एनटीपीसी
NTPC

Indian Power Stations
Power Plant O&M Event : NTPC Anchored
2024

Compendium of Papers

IPS 2024

13th to 15th February 2024

Raipur, Chattisgarh

Theme

O&M PRACTICES FOR
SAFE, RELIABLE & COST-EFFECTIVE
POWER GENERATION

एनटीपीसी लिमिटेड
(भारत सरकार का उद्यम)
NTPC Limited
(A Govt. of India Enterprise)

के. एस. सुंदरम
निदेशक (प्रचालन)
K. S. Sundaram
Director (Operations)

केन्द्रीय कार्यालय/Corporate Centre

Message from Director(Operations)

It gives me immense pleasure as NTPC is organising the "International Power Plant O&M conference, **Indian Power Stations-2024"** from 13th - 15th February 2024 at Raipur, Chhattisgarh. I on behalf of NTPC, welcome all the participants in IPS -2024 from India and abroad.

NTPC recognises the need for energy security of the country along with energy transition and has emerged as India's premier integrated power major, boasting an impressive installed capacity of 74 GW, encompassing a diverse mix of fuel. NTPC's first unit commenced its operations on February 13, 1982, in Singrauli, Uttar Pradesh. In commemoration of this milestone, NTPC hosts this annual International O&M (Operation and Maintenance) conference on the same date every year.

India is witnessing a robust economic growth resulting in significant surge in power demand. Moreover, with increased integration of renewable energy into the grid is necessitating greater flexibility in thermal installations. In the era of escalating demand and heightened flexibilization, importance of safety, reliability and cost effectiveness cannot be over emphasised.

Accordingly, the theme for this year's conference, "O&M Practices for Safe, Reliable and Cost-Effective Power Generation," seeks to highlight cutting-edge solutions that prioritize safety while ensuring the environment friendly, reliable and affordable delivery of power in the evolving landscape of our times.

The IPS conference provides an invaluable forum for all the stakeholders of the power sector to share expertise on O&M, explore emerging technologies, and promote the dissemination of best industry practices. In the concurrent exhibitions "Techno galaxy", power sector vendors put up their stall to showcase their latest products & solutions. Year after year, this annual event is attracting participation from equipment manufacturers, power plant builders, service providers, researcher, and power plant professionals both domestic and international.

Moreover, use of emerging technologies, IOT based solutions, process automation combined with artificial intelligence and machine learning are being explored and applied for enhancing safety and reliability of units. It is need of an hour to ensure that units remain on bar with zero forced outages except planned outages.

I am confident that IPS-2024 and concurrent exhibition Techno Galaxy-2024 will bring the best minds in power sector together for detail deliberation and will provide the glimpse of cutting-edge technologies, products and O&M practices for enhancing safety, reliability and cost effectiveness of Power Plants.

I wish the Conference and Exhibition a grand success, enriching the learning for all participants.

(K. S. Sundaram)

एनटीपीसी NTPC

एन टी पी सी लिमिटेड
(भारत सरकार का उद्यम)
NTPC Limited
(A Govt. of India Enterprise)

अरिंदम सिन्हा
कार्यकारी निदेशक (प्रचालन सेवाएं)
Arindam Sinha
Executive Director (OS)

केन्द्रीय कार्यालय / Corporate Centre
इ ओ सी रायपुर / EOC Raipur

Foreword

With great pleasure, I extend a warm welcome to all esteemed authors, distinguished guests, honored business associates, and stakeholders to the International Power Plant O&M Conference, Indian Power Stations-2024, set to commence on the 13th of February 2024 in the vibrant city of Raipur.

This annual O&M conference holds a special significance for us as it marks the anniversary of the synchronization of our first generating unit at NTPC Singrauli in 1982. Over the years, this conference has evolved into a highly esteemed event within the power sector, serving as a platform for knowledge exchange and collaboration among industry professionals.

The theme chosen for IPS 2024, **"O&M Practices for Safe, Reliable, and Cost-Effective Power Generation,"** reflects the evolving landscape of the power sector, particularly in light of the increasing integration of renewable energy sources. As we navigate these changes, it is imperative to ensure the continued safe and reliable operation of coal-based units while embracing sustainability and cost-effectiveness.

NTPC, with its current installed capacity of 73.87 GW across various energy sources, is at the forefront of this transformation. With a commitment to enhancing renewable energy capacity and aligning with the Government of India's target for a net zero carbon emission economy by 2070, NTPC is driving innovation and sustainability in the sector.

Contd....

एन टी पी सी लिमिटेड
(भारत सरकार का उद्यम)
NTPC Limited
(A Govt. of India Enterprise)

अरिंदम सिन्हा
कार्यकारी निदेशक (प्रचालन सेवाएं)
Arindam Sinha
Executive Director (OS)

केन्द्रीय कार्यालय / Corporate Centre
इ ओ सी रायपुर / EOC Raipur

IPS 2024 promises to be a valuable opportunity for power professionals to exchange best practices, explore innovative technologies, and address the challenges facing the energy sector. With a diverse array of sessions covering topics such as safety, environmental compliance, technology advancements, and energy policy, the conference aims to enrich the knowledge and competency of participants.

The paper summary for IPS 2024 highlights the breadth and depth of contributions from international, national, and NTPC authors, totaling 88 selected papers and over 300 submissions. Across 18 sessions, diverse topics, as mentioned above, will be explored. This not only underscores the conference's commitment to addressing the multifaceted aspects of power generation but also promises an enriching and informative experience through its comprehensive lineup, fostering dialogue and collaboration across various domains of the power sector

I am confident that IPS 2024 will serve as a catalyst for meaningful discussions, fostering collaboration and driving progress in the power sector. I extend my best wishes to all participants for a successful and fruitful conference.

Arindam Sinha

CONTENTS

33	Environmental Challenges – Power Generation and Carbon foot-print Mapping - Net Zero, Bengaluru	
34	Coarse and Fine Ash Segregation and Evacuation: Maximizing Revenue through Innovative Ash Management - NTPC Kahalgaon	
35	Case study on O&M Practices for Safe Power Generation in Gas Base Power Plant-ONGC Tripura Power Company (OTPC) - ONGC	
36	FGD Gypsum quality improvement through innovative process improvements - AEJPL, Jhajjar	
37	Maintenance practices for enhancing asset management in EHV substation - NTPC Barh	
38	Motor Bus Transfer System: Implementation of Problem Experienced in Thermal Power Plant Live Motor Bus - CSPGCL Korba	
39	Monitoring of Corrosion Products in Low-Oxygen Regime Water Cooled Synchronous Generators with Copper Hollow Conductors - NTPC Dadri	
40	Case Study on 250MW Generator Stator Winding Bar failure detection and Repair Methodology - NTPC COS	
41	Study on impact of chemical cleaning of stator winding hollow conductors on generator cooling water system components - NTPC Korba	
42	Optimal Operational and Maintenance Strategies for a Flue Gas Desulphurization System in a coal-fired Thermal Power Station - BHEL PEM	
43	A Regular Inspection for FGD Systems contributing to Efficient Long-Term Stable Operation - Chugai Japan	
44	Life Enhancement of NDCT#1 by Reparing &Rehabilitation works including coating moisture cured Urethene on the Surface of the RCC shell:NTPC Simhadri	
45	How to plan your Budget for the next 10 years - Intertek USA	
46	Strategies for timely & quality overhaul - NTPC COS	
47	Design issues in HT motor leading to catastrophic damages at later stage of operation: NTPC Vallur	
48	Identification of austenitic stainless steel boiler tube weld joint having filler mix-up in Root weld - NTPC COS	
49	LJUNGSTRÖM AdvX® Upgrade Solution for Fuel Flexibility, APH Protection and Emissions Reduction - Ljungstrom Germany	
50	Improvement of Steam Oxidation Resistance through Shot Peening of Austenitic Stainless Steel (Superheater Tubes) and NDT Tools for In-situ Measurement - NTPC NETRA/Darlipalli	
51	Unique BTL Challenges encountered in Tower-type supercritical boilers - NTPC Solapur	
52	A Comprehensive Analysis by PAUT of Stress Corrosion Cracking (SCC) in Austenitic Stainless Steel Super 304H & 347H Grade Tubes in USC Boiler - NTPC CQA	
53	Case History: Low LP Turbine Differential Expansion in Super Critical Unit Diaphragm Type machines and Remedial Measures - NTPC SCU	
54	Modification of HP Control Valve to resolve HPCV delinking issue in Turbine at Sipat (3X660MW) units - NTPC Sipat	
55	Stress Corrosion Cracking on Steam Turbine Rotor Grooves: Experiences and Countermeasures from a 500MW Power Generation Unit - COS OH	
56	Renovation and Modernization (R&M) of Steam Turbines and its Systems for Improvements in Efficiency, Flexibility and Reliability - Siemens, India	
57	Understanding LPT Last Stage Blade Failure Mechanism and Prevention Techniques- NTPC Vallur	
58	Study on the Applicability of NTPC Fly Ash to OR Crete® Production - JCoal, Japan	
59	FTR is an Industrial Applicability of Slagging and Fouling Monitoring of Conventional and Renewable Energy Carriers, GEER Germany	
60	Improving Load Flexibility & NUHR Safely, Reliably and Cost-Effectively Using Closed-Loop Dynamic Optimization & Expert Knowledge Controls - Taber International, USA	
61	Enhancing fossil-fired boiler efficiency and competitiveness through advanced two-dimensional temperature measurement using optical pyrometers - Eutech Germany	

62	Repairs & protection of concrete in NDCT - MC-Bauchemie, Germany	
63	Quantum leaps in dry fly ash evacuation system to enhance dry fly ash evacuation capacity - An NTPC Darlipali Experience - NTPC Darlipalli	
64	In-house development (design, fabrication & programming) of belt patch open detection system for conveyor belts - NTPC Ramagundam	
65	Retrofitment of SealGuard Assly in Wagon Tippler for reliable operation of movable Side Beam in Wagon Tippler - NTPC Kudgi	
66	A case study on Ship unloader - BIFPCL, Bangladesh	
67	Case Study Interconnection of New Cold water channel with Existing Channel of Rihand Stage III:NTPC,Solapur	
68	Innovative Geosynthetics application to reduce use of natural resources in Ash Dyke of thermal power plants - NTPC PE Civil	
69	Introduction to Hybrid Model for sustainable Power generation from Coal - NTPC NETRA	
70	New technologies & best practices adopted by ITPCL - IL&FS, Tamil Nadu	
71	Liquid Hydrocarbon Economy: An energy efficient net zero alternative to the Energy Intensive Hydrogen Economy - NTPC Talcher	
72	Autonomous drone for Safety & Surveillance purpose in Power Plant - NTPC Gadarwara	
73	Hydrogen Production from waste:A path to sustainable energy: NTPC, Farakka	
74	R&M & Uprating of Hydro Power Station - NHPC	
75	Waste to Hydrogen: Oxy-gasification of Municipal Solid Waste - NETRA	
76	Providing Flexible Power through Gas Stations- NTPC OS-SIIS	
77	Zero Waste Approach - Enhance the Value of By-Products through Sustainable Practices - JSW Energy, Ratnagiri	
78	Water Conservation & Management at Sasan Power Limited - Reliance, Sasan	
79	Turbidity an Conductivity After Cation Exchange (CACE) for Cyclic operation - Forbes Marshall	
80	Optimization of dm plant regeneration process- to ensure DM water availability - NTPC Farakka	
81	Managing Steam Water Cycle Chemistry in Thermal Power Plant with Ion Chromatograph - NTPC Jhajjar	
82	Innovative tools & Techniques and new O&M practices - GMR, Warora	
83	Understanding the criteria and factors affecting quality of wet FGD Gypsum - NTPC Unchahar	
84	O&M Strategies for cost management - FluentGrid, Hyderabad	
85	Digital Transformation of Lube oil management system (LOMS) and Value creation by Lube oil consumption Optimization - NTPC Vindhyachal	
86	Digitalization of Periodic Ash Dyke inspection by Cross functional team through mobile App - NTPC Stn Engg	
87	Data Analytics to boost availability of Dry Ash Conveying System - Adani, Tirora	
88	Digitalizing Operations: best practices in GWEL Thermal Power Plant for logbook Management - GMR Warora	
89	Power Sector Scenario till 2032 and Flexibilisation Requirements from Coal based Thermal Power Stations: NTPC Approach for navigating the challenges for Flexible Operation - NTPC OS-SIIS	
90	Role of Flexibility in Thermal Plants for Energy transition - NTPC Corporate Planning	
91	Challenges with Biomass cofiring and enhancing the biomass cofiring in a coal based thermal power plant - NTPC COS	
92	Carbon Trading for Energy Transition towards Net Zero - NTPC NPGCL	
93	India's Biomass Blueprint: Policy Formulation and Global Case Study Synthesis - NTPC RE	

Session- 1: Theme Paper : O&M Practices for Safe, Reliable and Cost-Effective Power Generation

C S SRINIVAS NTPC COS

A comprehensive approach towards adherence to safety regulation, implementation of latest safety standards not only ensures the well being of our workforce but also fortifies the reliability of power generation. Safe environment is the foundation for sustained operational excellence.

Quality control and maintenance practices in power generation play a crucial role in maintaining the optimum performance and operational integrity of power generation assets. Robust quality control measures are essential throughout the entire life cycle of project construction, operation, and maintenance of power stations. These measures are vital for ensuring reliability, operational efficiency, and effective risk mitigation. The implementation of modern technologies such as condition based maintenance, remote monitoring, and predictive analytics enable the operators to optimize maintenance schedules, minimize downtime and improve reliability. Embracing cost effective O&M practices is imperative for sustainable operations and efficient resource utilization.

Digital Block Driven Transformation for Fast-track or Shutdown and Turnarounds projects

Consuelo Granata , Yogesh C. Srivastava, Tanvi Garg, Technobuilt UK

Fast track projects in an operating facility as well as Shutdowns and turnarounds have important financial implications, both in terms of the direct cost of the maintenance activities and the potential loss of revenue during the downtime. It is essential to strike a balance between addressing critical needs and optimizing the overall maintenance and inspection schedule to ensure the long-term success of the facility or plant. The authors present how some of the major energy companies are transforming in this aspect taking an innovative approach for effectively managing time-sensitive projects based on the connection of different tools and information in multidimensional digital Kanban (visible) Containers™.

These Digital Blocks, help break through a century old paradigm that saw the activity-based planning as the primary approach and fluidly helps to transition the planning into execution and completion. The Digital Block methodology embeds process and method improvement such as Advanced Work Packaging to manage scope better and LEAN for operational efficiencies. in With the Digital Block at the core, by orchestrating the end-to-end process on a unified digital platform, PACE XT, what emerges is a game-changing system and a comprehensive solution to the challenges faced during fast-track projects.

Transforming the way projects are built & operated, an unmatched digital assurance in meeting delivery timelines can be achieved. With the vantage of the unified digital platform, acceleration of execution efficiency, standardization and predictability can help retrieve up to 8 to 20% as actual cost reduction from the estimate.

Leveraging Aveva PI system for Advanced Enterprise Asset Management

Scott Gronwold, USA

Ashwin Iyer, Aveva USA

The growing integration of renewable energy sources into the grid significantly impacts both grid infrastructure and power generation companies. While the transition to renewables offers positive environmental benefits, it introduces distinct challenges for power generators due to increased intermittency and variability. In such a context, implementing a comprehensive asset management strategy for critical equipment designed for base load operations becomes essential.

Presently, power generation utilities rely on the PI System for performance monitoring, optimization, and analytics of critical equipment and processes. The incorporation of add functionalities, along with the ability to collect manual data and perform data analytics for maintenance strategy optimization, becomes crucial. Additionally, the democratization of AI/ML algorithms for anomaly detection can provide substantial benefits to power generation utilities.

This paper aims to summarize the methodology and best practices for deploying such a complex system, outlining associated benefits. The focus is on understanding deployment of this complex system to optimize performance in the face of renewable energy integration challenges.

New Condition Based service concepts with Optimized Inspection intervals for Siemens Steam Turbines in SPPS and CCPPS

Andreas Schaarschmidt,Indranil Acharya

SIEMENS Energy, India

The reliability, efficiency and performances of old steam turbines decreases with aging, due to major turbine components and steam path deterioration like due to solid particle erosion, erosion-corrosion, deposits, foreign object damage and worn-out packings with time as examples.

In old steam turbines problems occur frequently on major components and may require long time for repair or replacement, if a pre-planned “state-of-art” “Turbine Service & Maintenance Plan/Strategy” not in place either from bidding or after commissioning.

Considering the current scenario of the power industry, there is a need for optimization of outage intervals for gas based (CCPP) and coal fired (SPP) power plants.The aim of this paper is to share the “experience based” best practices of Siemens Energy with the Indian

Customers that once the classical periodic steam turbine service concepts is established within Indian

Power Plants, further evolution of "Classical Service & Maintenance" practice is beneficial towards "Condition Based Preventive Maintenance Concept". This was developed and introduced in the market (industry) by Siemens Energy Steam Turbine Service Engineering, in order to increase the turbine lifetime, availability, reliability & performance as example.

