

Report of Symposium on

Energy Asset Integrity Management (EAIM)

(Operations – Performance – Inspection – Integrity Assessment -Life Extension – Digitalisation)

22-23 June 2023, IISc Bengaluru

Organised by

India Energy Network

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Sri Tarun Kapoor
IAS (Retd), Advisor, PMO

Sri Tarun Kapoor set the context for deliberations. Explained India's energy scenario. Highlighted the importance of innovative energy on affordable storage options, and safe materials with high energy densities. He discussed various schemes of the Govt. of India which belong to the energy sector and could help India in achieving energy security and net zero. **"All our efforts should be directed towards achieving energy security at net zero on environment"**

Sri Sunil Kumar
IRS, Joint Secretary,
Ministry of Petroleum and Natural Gas

Sets the objective from oil and gas sector, with emphasis on exploration & production. Voiced the importance of the energy consumption to generation ratio in India. India consumes 5 million barrels per day and generates only 0.5 million barrels. He focused his further remarks on depleting oil fields indicating that 10-15% of depletion is due to failure of asset integrity. He highlighted the importance of managing the depletion of wells to maintain production. He indicated the strategic importance of ultra-deep and deep-water exploration and the need for support from the energy industries in developing the related technologies and the importance of the role of every stakeholder in water exploration. He highlighted the importance of house-keeping in asset management. **"Knowledge is important for informed decision-making"**



Prof ASK Sinha
Director, RGIPT,
(an institution of national
importance under MoPNG)

Prof ASK Sinha explained the objective of the organization, its history and activities of its centers in Shivsagar, Assam; and Bengaluru and in main campus at Jais, Uttar Pradesh. He cited collaborative projects with NTPC, IOCL ONGC and activities of RGIPT in areas related to energy transition, EV, PVs, digital technologies. Prof Sinha gave details of diploma, degree, post graduate and PhD programs of the institute. **"Director sought for deeper collaboration between RGIPT and industry"**



22nd-23rd June 2023
Indian Institute of Science, Bengaluru

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India Energy Network
(An initiative of Science and Engineering Foundation of India)

In Collaboration with

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Dr. S. Shamasundar

Chairman,
Organising Committee of Symposium,
President, Board of Governors, RGIPT,
MD, ProSIM R&D Pvt Ltd

Shamasundar highlighted the objectives of the symposium. Need for energy asset operators to enhance the operational efficiency, with safety and reliability; need to develop appropriate maintenance practices to reduce downtime; measures for risk assessment in early stages; develop and update inspection protocols to assess fitness for service (FFS); develop methodologies for asset life assessment and extension.

Symposium provides a platform for networking and interaction; an opportunity to pose problems & seek solutions; learn from experience of others; and develop collaborations. Shamasundar stressed the need for developing a holistic framework for energy asset integrity management and the need to include all stakeholders within and outside energy companies.

He emphasized the need to develop a framework for asset integrity management that draws expertise from technology/ service providers, academics, R&D professionals, start ups, for collaborative work in a seamless manner.

There were 127 participants from 36 different organization spanning across the spectrum of energy asset integrity management. Participants were a representative cross section of all stake holders involved in energy asset integrity management.

Contents	Page 3
Co-organising Institutions	4
Keynote speakers	5
Participating organisations	6-8
Operations	9-10
Inspection	11-14
Corrosion, Materials	14,16
Integrity Assessment	17-22
Digitalisation	23-26
Way Forward	27
Committees	27
Photo Gallery	29-31
Organizing institutions	32



Prof G Jagadeesh

Chairman, CoE in Hypersonics, Aerospace Dept, IISc
Member, Organizing Committee

Sets objective on how to generate & use information for energy security. Spoke of emergence of NDE 5.0 integrating advancements in technology and energy, a fusion bringing together hardware and software, transcending the traditional technologies like maintenance and repair. A single dashboard for holistic control is being implemented to streamline operations in the energy sector. Explained activities in IISc in development of drones for inspection. Utilizing microsattelites and hyperspectral imaging instantaneous data capture and asset monitoring become feasible. Early satellite initiatives such as Energy Information Bureau, Energy Information Network and the international telecommunications satellite corporation. **“One Could capitalize on Space capability, IT capability to create Energy Information Networks in India”**

Prof Vikram Jayram

Emeritus Professor, IISc, President, InSIS
Member, Organizing Committee

Sets context for inherently safe structures Prof Jayram spoke of various aspects of structural integrity such as failure, corrosion, spectra, fatigue, and more, including the application of AI and machine learning techniques, to assess structural integrity, methods like digital image correlation and scanning electron microscopy (SEM) and transmission electron microscopy (TEM) for non-destructive evaluation (NDE) are employed. He explained standards set by organizations like ASME (American Society of Mechanical Engineers), ASTM (American Society for Testing and Materials). He explained activities of Indian Structural Integrity Society (InSIS).



