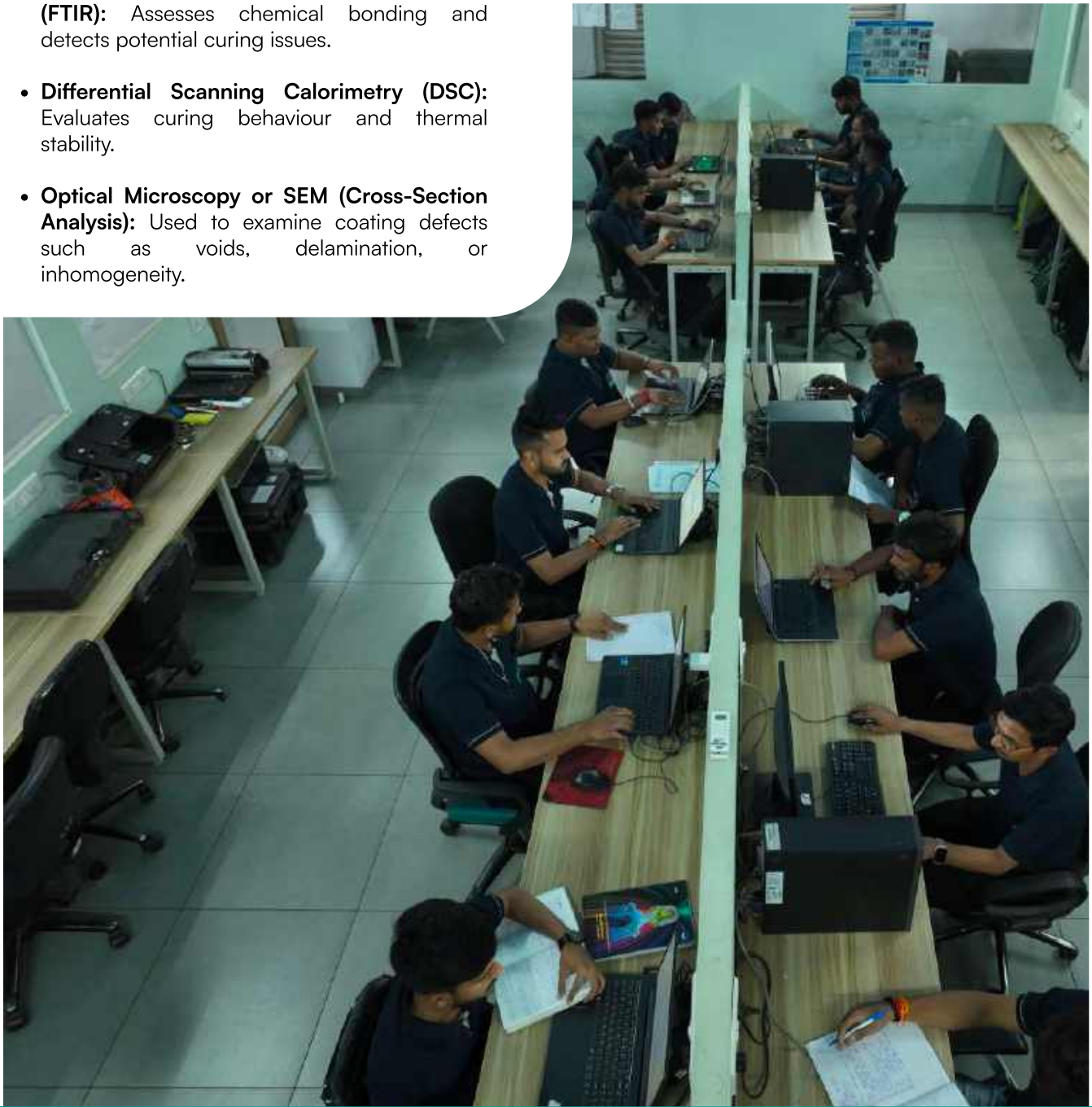
Adhesion testing evaluates the bonding strength between the coating and the substrate. Common methods include:

- **Tape Test (ASTM D3359 / ISO 2409):** This test involves cross-hatching the coating surface and applying a standardized adhesive tape (e.g., 3M tape) to determine the degree of coating removal under peel-off conditions.
- **Salt Spray Testing (ASTM B117 / ISO 9227):** Often used to assess adhesion under accelerated corrosive conditions. Coating delamination or blistering around scribed areas indicates adhesion degradation.
- **Coating Thickness:** Coating thickness is measured using a coating thickness gauge (e.g., Elco-meter) based on magnetic induction or eddy current principles, depending on the substrate material. This non-destructive method ensures uniform application and verifies compliance with specified thickness standards (e.g., ASTM D7091, ISO 2808).

(B) Coating Quality Evaluation

Coating quality involves analysing the uniformity, integrity, and composition of the applied coating. The evaluation approach varies depending on the type of coating:

- ☑ **For Galvanized (Zinc) Coatings:**
  - **Scanning Electron Microscopy (SEM):** Used to analyze the surface morphology and microstructure of the zinc layer.
  - **Energy Dispersive X-ray Spectroscopy (EDS):** Provides elemental analysis to determine the purity and distribution of the zinc layer.
- ☑ **For Epoxy and Paint Coatings:**
  - **Fourier Transform Infrared Spectroscopy (FTIR):** Assesses chemical bonding and detects potential curing issues.
  - **Differential Scanning Calorimetry (DSC):** Evaluates curing behaviour and thermal stability.
  - **Optical Microscopy or SEM (Cross-Section Analysis):** Used to examine coating defects such as voids, delamination, or inhomogeneity.
- ☑ **For Bituminous Coatings:**
  - **Thermogravimetric Analysis (TGA):** Assesses thermal degradation characteristics and organic content.
  - **Holiday Testing:** Holiday testing is performed to detect pinholes, voids, or discontinuities in non-conductive protective coatings over conductive substrates. Using a high-voltage holiday detector (as per ASTM G62), the test identifies flaws that could expose the underlying metal to corrosion.



World Class Training Facility – Evolve by TCR

Evolve by TCR Training & Development Institute, headquartered in Vadodara, Gujarat, is a premier technical education center established by TCR Advanced Engineering Pvt. Ltd. Since its inception in the year 2017, Evolve has been committed to bridging the gap between theoretical knowledge and practical industry skills, aiming to produce job ready professionals equipped to meet the demands of various sectors.

The institute offers a comprehensive array of skill-based development programs tailored for engineers, technocrats, and technicians from Energy Intensive Sector, Manufacturing Sector, Engineering and Fabrication Sector.

Evolve's curriculum is designed to align with current job requirements, ensuring that participants not only understand advanced concepts but are also capable of implementing them in real-world scenarios.

Evolve's training programs encompass a wide range of courses, on Asset Integrity Optimization, Welding Technology, Metallography and Metallurgy. These courses are conducted by industry veterans and subject matter experts who employ the latest pedagogical methods to provide a seamless learning experience.

What sets Evolve apart is its emphasis on practical learning. Participants engage in hands-on experiences, live case studies, and demonstrations, gaining a deeper understanding of how theoretical principles apply in industrial settings.