To ensure best possible availability, reliability, and flexibility of the Steam Turbine (ST) components for power plants, Siemens Energy has developed intelligent maintenance strategies which consider new concepts and new technologies. The objective function is achieved while optimizing cost and effort also. Under this focus, a complete re-assessment of the inspection systematic was carried out and a new technology as "Condition- Based Maintenance (CBM)" was introduced.

CYCLE REGENERATION DEFICIT: PROFIT EATER

Shri Ritesh Agarwal, Shri Rajeev Kumar

NTPC : VSTPS & COS-CenPEEP

Operation of ageing units at optimized heat rates and rated capacity is challenging under the present power sector scenario with stringent operating norms. Feedwater heaters are vital components of power plant immensely affecting their profitability. Significant, yet often hidden thermal performance losses occur in heaters. A feedwater heater that does not perform as specified leads to higher overall coal consumption than expected. This in turn leads to lower plant output, and higher plant heat rates. The end results are significant economic penalties to the plant as a result of higher fuel costs and lost plant generating capacity.

Performance parameters of heaters include feedwater temperature rise across heater, terminal temperature difference, drain cooler approach and extraction steam flow. Case studies of Vindhyachal U#1 (210 MW), Unchahar U#2 (210 MW), Rihand U#3 (500 MW), having improvement potential with respect to feed water heater performance are discussed. In all these cases performance shortfall cause diagnosis through extensive performance testing in field was done.

The objective was to identify the heater parameters that have deviated from the design heat balance diagram conditions and diagnose the problem in order to decide the necessary future actions to improve the cycle efficiency. Diagnosed areas of heater performance improvement in discussed case studies were off design operation of heaters, operation of heaters with opening of emergency drip lines and partial closing of extraction steam line NRV. Series of continuous improvement initiatives during appropriate opportunity can play a major role in optimization of thermal performance of heaters.

Session 2: Institutional Papers

BEST O&M PRACTICES FOR FLEXIBLE OPERATION OF TPPs

Kiran Ananth, Dinesh Ghai, Marimuthu K

CII ,GBC Hyderabad

India has great potential for renewables: Attaining 500 GW has been set by the year 2023. The introduction of large-scale renewable generation in the grid is bringing a new set of challenges in the power sector. Three fundamental constraints affect the output of renewable energy: its variability, which changes instantly, its uncertainty, which cannot be forecast with any degree of precision beforehand, and its concentration, which is restricted to a few hours per year. Thus, creating a need for the balancing of the demand on various time scales for proper functioning, stability, and security of the grid. For the grid to remain stable, other forms of generation must be able to handle the irregularities and intermittent nature of solar and wind power.

The generating capacity of hydroelectric stations is quite low (50 GW as of 2023). It is necessary to make TPPs flexible to accommodate the uptake of renewable energy. With the anticipated 175 GW of RE Capacity by the end of 2022, it has been targeted to adapt 60% of the installed fleet of Thermal power plants (TPP) to operate at 55% Minimum Technical Load (MTL).

There are many operational challenges during the flexible operation of the thermal fleet. However, to cater to the VRE penetration, utilities have started adopting new technologies to improve the system's performance. Power plant operators are always looking for ways to boost performance.

Power plants have been observing a decline in their efficiency as they get older. Inadequate operations and maintenance (O&M) procedures cause this to happen more quickly. Adhering to good operations and maintenance (O&M) procedures is crucial for thermal power plants (TPPs) to maintain the equipment's health as well as reach optimal performance levels. In terms of labor, technology, procedures, and infrastructure, this calls for several interventions. Reducing generation costs and increasing efficiency are key factors driving the use of O&M.

This paper discusses operational challenges during flexible load and the best O&M practices that industries adopted to keep the performance at its best. Operation and maintenance excellence for any industry is a philosophy of the workplace where problem-solving, teamwork, and leadership result in the continuous improvement of the organization.

INNOVATIVE SUSTAINABLE SOLUTIONS FOR HIGH VOLUME UTILIZATION OF FLY ASH

Sandeep Singh, Satyajit Patel

S. V. National Institute of Technology, Surat

Rapid industrial and transportation infrastructural growth in India has exacerbated environmental issues like metal slag, fly ash open dumps, and depletion of natural aggregate resources. This study proposes two innovative sustainable solutions to address these challenges, aiming to achieve 100% utilization of fly ash by thermal power plants and meet the aggregate demand. The first innovation focuses on using fly ash and granulated blast furnace slag (GBFS) as substitutes for granular subbase (GSB) in flexible pavement. After extensive laboratory studies, optimal combinations of fly ash with 5% lime (FL) and a mix of 80% fly ash with 20% GBFS (FG) were identified. 7 test sections (each 3.5 m wide and 50 m long) with different thicknesses of waste mix subbase (200, 300 & 400 mm) layers were constructed.

A two-year structural evaluation comparing these sections with a conventional GSB control section using a falling weight deflectometer (FWD) showed potential savings of up to 4200 tons of natural aggregates per lane per km of highway construction, with cost reductions ranging from 4% to 10%. The second innovation targets aggregate demand by introducing a rapid, cost-effective four-step process for producing angular-shaped and high-strength fly ash aggregate. A mixture of 88% fly ash and 12% hydraulic binder yielded lightweight aggregates with dense structures, angular shapes for better interlocking, and excellent mechanical properties. These aggregates met MoRTH (2013) and IS:9142-Part 2 (2018) standards. The production cost of fly ash aggregate was estimated to be Rs. 950 per m3 , approximately 32% lower than natural stone aggregate costs according to DSR, CPWD, 2021 rates.

ANALYSIS AND MODELLING OF SPECIFIC ENERGY CONSUMPTION USING CFD FOR TRANSPORTATION OF COAL ASH SLURRIES IN THERMAL POWER PLANTS - MANIT PRAYAGRAJ

Dr Anubhav Rawat,Ankit Prakash ,Ashutosh K. Upadhyaya MNNIT-Allahabad

One of the major challenges in thermal power plants is cheap and environmentally safe disposal of coal ash. Ash needs to be transported to ash sump (pond), from the ash generation unit. Various modes of transportation like through trolleys, trucks, etc. can be used for this purpose. But pipeline transportation is the cheapest among all. Present study is focused on the optimization of required energy under turbulent flows using CFD while establishing the effect of various parameters like flow velocity, pipe diameter, weight concentration, and solid throughput on specific energy consumption. Present study concludes that the energy required can be reduced substantially through wise selection of the above-mentioned parameters for the hydraulic conveying of coal ash through pipeline. The study shows that the energy required (specific) increases with the increase in flow velocity, concentration, and solid throughput, whereas decreases with the increase in pipe diameter.

REDUCTION OF THE CARBON FOOTPRINT IN THE EXISTING PLANT BY BLENDING STEAM WITH SOLAR TOWER TECHNOLOGY

T. Mallikharjuna Rao, Additional Director, Central Power Research Institute, Bangalore

This study addresses the mixing of coal- and solar-powered steam to lessen the carbon impact of the current thermal power plant. The details of the blending procedure have been revealed. The outline of the solar tower receiver is also explained. The suggested method's decrease in pollutant emissions is also highlighted.

MARRYING 'IT' WITH 'OT' IN POWER SECTOR- DRIVERS, CHALLENGES: DEPLOYMENT OF DRONES-AN OUTLOOK - DY PATIL UNIVERSITY, PUNE

Dr. Vijayakumar Varadarajan, Swiss School of Business and Management, Switzerland Pothala Koteswara Rao, Swiss School of Business and Management, Geneva, Switzerland

The marriage between IT and OT is the need of the hour. It provides a lot of respite to power companies by way of providing quicker, accurate and prompt insights and the ability to automate things assuring flexible, safe, and cost-effective plant operations. Few examples of digitization in power sector include Digital control systems (DCS), plant maintenance modules in SAP, condition monitoring , performance analysis diagnostic optimization (PADO) digital worker, asset performance management (APM), enterprise asset management (EAM), digital twin, environment , health and safety (EHS) software, continuous emission motoring (CEMS), Procurement and sourcing software, risk assessment and priority planning (RAPP), gate pass control, infrared image analysis for insulation survey, AI based transmission lines, towers inspection etc. Drones have a role to play in the endeavor to reap a plethora of benefits like enhanced safety, efficiency, productivity, security, and sustainability that emanate from the marriage between IT and OT in power plants. Several use cases are available to demonstrate the useful deployment of drones in the power sector. For example, non-destructive testing and inspection of tall structures like chimneys, boiler furnace internal inspections, pipe line integrity inspections, transmission tower inspections , physical volume estimations of bulk solids, solar panel inspections and their surface cleaning, wind mills inspection, environmental impact analysis, topographical survey, mines contouring, warehouse management, firefighting, 3D scanning of tall structures, LIDAR analysis, thermography and insulation survey of boilers so on and so forth. This paper discusses drivers for IT-OT integration, challenges, and outlook on drones' deployment

Session -3: Virtual Session, EPRI USA

GENERATION FLEXIBILITY INSIGHTS.

Stephen Storm, EPRI, USA

Aligning programmatic guidance to help thermal generating fleets deliver increased flexibility and efficiency is critically important and essentially the vision for P223. Fuel cost is 60-80% of the overall cost for producing electricity. Thus, by improving heat rate, this has a direct influence on the plants economics, air emissions and CO2 output. With the clean energy transition. Rising operating costs, increased competition from other non-thermal power generating sources, and regulatory pressures have increased the need to improve heat rate and flexibility. Generation flexibility has a direct relationship on the ability to integrate additional VRE. The optimal flexibility solution for any generating fleet is determined by the complex interplay of its existing assets, their condition, market drivers, and the direction of regulatory policy where the fleets operate.

There is a global demand for management of thermal plant flexibility. Improvement of flexibility requires the integration of core programmatic actions that include training, O&M best practices systematic program management and defence strategies to optimize operating, maintenance, and investment strategies. Key and emerging areas that should be considered. The flexibility program focus is on helping advance flexibility and delivery of solutions that provide guidance and tools needed to improve generation flexibility and efficiency. The systematic approach and efforts behind improving both heat rate and flexibility requires a holistic focus that crosses the generation sector. Cost prioritization, efficiency and gap analysis are critical parts of the fleet optimization strategy. Most importantly, we must ensure dispatchable thermal energy resources are available to meet peak demands when renewable output is low. The longer-term value of program engagement is to sustain approaches that keep thermal plants reliable, resilient, and economically viable as we move energy transformation forward.

ADVANCED PROCESS CONTROL DEMONSTRATIONS FOR IMPROVING STEAM TEMPERATURE CONTROL.

Paolo Pezzini, EPRI, USA

As the penetration of renewable energy continue to increase on a global scale, the need to increase the control and automation of the existing power fleet is growing exponentially. To support this goal, several new advanced control algorithms have become commercially available to increase the automation level of existing power systems and reduce the burden on power plant operators in the process of retuning critical control loops, not only for seasonal retuning but also to manage day-by-day automatic generation control (AGC) operation. However, the complexity for power plant operators in choosing the most appropriate control algorithm and the complexity of using it to address specific control issues can be still relatively high due to the limited documentation and access to the source code of these algorithms. The main goal of this presentation is to provide a technical overview of advanced process

controls and highlight implementations of these controls on power plants, while describing the benefits of implementation.

EXPLORING FREQUENCY RESPONSE.

Steven Seachman, EPRI USA

In recent years, the growth of renewable energy resources in the bulk system generation portfolio is creating new opportunities and challenges to maintain grid reliability and resilience. Among these challenges is the control of grid frequency as both inherent inertia provided by synchronous generation and primary frequency response from steam turbine generators reduce. To address this, generators and authorities have growing interest in advanced control and optimization schemes to respond to under-frequency and other disturbances of the grid. This presentation explores those challenges and discusses innovative control techniques to improve or supplement primary frequency response speed and quantity, using simulation studies to assess the capability of the designs, and as appropriate to assess plant impacts and limiting factors.

ENERGY STORAGE IN ACTION.

Andrew Maxson, EPRI USA

Energy storage is projected to grow globally to TWh size withing the next 10 years to provide grid stability and reliability in a lower-carbon future created with more intermittent solar and wind. A large number of technologies of various stages of development are being advanced to fill this significant need. These energy technologies have a wide variety of types and are designed to meet a range of use cases. Particularly important for India is capitalizing on existing thermal power plant infrastructure, which can be converted to thermal energy storage systems cost effectively.

This presentation will review energy storage needs and options, and outline the significant R&D EPRI is performing on assessing these technologies in terms of costs, performance, safety, O&M, and field pilot work, to aid in selecting the right energy storage technologies for a particular portfolio and helping ensure they operate as designed.

USE OF EPRI DEVELOPED KNOWLEDGE-BASED FAULT SIGNATURE WITH ADVANCED PATTERN RECOGNITION (APR).

Prayag Parikh / Michael Liebenow, EPRI USA

Power Generation is undergoing many changes, including a digital transformation to improve or adapt to a dynamic energy landscape. Leveraging data and digital tools can be a challenging undertaking but holds many measurable benefits. Common drivers include, potentially reducing maintenance cost, improved asset reliability, operational improvements, workforce efficiency, and improved safety. A digital

transformation is a targeted journey that begins with existing data, software, and digital tools. For power generation, this includes existing sensors and instrumentation used in plants and on system, along with other inspections or measurements to estimate the health of a piece of equipment.

One of the more powerful and near-term data uses is to diagnose a fault or degradation of a component or piece of equipment. The advanced computational algorithms can identify two different datasets as being different. However, these advanced algorithms cannot determine the reason for the difference unless these algorithms have data to compare. Intuitive example of such algorithm is biometrics for smartphone, unless you provided the sample of the biometrics; the smartphone cannot recognize if it is a person A or B. Diagnostics is rapidly expanding and its foundation centers around data sets aligned with algorithms and computations. Many utilities are using various software with variety of algorithms that can support diagnostic of equipment. EPRI has been developing the software agnostic fault signature database that can be used by these algorithms for fault detection.

Fault signatures are structured fault information that can be used by these algorithms to compare with when it sees the abnormal data. Software agnostic fault signature database consists of fundamental fault information that can support any diagnostic algorithm. However, each algorithm will have a few unique requirements, that will require edit and addition to these software agnostic fault signatures. Many of the newer version of the advanced pattern recognition software has diagnostic module.

The presentation aims to discuss how various EPRI's continuous online monitoring (COLM) quick guides and knowledge-based fault signatures can help utility with asset health diagnostics that is beyond traditional APR.

PREVENTING CYBER ATTACKS WITH HARDENING.

Jeremy Lawrence, EPRI USA

This presentation will discuss the importance of hardening in preventing cyber-attacks on power generation OT systems. We will begin by exploring the reasons why hardening is crucial for OT systems, followed by examples of past attacks in the industry that could have been mitigated with hardening. Next, we will delve into the challenges and barriers that OT systems face when implementing hardening practices. Finally, we will provide examples of hardening guides and practices that users can implement tomorrow for little cost.

Session- 4: Improved Safety in Power Plants

Project "DRISHTI" to enhance site safety by integration of AI, VA and PA with CCTV VMS

Ankit Anand, Tata Power

Prince Kumar

Mayank Garg

Digitalization of safety round by integration of CCTV Video Management System, Video Analytics and Public Annunciation system which will proactively identify unsafe act as well as Unsafe condition. Implementation of Artificial Intelligence and Video Analytics in CCTV system for early detection of Safety hazards including unsafe conditions as Fire and Smoke, collapse of person, manpower in hazardous zone as well as unsafe Acts as Violation of Safety Helmet, Safety jacket or Safety Harness at height work. Mentioned hazards are very common reasons of major and minor accidents, early detection of these issues can save human, equipment & environment. Along with alarming the operator for any detected violation, public announcement speaker is installed at various areas throughout the plant, from which the operator can announce at the particular area or all areas as per requirement for necessary action.

IMBIBE SAFETY CULTURE THROUGH REAL TIME MONITORING

Manoj Kumar, Satya Ranjann Mahapatra

NTPC North Karanpura

Safety is paramount in any industry and imbibing a culture of safety is of foremost importance. Accidents occurs due to non-usage of safety PPEs at site. This can be prevented by real time capture of local view through camera, processing the image for identification of living objects, thereby making it as an input parameter for distributed control system (DCS system) to generate warning signal. The present paper discusses such cases and presents a pragmatic solution to avoid potential accident potholes by use of simple low-cost real-time camera (ESP32 Camera) as input to microprocessor and relay for DCS input. This input is transmitted through WiFi to a laptop/computer system for analysis and give siren at the local with the audio sound "Caution! Wear helmet".

Based on artificial intelligence and state-of-art technologies on video streaming and face recognition like YOLO for image annotations, counting, activity and face recognition and application-specific integrated circuit (ASIC) design services, specific logic has been developed to address situation-based safety issue.

The output of the system can be of need-based type like warning siren/sound, alarm system or logic incorporation and can be used for monitoring purpose to ensure safety. The process ensures mistake proofing by design where the site operator is warned through signal and a centralized monitoring system for recording. Being real time and low-cost, the paper presents a practical model of Real Time Human Safety to nurture a culture of safety in day-to-day activities.