Mr. Umesh Chandra

India Energy Network
Member, Organizing Committee

Described objectives and activities of India Energy Network towards energy transition and achieving energy efficiency. Spoke of asset base of oil and gas, and thermal power sectors which have an asset base of over Rs 40 lak crores, and an annual cost of managing assets exceeding 2 lak cores. He spoke of huge energy needed about 105 trillion units - for energy transition from carbon based fuels to renewable sources in electricity sector alone. He said, IEN is set up with an intent of promoting public-private partnership, and bring together several organisations of eminence to develop and improve technologies that make India energy surplus at reasonable cost, and with least harm to environment. **“Energy Transition is the single most exciting transformation in Indian and global context, surpassing telecom and IT Transformation”**





Srivastava spoke on the need for power, asset utilization, and asset life cycle. He spoke about NTPC initiatives such as Inhouse asset integrity management – SARTHI, Centralized monitoring, and diagnostic center. He highlighted the importance of renovation and modernization to extend the life of assets with much-reduced cost. Cited examples of SoPs for asset management providing instructions for asset integrity throughout life cycle, creating of 3D models that enable future personnel to visualize and understand plant operations.

M K Srivastava
ED Engineering, NTPC

Vartika Shukla spoke about maximizing the usage of the asset; need for assets speaking through AI/ML technologies which benefit in real-time monitoring and efficient utilization of the assets with reduced downtime; criticality of documentation of old assets; the need for qualitative and quantitative performance benchmarking; developing a matrix for benchmarking. She spoke about the initiatives taken at EIL related to asset integrity, management, and digitalization ESG goals.

Vartika Shukla CMD
EIL



EAIM-2023 Participating Organisations



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Solicitation of volunteers / nominations for working groups

To take energy asset integrity management related discussions further, four working groups, on four key pillars of energy asset integrity management viz., Operations, Inspection, Structural Integrity, Digitalisation - are being formed to discuss the issues in detail on a continuous basis.

All those interested are requested to register their interest.
Email: info@indiaenergynetwork.in



Dr. Manoj Gonuguntla spoke the risks in asset integrity as under maintenance, improper operation, improper risk management, sub-optimal asset management, inability to quantify threat. He explained the importance of proper risk quantification. He addressed the necessity of accurately assessing the scale of potential failures and their implications. **“He highlighted three stages of threat identification – asset information collection; degradation identification; and quantification of threat. Based on the threat identified and quantified, the need for suitable barrier design and barrier verification and maintenance”**

During the planning stage of symposium, multiple stake holders from all cross section of energy asset integrity management were involved.

Program was tailorized considering inputs in the steering committee.

This became a key factor that ensured the success of the symposium.



Dr Manoj Gonuguntla
Sr Corrosion and
Materials Engineer
Session chair



Suresh S.
Chief General Manager, BPCL
Invited Speaker

Suresh spoke of Asset Integrity Management System & retrofitting of refinery equipment practice @ BPCL. He narrated case studies from Mumbai, Kochi, and Bina refineries. Suresh explained asset integrity management for stationary and rotating equipment at BPCL; importance of maintenance history; importance of close monitoring of health of assets. He explained case studies on (1) revamp of RFU splitter which resulted in reduced fuel oil consumption; (2) upgradation of pumps leading to improved reliability and reduced operational issues, (3) upgradation of reciprocating compressors in hydrocracker, resulting in 4-6% energy consumption, and (4) installation of E-FRP blades in the FCCs project leading performance enhancement and efficiency improvement.



Mr. Udit Nandi
Chief General Manager, HPCL
Invited Speaker

Mr Udit Nandi, Chief General Manager, HPCL spoke on “Modern asset integrity management: A process safety approach from prevention to protection”. He presented various aspect of modern asset integrity management revolving around a process safety approach, starting from prevention measures such as risk assessment, design controls, and operating procedures and extending to protection strategies, including safety instrumented systems, process safety management, and asset monitoring. This holistic approach ensures the overall integrity of assets and enhances the safety and reliability of operations. He narrated interrelation between asset integrity and safety. Maintaining asset integrity through regular inspection, maintenance, and risk mitigation measures significantly contributes to a safer working environment, reduces the likelihood of accidents, ensures compliance with regulations, prevents major incidents, and enhances an organization's reputation. Return on average assets (ROAA) shows how efficiently a company is utilizing its assets and is also useful when assessing peer companies in the same industry.

Piyush presented vibration monitoring based on IS 10816. He explained vibration monitoring, methodology, trend comparison, and FFT analyzer which converts amplitude vs time data to frequency vs amplitude data. Amplitude indicates the severity of the fault and frequency shows the origin. He showed plots of the time waveform of equipment and the FFT spectrum of time waveform. He stressed that analysis of amplitude and spectrum is insufficient to know the machine's health and sometimes it's necessary to use phase analysis, run up and coast down to detect the faults. He demonstrated a case study in which despite motor meeting the limits of ISO 10816, faults were diagnosed during spectrum analysis.