Evolve's state-of-the-art facilities and commitment to continuous improvement have made it a preferred training destination for professionals from industry giants. The institute's track record of training professionals across various sectors underscores its dedication to fostering a technically proficient manpower pool to meet global industry requirements.

In addition to its technical courses, Evolve offers management courses aimed at developing the soft skills of the workforce, making them more productive and adaptable to the dynamic industrial landscape.

Evolve's flexible learning modules cater to both aspiring and experienced professionals, enabling them to balance work, family, and education seamlessly. The institute's well- structured curriculum is designed to accommodate the diverse needs of its participants, ensuring that they receive relevant and up-to-date training.

With a mission to deliver industry-oriented technical education that aligns perfectly with current job requirements, Evolve by TCR continues to play a pivotal role in shaping the future of industrial engineering. By leveraging the expertise of industry veterans and providing hands-on training, Evolve ensures that its students are well-equipped to excel in their respective fields.

For more information about Evolve by TCR Training & Development Institute and its programs, please visit www.evolvetcr.com.

Industries We Serve


Power


Refineries & Petro-chemical


Oil & Gas


Fertilizer


Process & Chemical


Insurance


EPC


Manufacturing


Automobile


Pharmaceutical


Fabrication


Construction, Utilities & Pipeline Laying


Mining & Metals


Marine & Shipping


Medical


Water & Wastewater Treatment Industries


Offshore Industries like Subsea platforms, Jetty Piles etc.


Cement

THE CORE TEAM

Leadership Team

Neelam Virendra Bafna
Chairperson

"Your Confidence in Every Result"

The powerhouse behind TCR Advanced, embodying a legacy of quality, respect, and enduring impact.

Paresh Ushakant Haribhakti
Managing Director

"Chase The Vision"

Grow and expand TCR Advanced with passion, vision and courage and inspire the team to create a leading culture.

Rohit Virendra Bafna
Director

"Data that drives Durability, Result you can Trust"

With an innate drive to propel companies to their full potential in identifying opportunities that align with his values of integrity, precision, and growth

Alpana Paresh Haribhakti
Director

"For every minute spent in organizing, an hour is earned"

Inspire cleanliness and organization skills amongst TCR family to ensure clean and safe work environment for TCR Advanced

Viren Chandrasen Khandwala
Director

"The Mark of Trust"

His deep expertise and broad experience make him a valuable asset to TCR's Board of Directors, adding both strategic depth and financial rigor

Aashana Haribhakti Gupta
Director

"For a Future that Stands the Test of Time"

Develop, maintain and enhance new ideas, services and processes to ensure TCR Advanced is evolving customarily

Key Personnels

Paresh Haribhakti
Managing Director

Mr. Paresh Haribhakti has been at the helm of TCR Advanced Engineering Services (a TCR Engineering Services partner company) since its inception. He is a pioneer in promoting in-situ metallography, has solved more than 9,000 industrial problems and is an acclaimed boiler tube failure investigation expert. As a Managing Director for TCR Advanced, Paresh Haribhakti has authored a book titled 'Boiler Tube Failure Investigation - A Comprehensive Approach' that has been published by ASM International USA.

Ketan Kumar Upadhyaya
Senior General Manager

Mr. Ketan Upadhyaya brings 35+ years of expertise in Reliability Engineering, Corrosion, Inspection, Testing, and Metallurgical Analysis. He specializes in Engineering Critical Analysis, Fitness-for-Service (API 579-ASME FFS-1), Remaining Life Assessment, Failure Analysis, and NDT techniques. His work has consistently supported asset integrity, quality assurance, and operational reliability across industries. A certified professional with strong focus on R&D, innovation, and international standards compliance, he combines deep technical knowledge with proven leadership in large-scale projects and client advisory.

Gopul Patel
General Manager

Mr. Gopul Patel is a General Manager of TCR Advanced Engineering, He is a API certified personal for Risk based Inspection Methodology as per API 580.
He has been associated in development of AiOM tool since inception for TCR advanced. He has contributed in development and conceptualization of Asset Optimization modules such as Material library, Engineering Tools, FFS calculations, semi quantitative Risk analysis based on API 581, spare refurbishment, Integrity Operating Window (IOW), Intelligent Plant interface. He has gained significant knowledge in understanding Plant Operations and identifying and categorising Risk.

Sohel Vaidya
DGM - Business Development & Projects.

Mr. Sohel Vaidya serves as the Deputy General Manager — Business Development & Projects at TCR Advanced Engineering. With over 15 years of dedicated experience at TCR, he brings a deep understanding of client needs and strategic business growth. Holding a Master's degree in Applied Physics and Sales & Marketing, Mr. Vaidiya leads the Business Development and Projects division, playing a key role in identifying opportunities, designing customized proposals, and successfully converting them into long-term business engagements. His strength lies in building and nurturing client relationships, ensuring high levels of client retention and satisfaction across various industry sectors.

Key Personnels

Deepak Chandarana
Vice President (Evolve)

Mr. Deepak Chandarana heads Evolve by TCR, the training and knowledge-sharing vertical of TCR Advanced Engineering, with a clear mission to elevate technical awareness and operational competence across key industrial sectors. With a forward-looking vision, he is committed to delivering impactful, industry-relevant training programs that enhance workforce capabilities and support continuous improvement. He ensures that all training initiatives are aligned with applicable industry standards and regulatory frameworks, while maintaining a focus on practicality, flexibility, and real-world applicability. Under his leadership, Evolve has established a strong reputation for providing concise, high-value technical training that meets the evolving needs of India's industrial ecosystem.

Kamlesh Rana
Technical Manager (Testing)

Mr. Kamlesh Rana has over 35 years of experience in the fabrication and forging industries, he brings deep expertise in quality assurance and process control. As a qualified internal auditor for ISO 9001 and with hands-on experience handling API audits, he has successfully led Quality Assurance departments across multiple forge shops. His leadership has ensured compliance with international standards while driving continuous improvement in product quality and operational efficiency.

Ankur Haribhakti
Senior Manager (Lab)

Mr. Ankoor Haribhakti ensures that all testing activities meet stringent technical requirements while delivering accurate and reliable lab results. He effectively balances operational efficiency with employee engagement and client satisfaction. Through strong leadership and a commitment to quality, he drives laboratory excellence and supports the sustained growth and reputation of TCR Advanced

Henil Shah
Quality Manager

Mr. Henil Shah, Quality Manager at TCR Advanced Engineering Pvt. Ltd., holds an M.Sc. in Applied Physics and brings over six years of experience in the material testing industry. He specializes in analytical techniques like OES, XRF, and Wet Chemical Analysis, along with corrosion testing methods such as IGC, electrochemical, salt spray, and immersion testing. Proficient in material grade identification and compatibility studies, he supports material selection and specification verification. A certified Internal Auditor for ISO/IEC 17025:2017, he also leads QMS and process audits to ensure compliance and continuous improvement

Key Personnels

Pooja Mehta
Senior Manager (Failure Investigation)

Ms. Pooja Mehta brings over 15 years of extensive experience in the field of failure investigation. As a Senior Manager, she leads a specialized team focused on root cause analysis of material and component failures across diverse industrial applications. Her expertise spans metallurgical evaluation, fracture analysis and corrosion mechanisms. In addition to leading failure investigations, she also oversees metallurgical testing activities in the laboratory, ensuring accuracy, compliance, and quality standards. Known for her collaborative leadership and technical depth, she plays a key role in delivering reliable and actionable insights to clients.