REVERSE CAMERA SYSTEM FOR COAL RAKES

Prakash Sutradhar ,Bhushan Verma

NTPC, Bongaigaon

Reversing Camera consist of a camera and a display monitor. When your car is in reverse, the camera located at the rear of the vehicle activates to show what is behind your car on the monitor. These cameras can help to view objects that may not be visible through head checks and using your reversing mirror.

We have used Waterproof, Dust-proof & vibration proof camera & other accessories. Normal CC-TV won't work for coal rakes due to high vibration on a moving train. All the items are packed into a portable solution, a rechargeable, waterproof, dust-proof, vibration proof, night-vision light weight (1.5 kg), easy to carry & easy to hang. One time charging will last for 6 Hours operation. Realtime data is captured and transmitted to the cloud through 4G Mobile SIM network inside the portable box. Presently, 4G SIM cards are used for Internet Connectivity. As a future development, we have started creating Wireless Lan Network covering 25 KM track of BgTPS Railways Siding.

BEST SAFETY PRACTICES FOR EFFECTIVE O&M

Sitaram Sahu, OPGC, Odisha

Sarat Chandra Nayak, OPGC, Odisha

This document aims to describe, in a simple and precise manner, what best practices of Safety are implemented in OPGC to make the workplace a safer workplace. It vows for continuous improvements in safety culture by involving everyone who works at our facilities and on our activities. There are risks for employees working on or near improperly maintained equipment or in poorly maintained facilities. Many accidents, including machine incidents and slips, trips, falls and exposure to toxic gases are the result of a lack of maintenance or poor-quality maintenance. Maintenance is a high-risk activity because it often requires working together with a running process and in close contact with machinery. During normal operations, automation typically reduces the likelihood of human error that can lead to accidents. However, in maintenance activities, contrary to normal operation, direct contact between the worker and machine cannot be reduced substantially, as maintenance

is an activity where workers need to be in close contact with operations and running machines. Maintenance operations typically include both disassembly, reassembly, working near high voltage and energized equipment, confined space, height work often involving complicated machinery. This can be associated with a greater risk of human error, increasing the accident risk.

Best O&M Practices for Generating Stations w.r.t CEA Safety Regulations, 2023

Rishika Sharan, CPES

Chief Engineer, CEI, CEA

Safety is utmost important in any generating station. The safety measures are needed to ensure incident free work place, deliberated in details with respect to regulations laid by CEA 2023.

Regulations are defined in details with role and responsibility that covers RE station also. Safety measures related to machine as well as equipment along with human safety described in details.

Electrical safety hand book is "SACHET" i.e compilation of all safety regulations in details published by CEA.

Lets strive to make Electrical incident Free India .

Session -05: Control & Instrumentation

Alarm Management & Optimization

C RAMESH BABU

NTPC, DARLIPALLI

TPC the India's largest energy conglomerate has been operating its plants at high efficiency levels with state of art technology. All the NTPC plants are equipped with latest best DCS automation for continuous operation.

A Distributed Control System (DCS) acts as the central brain of an industrial facility. It is a central control system that autonomously coordinates the many subsystems (such as sensors and controllers) located around a plant in real-time. DCS are particularly important for controlling complex processes or for large continuous generating power stations where top-down control and coordination is vital for efficiency.

Most current alarm systems used in power plants show poor performance due to alarm flooding. This paper focuses on alarm management systems optimization. The alarms of power plant are an important data basis for monitors to identify monitoring events, but a large number of invalid and redundant information seriously affects the analysis and judgment of anomalies or accidents, thus reducing the efficiency of power plant. In this paper, we use time-delay, decision tree to filter the invalid alarms with frequent actions, automatically restore and repetition.

Practically, a well-designed alarm system is an essential tool in to maintain effective plant operations. Poorly designed alarm systems cause unnecessary disturbances, a waste of resources, and decreased plant operability. Ongoing production system changes and enhancements typically increase the number of potential alarms. They are added to the existing alarm trip points, which are usually kept originally designed. This causes an ever-increasing number of alarms to be generated. On the other hand, the number of operators is usually kept the same or is even reduced for the requirements of the cost control. This results in an increasing number of alarms for each operator to handle, thereby worsening total productivity. It is important to evaluate repeatedly how operators react to the alarms. Alarm system efficiency can be evaluated by capturing when, where, and how frequently alarm messages are generated, and by comparing how operators respond to them.

AGC modifications for coal plant performance improvement

Anoop K

NTPC: COS-C&I

Automatic Generation Control (AGC), a well-established concept in place in major power grids world-wide, was implemented in Indian power grid by Grid-India with participation mainly from central generating utilities. NTPC coal is presently the major contributor serving about 75% of total available AGC reserves, pending wider participation base.

AGC is implemented in Indian coal units as a remote bias to the local set point in Coordinated Master Control (CMC). Required start of AGC response on consistent basis after nominal 30 sec is a challenge, on account of inherent thermodynamic delays in boilers firing higher ash content coal, with dynamically varying GCV. This limitation is aggravated in overall perspective for grid frequency control, due to the unique Indian grid energy mix which is heavily coal-centric (about 75%), limited on faster Gas/Hydro reserves.

In 2022-23 there were significant indicators of increased thermal fatigue to steam circuit components attributed to fast ramping (since 2020 Apr) and AGC (since 2021 Sep), from failure post-facto analysis as well as rigorous boiler tube inspections during overhauls. In fact trends have shown that temperature cycles during sustained AGC oscillations are even higher than those induced during a fast unidirectional load ramp. An urgent need arised to optimize the existing AGC scheme, maximizing control efficiency by reducing cyclic movements.

The paper provides details of modifications in AGC scheme by NTPC, progressing in systematic manner in close coordination with Grid-India side parallel re-tuning. Paper limits its scope to AGC, excluding primary and manual/tertiary frequency control mechanisms in discussion.

Asset Fault Prediction through Machine Learning Models

ABHISHEK JOSHI, SOUMITRA GHOSH

NTPC, Singrauli

Thermal power plants are an important asset in the current energy infrastructure, delivering ancillary services and power to their respective consumers. Faults on critical systems, such as EHG (electro-hydraulic governing) control of large pumping systems (TDBFP) and EHG control of main turbine, can lead to material damage and opportunity losses. Pumps and turbines play an essential role in various industries and as such clever maintenance can ensure cost reductions and high availability. Asset Fault Prediction is the study of utilizing data to estimate the current and future conditions of a system. Data-driven models can be built using Machine learning algorithms to predict the fault in the system before it occurs that would be difficult to identify by man.

This paper discusses the concept of Asset fault prediction. It is the development of machine learning models using past data sets, testing the model with existing data sets, and deploying the model to assess the health of the particular asset. Machine learning models helps in data-driven decision making, thereby improving performance, efficiency and reducing partial outages and forced outages. It helps in condition-based maintenance and proper planning of preventive maintenance. The paper discusses a case study of electro-hydraulic control failure of Turbine driven boiler feed pump. It also depicts how machine learning model, developed, and implemented using historical data, has predicted the fault and helped us to prevent further failure of electrohydraulic control. The model has thereby reduced forced outages and equipment failure at NTPC Singrauli in case of failure of EHG. Further, an image analytics model has been developed and trained using past historical images. The model helps in diagnosis of a fault generated in TDBFP and in can be further modeled for Asset fault signature analysis. Use of Machine Learning concepts in the predictive maintenance as demonstrated in the paper goes a long way in safe and optimized operation of commercial industrial assets.

Cost Optimization by In-House Development in Measurement and Calibration Techniques

ASHISH KUMAR SAHU, PANKAJ KUMAR SINGH CHAUHAN, SANDEEP KUMAR MISHRA

NMUNL,MEJA

In super critical Power Plant, Boiler expansion monitoring, Ash Load monitoring in bottom Ash hopper and Control of Condensate Polishing Unit parameters monitoring (CPU) is a major challenge in the control room.

Presently for Boiler Ash load monitoring load cells are provided in the Boiler water wall hangers whereas for Boiler expansion local gauge (Plate with needle) is provided. Further, for CPU separate DDCMIS is provided in offsite area and no parameters and operation is available to CCR operator for timely action.

Without accurate and reliable measurement, the plant may suffer heavy mechanical damage that can be caused due higher ash deposition in the bottom ash hopper. Further non-availability of CPU parameters in CCR may lead to delay in action by operator for maintaining the steam & water parameters. Since Thermal power plant are operated with coal from different mines and different ash load content, Ash collection in Bottom ash hopper varies with type of coal as well as load. Due to liberalization of power market, thermal power plants are frequently operated in cycling mode and reserve showdown have become more common. Water chemistry plays a very vital role for the reliable & durable operation of boiler & turbine. Hence, availability and reliability of online measurement and operation has become the need of the hour.

The major challenge is the selection of the Measurement techniques utilized for Boiler Ash Load and Boiler expansion. Further, provision of additional OWS in the CCR of CPU plant connected. These challenges were mitigated by in-house research of available resources, local vendor development

for supply of cost-effective solution. Solution of Calibration of Boiler Load cell was done through in-house technique. Boiler expansion remote measurement by laser-based sensors. For CPU OWS development of vendor supply of special type of optical fiber cable with connector used in Toshiba DCS, which saved 90% of the cost as quoted by OEM.

MODIFICATION IN MOIS FLAME SCANNER

Samir Kumar Bhatnagar

Adani,Baran

Adani Power Ltd, Kawai is 2x660 MW coal based thermal power plant located near Kawai Village of Baran district in Rajasthan. The power plant is based on supercritical, energy efficient & environmentally friendly technology. It is supplying power to RVUNL (Rajasthan Government) and connected to western grid of India. MOIS-Micro Oil gun ignition system is installed in both units in boiler of plant. MOIS is used during light-up while using LDO.

When desk engineer takes MOIS Guns, then guns will be proved by its flame scanner signal from flame scanner control card. This control card generates Flame-ON bit when flame intensity is above the threshold limit set in card. If flame frequency is below threshold value, then ON bit becomes low and MOIS gun oil valve will be closed.

At present Yantai make MOIS Flame scanners are provided by OEM. Many times, flame is not being detected even though good flame visible inside the furnace and while checking the scanner outside with normal torch light, it shows healthy.

On further checking it was observed that sometimes there was coal deposition on atomizing mesh and oil gun chambers which reduces the visibility from flame scanner to sense flame in furnace. On detailed investigation it was also noticed that the sensitivity of photo diode integrated in the flame scanner module for sensing Flame got degraded due to ageing. This requires complete replacement of flame scanner module whenever such problem arises.

These flame scanners are being imported from China and has high lead time associated with many unforeseen issues. Non availability of MOIS flame signal led to delay in light-up process to proceed further. There was a need to develop a solution which will overcome the problem of flame visibility while using the existing MOIS flame scanner. Hence brainstorming was done to :

1) Shift the location of flame scanner without compromising the sensing of actual flame inside the furnace & avoiding the interference of deposition of coal dust in atomizing mesh & Gun Chamber
2) Use of Coal/Oil Flame scanner in place of dedicated MOIS flame scanner module to avoid high dependency.

Session-6: Efficiency

PLANNING FOR ECONOMIC, SAFE & EFFICIENT FLEXIBLE OPERATION

Anjan Kumar Sinha , Technical Director , Intertek

In the Indian coal dominated power system, the increasing intermittent, variable renewable energy RE targets, coupled with rapid electricity demand growth calls for unprecedented increase in demand for flexibility from thermal generating plants for balancing the grid. The change in market demands and system status changes can ensue, with increased cycles (of load following, starts & stops) and ramp rate demands. Additionally, system inefficiencies and reduced productivity can lead to shattering of the system, causing frequent excursions to the system, including parametric deviations, changes in in heat transfer pattern, chemistry upsets, vibration, and safety issues. Moreover, starts, stops, and load cycles and increased low-load operation have "cause and effect" variables that relate to common damage mechanisms. It is important to understand the precursors- the cause that leads to a certain effect, can empower the operators to apply the best practices for mitigating and minimizing damages, improving system safety and efficiency.

With the recent regulatory interventions, the Indian market offers huge opportunities for the flexible units to maximize their profits. The paper focusses on planning for cost effective solutions for enhancing the coal-based flexibility -which have been implemented globally. As the struggle to manage the trilemma (Sustainability, affordability & Energy security) of the energy sector continues, it is important to understand and manage the life-cycle costs of flexibility- which can be achieved only after proper awareness on the mechanisms that increase the costs. Any investment decision on retrofits must be taken on cost-benefit analysis, considering the life cycle costs. In this paper, apart from cost management & O&M strategies, we also present some innovative, cost-effective techniques especially suited for the Indian conditions- for example, real time coal quality monitoring, online coal flow balancing, real-time cycling costs monitoring.

OPTIMIZING THERMAL POWER PLANT AUXILIARY POWER CONSUMPTION (APC) THROUGH UNCONVENTIONAL INNOVATIVE APPROACHES IN THERMAL POWER PLANT

Arijit Debroy ,Prakash Upadhyay

Reliance Power ,Sasan

This paper explores the inventive strategies deployed by Sasan Power Limited (SPL), a key entity within the Reliance ADA Group, to optimize Auxiliary Power Consumption (APC) at the Sasan Power, a leading generator in the power industry with a robust 3960 MW capacity. The document presents a comprehensive overview of unconventional modifications implemented across systems, including the

Seal Air System, Mill Clean-Out-Conveyor (COC) System, Steam Coil Air Pre-Heater (SCAPH) System, and Air Washer Units (AWU) System.

The enhancements made to the Seal Air System involve the addition of extra lines and impeller trimming, effectively improving both reliability and energy efficiency. The deliberate operation of the COC System for 5 minutes after every 6 hours of downtime achieves a substantial reduction in APC without compromising safety. Additionally, adjustments in the SCAPH and AWU systems, such as impeller trimming and a shift from a static SCAPH to a Rotary type SCAPH, exemplify a holistic approach to energy savings. This paper highlights additional measures, including CEP stage reduction, strategic equipment shutdowns throughout the year (especially in peak winters), orifice installations in the Service Air system, and impeller trimming of the CCCW pump. These measures collectively result in significant reductions in power consumption, addressing APC challenges while emphasizing cost-effectiveness in the context of competitive tariff rates and low revenue generation. SPL's implementation of these measures showcases notable energy savings of nearly 65 MUs, contributing to the continual improvement of operational efficiency and setting a noteworthy precedent for sustainable practices within thermal power plants.

Ultra supercritical Boiler Combustion optimization via Furnace Zone temp. Monitoring & Burner Management

Abhinandan Pramanik , Akalp Singh

Adani Power,Godda

After the comprehensive transformation of the combustion system for an 800 MW ultra-supercritical boiler, several issues emerged, including combustion deviation on the left and right sides, elevated CO content at the economizer outlet, increased carbon in the slag, and a subpar low-nitrogen combustion effect due to unsatisfactory operational adjustments. To address abnormal combustion, a combustion optimization adjustment test was conducted, involving furnace zone temp. monitoring, oxygen leveling, secondary throttle adjustment, exhaust throttle adjustment, and optimal oxygen adjustment. Through this test, the boiler's combustion system saw a significant improvement in economy, safety, and environmental protection. Oxygen distribution became more uniform along the furnace width, resolving abnormal combustion issues. Wall temperature distribution also became more consistent along the furnace width, leading to an evident reduction in wall temperature deviation.

What affects the Thermal Performance of a Cooling Tower?

Upendranath Bhupal

Cooldeck Industries Pvt. Ltd., Mumbai

The optimal performance of a cooling tower is of vital importance in achieving the desired heat rate of a thermal power plant; about 15% of the heat rate is affected by the cooling tower.

Several aspects comprising of ambient conditions, circulating water quality, fill selection, availability of fill performance characteristics, structural blockage in the air flow path, plenum height vis a vis cell aspect ratio, reliability of fan performance, tower orientation and citing and the associated recirculation and interference, etc need careful consideration before designing the cooling tower for a given thermal duty.

Availability of reliable meteorological data for determining the ambient WBT is of prime importance. Presently, no statistical analysis of the met data as per ASHRAE standards is carried out by the specifiers for the determinization of the local ambient WBT. Similarly, no design methods or guidelines are referred to by end users while evaluating bids received for cooling towers. And with the added problem of unreliable fill and fan performance, the overall thermal performance of a cooling tower becomes questionable.

A similar situation existed in the USA during the 1980s before the American Power Producers Association commissioned a study by EPRI to experimentally evaluate the performance characteristics of various fills used in cooling towers at the time. The EPRI report, though considered impugned, has contributed significantly to the design improvement of cooling towers.

Presently, this paper aims to briefly enumerate the reasons for inadequate performance of cooling towers and the possibilities of upgradation with least costs.

EXPLORATION OF ENERGY SAVING OPPORTUNITY AND ENERGY EFFICIENCY IMPROVEMENT THROUGH ENERGY AUDIT

Dr. Mehebub Alam ,Joydev Adak ,Narendra Nath Maji ,Sumanta Mondal

DVC,Bankura

Energy conservation and energy efficiency have been emerged as a burning area of research nowadays. The saving of energy whether in macro or micro scale will be beneficial to power generators, industry and environment. It is worth noting that one unit energy saving is better than one unit generation. In view of this, guidelines have been issued regarding energy efficiency under the ambit of BEE and energy audit has been mandated to each energy intensive utilities, consumers. It has been mandated to identify and explore the energy saving opportunities in each intensive utilities or industries. This paper represents case study of DVC owned power plant regarding energy efficiency improvement.