Piyush Arya
GM, ONGC

Prof. Krishnan Balasubramanian, IIT Madras and President elebt of ISNT, chaired session on structural integrity. He talked about the NDE 4.0 in which India is a leader of technology. By using robot and drone technologies the asset integrity managers can reduce the impact of huge loss suffered by the industries. He mainly talked about asset integrity risks which can quantify with drone and robotic technology which increases the life of all parts of the plant.

Annual spend on
Asset Management
in this energy sector
is in range of
Rs 3-4 lak crore



Prof Krishnan Balasubramanian
IIT-Madras, Session Chair



Debashish Mitra
GM, HPCL, Invited Speaker

Mr Mitra spoke on “New age Advancements in Refinery Inspection Technology”. He briefed on the roles and functions of refinery inspection – Inspection philosophy, Inspection governance usage of advanced NDE, robotics, and drone in inspection.

He demonstrated the practical application of advanced NDE for insulated piping and corrosion under insulation in pipe support, phonon technology for underground piping inspection, and Line CAT technology for ferrous and non-ferrous pipe scans. He introduced the initiatives taken at HPCL such as augmented reality scans, underwater robotic visual inspection, UT gauging with drones, and insulation coating techniques. He also touched upon future inspection techniques and expressed current inspection challenges in cases like corrosion under insulation, an inspection of underground assets, inspection of pipe racks between tiers, internal cement lining, etc.

Prof Bhattacharya spoke of Structural Health Monitoring of gas pipelines using in-line Crawling Robots. He discussed about the pipeline which is a key component/nervous system to transfer fluids for energy industry. The structural health monitoring of gas pipelines is of paramount importance in ensuring their integrity and preventing potential failures. As the demand for natural gas continuously increases, with 13,840 kilometers of pipelines in 2021. The projection of network reaching up to 28,000 kilometers by 2030 highlights the need for effective monitoring and maintenance strategies. Spoke of loss of about 500 million USD due to pipeline accidents in past, He also addressed the challenges, & several existing solutions are being implemented. Pipeline inspection gauges are widely used for monitoring pipeline conditions. These gauges, which cost approximately 100 USD per pipeline, provide valuable data on the health and integrity of the pipeline.

Another solution involves the deployment of pipe health monitoring robots. These robots are designed to navigate the pipeline infrastructure, equipped with sensors.



Prof Bishakh Bhattacharya
IIT-Kanpur, Invited Speaker



Dr Shyamsunder Mandayam,
VP, ISNT – Invited Speaker

Dr. Mandayam, He presented about trends and advances in NDE, inspection for EAIM. Talked about the core techniques used for inspections using sensors, robotics, digital twins and showed the graphical representation of 2023 Gartner emerging technologies and trends impact radar. He spoke about the difference between digitization, digitalization, and digital transformation. He explained the AI-ML-DL ecosystem and the interconnection between deep learning, machine learning, and artificial intelligence. He highlighted the role of robotics as a key enabler that plays a significant role in automating and augmenting manual inspection processes. He expressed the importance of Xtended reality (XR) and metaverse in the role of digital transformation. He also stressed the disruptive trends for AIM. The causes of failures by three reason i.e. loading environment, material properties, and flaws. **“Don’t Let Bad Things Happen to Good Materials”**.

Dr Ajay Krishnan spoke on - “Silos v/s Integrated Approach in Inspection”.

He spoke about inspection planning, approaches: silos and integrated. Silos inspection planning involves individual assessments and inspections for different components or systems, often resulting in fragmented data and limited coordination. On the other hand, the integrated approach focuses on a holistic and comprehensive inspection strategy that considers multiple aspects of the asset or facility. In the context of inspection planning, various techniques and technologies are employed, including drone-based inspections and advanced non-destructive testing (NDT) techniques. Drones equipped with sensors offer a valuable tool for conducting inspections in hard-to-reach or hazardous areas, providing visual data and facilitating efficient data collection. The focus of inspection planning is to develop a feedback loop that ensures the captured data is analyzed, evaluated, and utilized effectively. This feedback loop helps in identifying areas of concern, prioritizing maintenance activities, and making informed decisions.



Dr Ajay Krishnan
Shell – Invited Speaker



Saugata Sahu
General Manager, IOCL
Invited Speaker

Saugata Sahu, General Manager, Inspection, IOCL spoke on “Inspection practices of refineries at IOCL”. Mr. Saugata Sahu spoke about the structural integrity of assets, failure causes, and the role of inspection, ability of asset to support designed load for intended life span, He talked about different inspection practices at IOCL refineries. He highlighted the reasons for failure in refineries such as breaching of pressure boundaries, cracking, and physical deformity of assets & structure, and collapsing. He also explained damages dealt in refineries such as section wall loss, physical damage due to aging and incident, creep due to high temperatures, fatigue due to cyclic loading, service-induced cracking, hydrogen attack, and embrittlement & metallurgical degradation.