Nikhil Sabhaya
Technical Manager (NDT and RLA)

Mr. Nikhil Sabhaya is a post graduate engineer in Metallurgy having 10+ years of industrial experience in Remaining Life Assessment of Boiler and NDT. He is Certified ASNT Level III (ET, UT, PT, MT), API 510 Pressure Vessel Inspector and CSWIP 3.1 Welding Inspector. He is proficient in developing various NDT procedures as per national and international codes. Having experience in power, petrochemical, refinery, structural, and automotive sectors, his expertise focuses on boiler tube inspection, defect characterization, and life assessment using surface and volumetric NDT methods.

Chiral Patel
Head Business Development
(Refinery, Petrochemical & Pipeline Integrity)

Mr. Chiral Patel has over two decades of specialised experience in corrosion prevention, I bring deep expertise in Cathodic Protection, Corrosion Inhibitors, and Protective Coatings, contributing significantly to Plant and Pipeline Integrity Management Systems. I have successfully collaborated with leading Oil & Gas PSUs, refineries, petrochemical plants, and consultants across India and Qatar. Academically qualified with advanced credentials from reputed institutions in India and the UK, I combine strong technical proficiency with project management acumen. My work spans the full lifecycle of corrosion control—from design and commissioning to audits and maintenance—ensuring asset longevity and regulatory compliance. I am also well-versed in implementing QMS, EMS, and OHSMS frameworks to enhance operational excellence and safety.

Ashu Sharma
Manager (Operations & Business Development)

Mr. Ashu Sharma leads the operations team with a focus on ensuring seamless business operations and project execution. In addition to driving operational excellence, he spearheads the business development of Non-Destructive Testing (NDT) services, contributing to the company's strategic growth and client engagement. His dual focus on operations and business growth positions him as a key contributor to the company's long-term success and strategic vision.

Key Personnels

Rajesh Lakhnotra
Manager (Business Development)

Mr. Tajesh Lakhnotra Plays a pivotal role in identifying new market opportunities, building strong client relationships, and driving revenue growth. With a strategic approach to business expansion, he collaborates closely with cross-functional teams to align solutions with client needs and market trends. His focus on delivering value and fostering partnerships contributes significantly to the company's long-term success and competitive edge.

Sonal Patel
Manager (Accounts)

Ms. Sonal Patel is responsible for ensuring accurate, timely, and insightful financial analytics and accounting operations. With a strong focus on cost optimization and financial efficiency, she plays a key role in maximizing financial retention and supporting strategic decision-making. Her expertise lies in maintaining compliance, streamlining financial processes, and delivering data-driven insights that contribute to the company's fiscal health and operational success.

Dhruvi Champaneri
Jr Manager (HR)

Ms. Dhruvi Champaneri is the driving force behind the Human Resources function at TCR Advanced Engineering, leading with a vision to create a dynamic, inclusive, and performance-oriented workplace. With a deep understanding of organizational behavior and strategic workforce planning, she ensures that TCR attracts, nurtures, and retains top talent aligned with the company's commitment to technical excellence and integrity.

Team of Experts

Ashok Kumar Srivastava
Vice President- Fertilizer (Asset Integrity)

Ashok Srivastava is a veteran mechanical engineer with 47+ years of experience in NDT, QA/QC, and asset integrity management. He graduated top of his class with a diploma in Mechanical Engineering from UP Technical Board. Currently, at TCR Advanced Engineering, he leads business development in the fertilizer sector. Internationally, he has held leadership roles at Dangote Fertilizer, Indorama Eleme, and Algeria Oman Fertilizer. Ashok is certified in multiple NDT methods (RT, UT, MT, PT, LT, VT) and has set up several NDT labs and training programs. He's a life member of ISNT and ASNT, known for driving plant safety and efficiency. His expertise continues to add immense value to global fertilizer and process industries.

Dr. M. M. Pandya
Corrosion Expert

Dr. Pandya is a corrosion expert and technical consultant to the TCR Group, with over 30 years of experience and 200+ industrial problem-solving cases. He specializes in online corrosion monitoring, failure analysis, and material selection across fertilizer, chemical, and petrochemical industries. His expertise includes ER/LPR methods and electrochemical techniques for accurate corrosion measurement. Dr. Pandya has led studies on material selection for urea, ammonia, and caprolactam plants. He has investigated corrosion mechanisms using both lab and field data to identify root causes. As former Head of R&D, he contributed to microbial effluent treatment and fertilizer design projects. He has collaborated internationally with Avesta (Sweden), Krupp VDM (Germany), and Cormon (UK), and was an 8-year member of NACE, USA.

M. N. Patel
SEM & EDS Expert

M. N. Patel, with a B.E. and M.E. in Metallurgy from M.S. University, Vadodara, has nearly 33 years of teaching experience at UG and PG levels. He has taught subjects like NDT, Mechanical Metallurgy, Welding Metallurgy, and Failure Analysis. He has published 16 research papers and guided 20 M.E. dissertations in metallurgy and welding. His consultancy work spans material characterization, microstructure-property correlation, and failure analysis. He is skilled in SEM and EDS techniques for defect investigations. Patel has contributed to studies on corrosion, weldability, and sensitization of steels. He is a life member of IIM, IIW, and ISTE.

Dr. P. B. Joshi
Consultant

Dr. P B Joshi is Ex-Head of Department of Metallurgical and Materials Engineering, Faculty of Technology and Engineering, Maharaja Sayajirao University, Vadodara. He is a Ph. D. in Material Engineering. Dr Joshi is having more than 25 years of teaching experience in the field of metallurgy. He has more than 50 research publications in International journals & National journals, and authored a book titled "Materials for Electrical and Electronic Contacts".

Subrahmanya Bhat
Corrosion Specialist

Subrahmanya Bhat, a postgrad in Analytical Chemistry, served ONGC for 32 years across oilfields, research centers, and E&P operations. He led over 100 R&D projects focused on material selection, corrosion control, chemical process design, and failure analysis. Bhat published 24 technical papers, including 7 in Material Performance (USA), and holds a patent for a non-carcinogenic corrosion inhibitor. He received the PETROFED Invention Award (2013) and NACE Award for Excellence (2005). As Head of Corrosion Labs at ONGC's R&D division, he specialized in experimental protocols for deep water and HPHT environments. Recognized as an in-house expert on MOC and corrosion mitigation, he was also a key faculty for ONGC training programs. His core strength lies in integrating materials science with practical chemical and process engineering solutions.

Prof. Awadhesh Kumar Singh
Vice President Powerplant & Turbine

Prof. Awadhesh Kumar Singh is a distinguished mechanical engineer and academician with over four decades of experience spanning power engineering, turbo-machinery, R&D, and technical consultancy. A graduate in Mechanical Engineering with Honours and M.Tech. in Turbo-Machines from IIT Delhi, he began his career at BHEL and later held senior roles at ABB and ERDA, where he led major engineering and R&D initiatives. Prof. Singh has contributed significantly to thermal power plant life assessment, energy management, and non-destructive testing. A recipient of multiple national and international awards, he is also a prolific author with over 60 technical papers. He continues to serve as a visiting faculty and consultant, widely recognized for his expertise and leadership in engineering education, power sector strategy, and human resource development.