Two different cases are highlighted in this paper through energy audit and detail analysis. Case-1 deals with the controlling of discharge pressure of compressors without any financial involvement and the benefit is immediate. Case-2 highlights the incorporation of variable frequency drive into the condensate extraction pump where more energy consumption was observed during comprehensive energy audit. For the second case, the cost- benefit analysis is also conducted in terms of payback period which is found around 25 months. Both the cases have been thoroughly analysed from the various operational data like power rating, current drawn, percentage average loading, running hour etc. The energy saving per annum is found to be around 0.05 million unit (MU) and 0.6 MU for case-1 and case-2 respectively. The practical case study presented in this paper will be beneficial to the power utilities, consumers, policymakers etc.

Session-7: Mitigating Environment Challenges & Ash Utilization

WAY OF SUSTAINABLE ASH UTILIZATION: FINE FLY ASH COLLECTION AND TRANSPORTATION THROUGH BTAP WAGONS

Sanjay Asati, Amit Dhiman, Ashish Kumar, Pradeep Kumar, Utung Sribasu

NTPC.Rihand

Coal is used as main source of fuel for power generation in thermal power plants in India. Coal is fired in boilers for steam formation which in turn results in generation of ash. The prime concern for coal based power plants is the quality of Indian Coal, as India coal has low calorific value & sulphur content but has a high ash content in the range of 30 - 45% due to which ash is being generated in abundance. Fly ash generation in India has increased from 70 million tonne per annum (mtpa) during 1996-97 to about 226mtpa during 2019 - 20.Sonebhadra -Singrauli region is known as power capital of the country where coal based thermal power plants owned by public & private sectors are operating with installed capacity of more than 20,000 MW of power generation. Sonebhadra - Singrauli region has generated more than 28 MTPA of fly ash during the year 2019-20 whereas its utilization was only 34% approx. Due to distant location from the major ash consumption belts, gainful utilization of such a huge quantum of ash in environment friendly manner is a big challenge for the region.

NTPC Rihand is the largest power plant of Uttar Pradesh (3000 MW) and is operating in Sonebhadra - Singrauli Region. This power plant generates around 3.9millions of ash annually. Fly ash generated at NTPC Rihand is mainly utilized in cement manufacturing, ash brick manufacturing, raising of ash dykes, low lying area filling works etc. Although the stations has increased its ash utilization by 05 times in last six years (from 10% to 51%) but due to limited avenues of ash utilization through conventional methods is the main challenge of NTPC Rihand for meeting the regulatory norms of 100% ash utilization in environmentally safe manner is and there is a need to explore and establish new avenues of Ash Utilization on sustainable basis.. This paper discusses the efforts being made by NTPC Rihand for innovative ways of ash utilization through Classified Fine Fly Ash and possibility of transporting Fine Fly Ash Through BTAP wagons to Consumption centers like Delhi NCR and the associated experiences, issues and challenges in respect of effective management of Fine Flyash through collaborate approach of fly ash user and power plants

ENVIRONMENTAL CHALLENGES – POWER GENERATION AND CARBON FOOT-PRINT MAPPING

Dr. Kruthika Eswaran, Lead Consultant at Net Zero Think Private Limited

Mr. Manoj Kumar Singh, Founder- Net Zero Think Private Limited.

Mr. Rabinder Kant Sikri, Former NTPC Professional

As the global energy demand continues to rise, the environmental implications of power generation, particularly concerning carbon emissions, have emerged as a pressing concern. India, a rapidly advancing nation with a growing population and a strong economy, finds itself on the frontline of this challenge. This summary offers a comprehensive overview of the paper titled "Environmental Challenges - Power Generation and Carbon foot-print mapping" which seeks to analyze and comprehend the carbon footprint associated with various power generation sources within India.

The paper explores the multifaceted landscape of power generation, encompassing conventional sources (coal and gas) and renewable sources (solar, wind, biomass, among others). Its objective is to quantify the emissions linked to each power generation method, providing a nuanced understanding of their environmental impact. Beyond carbon emissions, the environmental challenges posed by power generation include air pollution resulting from fossil fuel combustion and its consequential effects on air quality and public health. Additionally, the paper investigates water usage and potential contamination associated with specific power generation methods, shedding light on the broader ecological consequences. In conclusion, the paper summarizes key findings, puts forth recommendations for policymakers, industry stakeholders, and the public, and emphasizes the urgency of addressing environmental challenges within India's power generation sector.

By offering a holistic assessment and actionable insights, this paper contributes to the ongoing dialogue on sustainable energy best practices in India, and reducing global emissions can facilitate and safeguard the achievement of stability, independence, and a better life for individuals and their families.

COARSE AND FINE ASH SEGREGATION AND EVACUATION: MAXIMIZING REVENUE THROUGH INNOVATIVE ASH MANAGEMENT AT NTPC KAHALGAON

Shyam Sundar Kumar, Dey, Asesh Singha Roy,Rupesh Kumar

NTPC Kahalgaon

This paper presents a pioneering pilot project conducted at NTPC Kahalgaon Stage 2 (3*500 MW), focusing on evacuation of coarse and fine ash separately from ESP hoppers to the ash silos with the existing system. Unlike traditional approaches where both types of ash are sold mixed, this project aims to make a sustainable provision for segregating fine and coarse ash which can help us in selling fine ash

separately due to its higher value in the cement and other industries. This project aims to optimize ash resource utilization, thereby increasing profitability and sustainability.

The project utilized the existing pneumatic conveying system to transfer both coarse and fine ash to designated silo areas. The system employed compressed air to convey the ash through closed pipelines, minimizing dust emissions. Additionally, vacuum and pressure systems were used to transport the ash from hoppers to conveying pipes, ensuring efficient evacuation.

The project achieved its objective of evacuating coarse and fine ash separately. Problems such as clogging, dust emissions, and wear and tear were effectively addressed through meticulous planning and efficient problem-solving, leading to uninterrupted system operation. The project demonstrated the feasibility of segregating and evacuating ash particles without major modifications, instilling confidence in trouble-free long-term system operation. If this project is fully implemented at NTPC Kahalgaon Stage 2, it could generate annual incremental revenue of approximately Rs. 14.13 Cr.

The successful execution of this project marks a significant achievement as the first of its kind at NTPC Ltd, to make our company future ready for effective ash utilization. The methodologies and strategies developed can serve as a blueprint for future ash management initiatives, highlighting the potential for enhanced revenue generation and sustainable practices in the power generation industry.

Case study on O&M Practices for Safe Power Generation in Gas Base Power Plant-ONGC Tripura Power Company (OTPC)

Arko Ghosh Head EHS & F

The case study delves into OTPC's proactive Health, Safety, and Environment (HSE) strategies aligned with their business plan. It highlights the crucial objectives across various domains: worker safety, environmental impact mitigation, public health considerations, regulatory compliance, operational efficiency, and risk management. OTPC emphasizes rigorous safety protocols, environmental assessments, community engagement, and strict adherence to regulations to ensure operational continuity and excellence.

The HSE Strategy Roadmap outlines clear objectives, regulatory compliance measures, technological integrations like IoT and AI, comprehensive employee training, and transparent reporting mechanisms for continuous enhancement. The study underscores technological advancements in IoT, AI, and data analytics for real-time monitoring, risk prediction, and continuous improvement

Additionally, it focuses on fostering a culture of HSE excellence by emphasizing leadership commitment, employee empowerment, communication, and regular training. The integration of technology enhances efficiency and provides insights for continuous improvement while acknowledging the centrality of leadership commitment and employee involvement in HSE success. The way forward suggests continuous review and adaptation of the HSE strategy, collaboration with peers

and regulatory bodies, assessment of technological effectiveness, and regular audits to ensure ongoing compliance with HSE standards. Overall, OTPC's proactive approach aims to create a safer, sustainable working environment while meeting regulatory requirements and achieving business excellence.

GYPSUM QUALITY IMPROVEMENT THROUGH INNOVATIVE PROCESS IMPROVEMENT

Sandeep Jangra,G V N Vishnu, Dipanjan Basu

Jhajjar Power Limited, Haryana

This technical paper focuses on the improvement of gypsum quality in the wet FGD process. Wet FGD systems are widely used in power plants to remove (SO2) emissions from flue gases. However, the quality of the gypsum produced as a byproduct in these systems can vary, impacting its potential for reuse or disposal. JPL owns and operates a 2x660 MW coal based supercritical thermal power plant installed with wet FGD. The FGD process produces gypsum as a byproduct of quality standardized by OEM. Chloride content in gypsum is an important quality parameter which was observed to vary widely from the standard value. The present study was aimed in research of the few controllable process variables which have an impact on gypsum quality and hence in chloride reduction. The variables were exercised, observations and data recorded. The improvements were noted, and the process were finally tuned to achieve desired result. The findings of this study will provide valuable insights into the optimization of FGD gypsum dehydration process for improved gypsum quality. By implementing the modified processes, power plant operators can enhance the market value of the byproduct gypsum, reduce environmental impact, and ensure compliance with regulatory standards.

Session-8: Electrical Systems

MAINTENANCE PRACTICES FOR ENHANCING ASSET MANAGEMENT IN EHV SUBSTATION

Parag Chatterjee, Sushil Kumar

NTPC Barh

With the ever-growing energy demand across the country, asset management of EHV substations has become increasingly important to ensure 24x7 electricity. To ensure round-the-clock electricity, modern tools like digital substations and Intelligent Electronic devices (IED) are being used to enable end users such as desk operators and maintenance personnel to effectively monitor large data and take actions thereon. Supervisory Control and Data Acquisition (SCADA) is one such tool to access operating data and parameters, often built as either stand-alone system or as an integrated system encompassing more than one substation. These data include EHV equipment status, real-time current, voltage, MW and MVAR, IEDs' healthiness, alarms, and annunciation signals on the dashboard. The controlling actions are carried out by bay control units (BCU), which enable a digital pathway for opening and closing action from remote. Substation maintenance practices include routine maintenance, preventive maintenance, conditionbased maintenance, and predictive maintenance. There are well-established standard operating procedures (SOP) for the mentioned maintenance formats. This paper will strive to delineate certain key action points and analytical approaches within this maintenance framework that have proven to be beneficial in asset management. Adoption of new technologies for enhanced reliability and better condition assessment of assets has also been discussed. In conclusion, certain key analytical tools and technological advancements have been discussed. These practices, if implemented, will help in developing an EHV substation into a state-of-the-art establishment.

MOTOR BUS TRANSFER SYSTEM: IMPLEMENTATION OF PROBLEM EXPERIENCED IN THERMAL POWER PLANT LIVE MOTOR BUS

Lav Kumar Kaushik,

Hasdeo Thermal Power Station,CSPGCL

A Bus Transfer is a process of enabling power continuity to unit motor bus during unit startup, shutdown, maintenance and contingency condition by successful changeover of sources. The field of live Bus Transfer has undergone rapid change in the past two decades due to rapid integration of computer based system in relaying and power system protection. This paper highlight implementation of problem experienced in power plant motor bus transfer system during load throw-off condition and due to breaker mal function; the above problem has been analyzed, solution has been implemented and tested.

Monitoring of Corrosion Products in Low-Oxygen Regime Water Cooled Synchronous Generators with Copper Hollow Conductors.

Dharmendra Dange, Madhur Sherawat

NTPC Dadri

The large synchronous generator uses direct DM water cooling for the stator windings, phase connectors & bushing & direct Hydrogen cooling for the rotor winding, Iron losses, windage losses & stray losses are also dissipated through Hydrogen.For stator winding cooling, the stator winding bars are equipped with hollow conductors made of copper embedded in between the individual solid copper conductors. The stator water system consists of pumps, coolers, mechanical cum magnetic filters, fine filter, conical filters SPU, stator water tank & alkaliser.

The cooling water is purified by ion exchanger & it's DO (dissolved oxygen) concentration is designed for both very low levels (i.e. < 20 ppb) & very high levels (i.e. > 2 ppm) depending on manufacturer. For example at Dadri thermal our 490X2 MW machines are designed for low DO regime whereas the 210X4 MW machines are designed for high DO regime.

If the stator winding cooling water contains oxygen the hollow conductors release dissolved copper or its oxides, once they re-depositing may cause flow restrictions through the hollow conductors. Thus plugging of hollow conductors impacts winding bar cooling.Plugging of stator winding hollow copper conductors has affected all water chemistry regimes whether it operated in LOW DO regime or High DO regime.

Presently in this paper we will discuss about plugging mechanism of stator winding hollow copper conductors, monitoring of corrosion products, addressing plugging & a case study based on hands-on experience that addressed plugging which was observed in one of the water cooled generator operated in Low-oxygen regime.

The name plate details of the generator under discussion is:500MW, 588 MVA, 0.85 P.F. (Lag), 21 KV , 50 Hz. Corrosion will impairing long life and trouble free operation of an equipment. Large sums of money are spent each year repairing the effects of, or preventing, corrosion. A defined water chemistry regime if operated properly reduces corrosion & it's after effects.

Despite defined chemistry regime, corrosion observed in generator with copper hollow conductors.

Based on condition of plugged hollow conductors, chemical cleaning which uses a chelating chemical is planned, it dissolves copper oxides without affecting the base copper & shall increase the flow through hollow copper conductors.

Effective heat dissipation from stator windings is very important to maintaining generator electric power output and winding performance.

Hence, maintaining the operational reliability of the stator winding cooling system is very important for safe, reliable & cost-effective power generation

CASE STUDY ON 250MW GENERATOR STATOR WINDING BAR FAILURE DETECTION AND REPAIR METHODOLOGY

Debabrata Nanda, NTPC Ltd-COS

Ajay Kumar Gupta, BHEL-HEEP,Haridwar

Sachin Garg. NTPC Ltd-COS

Generator is one of the most critical equipment in power station. Reliable operation and availability of the generator are of utmost important to any power generating utility. The damage to generator core can lead to prolonged outage period which will be a huge loss to owner in this competitive world. In order to achieve above objective, three pronged approach – analysis of early indication of impending stator bar failure/defect, failure mode and effect analysis (FMEA) of the failure and accordingly corrective action and repair work have to be adopted. Present paper illustrates how one 250 MW hydrogen cooled, global VPI (Vacuum Pressure Impregnation) generator stator was saved from catastrophic damage by stopping the machine after analysis of early indications subsequently FMEA and corrective repair works of affected winding

STUDY ON IMPACT OF CHEMICAL CLEANING OF STATOR WINDING HOLLOW CONDUCTORS ON GENERATOR COOLING WATER SYSTEM COMPONENTS

Anand Pandey,Nitesh Khandelwal

NTPC Ltd.

Turbo generator is one of the most critical & costlier component of power plant. Water cooled Stator winding with hollow conductors were designed to keep the size of the machine smaller with higher power output capacity. Maintaining adequate primary cooling water flow through stator winding hollow conductors is one of the most critical requirements for sustainable operation of generators. Power plant operators face severe problems when dealing with reduced cooling efficiency in large water-cooled generators. Often this is caused by plugging of copper hollow conductors by the oxides of copper. The copper oxides plugging the generator windings can be removed by acid cleaning. For this to be efficient, the cleaning solution should contain an oxidizer. However, these solutions attack the system materials

more than those without an oxidizer. These methods can remove all the oxides from the system as long as the chemicals have access to them; they cannot access completely plugged hollow conductors. If done incorrectly, chemical cleaning carries considerable risk.

Risks range through incomplete cleaning, unstable oxide layers, release of clumps of oxide build-up, damage to system materials such as brazing joints. EDTA (Ethylenediamine tetra- acetic acid) along with controlled used of oxidiser acts as a chelating agent and works effectively to remove oxides of copper from generator. A study was carried out to analyse the impact of chemical cleaning of hollow conductors on various component of Generator primary system by comparing the data obtained through different electrical and mechanical test on generator. This paper with the help of real time case study share the analysis of data obtained through various test for generator without chemical cleaning, with single chemical cleaning and with repetitive chemical cleaning.

Session-9: MMSD / RE / Mining

OPTIMAL OPERATIONAL AND MAINTENANCE STRATEGIES FOR A FLUE GAS DESULPHURIZATION SYSTEM IN A COAL-FIRED THERMAL POWER STATION

Rajesh Ranjan ,Prabhat Shukla Ranjan

BHEL

In the ever-evolving landscape of Indian power generation, the implementation of Flue Gas Desulphurization (FGD) plants has become imperative to mitigate SO2 emissions and demands a keen focus on operational excellence. This paper extensively explores the essential practices required to ensure the optimal and reliable performance of the FGD system. Given the relatively recent introduction of FGD technology to the Indian power sector, professionals are progressively acquainting themselves with its intricacies through ongoing operations and maintenance (O&M) activities.

This comprehensive examination highlights key facets of FGD O&M practices, emphasizing the paramount importance of emergency preparedness alongside routine inspection and monitoring procedures. The discussion encompasses the pivotal role of skilled manpower, emphasizing the necessity of continuous training to enhance their competency in operating, and maintaining troubleshooting the FGD equipments and components. Additionally, the paper underscores the significance of spares availability, efficient resource utilization, and the judicious implementation of preventive and predictive maintenance strategies. In conclusion, this paper serves as a valuable resource for power plant professionals, offering insights into the best practices for FGD O&M. By incorporating these recommendations, power stations can ensure not only compliance with emission control regulations but also the sustained and efficient functioning of their FGD systems, thereby contributing to environmental preservation and operational excellence.