He explained different inspection and NDT approach to detect section loss – time-based monitoring at predetermined vulnerable locations, installation of permanent devices for real-time monitoring, digital radiography for insulated piping.



Mr Mukesh Arora
CEO Arora NDT, Sponsor

Mr Mukesh Arora explained various products and services of ARORA NDT, including Magnetic Particle Testing, Liquid Penetrant Testing, Ultrasonic testing, Radiography testing, Eddy Current Testing, etc.

Dr Gayatri Ramaswamy, Program Manager at Sprint Robotics, an NGO in Singapore a collective of robotics companies working in the area of Asset Integrity Management.

She highlighted importance of discussing way forward, and working groups. She narrated experience of Sprint Robotics in growing from a five member organization to 125+ members including asset owners & robotic solution providers. Sprint is an robotic industry driven collaboration. She highlighted the importance of creation of an ecosystem. Apart from the working group, she emphasized need for a proper structure and governance mechanisms for operation of such groups.



Dr Gayatri Ramaswamy
Sprint Robotics
Invited Speaker

Corrosion



Dr Deepak Dwivedi
RGIPT

Dr. Deepak Dwivedi, RGIPT, Jais, Amethi, spoke on "Corrosion Investigation and Research: The Future Ain't What It Used to be Or, DEJA VU". He emphasized on the modern tools available for corrosion analysis and highlighted the ongoing work on corrosion prevention technologies at RGIPT. He highlighted the products developed such as corrosion inhibitors for corrosion prevention. He showcased competence at RGIPT for corrosion research.

Dr. Dheepasri Nage, DGM, HPCL presented about external corrosion management in structural integrity. This can be overcome by appropriate material selections, corrosion allowance, use of CRM, alter the environment, alter design, protective coatings, cathodic protection. She discussed about the corrosion costs which affect the global economy around \$2.2 trillion each year, according to the World Corrosion Organization. It is estimated that 40-60% of pipe maintenance costs are due to corrosion under insulation (CUI). She explained the corrosion research activities at HPCL Green R&D in Bangalore. To combat corrosion, various methods are employed, including the use of inhibitors, corrosion-resistant alloys (CRA), protective coatings, and cathodic protection. These measures are implemented after careful design considerations. She explained industry standards such as NSE SPO198 and API RF 583 that deal with corrosion under insulation. She talked about the selection of thermal insulating coatings and fireproof coatings which is very crucial in mitigating corrosion risks.



Dr Dheepasri Nage
DGM, HPCL



Dr V Valliappan
Shell- Invited Speaker

Dr Valliappan from Shell, delivered a presentation titled "Virtual Corrosion Engineer (VCE)", a revolutionary solution designed to address the need for reducing unplanned fatalities in assets caused by corrosion issues. Highlighted the significance of VCE, emphasizing its ability to automatically assess corrosion rates and threat levels in assets, considering various corrosion mechanisms. He emphasized the importance of such a solution in mitigating the risks associated with corrosion. VCE was described as a knowledgeable and adaptable corrosion engineer operating within assets. The solution leverages vast amounts of data, supported by practical examples, to provide accurate assessments and insights. VCE was presented as a simple, scalable, and web-based monitoring tool that can be easily integrated into existing systems. Valliappan explained details of operation of VCE, encompassing crucial steps such as data integration, training the model, computation etc.

Professor Raghu Prakash of IIT-Madras spoke about the significance of arriving at material properties from in-situ specimen tests for remaining life assessment. He spoke about the importance of arriving at material properties as a starting point of the remaining life assessment. He explained material scooping methods, SSTT which is a test technique that uses small-volume samples to extract the mechanical properties of the material, and miniature specimen test methods. He informed the audience of the work happening at IIT Madras in terms of using small-volume specimens to test tensile properties and fatigue properties – development of miniature test specimens, automated ball indentations and small punch testing, and multi-sensor techniques to identify failure in miniature specimens and fatigue crack growth studies using miniature SE(T) specimen.



Prof Raghu Prakash
IIT-Madras, Invited Speaker



Dr Dheepa Srinivasan
Pratt & Whitney – Invited Speaker

Dr. Dheepa Srinivasan, Pratt & Whitney spoke about role of 3D printing in Asset Integrity Management, She talked about how field of asset integrity management is witnessing advancements in alloy development and inspection technology, enabling more effective assessment and maintenance strategies. She discussed the large scale additive manufacturing and small scale test methods. She talked about the uniaxial and bending creep with ASTM E8/E8M21. Atom probe tomography and correlations were used for bending creep testing. These advancements in alloy development and inspection technology, along with the utilization of scale testing, metal 3D printing, and creep testing methods, contribute to improved asset integrity management. She talked how industries can enhance the reliability, safety, and longevity of their assets, ensuring optimal performance and minimizing the risk of failures.