Team of Experts

Narendra Kumar Roy

Failure & FEA Analysis Experts

“A seasoned mechanical engineering professional with a B.Sc. (Engg.) from BIT Sindri (1966) and a Master's in Mechanical Machine Design from the University of Roorkee (1968). Actively involved in Fitness for Service (FFS) evaluations of aging process equipment, piping, and structures in refineries and chemical plants. Areas of expertise include fracture mechanics, fatigue analysis, and FEA interpretation. Has conducted numerous training programs on process equipment and piping design, fabrication, inspection, failure analysis, and corrosion control across India and internationally (Oman, Qatar, Malaysia, Indonesia, Mozambique, Nigeria, Thailand, and New Zealand). A member of the American Society of Mechanical Engineers (ASME), USA”.

Dinesh Butala

Process Design & Safety Experts

Dinesh Butala is a seasoned Chemical Engineer with over 47 years of experience in project management, process design, technology upgradation, troubleshooting, and process safety across the petrochemical, fertilizer, plastics, and refinery sectors. He played a key role in the revival of Gujarat State Fertilizers & Chemicals Ltd (GSFC) and served as its Executive Director, leading operations, strategic planning, and safety initiatives. Mr. Butala has collaborated with leading global licensors and engineering consultants, and supported major projects for Deepak Nitrite, Tata Strategic Management Group, and State Bank of India. He is currently a Process Safety Consultant and Technical Advisor to multiple firms, including UL India and ENPRO Projects. A prolific contributor to industry knowledge, he has authored over 50 technical papers and actively serves with IIChE, AIChE, and academic institutions.

Jaiprakash N Agarwal

Project Consultant & Technical Advisor for Cathodic Protection and Pipeline Asset Integrity Management.

A highly experienced professional with over 40 years in the oil and gas industry, specializing in cross-country pipeline construction, O&M, and integrity management. A core expert in cathodic protection (CP), with ICorr (UK) Level 4 certification and Fellow membership. Recipient of the AMPP Corrosion Awareness Award (2023) and the Glory of India Award (2024). Author of three books on CP and pipeline integrity, and a regular presenter of technical papers at AMPP, ASME, and other international conferences. Extensive expertise in protective coatings, integrity surveys, and corrosion mitigation. Conducts audits (T4S, IMS, ERDMP) and training for leading organizations, and develops SOPs, QMS, and technical specifications for corrosion control. Held key roles at GAIL (India) Ltd. for 28 years and Oil India Ltd. for 5 years

KEY PROJECT LIST

KEY PROJECTS LIST (DOMESTIC)

Client Name	Location	Detailed scope of work	Year	Value Delivered
Asset Integrity Management - Risk Based Inspection (RBI)				
BPCL	Bina	Risk Assessment of Duplex AFC and Piping in HCU Plants as per RBI, including data review, failure analysis, and risk matrix development.	2025	Trusted by BPCL for RBI solutions, TCR Advanced consistently delivered measurable improvements in safety, reliability, and cost efficiency.
IFFCO	Kandla & Kalol	Risk Based Inspection (RBI) study of Ammonia Storage Tank B (5000 MT) to ensure integrity and operational safety.	2025	Executed RBI studies enabling clients to adopt risk-based maintenance strategies for safer, more economical operations
RCFL	Mumbai	RBI study of two double-wall, double-integrity ammonia storage tanks at Ammonia-I Plant, RCF Trombay Unit.	2023	Delivered RBI assessments that empowered clients to optimize maintenance, enhance safety, and reduce cost
Asset Integrity Management- Knowledge Based Audit (KBA)				
Tata Power Company Limited	Jojobera	Knowledge-Based Audit (KBA) for Residual Life Assessment of 67.5 MW Unit, including economic loss evaluation and decommissioning plan validation.	2025	TCR Advanced extended the life of TPCL's 67.5 MW unit by 12 years through a knowledge-based audit, delivering actionable repair and replacement strategies while ensuring zero disruption to operations
Specialized Studies & Evaluations				
Shiva Engineering Services	Jhagadia	ComprehensiveInspection and assessment of 1,500+ plant assets to determine condition, integrity, and remaining life, with a prioritized plan for optimized maintenance and lifecycle management	2025	TCR Advanced mapped 1,500+ assets at a specialty chemical plant, providing independent evaluation and data-driven insights that strengthened asset condition, compliance, and lifecycle decisions
SARK, BSS for Reliance Industries Limited	Mumbai	Accelerated Life Testing of 1.5 mm MMO wire covering coating thickness, chemical analysis (EDS & wet), coating uniformity (OM & SEM), and flexibility by bend testing	2025	Through rigorous testing, TCR Advanced confirmed MMO Wire Anodes meet global standards, enabling clients to adopt reliable, high-performance cathodic protection systems
L&T - VHEW	Ranoli	Established advanced material testing lab with metallography, microscopy, and mechanical testing for qualification and quality assurance	2024 -25, 2019 -20	TCR Advanced supported PFBR fabrication by establishing a dedicated lab at L&T Vadodara, providing microstructural, weld, hardness, and mechanical evaluations to secure uncompromised quality
L&T Construction	Vadodara	Statue of Unity Project — Mechanical, Chemical, Metallurgical & NDT testing of materials and components to ensure quality, reliability, and safety	2014 -18	TCR Advanced supported the Statue of Unity project with rigorous testing that validated quality, strength, and lasting structural performance.
Jiangxi Toqine Metal Crafts	Omkareshwar	Statue of Oneness — Adi Shankaracharya: Conventional NDT for quality control of structural fabrication.	2024	TCR Advanced safeguarded the Statue of Oneness project by performing NDT that ensured fabrication quality, structural soundness, and lasting performance.
ITER -India for Institute of Plasma Research (IPR)	Gandhinagar	Crevice Corrosion & Electrochemical Study for ITER- India	2012	TCR Advanced supported the ITER program by evaluating boronated stainless steels under pressurized autoclave conditions, enabling informed, reliable material selection for nuclear applications.