A REGULAR INSPECTION FOR FGD SYSTEMS CONTRIBUTING TO EFFICIENT LONG-TERM STABLE OPERATION

Nobuhiro Kuroki,Sarangaraja Balakrishna

Chugai,Japan

Proper process status monitoring and system maintenance are necessary to maintain stable system operation in any process. Power plants (with a particular focus on FGDs in this document) are no exception. To maintain stable operation, the condition monitoring by checking process instruments must be continued. However, there are some parameters that cannot be checked only by the permanent instrument, and these might affect the stable operation of the system. For the measure, periodic liquid-

solid analysis and gas measurement have been adopted in Japan. Our Japanese headquarter have been support for their system maintenance management.

With respect to environmental systems that have been commissioned and are operating normally, we would like to propose the following.

(1) To perform periodic (weekly or monthly) parameter analysis to verify that the process doesn't have problems.
(2) To conduct a regular inspection test once every 1-2 years to understand the current state of your system.

LIFE ENHANCEMENT OF SIMHADRI NDCT#1 BY REPAIRING &REHABILITATION WORKS INCLUDING COATING WITH MOISTURE CURED URETHENE ON THE SURFACE OF THE RCC SHELL

Rajesh Chawla, Mahesh Alugolu, Pandab datta, Madhup Chandra Yadav

NTPC,Simhadri

Cooling towers are used in thermal power generating units to reject heat gained during condensing of steam (in the condenser) to the atmosphere through the flow of cooling water stream.

Simhadri STPP is a 4*500 MW coastal thermal power station using Natural draft cooling towers (NDCT) for cooling of condenser cooling water. Sea water is used as condenser cooling water. There are 4 numbers of NDCT's, one for each 500 MW unit. Sea water is drawn from Bay of Bengal through a sea water jetty located 8 kms from the plant and is circulated in the closed cycle.

NDCT`s are subject to severe spalling of concrete and corrosion of reinforcement due to sustained operation in saline environment, saline mist & use of sea water.

In this paper we have demonstrated the methodology used for repair and rehabilitation of a 165 m high hyperbolic shaped NDCT#1 facing the problem of Spalling of concrete due to exposure of re-bars with loss in diameter due to corrosion of reinforcement on the concrete shell at various elevations. The structure was inaccessible as the approach ladder was damaged due to impact of falling concrete and the connection with the main structure uncertain.

The structure was once considered to be abandoned in near future due to severe spalling of concrete. It was barricaded from all around due to safety concerns on account of falling of loose concrete.

Access to the top of cooling tower has been created by erecting mast climber along the outer surface of NDCT#1. Use of mast climber on the curved surface of NDCT#1 has been done for the first time in NTPC.

The erection of mast climber also faced challenge due to falling of concrete debris during the anchoring process.

After creation of access, Rope suspended platforms were erected and Internal repairs and painting of NDCT#1 was completed during Unit#1 OH. The external repair is in progress now.

HOW TO PLAN AND BUDGET FOR THE NEXT 10 YEARS

Tom Burnett , Technical Director, Intertek

Managing generation assets in today's volatile electricity markets and regulatory environment is a challenge to all power plant owners and particularly in the Indian coal dominated power system with the increasing intermittent, variable renewable energy RE targets, along with rapid growth in electricity demand. The change in market demands and system status changes with reduced plant staffing, aging fleet, retiring expertise and knowledge, volatility in fuel markets and Chaotic State of Historical Maintenance Data will make it even more challenging to maintain the reliability, safety and profitability of the utilities.

The paper presents Risk Based Equipment Assessment, which is a tool that has been developed based on the original Generation Reliability Improvement Program (GRIP), Boiler Strategy, and Equipment Life Optimization Program (ELOP). The purpose is to integrate long term optimization with risk by using expert knowledge with industry experience and plant history.

STRATEGIES FOR TIMELY & QUALITY OVERHAUL

S.P.Karna, AGM (OS-MMSD)

Balkishan Singh, GM (OS-MMSD)

NTPC holds leadership position for power generation in the country and aims to become a world class integrated power major. In order to realize the above vision, it is important to focus on our O&M practices. The introduction of concepts like Zero forced outage by design, increasing the gap between overhauls, improving plant efficiency to design levels, and attaining 105% capability of machine is the need of the hour. The above goals can be achieved by quantum improvement in Quality of Overhauling, which requires advance planning and monitoring their preparedness levels since two years prior to start of the overhaul. Preparation of Engineering declaration, quality/re-commissioning check lists, review of scope of work and ensuring timely availability of all the materials and contracts are the vital inputs for ensuring a quality overhaul. Overhauling thermal power plants is a critical task that requires careful planning and execution to ensure both timely completion and high-quality results. Strategies that can be adopted for the timely and quality overhaul of thermal power plants is discussed in this paper.

DESIGN ISSUES IN HT MOTOR LEADING TO CATASTROPHIC DAMAGES AT LATER STAGE OF OPERATION

GOPINATH KARUNAKARAN, Prabhu Ramakrishnan

NTSCEL,VALLUR

In this paper, the design issues related to failure of bearing which in turn leads to catastrophic damage to both stator and rotor of motor is discussed. Any damage of bearing during running condition of motor leads to rubbing of stator and rotor instantaneously. If the stator is manufactured under vacuum pressure impregnation (VPI) process, then repair of part winding is not possible and complete rewinding is required. In such cases, repair cost of the damaged motor is almost near to the cost of a new motor. To summarize, bearing failure in a VPI machine is a costly affair!

Session – 10: Steam Generator & Auxiliaries

IDENTIFICATION OF FILLER MIX-UP DEFECT IN WELD JOINTS OF AUSTENITIC STAINLESS STEEL BOILER TUBE

Arabinda Samanta ,Leeladhar Dewangan

NTPC ,COS Boiler

Stainless steel use has become more prevalent in Boiler pressure parts owing to attain higher temperature and hence higher cycle efficiency of thermal power plant. Stainless steel weld joint crack has been a major concern in many of the boilers, contributing to boiler tube failure and forced outages. On analysis of failure data, it was found that the failure was more prominent in boilers where substantial work has been carried out in stainless steel portions of Super heater and Reheater at site for modification or maintenance purpose. Laboratory testing of some of the failed tube weld joints revealed that filler wire mix up was the root cause of failure. But detecting such defective weld joints as a preventive measure during overhauling was a major challenge. This paper elaborates the study undertaken to devise methodology to detect such defective joints and the practice followed for the same, which has been really effective in ruling out such failures in boilers.

This method is being widely used in NTPC in overhauls and opportunity shutdown and till date more than 2000 defective weld joints in Stainless steel tubes have been identified using this technique in both furnace as well as penthouse and the same have been attended. Two of the weld joints replaced were tested in an advanced material research laboratory and the weld material mix up was confirmed by the laboratory analysis too. Now this method of inspection has been incorporated as a standard maintenance practice for all boiler overhauls wherever site welded Stainless steel joints are there. As a result, there has been a substantial reduction in outages due to this cause in current FY in NTPC boilers. After much deliberation and experimentation this has evolved as a really economical, quick and effective technique for Identification of filler mix-up defect in weld joints of austenitic stainless steel boiler tube.

LJUNGSTRÖM ADVX® UPGRADE SOLUTION FOR FUEL FLEXIBILITY, APH PROTECTION AND EMISSIONS REDUCTION

Jehn Wolf-Peter,Gus Shearer

Ljungstrom USA

LJUNGSTRÖM's latest AdvX Solutions are focused on providing fuel flexibility together with protection of the APH and SCR. The AdvX Solution combines three key components. First, SO3 controls upstream of the selective catalytic reduction (SCR) or air pre-heater (APH) by injecting a sorbent into the flue gas

to remove the SO3. Second, an APH upgrade which is accomplished through more efficient heating elements in addition to eliminating the combustion air preheat – both improving heat rate. The final component is the use and application of the additional recovered energy.

IMPROVEMENT OF STEAM OXIDATION RESISTANCE THROUGH SHOT PEENING OF AUSTENITIC STAINLESS STEEL (SUPERHEATER TUBES) AND NDT TOOLS FOR IN-SITU MEASUREMENT OF THE EFFECTIVENESS OF SHOT PEENING

Jacob Debbarma, NTPC Darlipalli

Avijit Mondal, Anil Kumar Das, NTPC NETRA, Noida

Rajat K. Roy, Ashis K. Panda, CSIR- NML, Jamshedpur

It is known that in the austenitic stainless steel boiler tubes (SS347 or similar), there is higher tendency of exfoliations of internal oxides, which may subsequently accumulate at lower bend of the coil causing blockage/restriction in steam flow. Shot peening of internal surface of these tubes is considered beneficial in reducing the exfoliation from these tubes. NTPC has started shot peening of these tubes, where they are already installed, while changing the specs to include the process for this type of boiler tubes being procured. Presently, the adherence to and effectiveness of the shot peening procedure (executed by external agency for tubes already installed) is being ensured through following checks: visual examination and an Almen Strip Test for measuring Shot Peening Intensity and laboratory checks on cut random samples (Samples from tube inlet, bend and outlet) of the tube undergone shot-peening. Presently no method is available for quick checking/screening of all the tested tubes (from large number of tubes (normally 900~1000 numbers being shot peened in in-situ condition) to distinguish efficacy of shot peening or identifying any tubes where shot-peening has not done.

The literature showed that shot peening creates uniform cold-worked layer along the tube ID and that has a profound effect on oxidation resistance. Shot penning introduces compressive residual stress through plastic deformation and work hardening of the underlying material by increasing the dislocation density (i.e. forming slip bands and dislocation piles) and material constraint. Shot peening also modifies the ID of austenitic stainless steel (SS 347/S304) superheater tubes. It is reported that both improve the overall oxidation resistance in steam. Decreasing the oxidation rate directly impacts the exfoliation rate. Most of the improved oxidation resistance can be attributed to the presence of a spinel oxide layer combined with a continuous chromia layer formed near the steam-touched surfaces. The presence of a continuous chromia layer greatly reduces the outward diffusion of iron and minimizes the formation of iron-based scales that exfoliate. In the present investigation, the entire process has been described. Although destructive testing is a very reliable method available for estimation of shot peening efficacy, an attempt has been made to measure the shot penning efficacy at site using a Magneto strictive sensing device. The impact of such shot peening on the magnetostrictive sensor (MsS) signal is also addressed.

UNIQUE BTL CHALLENGES ENCOUNTERED IN TOWER-TYPE SUPERCRITICAL BOILERS: A SOLAPUR PERSPECTIVE

Harsh K Srivastava, BV Rama Krishna Naik, Tom K Thomas

NTPC,Solapur

The economic growth of any country is inextricably linked to its infrastructural development, and the availability of reliable, uninterrupted power supply is one of its cornerstones. The electric power generators are mandated by the regulatory bodies and the Govt to ensure that their power plants run efficiently, minimizing forced outages and downtimes. Boiler Tube Leakages (BTLs) continue to be the single major cause of Forced Outages in Thermal Power Stations. The loss of availability due to BTLs not only causes huge revenue losses to the plant operator but also affects the overall power scenario of the country. The cost of Boiler Tube Failures (BTFs) is comprised of three main components – cost of repair, cost of start-up oil during unit light up and cost of lost production. This paper chronicles the journey of NTPC Solapur, wherein we experienced repeated BTFs in Superheater and Reheater Sections, which have been brought under control. Several innovative methods were explored, and rectification works were taken up by the Boiler Maintenance Department of NTPC Solapur, in association with site Quality Assurance and Corporate Centre – Operation Services Departments. The paper is a report of the challenges faced, the way each challenge was approached, the methodology adopted in solving them and the results obtained thereof with the intent that it might provide anyone undertaking the same journey a proper base to build their case quicker and on a stronger foundation.

The methods enumerated here are simple, cost-effective and can be deployed easily without much additional resource mobilization. The benefits accrued in the form of reduced Forced Outages (BTLs) more than compensates for the minimal investments (time, monetary and manpower) which may be required for adoption of the technologies.

A comprehensive analysis by PAUT of stress corrosion cracking (SCC) in austenitic stainless steel super 304H & 347H grade tubes in super critical thermal power plant: Detection of defects and rectification in weld joints due to SCC of boiler tubes - A Case Study

B C Roy, R K Jain, U. Srinivasa Rao, Aditya Kumar Gupta

NTPC Ltd.

The escalating demand for efficient power generation has intensified the reliance on supercritical thermal power plants. The Ultra Supercritical (USC) Boilers with the operating steam parameters around 600^0C

temperature and 280 KSC pressure requires advanced metallurgy for boiler components (Super Heater & Re-heater) to withstand higher steam parameters for a designed life of 25 years. It necessitates the use of materials with desired creep strength and corrosion/oxidation resistance. Austenitic Stainless Steel like Super 304H and 347H Grade Tubes have emerged as preferred choices. However, the susceptibility of these materials to stress corrosion cracking (SCC) poses a critical challenge, particularly in the vicinity of weld joints. NTPC has faced the problem of SCC in Austenitic Stainless Steel boiler tubes in one of the thermal power plants. The root cause analysis of SCC was carried out by conducting chemical, mechanical, advanced metallurgical testing and advanced Non – Destructive Testing. It was concluded that presence of chloride in SS tubes along with residual stresses in sensitized austenitic stainless steel Super 304H & 347H tubes due to welding resulted in Stress Corrosion Cracking (SCC) adjacent to weld joints.

The typical nature of SCC imposes a challenge to identify the defect by conventional RT/ DPT etc. The cracks were very fine and tight in nature hence PAUT emerges as suitable NDT technique to identify this branch like cracks where simultaneously rectification and testing is to be carried out within short span of time for early restoration. PAUT has advantages over conventional radiography methods having enhanced detectability & resolution, real-time imaging, reduced inspection time and avoiding radiation hazards. Once the root cause of failure was established, before the start of the rectification work, roadmap for rectification were formulated e.g., recleaning & passivation, Chloride checks etc. The WPS was revised with PWHT soaking temperature maintaining on lower side. In-situ repair imposes challenges to welder due to space constraints, accordingly the welders were qualified by simulating actual site conditions. The Case study employs PAUT, a cutting-edge non-destructive testing technique, renowned for its ability to provide detailed and accurate inspection results. This paper also deals with mitigation plans and preventive measures for avoiding stress corrosion cracking and thereby enhancing safety, availability, reliability, and efficiency of the power plant units.

Session – 11: Steam Turbine - Challenges & Advancements

CASE HISTORY: LOW LP TURBINE DIFFERENTIAL EXPANSION IN SUPER CRITICAL UNIT DIAPHRAGM TYPE MACHINES AND REMEDIAL MEASURES.

Satya Brat Yadav, V. Rambabu, Tanveer Alam, Avishek Ghosal, K Rajmohan Sanjeev

NTPC: SCOH

Steam turbine is a prime mover for thermal power plant generation. The main component of a steam turbine is its rotor and moving blades mounted on it which rotates inside bladed casing with extremely low radial and axial clearances. In super critical units Steam turbine consists of HP, IP and LP turbines. There are usually 2 LP turbines with a 4-flow tandem compound. The diaphragms and moving blades of turbine rotor have axial clearances to cater the unequal axial thermal expansion of rotor and inner casing. Usually in diaphragm type turbines there are fixed points to anchor the turbine casing with TG deck as shown in Figure 2. The rotor is also fixed at thrust bearing and thermal expansion will take place on both the sides of anchor points. During initial heating the rotor starts to expand more rapidly than the casing. To monitor the difference in thermal expansion approximator probes are typically installed in Pedestal 1 for HPDE, Pedestal 3 for IPDE and Pedestal 5 for LPDE. In absolute cold conditions the Differential Expansion values are set at a particular value and the change in differential Expansion from initial turbine start to turbine on full load is monitored. The rotor long and short limits are decided considering the minimum clearance between fixed and moving blades beyond which turbine operation is not recommended. Differential expansion of turbine rotor w.r.t turbine casing may reach limiting value due to very fast heating or cooling especially during transient condition of unit start up and shut down. In case of steady state operation or absolute cold condition differential expansion shall reach the design and zero values respectively. Deviation in differential expansion in steady state can occur only in the case of permanent deformation of turbine components like casing or undue forces from turbine supports. The paper deals with NTPC's experience on various cases of LP turbine differential expansions where unusual behavior have been observed especially in newly commissioned 800 MW units. Instances of damage in turbine rotor and diaphragms due to axial contact also occurred. Long term trending of rotor & casing expansions along with mapping of TG foundation is required to identify any onset of changing differential expansion values. The paper describes the remedial measures like turbine casing relocation and increase in turbine rotor coupled length by inserting higher thickness spacer to regain design axial clearances.