Mr M Somasundar
Chief General Manager, HPCL,
Invited Speaker,
Steering Committee Member

Mr. Somasundar, CGM, HPCL presented about “RLA, FFS and structural stability in asset integrity management”. Mr. Somasundar provided a brief introduction to HPCL refineries. He talked about in-service components inspection with damage, flaws and life assessment of equipments. Narrated on visual inspection, NDT testing of RCC and fire proofing of steel supporting in Oil & Gas industry and gap analysis. He explained the three integral components of AIM: Part 1 - Fitness for service (FFS). Part 2 - Remaining life assessment (RLA) and Part 3 - stability certification. He explained one of the works carried out in HPCL- Fire damage assessment in the crude distillation unit. This assessment was as per parts 4,5,9 & 11 of API 579. In this case study, FFS assessment revealed that the equipment satisfies the criteria at level 2 of API 579-1. The assessment of fire-exposed equipment of a CDU was performed as per API 579 to decide the extent of repair, replacement, or continuation for future operations. It was observed from the assessment, that the MAWP for all fire-affected piping.

Mr Shivakumar explained computer simulation and modeling based activities at ProSIM, and services delivered to oil& gas sector. Shivakumar highlighted the role played by finite element analysis (FEA) in fitness for service assessment in the Oil & Gas industry. API 579 mandates use of FEA techniques for FFS Level-3. Shivakumar demonstrated case studies of application of FEA for FFS Level-3 and making decisions on reuse/ repair / retire judgements. Case studie included RLA/RLE of a variety of static and rotating equipment.

- Crack initiation at the nozzle junction was studied using FEA. Effects of temperature and pressure on equipment were analysed. Allowable stress limits were estimated and preventive measures for further damage mitigation were developed.
- Effects of corrosion in a vertical heat exchanger and effect of thickness reduction were analysed. FEA helped to asses the impact of corrosion on fitness for purpose.
- Remaining life of a spent cooling catalyst reservoir vessel of a fluidized catalytic cracking (FCC) unit was analysed for continued and safe operation.
- Storage Tank FFS and RLA



Shivakumar H
Project Manager, ProSIM

Mr. Suyog Dhongade explained concepts of structural integrity and the need for ascertaining structural integrity. He explained the approach adopted for different cases. (i) Integrity assessment of an existing structure is performed to ascertain its ability to withstand its original design load; (ii) Case in which structural integrity assessment is performed to determine the ability of the structural member to carry the additional loads. He presented a case study of integrity assessment of a building that has worked well for its design life to extend its life. He presented a case study on structural integrity assessment of an existing 3-story building. He explained the steps followed for the assessment of structural integrity in his work which included requesting data from clients, reviewing results of existing data, performing site exploration, control, predictive analysis, and design approach, and finally conclusion and recommendations based on control model analysis.



Suyog Dhongade
Senior Manager,
Assystem STUP



Prof Nagesh Iyer
IIT-Dharwad

Prof. Nagesh Iyer explained the key steps in structural integrity assessment which are to evaluate the condition of structural elements, identify potential deficiencies, and estimate the remaining service life. In his presentation, he touched upon visual inspection methods, NDT methods, load testing, structural health monitoring and management, computational modeling and analysis, risk assessment & reliability analysis. He also highlighted challenges in SIA such as limited data availability, uncertainty in modeling parameters, complex structural systems, and integration of multiple assessment techniques. He spoke about emerging trends such as sensor technologies, data-driven approaches, probabilistic modeling, AI/ML, forensic engineering, and sustainability. He also shared an interesting bit related to increased load on old structures – In this case, the railway ministry increased the cargo load and axle load of engines and at that time 1.25 Lakh bridges across India were more than 100 years old.



Akhilesh Poddar
AGM, NTPC-Invited Speaker

Mr. Akhilesh Poddar spoke on Inspection & testing of civil structures in power plant. He talked about the requirement of structure inspection at the right time and indicated that delay in the inspection may cause structural and operational failure. He explained the causes of failure in concrete and steel structures and showed examples of the same. He categorized failure into avoidable, repairable, and replaceable based on various case studies and conditions encountered. Good quality construction and regular maintenance fall into the avoidable failure category. He explained different methods of structural assessment of concrete, NDT on steel, and repair techniques. He showed the importance of inspection by a drone which helped to find abnormalities at the initial stage in the creek bridge. He explained the advantages of a mobile application that is used for ash dyke inspection. He also highlighted important maintenance practices and future needs in terms of the installation of sensors to monitor abnormal vibration, temperatures, corrosion monitoring, and the use of image analytics and fault signatures.