Client Name	Location	Detailed scope of work	Year	Value Delivered
Failure Analysis				
Adani Power Limited	Mundra, Kawai, Raigarh, Etc.	Failure Analysis of Boiler Tubes	2025	TCR Advanced conducted root cause failure investigations, delivering actionable insights that enhanced safety, reduced downtime, and optimized reliability
Tata Power company Limited	Mundra, Jojobera & Trombay	Failure Analysis of Boiler Tubes	2025	Through detailed failure investigations, TCR Advanced empowered clients to prevent recurrence, extend equipment life, and achieve cost savings.
BPCL	Mumbai, Kochi & Bina	Failure & Root Cause analysis for Various Refinery Equipments	2025	TCR Advanced's root cause investigations provided clear solutions for safer operations, improved reliability, and long-term asset performance
Reliance Industries Limited	Jamnagar, Vadodara, Dahej, Hazira, Patalganga	Failure & Root Cause analysis for Various Refinery Equipments	2025	TCR Advanced delivered fact-based failure analyses that helped clients strengthen reliability, improve safety, and cut maintenance costs
Gail India Limited	Vijaypur	Failure & Root Cause analysis for Various Static & Rotary Equipment Equipments	2025	By uncovering true causes of failure, TCR Advanced enabled clients to implement corrective actions, prevent future breakdowns, and boost efficiency
Mahanagar Gas Limited	Mumbai	Failure & Root Cause analysis for Various Components including piping components	2025	TCR Advanced's investigations transformed failures into learning opportunities, driving safer operations, longer equipment life, and measurable savings.
HURL	Barauni & Sindri	Failure & Root Cause analysis for Urea Reactor	2025	Through scientific failure analysis, TCR Advanced supported clients in minimizing risks, reducing unplanned outages, and ensuring sustainable reliability
IFFCO	Kalol	Failure & Root Cause analysis for Secondary Super Heater Coil	2024	TCR Advanced empowered industries with data-driven root cause insights, enabling proactive maintenance strategies and improved asset performance
GNFC	Bharuch	Failure & Root Cause analysis for Water wall tube at Burner elevation of Boiler -II	2023	TCR Advanced turns failures into actionable insights, ensuring safer, more reliable, and cost-efficient operations
Failure Analysis -Insurance Sectors				
Proclaim Insurance Surveyors and Loss Assessors Private Limited	Chattisgargh	Failure investigation of dust catcher of a 250 cubic meter, mini blast furnace (MBF #2)	2024	TCR Advanced delivered independent technical assessments for insurance claims, enabling fair, evidence-based decisions and minimizing disputes
Protocol Insurance Surveyors & Loss Assessors Pvt. Ltd.	Chattisgargh	Failure investigation of In-motion Wagon Loading Station (IMWLS-1) for a reputed Mining Industries	2023	TCR Advanced provided neutral technical assessments, helping clients resolve insurance claims with fairness, clarity, and confidence
Mehta & Padamsey Insurance Surveyors & Loss Assessors Pvt. Ltd.	West Bangal	Failure Investigation Of FIX ROLLER PRESS#EL475-01-709 In Cement Mill	2021	Through unbiased evaluations, TCR Advanced supported insurers and clients with credible insights that built trust and ensured transparency savings.
McLarens	Odisha	Failure investigation of iron ore ship loader - SL2 in a reputed Steel plant	2022	With impartial technical expertise, TCR Advanced safeguarded credibility in insurance claims, ensuring fair outcomes for all stakeholders

Client Name	Location	Detailed scope of work	Year	Value Delivered
New India Assurance Co.	Rajasthan	Failure investigation of roller press shaft of RP1 in a reputed cement industries	2020	TCR Advanced's independent assessments brought clarity and transparency to insurance claims, reducing conflicts and strengthening client confidence
Remaining Life Assessment of Boilers				
Adani Power	Mundra	Remaining Life Assessment of 660 MW supercritical boiler and critical piping (590 °C, 281.3 bar)	2025	Successfully completed an RLA study of a supercritical boiler in 25 days — a milestone achievement supporting safer operations of next-generation thermal systems.
Adani Power	Tirora	Remaining Life Assessment of 660 MW supercritical boiler and critical piping (590 °C, 272 bar)	2025	Completed a comprehensive RLA study within 25 days, enabling the client to make informed decisions on reliability and continued operation.
Vidarbha Power Limited	Butibori	Remaining Life Assessment of 2×300 MW subcritical boilers and critical piping (552 °C, 201.8 bar).	2024	Executed dual boiler RLA projects within 36 days, providing detailed analysis and recommendations for extending safe operational life.
Torrent Power Limited	Ahmedabad	Remaining Life Assessment of 2×120 MW subcritical boilers and critical piping (540 °C, 158 bar)	2024	Delivered complete RLA for both boilers within 32 days, balancing accuracy with efficiency to meet client deadlines and enhance plant reliability.
Tata Power company Limited	Trombay	Remaining Life Assessment of 2×500 MW subcritical boilers and critical piping (541 °C, 177 bar).	2022	Achieved RLA completion in just 14 days, offering timely insights for proactive decision-making and safe operations.
Reformer Tube -ARTiS™				
RFCL	Ramagundam	Automatic Ultrasonic Scanning (AUS) inspection of reformer tubes in the ammonia plant	2025	Deployed ARTiS™ reformer tube scanning technology, securing uninterrupted production and improving plant efficiency through precise integrity evaluation.
HMEL	Bhatinda	HGU-Reformer tube external Inspection (using crawler) & Along with Residual Life Assessment (RLA) of tubes	2025	Executed advanced reformer tube integrity studies, allowing the client to optimize maintenance strategies while safeguarding against costly downtime.
NFL	Bathinda, Vijapur & Naya Nangal	Inspection of primary reformer catalyst tubes with Automated crawler	2025	Covered multiple refinery sites (Bathinda, Vijapur, and Naya Nangal) with integrated studies, ensuring standardization and consistency across client facilities.
IOCL	Bongaigaon, Guwahati & Haldia	Health Assessment of Hydrogen Reformer Catalyst Tubes by Ultrasonic Scanning or eddy current scanning or combination using automated scanners in HGU	2024	At Haldia Refinery, completed an extensive RLA study along with Level 3 FFS on reformer tubes, providing clients with world-class integrity assessment solutions.
The Fertilisers and Chemicals Travancore Ltd.	Travancore	RLA study of Reformer tubes using automated creep scanning, with condition assessment of inlet hairpins and outlet pigtails in the Primary Reformer of an ammonia plant.	2023	Regularly deployed ARTiS™ technology to deliver reformer tube reliability, helping clients run their units at optimum performance without disruption.
Fitness for Services				
Heavy Water Board Facilities, Department of Atomic Energy Govt. of India	Vadodara	Fitness-for-Service (FFS) assessment of SS347H Cracker Bottom Header using NDT and API 579 / ASME FFS-1 guidelines	2025	Performed Fitness-for-Service assessments in accordance with global codes, enabling clients to extend safe operation of assets while optimizing capital expenditure.