MODIFICATION OF HP CONTROL VALVE TO RESOLVE HPCV DELINKING ISSUE IN TURBINE AT SIPAT (3X660MW) UNITS

Rajesh Daga, Chandrashekhar Dewangan, Pushpendra Singh

NTPC ,Sipat

NTPC Sipat is first supercritical power station of its kind installed in India at Sipat Bilaspur CG. Sipat is having generating capacity of 2960MW with supercritical (3X660MW) and Subcritical (2X500MW) units installed. The Steam Generator and associated systems including critical piping for Stage#1 660MW units were supplied, installed & commissioned by M/s Doosan Heavy Industries & construction Ltd., South Korea. Similarly, the Steam Turbine & associated systems were supplied, installed and commissioned by M/s PJSC Power Machines, Russia. The 1st, 2nd & 3rd units commissioned in June 2011, Dec 2011, and June 2012 respectively and are in operation since then.

Control valves are critical part of governing system of a turbine, which control/regulate the flow of steam into turbine according to load demand through a logic. Failure/abnormal operation of any control valve will create disturbance of critical parameters of turbine which may lead to trip of failure of turbine. Sipat stage-I (3X660MW) units having HP, IP and 02 LP turbines in each unit operating at supercritical parameters. The HP and IP turbine modules are provided with 4 nos of HPCVs and 4 Nos of IPCVs. Rolling of turbine is done with IP valves and all the 4 IPCVs operates simultaneously and remains open at all loads above 90-100MW.

For load variation modulation of HPCVs is being done. HPCV 1& 2 operates simultaneously and based on requirements further HPCV 3 and HPCV 4 opens. HPCV#1 and #2 fully open till 580MW, HPCV#3 open around 580 MW and HPCV# 4 after 650MW.

Sipat stage-1 has history of failure of HPCV since 2017 and it increased with time and due to flexible operation. After repeated failure modification of HPCV was done with OEM M/s Power Machines and old valve replaced with modified HPCV.

STRESS CORROSION CRACKING ON STEAM TURBINE ROTOR GROOVES: EXPERIENCES AND COUNTERMEASURES FROM A 500MW POWER GENERATION UNIT

Krushna Prasad Pradhan, NTPC SR-HQ

Susil Chandra Bhoi, NTPC TSTPS KANIHA
Avijit Mondal, NETRA, NTPC Ltd.

Although Stress Corrosion Cracking (SCC) can occur in many locations of steam turbines, most of them initiate at LP disc rim, rotor groove or blade attachment area. According to a literature report, in LP turbine section, cracking on rotor due to SCC has been most prevalent in fir-tree or inverted fir-tree groove designs but it also has been noted in other designs such as finger type design. Normally, cracks initiate from the surface especially around the notches of the grooves and propagate across the steeples. Failure mechanism is a function of stress intensity, rotor material, and steam environment so that the probability of occurrence is higher in the longer lasting stage blades when the moisture of condensation begins to form. Usually, power plants operating for more than 15 years are susceptible to this failure mechanism. If SCC happens, especially in rotor grooves, it has a major influence on steam turbine life. Because of the complexity of crack growth behavior, it is difficult to estimate the remaining life of the rotor with cracks found. In some cases, short term remedies are urgently needed in order to return the unit back in operation before long term actions can be decided. Two of the steam turbines, both 500MW units that faced such problem, we had experience and countermeasures both from Original Equipment Manufacturers (OEMs) and in-house learning by doing. In the first unit (U#3), crack was observed at a single 5th stage (Generator Side) LP turbine rotor groove while carrying out MPI. While in the second unit (U#4), all the 5th stage rotor grooves (both Generator and Turbine Sides; total 124 numbers) were found to have cracks while carrying out MPI. Exact dimension of crack (depth of crack) couldn't be ascertained. While in the first case, the nature of crack was intermittently breaking (not continuous) (starting at ~ 12 mm from the edge), in the latter case, cracks were more prominent and continuous across the length of steeple 1. Also, in the latter case, some of the cracks (35 nos) were observed to have propagated to the rotor side faces. The units had crossed ~ 164000 and 158000 hours of operation respectively. Maximum crack depth, allowed outage duration, spare parts and repair cost are the key factors for deciding on which suitable actions are to be taken. The study focuses on issues related to the integrity of the turbine rotor grooves and this involves a comprehensive analysis of the probable causes behind the cracking phenomena, considering factors such as operational conditions, and maintenance practices etc. Advanced inspection techniques to understand the nature and extent of the cracking and historical operational data and maintenance records are scrutinized to identify any patterns or anomalies that may contribute to the observed cracking.

RENOVATION AND MODERNIZATION (R&M) OF STEAM TURBINES AND ITS SYSTEMS FOR IMPROVEMENTS IN EFFICIENCY, FLEXIBILITY AND RELIABILITY

Shekhar Thakur, Siemens Limited, India

Archan Gor, Siemens Limited, India

Decarbonization of thermal power plants and energy transition towards renewables has become one of the most important factors for energy policies worldwide. In India, the rapid economic growth is leading to strong demand for power and new power projects are becoming more difficult as the availability of the resources like fuel, land, and water in India are decreasing. Energy Efficient Renovation and Modernization (EE R&M) of thermal power plants is critical to support the energy transition, while sustaining economic development. R&M helps to improve the performance of the unit, leading to decarbonization, extend the design life of critical components, improves flexible operations capability, while maintaining the reliability for continuous operation. Energy Efficient Renovation & Modernization (EE R&M) along with Life Extension to extend the normal design life of existing aging power plants is an economical option for addressing the continuously growing power demand. Steam turbine modernizations are a key element in this program. Using state of the art materials and technology-enhanced components such as blades, sealings, inner casings, and rotors provides increased efficiency and optimized maintainability. In addition, future electricity markets with high levels of renewable power generation are expected to be typically forcing radical changes on the fossil fuel steam power plants operating regime in these markets. As a result, many existing Steam Power Plants (SPP) designed for base-load operation may have to change to flexible mode, requiring optimized startup performance. As many of the plants have already completed the designed lifetime (and many in the verge of completion) in India, it is not practically a feasible option to run these plants in flexible mode. The option left is, shift to flexible mode only after the old turbines are modernized using state-of-the-art materials and technology-enhanced components such as blades, sealings, casings & rotors. In short and near medium term, Energy Efficient Renovation & Modernization (EE R&M) along with Lifetime Extension (LE) measures to extend the normal design life of existing aging power plants is an economical option for addressing the continuously growing power demand for India and for transformation of the existing conventional electricity generation with new, more efficient, low carbon emitting technology, considering the fact that coal shall remain a dominant fuel for power generation in next decades. This paper outlines the typical R&M scope of work for various make of steam turbines, including unique design features and pre-engineered modules of the Siemens steam turbine modernization applications for thermal power stations, emphasizing the solutions for LMZ 210 and Siemens-licensed machines such as KWU 210MW and KWU 500MW class turbines installed in the Indian market.

UNDERSTANDING LPT LAST STAGE BLADE FAILURE MECHANISM AND PREVENTION TECHNIQUES

Sanjay Nandal, DGM (NTECL Vallur)

Vikram Jeet Saini, Sr. Manager (COS-Raipur)

A. Jyothi Prasad, DGM (NTECL Vallur)

Exhaust loss refers to the energy lost to the condenser because of the steam velocity going into the condenser. The faster the steam leaves the Low Pressure (LP) Turbine's last stage blades, the greater the energy loss. Since the backpressure is a function of the plant cooling system, and the flow is a function of the initial plant design, increasing the area is the only cost-effective way to reduce the velocity. This is achieved by increasing the length of the LPT last stage bucket. Load and condenser pressure play an important role in the overall life of turbine blades, especially in the last stages of LPT. LP last-stage blades have the greatest potential to stall flutter during low steam flow and high backpressure. Whenever LP turbine is opened for inspection of its internals, the most important thing that is looked for is the condition of the rotating and stationary blades. Damages due to wear, wet steam impingement, corrosion, and erosion are not uncommon. If the machine is opened especially after long hours of operation, a couple of blades with root cracks is also not uncommon. A steam turbine is a typical multi-field coupling system where the steam forces, structural and thermal loadings contribute to blade vibration. The two primary forces acting on the blades are the steady centrifugal force due to rotation and the fluctuating steam bending force. Though the blades are designed to meet all the known sources of vibration, the unknown sources of vibration in the turbine are still significantly high. The complex fluid-structure interactions during the different conditions of plant operation have indeed caused gaps in understanding of the blade dynamics. Manifestation of crack on any part of the blade denotes that vibration could be the prime suspect. Self-excitation in the long blades is one such phenomenon. To sustain self-excitation all that is needed is part load operation and fluctuating condenser vacuum. With flexible grid regulation and wide variation in condenser cooling water conditions, part load and high back pressure operation is not uncommon. Without the knowledge of plant operators, the long blades operate with sustained blade vibration until the condition conducive to vibration prevails.

STUDY ON THE APPLICABILITY OF NTPC FLY ASH TO OR CRETE® PRODUCTION

Ohnaka Akira, Yokota Suehiko, Ozawa Masahiro, Yamada Fumiko

Japan Carbon Frontier Organization (JCOAL)

Steam Japan Carbon Frontier Organization (JCOAL) conducted a study on applicability of utilizing Indian fly ash (FA) to produce OR Crete®, artificial crush stone produced by FEC (FEC), Japan. The study consists of comparison of FA composition using XRF and test for leaching and acid extractable contents of chemicals as environmental safety performance assessment for FA, production of the OR Crete® using NTPC FA at the indoor test level and identify the physical characteristics through comparison with that of the Japanese FA, production of block test pieces with the actual plant molding machine, and applicability assessment. The study outcome, overall, shows NTPC FA can be mixed with cement to produce OR Crete® or its equivalent.

FTR IS AN INDUSTRIAL APPLICABILITY OF SLAGGING AND FOULING MONITORING OF CONVENTIONAL AND RENEWABLE ENERGY CARRIERS

Alex Ditiatkovsky, GEER Germany

Ash forming elements and their deposition characteristics have a direct bearing on the efficiency of boiler operations. Constant and reliable monitoring systems are therefore imperative to the economic viability of energy production. Slagging, fouling and reflectivity which are inherent of the combustion process of solid and renewable biomass fuels, require monitoring and mitigation. In dynamic boiler operations, changes to combustion boundary conditions can result in severe ash deposition problems. To avoid costly troubleshooting of boilers, real time slagging, fouling and reflectivity monitoring systems are essential to this goal. A monitoring system that can prompt an immediate response to avert inefficiencies in boiler operations is all but necessary.

At the Institute of Combustion and Power Plant Technology of the University of Stuttgart (IFK), Germany pioneering technologies are being developed and optimized to aid in the monitoring and prediction of ash related issues in dynamic boiler operations. These technologies include deposition rate probes to monitor deposition buildup. This device also functions as a research instrument to examine the composition, formation, and ash chemistry of the outer deposit layer. Another device at the disposal of the instate is the corrosion monitoring probe. This instrument simulates the impact of corrosive and aggressive flue gas atmosphere and their impacts on boiler material deterioration. In addition, deposition chemistry of inner deposition layers can be examined. Thirdly, the Fouling, Reflectivity and

Thickness measurement device (FTR-KSVA) has been successfully tested during solid fuel combustion at the institute. FTR-KSVA is based on the commercial FTR system from AMS and G.E.E.R. companies. The installed one at IFK boiler is especially adopted for the pilot scale facility requirements to perform fundamental research on deposition characterization of biomass and waste fuels. Efforts are on the way to systematically conceptualize a validation methodology which is expected to add to the robustness of the device. This device monitors the dual properties of ash formation, ash reflectivity and thickness growth in real time operation conditions. Reflectivity of the ash has a direct correlation to the heat transfer mechanism in the boiler. Monitoring of the thickness buildup allows for a systemic and cost-effective deployment of cleaning systems. Another essential monitoring system of the institute is called the slagging and fouling prediction tool. The principle of the zone-based model is core to the structure of the software. The device also has integrated thermochemical equilibrium calculation components to predict operational boundary conditions that can lead to severe ash deposition problems. This software has the capacity to examine fuels of varying chemical compositions relying on a rich thermochemical database. Insights can be developed for new fuels, biomass blends, agricultural residues, municipal solid waste, solid recovered fuels among many others before initiating their combustions in a boiler.

IMPROVING LOAD FLEXIBILITY & NUHR SAFELY, RELIABLY AND COST-EFFECTIVELY USING CLOSED-LOOP DYNAMIC OPTIMIZATION & EXPERT KNOWLEDGE CONTROLS

Dr Jacob Tuttle, Taber International USA

Load flexibility is becoming the standard for many thermal generators around the world. As the penetration of variable renewable generators expands, and climate demands call for reduced greenhouse gas emissions, it is becoming increasingly difficult to balance these objectives with operating metrics, and maintain grid demands and reliability. Advanced controls utilizing artificial intelligence, predictive modelling, and expert knowledge capture have proven effective in assisting thermal generators in meeting flexibility demands placed upon them. Taber International has deployed numerous solutions using its advanced closed-loop combustion optimization system (COS) to improve the operation of thermal power plants, particularly coal-fired power plants, regularly operating between 15% and 100% MCR. This system has demonstrated improved unit stability on the order of 12% - 27%, steam and metal temperature control with 36% setpoint stability improvement, reduced attemperator flow usage as much as 59%, reduced NOx emission rates 20% - 30%, increased overall ramping ability, net unit heat rate (NUHR) reduction as much as 2%, and enhanced low load stability using its dynamic AI optimization system. The same approach has also demonstrated its own flexibility in also being applied by to improving operations of wind farms, solar power installations, and other industrial processes.

ENHANCING FOSSIL-FIRED BOILER EFFICIENCY AND COMPETITIVENESS THROUGH ADVANCED TWO-DIMENSIONAL TEMPERATURE MEASUREMENT USING OPTICAL PYROMETERS

F Turoni, - EUTECH GERMANY

This article presents the successful application of a smart two-dimensional temperature measurement system based on optical pyrometers for real-time determination of the flue gas temperature at the end of the furnace (FEGT) in combustion driven boilers. The study revolves around the results achieved at a customer site where an advanced measurement system based on contactless optical sensors (EUtech EUflame 2DTM) was selected over acoustic pyrometers for two (2) 615 MWel wall-fired boilers.

The implemented 2D temperature measurement system has demonstrated its effectiveness in adjusting and thus homogenizing the temperature distribution within the boiler cross-section. The achieved homogenization not only served to optimize the combustion process but in turn enabled a significant reduction in excess oxygen, leading to a notable improvement in boiler efficiency across various load ranges. This flexibility is crucial in the current Indian market scenario where coal-fired boilers compete in a landscape increasingly dominated by renewable energy sources.

The case study highlights the economic viability and practical benefits of the EUflame 2D system, enabling the customer to enhance the safety, reliability, and efficiency of their boilers from the outset. By minimizing excess oxygen requirements and improving efficiency, the system contributes significantly to the reduction in NOx emissions, in line with environmental sustainability goals.

Notably, the presented state-of-the-art two-dimensional temperature measurement system is applicable to a wide range of thermal processes (e.g. coal-fired, biomass; waste-to-energy plants, etc.). It provides operators with a valuable tool to enhance the flexibility, reliability, and availability of their boilers, thereby minimizing emissions and optimizing performance in the competitive market environment. As fossil-fired power plants continue to navigate the evolving energy landscape, the adoption of advanced and cost-efficient measurement systems becomes imperative for maintaining competitiveness and sustainability.

Session – 13: Balance of Plant

COOLING TOWERS AND CHIMNEYS: TECHNOLOGY FOR CONSTRUCTION AND MAINTENANCE

Reinhard Martin, Siddhesh Rangnekar

MC-Bauchemie Germany

Natural draught coolers and chimneys in thermal power plants are exposed to numerous environmental and operational influences.

The presentation deals with the various influences, i.e. causes of damage, and shows suitable and proven solutions for repair and surface protection.

In particular experience gained on the basis of the German VGB Guideline R 612 "Procedures at cooling towers and chimneys for reinforced concrete as protection against operational and environmental impacts" will be taken into account in order to ensure long-term operation without further measures.

QUANTUM LEAPS IN DRY FLY ASH EVACUATION SYSTEM TO ENHANCE DRY FLY ASH EVACUATION CAPACITY - AN NTPC DARLIPALI EXPERIENCE

Raunak Singh Rana, S Suresh, Gurpreet Singh HeerLukesh Kumar

NTPC Darlipali

Day by day coal quality is deteriorating and ash content in coal is increasing, even increasing beyond design parameters of ash evacuation system. In this ever-changing scenario running dry ash evacuation system efficiently in thermal powerplants is a huge challenge. Evacuation capacity enhancement in fly ash evacuation system can be achieved through making quantum improvements in the system. ALV sequence timer optimization as per site condition is a must to improve the efficiency of the system. Root cause analysis must be done and suitable efforts to be made to avoid frequent damage to various components of dry ash evacuation system as each component plays an important role. Effectively operating a dry ash evacuation system in thermal power plants poses a significant challenge in this dynamic environment. Enhancing the capacity of the fly ash evacuation system can be achieved by implementing substantial improvements in the system. It is imperative to optimize the ALV sequence timer based on site conditions to enhance the system's efficiency. Conducting a root cause analysis is essential, and concerted efforts should be directed towards preventing frequent damage to various components of the dry ash evacuation system, given the crucial role each component plays.