Mr Srikant, Project Manager ProSIM, delivered a talk on Fitness for Service (FFS, Level-3) & Remaining Life Assessment (RLA) of critical piping & equipments of Thermal Power Plant. He introduced concepts of Fitness for Service (FFS) & Remaining Life Assessment and extension (RLA/ RLE) as per API 579. He demonstrated the workflow charts for same. He highlighted some critical points on the visual inspections of hangers/ supports and the study of NDT reports & input considerations. He also addressed the different aspects of the Piping Stress Analysis and its results summary and its outcome of pipe stress analysis. He presented case studies of FFS and RLA of high temperature critical pipelines, turbine parts including rotors, casting, valve etc. In a case study, he narrated experience of supports and hangars failures and care to be taken in design of the same to take care of qualification as per load cases defined in ASME/ API codes.



Srikant G
Project Manager, ProSIM-Invited Speaker



Bhavesh Vasiani, Section Head, ERDA presented talk on “Integrity assessment of steam generation system”. Need to regularly assess the performance and health of steam generator and its auxiliaries for safety of life as well as for economical steam generation. Proper utilization of various methods of life and maintenance assessment can result a good, healthy and reliable operation of steam generation assets.

Mr. Suraj Makkar, presented a case study of failure analysis of the tubing of an artificial lift well. This failure was noted when water seized suddenly in one of the wells of an onshore coal bed methane field during a production operation. A visual inspection was performed, and a significant amount of loosely adhered corrosion product was observed in the internal surface along with a localized slit inside the longitudinal groove.



Mr. Amit Jain provided an overview of India’s energy anchor. He introduced the audience to offshore platforms which are made of steel tubular structures and designed for 25 years of life. He spoke about different platforms such as well head platform, process platform, and living platform. He explained a case study of an offshore unmanned platform structure for which a total of 2 risers’ tubes and 1 riser protector were proposed. Design level analysis, linear ultimate strength analysis, nonlinear ultimate strength analysis, and load reduction calculations were performed on the structural model of the platform prepared.



Mr. Prateek Baruah presented his talk on “Condition-based predictive maintenance techniques (PV analysis) in reciprocating gas compressor packages of Oil India Limited – challenges, advantages, and benefits of this digital leap. “He explained different components and their functionalities in compressor. He explained PV analysis-based maintenance, its challenges, remedies, and implementation at OIL. He presented a case study of PV analysis of a reciprocating compressor which aimed at performance improvement on its rated capacity.



Prathik Baruah
OIL

Mr. Sathyanarayana gave a brief introduction about refinery plant MRPL and he also mentioned how maximum production was achieved by MRPL last year. He talked about the plant's health monitoring and integrity which can increase the life of all parts of the plant. He discussed the regular and proper inspection of the plant because corrosion is a very big issue of any industry. He emphasized that if the inspection of the pipelines, tanks and the other parts of the plant can be done by the use of drones with advanced cameras and sensors. He explained how plant health can be maintained better and how to get maximum production from the plant. He explained the working of center for high technology, and its activities to bring together people from different refineries, discussing various failures, improvements, and such topics. He highlighted the importance of merging experiences of oil and gas, and power sector in this symposium. He felt, sharing of experiences of all energy operators is important.



H.C. Sathyanarayana
 Group General Manager, MRPL
 Member Symposium Steering Committee,
 Session Chair



Rachit Agarwal
 ONGC

Rachit Agarwal, ONGC- spoke on “Structural integrity assessment of a fixed offshore jacket platform for proposed installation of riser guard”. Objective which was to perform a structural integrity assessment to assess the feasibility of installation of an additional riser protector in the jacket structure of the wellhead platform. He explained the need for an additional riser that guards the two existing risers carrying hydrocarbons. He further explained the modeling of the riser protector and methodology to evaluate the structural adequacy of the jacket and piles for the proposed installation of an additional riser protector by API standards. A set of design levels and simplified ultimate strength analyses was carried out for a 100-year return period in extreme storm conditions for 8 directions of the wave along with other loads.



Paresh Haribhakti
MD TCR Engineering – Invited
Speaker

Paresh Haribhakti presented about “driving success in process plants using the knowledge-based approach and data digitization”. Expressed to learn the lessons from history and then implement the knowledge for existing work. Talked about the in-service inspection and digital twins. Accidents occur due to lack of knowledge of technology and more than 85 damage mechanism comes from the lack of knowledge about the technologies. The implementation of Asset Integrity and Operational Management (AIOM) through a knowledge-based approach and data digitalization is proving to be instrumental in enhancing the safety and reliability of industrial assets. By leveraging data-driven technologies and capturing valuable insights from various sources, AIOM enables proactive decision-making and effective asset management. Through the analysis of over 8,000 failure case studies, a comprehensive understanding of asset integrity has been developed. This knowledge base encompasses 85 different damage mechanisms, including corrosion, fatigue, erosion, and others.

Mallikarjun Haragapure, ONGC spoke on Life extension of an aged offshore jacket platform situated in the western offshore of India. Mallikarjun provided background on the fixed offshore jacket platform of ONGC. He defined the scope of his work which included in-place analysis with 85% environmental load for 100 years, with various loading conditions, and to check joint strength for jacket structure, non-linear ultimate strength analysis, and fatigue analysis of an offshore jacket platform.