Client Name	Location	Detailed scope of work	Year	Value Delivered
CR3 (india) Pvt. Ltd for BPCL	Mumbai	FFS and RLA of vessels, columns, valve bodies, and piping using NDT per API 579 / ASME FFS-1 standards	2023	Completed a refinery-wide inspection program within tight deadlines, with TCR's reports formally recognized and appreciated by BPCL for quality and reliability.
Godrej Industries Limited	Valia, Bharuch	FFS and Condition Assessment of Fatty Alcohol Plant equipment using NDT per API 579 / ASME FFS-1 standards.	2022	Successfully inspected 29 critical equipment items within the scheduled shutdown, ensuring zero disruption to client operations.
HPCL	Visakh	FFS assessment of CDU-III plant equipment and piping using NDT per API 579 / ASME FFS-1 standards.	2021	Honored to be awarded a prestigious FFS project by a Maharatna PSU through limited tender, reaffirming our technical leadership in the industry.
BPCL	Mumbai	FFS assessment of HCU plant equipment and piping using NDT per API 579 / ASME FFS-1 standards.	2018	Trusted by leading organizations, TCR's FFS studies consistently delivered results that met international standards and enhanced operational safety.
Fire Damage Assessment				
Vision Products Private Limited	Mumbai	Fire damage assessment of reactors, columns, vessels, tanks, and receivers using NDT as per API and applicable standards.	2023	Executed urgent fire-damage evaluation with rapid mobilization, enabling safe resumption of operations while ensuring complete compliance with safety norms.
Bharat Rasayan Limited	Dahej	Fire damage assessment of reactors and tanks using NDT as per API and applicable standards.	2022	Responded swiftly with fire-damage integrity assessments, providing confidence to the client for safe and reliable restart of plant operations.
HMEL	Bathinda	Fire damage assessment of Exchanger 501-E-155NF and associated piping using NDT as per API and applicable standards.	2022	Delivered critical fire-damage inspections under stringent timelines, helping clients restore normalcy without compromising reliability.
Tagros Chemicals India Private Limited	Dahej	Fire damage assessment of plant equipment and associated piping using NDT as per API and applicable standards.	2022	Performed comprehensive fire-damage evaluations, combining technical accuracy with speed to minimize client downtime.
Conditional Assessment				
Apcotex Industries Limited	Dahej	Condition assessment of Stripper Column D-410 and Tank F-106 using NDT as per API and applicable standards.	2025	Conducted comprehensive asset condition assessments that extended equipment lifecycle, enhanced operational safety, and reduced maintenance costs.
GSFC	Vadodara	Condition assessment of 10,000 MT atmospheric ammonia storage tank (79-2001) using NDT as per API and applicable standards.	2024	Advanced asset integrity evaluations performed to help clients achieve operational efficiency and reduce risks of sudden equipment failures.
Sud-Chemie India Pvt. Ltd.	Vadodara & Kochi	Condition assessment of Reactor 101, furnace coil headers, and ammonia cracker using NDT as per API and applicable standards.	2024	Supported critical decision-making through in-depth condition assessments, allowing safe extension of asset life without compromising production.
Hindalco - Birla Copper Unit	Dahej	Condition assessment of Figee and Dalian cranes using NDT as per API and applicable standards.	2024	Successfully executed high-value conditional assessments, reinforcing TCR's commitment to precision, excellence, and operational reliability.
Gujarat Chemical Port Trust (GCPL)	Dahej	Condition assessment of ATM Gentryslop Tank using NDT as per API and applicable standards.	2023	Delivered asset integrity studies with actionable recommendations, helping clients optimize inspection intervals and achieve cost savings.

Client Name	Location	Detailed scope of work	Year	Value Delivered
FRP Tanks & Vessels Inspection				
BASF India Limited	Dahej	Condition assessment of FRP tanks through inspections using various NDT methods.	2025	Consistently serving client requirements since 2019, strengthening long-term partnerships and reinforcing TCR's credibility as a trusted testing partner.
Convergence Chemicals Pvt. Ltd.	Dahej	Condition assessment of FRP Vessels (V-0214A) through inspections using various NDT methods.	2022	Ongoing FRP inspection programs since 2019, ensuring the durability and safety of composite structures through continuous support.
Huntsman International India	Vadodara	Condition assessment of multiple FRP vessels and tanks at tank farm using NDT methods.	2020	Delivered reliable FRP inspection solutions on a continuous basis, helping the client avoid costly failures and extend asset life.
Advanced NDT Services				
Krishak Bharati Cooperative Ltd. (Kribhco)	Surat	PAUT , TOFD & LRUT Inspection for Plant piping	2025	Delivered advanced NDT services with precision and reliability, helping the client identify hidden flaws proactively and ensuring uninterrupted plant operations.
SRF	Dahej	UT, ECT, Helium Leak Testing, RFET, MPI & Videoscopy (VI - Boroscopy) for Plant Equipment	2024	Implemented cutting-edge NDT methodologies to detect anomalies that could compromise safety, thereby supporting long-term asset integrity.
BPCL	Kochi	DPT, UT, PAUT, AUBT, In Situ Metallography for Plant Equipment and piping	2023	Trusted by industry leaders such as BPCL, TCR's solutions consistently met stringent quality and safety requirements, strengthening our reputation as a dependable partner.
MRPL	Mangaluru	PAUT & TOFD Services for Inspection	2021	Designed and executed specialized NDT inspections that ensured zero unplanned shutdowns, while maximizing operational efficiency and productivity.
MRPL	Mangaluru	Fire damage assessment of plant equipment and associated piping using NDT as per API and applicable standards.	2020	Customized advanced diagnostic solutions for complex industrial assets, giving the client clear, actionable insights for safe and reliable operations.
DCM Shriram	Kota	DPT,UT, PAUT, ECT, RFET, In-Situ Metallography, UFD, MPI for Ammonia Plant Shutdown	2019	Rapidly mobilized expert teams for time-sensitive inspections, restoring operations without delay and reinforcing client confidence in TCR's responsiveness.
ACRT				
MRPL	Mangaluru	Life assessment using Omega Method (RLA) of CCR1 heater tubes and DCU coker heater tube samples at TCR Lab.	2025	Applied Omega Method-based life assessment, accurately predicting heater tube integrity and allowing for proactive maintenance scheduling.
Nayara Energy Limited	Vadinar	Life Assessment based on Omega Method (RLA) of Reformer tube/CCR heater tube samples was carried out at TCR lab	2024	Used Omega Method to deliver reliable life predictions, enabling safe extension of equipment operation while reducing risks of catastrophic failures.
BPCL	Mumbai	Life Assessment based on Omega Method (RLA) of 141AF102 tube samples was carried out at TCR lab	2022	Trusted for advanced life assessment techniques, TCR's Omega evaluations have supported critical decision-making in high-risk assets.

KEY PROJECTS LIST (INTERNATIONAL)