IN-HOUSE DEVELOPMENT (DESIGN, FABRICATION & PROGRAMMING) OF BELT PATCH OPEN DETECTION SYSTEM FOR CONVEYOR BELTS IN NTPC RAMAGUNDAM

Atul Krishna Gaikwad, Ratan Kumar Gulipilli, Devendra Patil

NTPC Ramagundam

A conveyor belt is a continuous moving band of fabric, rubber or metal used for transporting objects from one place to another. It is designed for handling products such as coal, sand, ores, minerals, chemicals, food stuff etc. A conveyor belt is the most cost-effective way of transporting bulk material. Thus, in every field of industry there is use of conveyor belts and conveyor systems involving bulk transportation. Ramagundam Super Thermal Plant (RSTPS) is a 2600 MW coal fired power plant and has seven units. Daily coal consumption of all seven units is approximately 42000 MT. Uninterrupted coal feeding to the coal bunkers is essential for uninterrupted power generation. Coal bunkers are fed through conveyor belts and breakdowns in critical conveyor belts may lead to generation loss and hence availability and healthiness of belt conveyors is very much vital. Coal Handling Plant (CHP) of RSTPS uses fabric conveyor belts for transporting coal. Fabric conveyor belts are made by sandwiching many synthetic fabric layers between rubber layers through an adhesive rubber called skim rubber. Belts are mainly joined through cold/hot vulcanizing method to achieve required length and to complete the loop. Belt patch opening/ layer opening is a common and serious problem in CHP. Presently this problem is detected by location workers in the initial stage and get attended. If this problem goes unnoticed and belt patch gets stuck up in nip points and joint gets opened beyond repair, then this will lead to high restoring time of system and may further lead to generation loss. Planned belt replacement work takes almost 12 hrs. and Unplanned belt replacement work takes more than 24hrs. Hence timely detection of belt patch is the need of hour. This paper confines its study to causes and effects of belt patch opening and in house development of solution called belt patch detection system for automatic detection of belt patch/layer opening at initial stage. Breakdown analysis was conducted among three different NTPC plants to find whether this problem is also common in other plants. Brainstorming and Fish bone analysis were conducted to identify various problems that lead to belt joint patch/layer opening. Through breakdown analysis and fish bone diagram analysis we have observed that there are many causes which lead to belt patch opening and we can minimize events of belt patch opening through best operation and maintenance practices but cannot reduce it to zero. Hence there should be a mechanism to identify belt patch opening at initial level to avoid major breakdown. We have surveyed for in-market-solutions which are suitable for the fabric conveyor belts but could not find suitable solution. After intense brainstorming we have come to the conclusion that either we can increase the deployment of manpower for continuous observation of all belts or to develop a system for automatic detection of belt patch opening. The cost of deployment of manpower is very high and always prone to human errors. Hence, we decided to develop a system to identify belt patch opening automatically. We observed behaviour of opened belt patch/layer in running condition and decided to design mechanical system with sensors to detect belt patch opening in running condition automatically.

After consistent and persistent efforts (trial & error method) we were able to design, fabricate and program the proof of concept (POC) of belt patch open detection system in-house. We have also tested our product by installing it in one of the conveyor belts and by using belt patch of different sizes like 50X50mm, 100X100mm and 150X150mm and observed that belt patch open detection system is getting operated with all sizes of test pieces. With a belt patch open detection system, we can automatically detect belt patch/layer opening at initial level and can avoid any major breakdown and therefore it is highly cost-effective. Thereby availability and reliability of conveyor system can be increased, and many tangible and intangible benefits can be achieved.

RETRO FITMENT OF SEALGUARD ASSEMBLY IN WAGON TIPPLER FOR RELIABLE OPERATION OF MOVABLE SIDE BEAM IN WAGON TIPPLER: A CASE STUDY OF NTPC KUDGI

Himanshu Kumar,Manish Kumar Sah

NTPC Kudgi

NTPC Kudgi has 3 x 800 MW coal units that get coal from diversified sources. coal is transported from more than 1500 kms of coal mines. Coal comes in different sizes up to 200mm and above. This coal is unloaded at wagon tipplers, crushed at Ring granulator and after getting crushed it is sent for direct bunker feeding or stacking /reclaiming. Being a non-pit head plant coal unloading healthiness is very much critical. Any failure of tippling equipment may stop functioning of the plant which may cause heavy loss in terms of demurrage and power generation. Coal unloading depends upon different equipment like wagon tippler, apron feeder, Side arm Charger, Dribble Conveyor ,flap gates , downloading conveyors etc. Due to several reasons like rake bunching, sick wagons, over heaped wagons, multiple tippling requirements problems in downstream conveyors etc. Wagon tipplers are always in a state of high duty operation and there is very less room for any breakdown maintenance. From last three years rake movements increased and coal unloading at KUDGI has been increased from 22.26 lac MT (FY 2018) on annual level to 43.5 lac MT (by Sep 2023). Wagon tipplers at KUDGI are M/s TRF make, and it was widely mentioned by OEM that to improve cycle time there is need of wagon tippler guide rod greasing frequently. Due to this WT system was becoming unavailable again and again and require top and bottom guide rod greasing round the clock irrespective of any weather condition. It has both operational and safety hazard including maintenance cost. It causes enhancement of wagon unloading time. In absence of guide rod greasing side beam of WT does not forward fully and top – bottom portion are not inline and not touching wagons body properly. As per RDSO there shall be metal to metal contact between the side support beam and the side stanchions of the wagon. Any lag in contact will cause multiple problems like PU pad falling. Refixation of wagon PU pads cause tippling time over-run and finally cost us in form of demurrage. To attend this problem various checking was done like equal pressure (forward–retard condition) at all guide rods, guide rod alignment, guide rod hardware intactness To overcome the problem one Sealgaurd assembly was designed in-situ to take care of all the Dust and contamination entry while in operation. This system is equipped with perfectly sealed Stainless-

steel bellows from all sides.

They restrict the entry of any foreign Particles and dust during the operation. In addition to this, the graphite Embedded bushes are fixed in bracket portions which takes care of sliding friction and lubrication. 3D model of sealguard assembly was made at site and bill of materials were decided with a local vendor. The same was installed in WT-2 during its overhauling on 30th Sep 23. After its installation and completion of three months ONLY ONE DAY greasing was done as a precautionary step. Now guide rod greasing requirement in WT-2 has been totally nullified and performance of this retro fitment has been also recognized by CHP Operation Department.

Guide rod assembly has multiple advantages like Wagon Tippling Cycle Time Reduction, Electrical module fuses safeguarding (as multiple time isolations and normalization cause damage to fuse), enhancement of workman's safety (as even in case of night or rain guide rod greasing was to be done to make system available), Reduction or elimination of persistent problem of repetitive PU pad , spring etc. falling and will avoid any problems with Indian Railways.

A CASE STUDY ON SHIP UNLOADER AT MSTPP/BIFPCL (BANGLADESH)

Satyajit Banerjee, Subba Ramaiah Pothireddy,Md. Injumam Ul Islam

BIFPCL Bangladesh

BIFPCL is located very near to Sundarbans World Heritage Site, The EIA study specifies the use of imported coal of high GCV with low ash content. Coal is transported by OGV from the source country to Mongla / Chittagong Port, Bangladesh. Lighterage is being used to transport coal from mother vessels to the BIFPCL jetty. The Ship Unloaders are envisaged to unload coal at MSTPP Jetty, as there is no other mode of coal supply, the availability of ship unloaders is of utmost importance. On 10.11.2022, SUL-3 was stopped on hearing abnormal sound from its hold drum. It was observed that the NDE shaft of the holding drum (1420 Dia. X 3380 Long) got detached from the drum body. Unit -1 COD was planned in December 2022 thus outage of only available SUL-3 (SUL 1&2 under erection) would have adversely affected the plans. Sending the drum to India & get it repaired will lead to a huge delay, so necessary repair work was done at the BIFPCL site. During operation, various forces like Tension/Gravitational/ Dynamic/Frictional and Inertia Forces will be acting on the drum. Accordingly, a detailed investigation was made & after re-analyzing the impact of various stresses, OEM suggested necessary repairing work, quality checks, welding procedures & suitable electrodes. Special fixtures were made at the site.

A case study of interconnection of New Cold water channel with Existing Channel of Stage III Rihand

Anurag Singh

NTPC Solapur

Helper cell cooling towers(CT) for Unit # 5 & 6 at NTPC Rihand were being constructed to augment the performance of Stage III Cooling towers. While the hot water(HW) offtake was envisaged from the HW duct of CT #5A & 6A, the discharge of cold water(CW) from Helper cell through new channel was to be done in the existing Stage III channel. The interconnection between new and the existing Stage III channel has to be carried out. The work was essentially cutting and removing a 6.5 mts X 4 mts reinforced concrete wall section of the existing channel at the interconnection. The methodology submitted by M/s Paharpur Cooling Towers Ltd. (PCTL) was approved by NTPC. The interconnection work was ideally to be carried out with both the units under shut down, however it was decided that the work to be carried out during unit running condition which resulted in savings of ~Rs, 23 Crs. The work was planned to coincide with overhauling schedule of Unit # 6, when the channel was carrying ~ 60,000 m3 per hour discharge for unit # 5 with a velocity range of 0.8 – 2 m/sec. The channel interconnection, during unit running condition, was first of its kind project for both M/s PCTL and NTPC. The methodology was continuously reviewed and revised at site to ensure safe and timely completion. The works of wall cutting and lifting to complete the interconnection work was concluded in 10 days including the preparatory works. This paper attempts to put in perspective and chronicle the challenges faced and the mitigation measures adopted ensuring safe and timely completion.

Session – 14: Innovative Technology

INNOVATIVE GEOSYNTHETICS APPLICATION TO REDUCE USE OF NATURAL RESOURCES IN ASH DYKE OF THERMAL POWER PLANTS

Vinod Kr Mauriya, DGM (PE-Civil), NTPC Ltd, CC-EOC, Hyderabad

Ash-dykes are used for disposal of coal-ash generated from power plants. Starter-dykes are constructed with earth as main construction material with sand blanket & sand chimney. It requires a very high quantity of natural resources which are often difficult to procure due to long leads. Furthermore, there are restrictions on quarrying, and in some cases, even ban on exploitation of sands. At many projects, these materials are not available in close vicinity and is to be borrowed from far-off sources making it unviable from both schedule of construction and cost considerations. Geosynthetics are modern construction materials like cement and steel and have become essential engineering materials in a wide range of civil engineering applications. Considering same and when land is at premium and natural resources are scarce, it is prudent to have Ash-dyke comprising of a reinforced system with a narrow footprint rather than conventional trapezoidal earth-embankment with wide footprint. Further, issues of natural sand-filter underscore the need to consider geosynthetic drainage systems. Also, sustainable slope protection from erosion can be provided using geosynthetic materials. Additionally, dyke's side slope erosion is a major issue in areas of heavy rainfall. Brick lining/ Stone pitching has been commonly used, which can be substituted with enhanced protection using geosynthetic materials. Unlike the traditional earth-embankment with a trapezoidal cross-section, Dyke with Geosynthetics is slim, occupying a reduced land footprint, with steep side-slopes resulting reduced use of natural resources, enhanced ash-storage capacity, reduced construction time and compared to a conventional ash dyke, its economical too.

INDUCTION TO HYBRID MODEL FOR SUSTAINABLE POWER GENERATION FROM COAL

Sudarshan Singh, Prabakaran S, Sahil Chopra

NETRA, NTPC Ltd.

COP27 particularly aimed to accelerate global climate action through emission reduction, 'just energy transition' for developing countries, scaled-up adaptation efforts and enhanced flows of appropriate finance. The decisions recognized the need to achieve reductions in global greenhouse gas emissions of 43% by 2030 in COP 27.

With Climate change-based policies and carbon-based market and ESG-linked financing, NTPC shall also place itself and prepare its strategy with hybrid type model power generation along with green chemicals through CCUS as part for its business portfolio diversification for uninterrupted , reliable and sustainable continuous power generation from coal fired plants with grid Stability by Utilizing our natural

resource (Total Coal reserve: 307 billion tones) and to maintain our energy security, employment & livelihood of mass directly/indirectly working in this sector with narrowing down the gap in Net Zero Policy Implementation. Futuristic demand in chemical sector for Ethanol it will be 1025 Cr Liter/year, Urea 34MT, Methanol 4 MT, Olefins 9 MT, DME 2 MT by year 2030.

This demand opens the huge market, and it will be key steps to meet the demands thru utilization of CCU technologies under government supportive policy at initial stage to meet the competitive price.

The 30% GHG emission from power plant which have around 10-15% of CO2 shall be captured and further it will be utilized through CO2 transformation technologies in synthesis of various hydrocarbons like methanol, Olefins, Urea, Ethanol, DME.

This circular carbon economy will help in reducing GHG emission and will also help us to continuously run our Coal fired station during transition period in power generation sector.

Purpose:·

Reliable and sustainable power and Grid Stability.

- Utilize our natural resource (Total Coal reserve: 307 billion tons) and maintain our energy security.
- To Maintain Employment & Livelihood of mass directly/indirectly working in this sector.
- Diversification of Business Portfolio.
- Allow NTPC to continue to run Coal Power Plant for longer period with Low volatility in during transition with Net Zero Policy Implementation

NEW TECHNOLOGIES & BEST PRACTICES ADOPTED BY ITPCL

K. Premkumar, Manager (OPN), IL&FS Tamil Nadu Power Company Ltd.

In the dynamic landscape of the digital era, IL&FS Tamil Nadu Power Company Limited (ITPCL) embarks on a comprehensive journey marked by a holistic approach. This strategic undertaking encompasses cybersecurity measures, regulatory compliance, environmental monitoring, and a steadfast commitment to sustainability. The company's unwavering dedication to innovation and adaptability not only fortifies the resilience of its power generation station but also aligns with overarching objectives of environmental stewardship and the promotion of sustainable energy practices. This paper delves into the transformative initiatives undertaken by ITPCL, shedding light on their multifaceted impact and the pivotal role played in shaping a responsible and sustainable future in the realm of power generation.

ITPCL's proactive exploration of cutting-edge technologies with an "inside-out" perspective demonstrates a commitment to enhancing operational efficiency. Embarking on the Industry 4.0 journey, guided by visionary leadership and a focus on sustainability, positions the company for transformative success.

To ensure a seamless integration, it is imperative to emphasize strategic planning, cross-functional collaboration, data-driven decision-making, cybersecurity measures, employee training, and a continuous improvement mindset. By staying true to these principles, ITPCL is poised to not only meet current operational needs but also to adapt and thrive in the dynamic landscape of evolving technologies and industry standards.

LIQUID HYDROCARBON ECONOMY: AN ENERGY EFFICIENT NET ZERO ALTERNATIVE TO THE ENERGY INTENSIVE HYDROGEN ECONOMY

Lakshmi Narayanan D, Sr. Manager, NTPC Talcher

Apoorva Prakash, Sr. Manager, NTPC Nabinagar

Hari Om Vishwakarma, Sr. Manager, CC-EOC

Due Hydrogen, the most abundant chemical element, is one of the cleanest forms of Energy as it emits only pure water in vapour form when burnt. However, Hydrogen is not present in its standalone molecular form naturally. Under the gambit of Hydrogen spectrum, Green Hydrogen is the only source of carbon emission free energy. Between production and use any commercial product is subject to the following processes: packaging, transportation, storage, and transfer. The same is true for hydrogen in a "Hydrogen Economy." Production, packaging, transportation, storage, and transfer of Green Hydrogen is much more energy intensive than present Fossil Fuel dominated Energy economy. Generated by electrolysis or chemistry, the fuel gas must go through these market procedures before it can be used by the customer, even if it is produced locally at filling stations. "Green Hydrogen" requires an extraordinary breakthrough in innovative technologies if it is to achieve its stated goal of emission free electricity for the masses. Nevertheless, Hydrogen will play a crucial role in decarbonizing the hard to abate sectors like Heavy Industries, Shipping and Aviation which cannot be directly decarbonized by use of electricity and are major emitters of GHGs next to Power Plants.

An analysis on the energy required to operate a pure Hydrogen economy is presented. Hydrogen Economy, when operated with only "Green Hydrogen," would consume more energy in the process of reaching the end user than what it can deliver to the end user as electricity from Renewable or Nuclear power resources would not only be required for production of Hydrogen but also the other essential steps before it reaches the end user. Thermodynamically, because of the molecular structure of hydrogen, a hydrogen infrastructure is much more energy intensive than a natural gas economy. We therefore suggest modifying the vision of a hydrogen economy by considering not only the closed hydrogen (water) cycle, but also the closed carbon (CO_2) cycle, wherein the precious energy can be saved by packaging hydrogen chemically in a synthetic liquid hydrocarbon like methanol or dimethyl ether DME. This could create the intellectual platform for the conception of a post-fossil fuel energy economy based on synthetic hydrocarbons. Carbon atoms from biomass, organic waste materials, Carbon dioxide captured from the Power Plants through CCUS, or recycled carbon dioxide could become the carriers for

hydrogen atoms. Furthermore, the energy consuming electrolysis may be partially replaced by the less energy intensive chemical transformation of water and carbon to synthetic hydrocarbons. As long as the carbon comes from the biosphere ("biocarbon") the synthetic hydrocarbon economy would be as benign with respect to environment as a pure hydrogen economy. This study proposes to have a justified "Liquid Hydrocarbon Economy" as the alternative to the enormously energy intensive "Hydrogen Economy," which has the potential to be the viable source of Energy Sustenance and Energy Development with a Net Zero Carbon Footprint.