He explained the structural integrity assessment methodology along with loads and boundary conditions.

There is a massive investment in energy assets in the country by government and private players, in excess of Rs 60 lak crores (Rs 60 trillion!!)



Mallikarjun Haragapure
ONGC



Shell

Dr David Wang
General Manager, Shell, Session Chair,
Member Symposium Steering Committee

Dr David Wang - he spoke of common interests and similar activities in different companies. He spoke of what can be the outcome of the working groups. He identified the need for leveraging the resources to do things of common interest to many organisations. When multiple users express the need, it motivates the service providers, technology developers to explore such options more vigorously. Such common interest activities including R&D, often cannot be achieved by any one organisation. He gave example of committees such as API and developing standards. He called for to develop best practices. Sathyanarany HC explained the working of center for high technology, and its activities to bring together people from different refineries, discussing various failures, improvements, and such topics. He highlighted the importance of merging experiences of oil and gas, and power sector in this symposium. He felt, sharing of experiences of all energy operators is important.

Abhishek Trivedi, ED, HPCL presented his talk on “refinery operations and digitalization at HPCL”. He talked about crude to customer value chain on a control tower project considering the stages from crude refinery to profitability. Abhishek spoke about the importance of vision, value creation, and long-term strategy in digitalization. He talked about creating building blocks, prioritization, and having an implementation approach to implement digitalization in large organizations such as HPCL. He stressed the need to embrace digital in all facets from projects to operations. He showcased different digitalization projects under implementation at HPCL including Crude-to-customer value chain – control tower project, Substation digital twin - SCADA system, Plant digital twin, Turnaround digitalization, AR/VR-based simulation training, process anomaly detection system, AI assemble, Regression-based crude column optimization model.



Abhishek Trivedi
Executive Director, HPCL
Invited Speaker



Sanjay Goswamy
GM, OIL – Invited Speaker

Mr. Sanjay Goswamy, GM and Head of IT, OIL, spoke about the digitalization journey of Oil India Ltd., and their objective to be a leading digital company with increased production growth with reduced operation costs, increase in reserves, excellent health and safety record, and enhanced worker productivity. This journey to digital transformation at Oil India was named “Drive”. He explained the building block of digitalization and 5 digital themes – intelligent production, smart exploration, and drilling, safe and productive workforce, project and supply chain excellence, and agile enterprise. He showed 11 initiatives under different digital themes taken up at Oil India as a part of digital transformation. He explained different issues addressed using drone surveillance which went live in February 2022. Using drone surveillance, OIL implemented intruder detection, crude oil tapping, crude oil leakage, and fire incident detection. He explained the functional requirements, system architecture, and key benefits of eDP – depth data drilling, real-time operations center for drilling systems (eRTMAC), browser logistic digitalization.

Mr. Sarangapani spoke on "Digital Transformation from a Utility Perspective." He explained how an increase in thermal efficiency of the power plant over the years. He said that the NTPC Simhardi plant achieved an increase of 0.3% in thermal efficiency. He indicated that the 0.3% efficiency increase can be achieved through digital tools without any mechanical modifications in the power plant. He shared NTPC's digital-first success stories such as the implementation of SAP, a remote monitoring and diagnostic (M&D) center called Antariksh, a Paperless office (Pradip), fully fledged remote operation of hydro (Koldam), AI/ML-based boiler performance optimization, Jyothi chatbot, application for Ash Dyke health monitoring and smart township. Mr. Sarangapani informed about a tool "SARTHI" which is developed at NTPC for the asset management system that includes a digital operator round for asset inspection, AI/ML for anomaly detection to track asset reliability, and health indexing. He explained that 3D printing technology is used to manage the on-demand manufacturing of spare parts.



Sarangapani R
Chief General Manager, NTPC, Member
-Symposium Steering
Committee



Derick Jose
Managing Director, Flutura

He spoke of Cerebra, proudly built in Bengaluru for the world, could be the catalyst to pioneer the Renaissance of Indian Energy Ecosystem through its AI capabilities. We present a first-of-its-kind consortium of 4 leading organizations, namely **IISc, Flutura, Accenture, and ProSIM**, to solve 5 burning problems.



Shridevi Bale **accenture**
Managing Director

She explained how Accenture's Enterprise Optimizer Accelerator can be leveraged to overcome challenges presented by time-consuming, siloed analysis to a synchronous, instantaneous decision making resulting in optimized planning with maximized returns and stable cashflow.



Tejas
Lead Solutions Consultant

He explained 3 core modules Cerebra that makes it uniquely poised to pioneer the Indian Energy Renaissance: Digital Twin Foundation: Digital replica of plant and processes and ready to use integrators with common Industrial Data systems such as Historians and Camera Systems Engineer's Workbench, Digital Assistant.