Client Name	Location	Detailed scope of work	Year	Value Delivered
PIC Fertilizer Plant - NBTCPIC Fertilizer Plant -NBTC	Kuwait	Remaining life assessment of 120 critical equipment in Ammonia & Urea Plant with recommendations for life extension.	2024	Through advanced NDT and metallurgical assessments, TCR Advanced ensured safe reuse of 120 dismantled plant assets, providing actionable life extension recommendations on a fast-track timeline
AIO Consulting Limited for ARAMCO	UAE	Engineering Critical Analysis of anomalies in 42″ underground oil trunkline girth welds (west & east) at BVS, as per API 1104, including Finite Element Analysis.	2025	TCR Advanced performed ECA of anomalies on a 42" trunkline, using API 1104 and FEA to define critical flaw sizes and strengthen the client's welding integrity strategy for safe operations
Mekdam Holding	Qatar	Tube bundle integrity check of Glycol Reactor Reboiler for Qatar Energy.	2025	TCR Advanced assessed tube bundle integrity of a Glycol Reactor Reboiler for Qatar Energy, identifying MOC and design factors to mitigate risks and ensure long-term safety
Indorama Eleme Petrochemicals Ltd.	Nigeria	Failure investigation of shaft of BFW Pump	2025	TCR Advanced investigated a BFW pump shaft failure, uncovering design gaps and enabling corrective modifications that improved reliability and prevented recurrence
QAFCO	Qatar	Remaining Life Assessment and In-Situ Metallography on Various Pressure Parts	2024	TCR Advanced deployed expert teams for in-situ replica metallography, delivering immediate on-site insights and SEM-based RLA to help clients extend plant safety and reliability
Petrokemya	Kingdom of Saudi Arabia	Remaining Life Assessment of Fire Steam Tube Boiler LK2M-20	2023	TCR Advanced conducted RLA of a Fire Steam Tube Boiler, providing insights that enabled long-term operation planning, improved reliability, and ensured production continuity
Emirates Steel Industries (ESI)	Abu Dhabi, UAE	Automated Reformer Tubes Inspection System (ARTiS) conducted on DRP1 tubes (Mar 2025) and DRP2 tubes (Jun 2025).	2025	TCR Advanced rapidly deployed teams for ARTiS inspection on DRP1 & DRP2 units, enabling timely tube replacements and preventing costly unplanned shutdowns
Dangote Fertilizers & chemicals	Nigeria	Automated Reformer Tubes (ARTiS) and tail tube inspection as per API standards for reformer life extension.	2023	TCR Advanced executed ARTiS™ and Tail Tube inspections as per API guidelines, delivering precise insights that enabled reformer life extension and safe operational continuity
JIFCO	Jordan	RFET & Videoscopy of Boiler Tubes of Waste Heat Recovery Boiler	2025	CR Advanced performed RFET and videoscopy of WHRB tubes, giving the client clear insights on tube health to plan proactive maintenance and extend equipment life
Binh Son Refining & Petrochemical Joint Stock Company	Vietnam	Life Assessment based on Omega Method (RLA) of Heater tube samples was carried out at TCR lab	2025	TCR Advanced conducted Omega Method-based life assessment of heater tubes, delivering accurate life predictions that enabled proactive maintenance, safety, and cost optimization
Various Fabricators & Manufacturer for Cameron International Corporation		First Article Qualification (FAQ) testing as per Cameron International standards, including comprehensive evaluation of samples for quality and performance compliance.	2012-ongoing	TCR Advanced executed First Article Qualification (FAQ) for Cameron International, validating material integrity and compliance through mechanical, chemical, metallurgical, and NDT testing

Prominent Clients


ओएनजीसी
ONGC
गेल
GAIL
HP
Bharat Petroleum
इंडियनऑयल
IndianOil
ऑयल इंडिया
OIL INDIA
NRL
ONGC
MRPL
CPCL
HMEL
Reliance
Industries Limited
NAYARA
ENERGY
CAIRN
WE FUEL AMAZING
vedanta
adani
GACL
Promoting Green Technology
GSFC
GNFC
IFFCO
पूर्णतः सहकारी स्वामित्व
Wholly owned by Cooperatives
KRIBHCO
Cooperative and beyond...
RFCL
DCM SHRIRAM
Growing with trust
DEEPAK FERTILISERS
AND PETROCHEMICALS
CORPORATION LIMITED
एनटीपीसी
NTPC
बीएचईएल
BHEL
TATA
TATA POWER
adani
Power
torrent
POWER
ESSAR
RELIANCE
Power
CGPL
AARTI
INDUSTRIES
UPL
OpenAg™
atul
SRF
Godrej
ALSTOM
SIEMENS

Client Testimonials “National”

GUJARAT NARMADA VALLY FERTILIZERS

“Their failure analysis was systematic, insightful, and operationally valuable.”- **M Y Joshi**

RELIANCE INDUSTRIES LIMITED

“Impressed by the crew’s knowledge, energy, and commitment to quality work.” - **U Anand**

ESSAR GROUP

“A dependable team that’s quick to respond and thorough in execution.” - **Pratapsing Parmar**

GODREJ INDUSTRIES LIMITED

“Helped us revive aged Incoloy joints with precision weld procedures and RLA insights.”- **B K Gupta**

WELSPUN GUJARAT STAHI ROHREN LTD.

“A team that brings solutions with professionalism, timeliness, and deep expertise.” - **Jignesh Chokshi**

Larsen & Toubro

“At the Statue of Unity project, their dedication truly stood out.” - **Dr. M. V. Venketesan**

ASEA BROWN BOVERI LTD. (ABB)

“Exceptional quality in microstructure replication and impressive daily output.” - **V J Shrikhande**

Client Testimonials “International”

GE ELECTRIC INTERNATIONAL, INC

The technical team’s timely support made a real difference on-site.” **- Abdul Hannan**

SABIC

“Played a crucial role in completing corrosion mapping with precision and speed.” **- Ali G. Al-Ghamdi**

IBN SINA

“The experience and professionalism of their manpower deserves full credit.” **- Y. D. Kim**

HYUNDAI HEAVY INDUSTRIES CO. LTD.

“Thanks to their efforts, our maintenance activities stayed right on track.” **- Majed Al Rassi**

SIPCHEM-SAUDI INTERNATIONAL

“At the Statue of Unity project, their dedication truly stood out.” **- Dr. M. V. Venketesan**

STANDKESSEL BAUMGARTE SERVICE GmbH

“A committed partner that helped us hit our project milestones with ease.” **- Engr Marwan Khader**

AL TOUKHI COMPANY OF INDUSTRIES

“Their inspectors ensured we wrapped up the turnaround well within deadline.” **- Homan Al-Madinii**

AWARDS AND ACHIEVEMENTS

Credential Certificates (TCR Advanced)


National Accreditation Board for Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

TCR ADVANCED ENGINEERING PRIVATE LIMITED

ISO/IEC 17025:2017

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

TESTING

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer


National Accreditation Board for Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

TCR ADVANCED ENGINEERING PRIVATE LIMITED

ISO/IEC 17025:2017

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

TESTING

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

TCR-Advanced-NABL-Certificate


FORM XVI-H
[see regulation 4C]

Central Boilers Board,
Certificate of Approval as
Well Known Material Testing Laboratory

M/S TCR Advanced Engineering Pvt. Limited,
Vadodara-390 010
Gujarat

Note: The recognition will be as per the standards specified under the provisions of the Indian Boiler Regulations, 1950

CBB

Secretary


FORM XVI-I
[See Regulation 4C]

Central Boilers Board
Certificate of Approval as
Well Known Remnant Life Assessment Organization