Abhishek Annamraju
Product Manager, Flutura

He explained Cerebra intelligence tool, that combines data based principles to solve Corrosion related challenges in Energy facilities. It leverages pre-built signatures to solve corrosion challenges in underground as well as above the ground pipelines using a combination of E/O and Hyperspectral camera systems.



Pallavi Narayanaswamy
Senior Manager, Energy Industry Practice



Mudit Gupta
Manager, Energy Industry Practice, Accenture

Prof Suresh explained drone research activities in aerospace engineering department at IISc. He explained case studies of using drones for inspection of tanks, pipelines in refineries.



Prof V S Suresh
IISc



Ms Ashwini Kadam
BPCL – Invited Speaker

Ashwini Kadam spoke about digital transformation in BPCL refineries. She talked about the measures taken at BPCL to implement IOT and ML technologies which have created a full-fledged digital solution targeting the digital transformation in refineries to obtain a digital onview refinery that can give a single view for all maintenance, reliability, inspection, fire, and safety information across all departments in the digital form. She explained the benefits of drone inspection which has decreased the turn-around time and optimized the actions of safety inspectors in the work area. She

Mr Pratik Shah explained the activities of ACOEM in areas related environmental monitoring, industrial reliability and security solutions.



Mr Pratik Shah
Manager, Acoem, Sponsor



Varun Kumar of Desapex explained the digital project management,



Varunkumar Sagrkar
Director of Digital engineering
Desapex

Dinesh explained the IIoT, edge computing and data transformation activities at Utthunga.



Dinesh Tukaram
Utthunga - Sponsor



Mr Mohapatra, Moderator of open house discussion on “Way Forward” session, spoke of need for continuation of activities and not end the symposium with a valedictory address. He spoke of not just focusing on successes, but on failures as well, what were the causes, how we attempted to solve them and share the experience. He highlighted the need to learn from failures and share the experience. He suggested that next year when EAIM is held, we should have at least one session for failure stories.

Ranjan Kumar Mohapatra
Executive Director, IOCL Head IloP,
and Member, Board, RGIPT



IndianOil

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Dr Debashish De

Dr Arjun Deo **Chinmay Sharma**

HIGHLIGHTS

Asset Integrity Management has several interesting aspects which were discussed in the symposium.



To ensure continuity of symposium and work, and ensure frequent interactions multi-organisation, inter-disciplinary orking groups involving all stake holders have been formed.

Opportunities and Actions “Atma Nirbhar Bharat” were identified

- ▶▶ Corrosion is a key challenge for energy industry. There is insufficient R&D focus on corrosion.
- ▶▶ Energy industries and energy departments have to impress upon agencies such as UGC, AICTE, DST, CSIR, etc, to promote and foster corrosion related research. Energy Industries have to invest in developing partnerships to initiate result oriented R&D activities in areas related to corrosion.
- ▶▶ Corrosion imposes a cost in the range of Rs 2 lak crores on energy sector.(cost of corrosion on Indian Economy is ~8 lak crores)
- ▶▶ India needs several R&D centers to come up to tackle the massive costs imposed by corrosion.
- ▶▶ RGIPT plans to set up a center of excellence in corrosion research bolstering current activities.
- ▶▶ Remote monitoring infrastructure including robotics, drones, satellites, and cloud computing to be setup.
- ▶▶ Next generation equipment, plants and services to be created in India through PPP mode, with involvement from academia and industries.









India Energy Network (IEN) is an initiative of “Science & Engineering Foundation of India”. IEN provides a platform for cross disciplinary interactions among Indian energy community including operators, technology providers, government agencies, policy makers & consumers. IEN strives towards Energy Security & Energy transition in India.

India Energy Network commits to take the cause of creating an ecosystem for energy asset integrity management including the four pillars of EAIM viz., Operations, Inspection, Structural integrity and Digitalisation. India Energy Network aims to work with all stake holders including government agencies, energy operators, technology and service providers, academics, and start-ups.

For more details visit <https://www.indiaenergynetwork.in/> ■

RGIPT is an institution of national importance under Ministry of Petroleum, Government of India. RGIPT has several R&D programs, academic programs related to energy including new and renewable energy. RGIPT plans to add subjects relevant to EAIM in the core curriculum of academic programs, strive towards R&D in corrosion related research, and work to solve problems related to energy asset integrity through collaborative R&D initiatives.



■ **For more details visit <https://www.rgipt.ac.in/>**

InSIS

Indian Structural Integrity Society



InSIS is a professional society uniting professionals from wide variety of disciplines that together impact safety & reliability of structures, machines, vehicles and devices. InSIS conducts a variety of programs. InSIS has started a series of foundation courses in various aspects related to structural integrity.

For more details visit <https://insis.in/> ■

Indian Institute of Science (IISc) is a premier R&D and academic institution conducting cutting edge research in several areas of strategic interest to India, including in energy sector. IISc has set up a interdisciplinary center for energy research.



■ **For more details visit <https://iisc.ac.in/>**