M/S TCR Advanced Engineering Pvt. Limited,
Vadodara-390 010
Gujarat

CBB

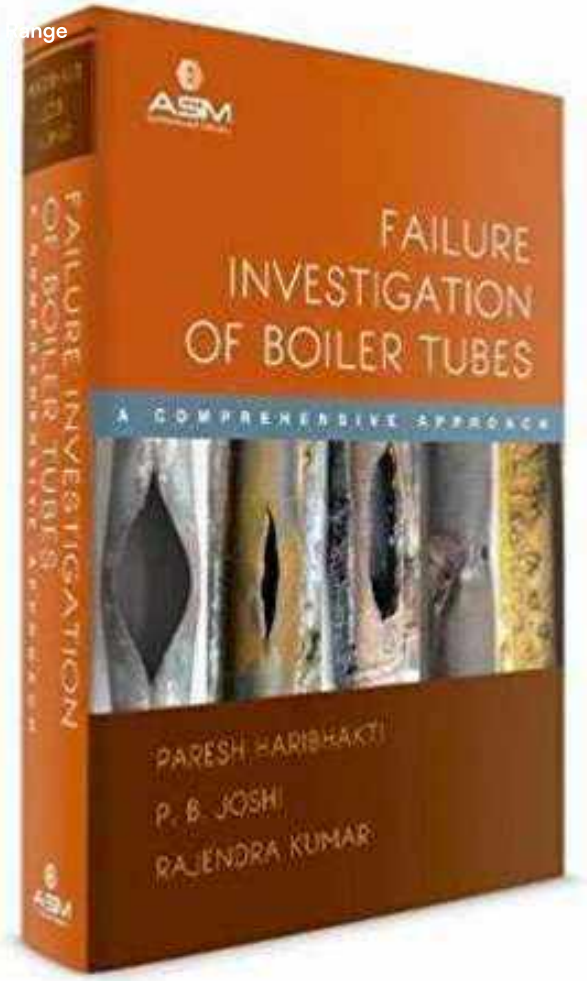
Secretary

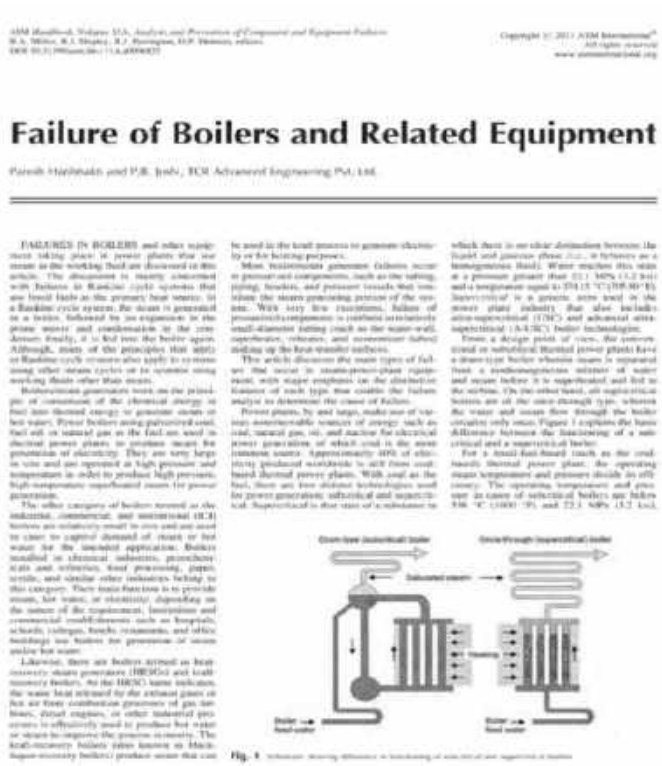
IBR-approval-for-RLA

Tap to open the "Certificate of Scope of Testing" - https://www.tcradvanced.com/pdf/TCR-Advanced-NABL-Scope.pdf

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.





Appreciation Certificates (TCR Advanced)

Appreciation Certificates (Evolve by TCR Advanced)

Global Offices

INDIA

VADODRA

Consulting HQ (Main Office)

TCR Advanced Engineering Private Limited,
250-252/9, GIDC Estate, Makarpura,
Vadodara-390010, Gujarat, India

Tel: +91.7574805594 | +91.8511117993
E-mail: testing@tcradvanced.com
www.tcradvanced.com

Engineering Consultancy, NDT & Research Division

TCR Advanced Engineering Private Limited, 42/A, GIDC Estate, Makarpura, Vadodara-390010, Gujarat, India

Tel: +91.7574805594 | +91.8511117993
E-mail: testing@tcradvanced.com
www.tcradvanced.com

Evolve by TCR Advanced, the Training Arm,

TCR Advanced Engineering Private Limited, 215, Pancham Icon, Vasna Road, near D-Mart, Vadodara, 390007. Gujarat India

Tel: +91 75748 34848
Email: evolve@evolvetcr.com
www.evolvetcr.com

BHARUCH

TCR advanced Engineering Private Limited

Shop No. 01 GF. Signature House,
Mira Park Society, Shravan Chokadi,
Bharuch, 392001. Gujarat, India

Tel: +91.7574805594 |+91.7574834899
E-mail: vijaylumar@tcradvanced.com
www.tcradvanced.com

BHUBANESWAR

TCR Engineering Services (Eastern)

Plot No. 125/2094, Vishnu Vihar Jayapur, Pahala, Bhubaneswar, Odisha 752101

T: +91-9776704680 / +91-6744602472
odisha@tcreng.com

ASSAM

TCR Engineering Assam

H. #28, Saiz Lane, Bethal Path, Bagharbori, Guwahati-781307, Assam

Tel: +91-9932034791

INDIA

MUMBAI

Mumbai (Corporate HQ)

TCR Engineering Services Private Limited

35 Pragati Industrial Estate,
N. M Joshi Marg Lower Parel, Mumbai - 400 011 Maharashtra, India

Tel: +91-22-67492324
E-Mail: sales@tcreng.com
www.tcreng.com

NAVI MUMBAI

Mumbai Laboratory

TCR Engineering Services Private Limited

VKB House, EL-182, MIDC-TTC,
Electronic Zone, Mahape, Navi
Mumbai-400 710 Maharashtra, India

Tel: +91-22-67380900 / 901 / 902
Tel: +91-9833530200
E-mail: sales@tcreng.com
www.tcreng.com

TCR-BME

TCR-BME Metal Market

BME House, 88/90 Kikka Street, 2nd Floor #18, Gulalwadi, Mumbai-4

Tel: +91-9699210864 |
+91-9920011298
Tel: +91-9820008656 |
+91-8779216510

NASHIK

TCR Engineering Maharashtra

Shubham Park, Building 7 #30,C Wing, Near Bhole Mangal Karyalay, Cidco, New Nashik - 422010

Tel: +91-8421922315

UTTAR PRADESH

TCR Engineering Services (UP)

Gangotri Nivas Ward - 51,
Parshuram Nagar, Shivpur New Colony, Gorakhpur, UP - 273016

T: +91-9967267412
E: up@tcreng.com

DUBAI

TCR Engineering Consulting

PO Box 122453, Dubai, UAE

Tel: +971-50-7858901
uae@tcreng.com
TEL: +603-61886311

KSA

TCR SAUDI ARABIA

TCR ARABIA COMPANY LIMITED
P.O. Box-2899, Gas Gardens,
King Abdulaziz Seaport Facility,
Dammam-32211, KSA

Tel: +966-3-8475784/85
Cell: +966-5-0499-7683
E-mail: sales@tcr-arabia.com
www.tcr-arabia.com

TCR Arabia (Jubail Branch)

Office No. 11, Executive Business Center, Jubail - Dammam Highway, Al-Jubail, KSA

Tel: +966-13-3449553/56

TCR Arabia (Yanbu Branch)

P.O. Box -30377, Office # 001,
Al-zakri Mall, King Faud Street,
Royal Commission,
Yanbu — 41912, KSA

Tel: +966-14-3932321

QATAR

TCR QATAR

C/o Biewu International Trading WLL
Building 256, Office# 8, Street 250
D-Ring Road, New Salata, ZONE:40,
P. O. Box 24534 Doha — Qatar

Tel: +974 5526 9747
Qatar@tcreng.com

KUWAIT

TCR KUWAIT

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