AUTONOMOUS DRONE FOR SAFETY & SURVEILLANCE PURPOSE IN POWER PLANT

Ravi Rituraj, Kanchan Singh

NTPC,Gadarwara

In our quest to ensure safety round the clock, reliance on traditional man-power dependent surveillance cannot be the remedy, as it has its human centered limitations. Technology needs to be harnessed to make the traditional approach more pragmatic and solution centric. AI enabled Aerial surveillance can be a solution, as it can have its reach and presence beyond human limitations. Aerial Surveillance can be achieved by using Drones/UAVs. But deploying personnel to fly drones again will have human centered limitations. So, the solution begets autonomous operation.

Our specific task-based needs require tailor-made solutions and trying to find a readymade solution may not be possible. Adapting readymade solutions to our need is a costly, unviable option and may not fully address our requirement. Indigenous Drone development is the only way out. So, the solution is an 'Automated Drone'- equipped with AI enabled specialized camera and a docking station for battery charging/swapping, also acting as Ground Control Station.

Possible use cases: (i) Coal Yard surveillance/ LIDAR based coal stock mapping, (ii) MGR railway track monitoring before Rack arrival, (iii) Reservoir surveillance, (iv) Ash dyke surveillance, (v) Switchyard hot spot monitoring, (vi) Construction sites (Project stage) critical surveillance, (vii) Township/ Plant premise security using thermo-vision camera equipped drone fleet, (viii) Safety surveillance at critical construction sites with AI equipped smart drones.

Hydrogen Production from Waste: A Path to Sustainable Energy

Rajan Varshney

NTPC ,FARAKKA

H2 from waste can be produced at below Rs 80 per kg via Anaerobic digestion followed by SMR(Steam Methane Reforming) process and is discussed in detail here in this paper. India is currently 3rd largest aggregate polluter and producer of greenhouse gases. According to WHO 14 Indian cities are placed in 15 most polluted cities in the world. Growing air pollution pose serious health hazard and may affect productivity and GDP. India is importing its large requirement of Petroleum and Gas. Imports of crude oil are increasing at a fast pace. 53% of petroleum products in India are consumed by the transportation sector. Rising transport demand has three main impacts: increase of oil imports, rising air pollution and ill-health and loss of productivity. Imports of crude oil are increasing at a fast pace. The ever growing demand for vehicle and the demand for motorable roads has led to cutting of trees, besides pollution from automobile exhaust on the one hand but on a positive note it has enhanced the demand of automobiles sector in the country and presently it is world's 4th largest and provides 8.7% of industrial employment. The domestic production grows at a CAGR of 2.36% from FY16-20 with 21.55 million vehicles being sold in FY20 (IBEF, 2020). Characteristics of hydrogen fuel such as long range, high energy density quick refuelling and lower extraction of precious rare earths makes it better choice than battery vehicle and thus it can be used as an alternative solution to address this issue. However, high cost of electrolysers, fuel cell, and lack of infrastructure are some of the challenges to be overcome with more penentration, technological advances and resultant economies of scale with bold policies, regulations and incentives.

Many developed countries like USA, European Union, Japan, South Korea are now concentrating on hydrogen economy. Many Indian Companies Like Reliance, Adani, L&T and many public sector companies have announced big plans and investments for Hydrogen and collaborations with different countries/ companies are happening. Extension of FAME-II provisions to FCEVs is expected as per Transport Minister's recent speeches. Government funding, favourable policies, Production linked incentive schemes and the recent bids opened for Hydrogen by SECI indicate many new companies are interested in Hydrogen. The sops for H2 value chain shall help reduce the cost of Green Hydrogen and of Fuel Cells and Vehicles (FCEV). JCB and other Equipment manufacturers have made ready H2 based versions. H2 ICE based Buses and Trucks are in various stages of Launch. FCEBs by IOC, NTPC etc are soon getting deployed. Union Transport Minister has started using Toyota Mirai and it will promote use of Hydrogen Infrastructure and FCEV use by public and this will create demand for increased Hydrogen infra including Hydrogen production and Hydrogen Filling Infra. H2 from waste is aligned with 'Make in India' and 'Atmanirbhar Bharat'. Waste is available everywhere. The vehicles H2 requirement can be met by waste to H2 in decentralized manner for filling into vehicles.

Session -15: Hydro, Gas, Conservation

Renovation & Modernization (R&M) & Uprating of NHPC Power Station: A Case Study

JAGANATH PANI, MOHAMMAD YUSUF

NHPC

Hydro Power plants built in eighties have become very uneconomical to operate due to ageing. Useful life of many components is already over. These Power Plants cannot be closed down permanently as setting up new Power Plants is cost intensive and involves long gestation period. Therefore another cost-effective short-term option i. e Renovation Modernization and life Extension of old Power Plants is being attempted throughout the world to bring additional power to the grid. Renovation & Modernization and Uprating and of hydro plants is a cost-effective way to extend the generation from the plant to the extended period of 20-25 years with improved reliability and availability. In a fast-changing of technological environment, Control system, software etc. becomes outdated in a period of about 10 to 15 years itself and spares also becomes unavailable. These equipment's can be modernized for reliability and higher yield by minor modifications. In peculiar situations like run of the river schemes in Himalayan and Sub- Himalayan range where excessive silt contained in the inflows causes enormous damage to the underwater components of turbines leads the periodic repair of underwater components to be carried out almost every year. Such situations call for technological innovations and modernization of repair & maintenance techniques for optimizing the renovative down time. Modernization is a continuous process. It can as well be a part of the renovation program. By adopting modern equipment like Digital Excitation system, Micro-processor-based governors, numerical relays, Disturbance Recorder/ Event logger, optical instruments for monitoring vibration, silt content in water etc. the power plant performance can be improved in respect of its reliability. Uprating can also be possible or added advantages by improving the hydrological parameters, electrical parameters etc.

The present paper deals on a case study on NHPC Power Station i.e. 3X60 MW Bairasuil Power Station relating to need for Renovation, Modernization and Life Extension where major E&M components have been replaced and radial/intake gates at Baira dam & Bhaledh Complex. Some components are refurbished due to technically constraint. Major generating plant equipment including Generator, Turbine and Generator Transformers were manufactured / supplied during the year 1975-76. Units were commissioned during 1980-81. Design Energy was 779 MU. (In last 34 years of commercial operation, the power station has not achieved design energy in 25 years. Average generation during the last 10 years was 695 MU. The cost benefit analysis shows the cost / MW for the proposed R&M works is about Rs. 2.0 Crs. as against cost / MW of about Rs.10.0 Crs. for new hydroelectric power plant of similar size. Finally, the paper highlights the major benefits for Life Extension and its timely management and execution. Post R&M, the levelized tariff is likely to be Rs. 4.09 / KWH. Levelized tariff for new project of similar size, considering present day cost of the project @ 10 Crs. per MW, works out to Rs. 6.37 / KWH.

Waste to Hydrogen: Oxy-gasification of Municipal Solid Waste

SHANTA KUMAR, YASHWANT KUMAR SAINI ,RAJESH DESHPANDE

NTPC,NETRA

Suitable waste for generation of energy includes biomass wood waste e.g. timber or paper industry waste, municipal solid waste, sewage sludge, packaging and plastics, solid recovered fuel (SRF) and refuse derived fuel (RDF) from MSW (9). MSW normally includes biodegradable waste, recyclable material, inert waste, electronic waste, hazardous and toxic waste which is discarded by the public (9). The everage lower heating value of MSW in around 10 GJ/Mg in the EU. As per central electricity regulatory commission, "Municipal solid waste' implies commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. The SWM Rules, 2016 defines "Refuse Derived Fuel" as fuel derived from combustible fraction of solid waste like plastic, wood, pulp or organic waste, other than chlorinated materials, in the form of pellets or fluff produced by drying, shredding, dehydrating and compacting of solid waste. RDF typically consists of the residual dry combustible fraction of the MSW including paper, textile, rags, leather, rubber, non-recyclable plastic, jute, multilayered packaging and other compound packaging, cellphone, thermocol, melamine, coconut shells, and other high calorific fractions of the MSW. The station heat rate for power projects which use municipal solid waste (MSW) and refuse derived fuel (RDF) shall be 4200 kcal/kWh. The composition and resultant energy content of RDF varies according to the origin of waste material and the sorting, separation, and processing being adopted in the facility. Gasification technology has been widely exploited for biomass conversion to Producer Gas as a waste to energy technology, a way to sustainable management of municipal solid waste. Technical challenges due to uncertainty of input feed compositions and thermoplastic waste makes it difficult to control. The above article is based on the live experience of Waste to Energy Plant operating at NTPC NETRA facility. The project aims to deliver 400 kWe. Hydrogen may be separated from syngas. There is a scope to develop on the concept by oxygen enrichment of air to maximise yield of hydrogen in the final Producer gas and then extract it through cold separation processes and use the rest for energy generation. Plasma gasification could be an efficient way to produce syngas with high percentage of hydrogen. Given the same input quantity of MSW RDF briquettes, potential generation of hydrogen is around 30 to 50% more than equivalent generation via electrical energy and electrolysis route. IT further saves pure water consumption that is required to be split in electrolysis.

PROVIDING FLEXIBLE POWER THROUGH GAS STATIONS

NISHANT BANSAL, SRINIVASA RAO GADDAMANUGU, SANJEEV KUMAR SINGH

NTPC-OS SIIS

India's all time high peak demand met reached 239 GW on 1st Sep 2023 and is expected to rise up to 258 GW in FY'25 and further up to 277 GW in FY'27. As per the National Electricity Plan 2022-32 published by CEA, the share of Solar and Wind power in total installed capacity is projected to rise up to 54% in FY'32 from 27% at present. This huge variable RE penetration in the grid would require higher injection from flexible power sources for safe and reliable grid operation. Gas stations, with their quick start-up time and higher ramp rate capability can provide the required flexible power.

India has 25 GW of gas based installed capacity as on Dec 2023. However, due to non-availability of cheap domestic gas and use of costly imported RLNG gas, cost of power generation from these stations is in the range of Rs 12-20 per unit compared to Rs 2-5 per unit from other sources like coal, solar, wind and hydro. This paper highlights the efforts by NTPC for revival of its stranded gas stations and making their operation commercially viable by exploring various options like financial support from PSDF, bidding in HP-DAM Energy and TRAS market, operation under TRAS-Shortfall and sale of power through bilateral contracts. Despite all efforts for revamping of gas stations, some commercial issues are currently being faced by NTPC like increased start-up cost due to more number of start-ups and non-availability of part load compensation in open cycle and half-module operation.

Moreover, in addition to annual LT-RLNG contract with GAIL, NTPC has explored the gas procurement through other means like Monthly spot contracts, IGX market and is also exploring cargo procurement in future. The paper concludes by proposing various strategies to recover the operating costs of gas stations in the upcoming years.

Zero Waste Approach - Enhance the Value of By-Products through Sustainable Practices

Peddanna Ramayanam, Prasanna Ghatge, Faizal Motlani

JSW,Ratnagiri

The disposal and management of coal combustion residues, particularly fly ash and bottom ash, pose significant challenges to environmental sustainability and resource management within the energy sector. This research paper explores an innovative approach to address these challenges by proposing a Zero-waste approach strategy for the handling of fly ash and bottom ash, emphasizing reutilization and

efficient transport mechanisms. Currently, thermal power plants generate a substantial percentage of fly ash and bottom ash. As per CEA report fly ash generation is around 270 million tones in FY 21-22. This escalating generation of ash calls for innovative solutions to manage the environmental impact while addressing future demands on thermal power plants and coal consumption. The proposed methods aim a zero-waste approach by repurposing bottom ash & legacy ash through a mill reject system and exporting fly ash using advanced pneumatic loading of ash in the vessels and further transporting to countries wherein demand is more. These strategies not only address the challenge of ash disposal but also contribute to a more sustainable approach in handling by-products of coal combustion. By exploring these innovative ash handling techniques, this paper aims to provide insights into enhancing the environmental sustainability of thermal power plants.

Water Conservation & Management at Sasan Power Limited

Prakash Upadhyay ,Arijit Debroy

Reliance Power Limited,Sasan

Thermal power plants are heavily reliant on water for various operations, including condenser cooling, ash disposal, and heat removal from plant auxiliaries. This dependency makes power plants significantly water-intensive. Recent governmental regulations have imposed a 60-70% increase in water charges, with an additional annual increment of 5%. Furthermore, a notification issued on December 7, 2015, mandates a specific water consumption limit of 3.5 m3/MWh for the existing plants and 2.5 m3/MWh for plants installed after January 1, 2017. These regulations necessitate the optimization of water usage in power plants through conservation, recycling, and reuse practices. This paper presents a case study of Sasan Power Limited which reveals the potential for substantial water savings. The implementation of water conservation measures at Sasan Power has resulted in raw water savings, translating into an approximate financial saving of nearly INR 10 Crore per year. These initiatives serve as a model for sustainable electricity generation and can be replicated in present and future plants across the country to promote water conservation. The year-on-year reduction of Specific Water Consumption (SWC) m3/MWh of Sasan Power is best in Power industry (1.80 m3/MWh).

Session -16: Chemistry

Turbidity an Conductivity After Cation Exchange (CACE) for Cyclic operation

Maria del Mar Nogales Lopez, Aditya S. Kanetkar

Forbes Marshall Pvt. Ltd.

Importance of Steam Purity During Startup & Reliable CACE Measurement: Steam purity is one of the most important factors for healthy and efficient operation of a steam turbine. Chemical analysis of steam during startup and inspection of the turbine helps to understand if these values are suitable, or should be tightened or relaxed. Such decisions may also be based on fleet experience with similar power cycles. Chemical analysis of the steam should include measurement of sodium, anions and cations CACE. This ensures that no anions or contaminants which can cause corrosion of turbine blades are present. Main steam CACE values are monitored continuously during plant startups. As specified in various international standards (IAPWS/ VGB/EPRI), steam with CACE value <0.2 µS/cm is not allowed to enter steam turbine.

Turbidity Measurement for Estimating Iron Transport during startup: Corrosion product monitoring (e.g., total iron) is essential to determine the effectiveness of applied cycle chemistry treatment program in a power plant. The monitoring of corrosion products is required by various standards including IAPWS, EPRI and VGB standards. The corrosion products consist of both dissolved and particulate oxides (iron and copper), which are transported and deposited throughout the water-steam cycle. Forbes Marshall and their Partner SWAN Analytical Switzerland provide field proven solution for these two measurements.

OPTIMIZATION OF DM PLANT REGENERATION PROCESS- TO ENSURE DM WATER AVAILABILITY

B.S.Rao, Dr. Dipravath Kumar Seth

NTPC,Farakka

Production of cost efficient and sufficient makeup DM water for sustain running of Power Plant Units in one of the main objectives of Chemistry department. Older units of NTPC Farakka required higher rate of makeup. Massive industrialization of upper Ganga basin in last few decades also deteriorated the raw water quality from design value which finally leads to decrease in DM water production from design value. So, keeping healthy DM tank level is a challenge to Chemistry. Situations worsen when rate of production of DM water decreased due to some unprecedent facts leading to pre-exhaustion

of resin beds by early leaching of Silica < 200 ppb. So, regeneration frequency increased resulting to the consumption of specific Chemicals and damage of resins, which became a matter of concern. Team Chemistry of NTPC Farakka investigate and analyzed the root cause problem and shorted it.

The bread and butter of Chemistry Department is to produce and supply DM water uninterruptedly for sustain running of units was getting question mark due to simultaneous attack of DM water consumption and poor function of DG Tower. Extra load of carbonates not only occupy SBA exchange sites, but also lowers the pH by converting into carbonic acid, which leads to dumping of insoluble silica in WBA. Using simple dumping

Managing Steam Water Cycle Chemistry in Thermal Power Plant with Ion Chromatograph

Deepak Sharma, Dr. Rakesh Kumar Sharma

NTPC,JHAJJAR

At the heart of nearly every power plant are a boiler, a turbine, and associated condensate and feedwater systems which are crucial components of thermal plant. The water and steam coursing through them is the lifeline fluid of the electrical generating process. As such, it is of the utmost importance that the water/steam is properly monitored and treated. Poor water chemistry control can lead to deleterious effects on equipment uptime, generation loss and even personnel safety. Due to mass consumption of ultrapure water coupled with high temperature & pressure conditions in boiler, a minor change in quality of input water may cause catastrophic effect if proper monitoring is not done as per defined guidelines. The present paper deals with the pivotal role of water chemistry, particularly sodium and chloride concentrations, in power plant efficiency and equipment longevity. Leveraging ion chromatography, the study aims to optimize water chemistry practices for sustainable energy solutions. The literature review emphasizes the significance of comprehensive water analysis in managing corrosion and scaling. Ion chromatography emerges as a superior analytical technique due to its sensitivity and versatility to measure anion & cation spectrum in ppb or sub ppb range. The paper addresses current gaps in knowledge, highlighting ion chromatography's efficacy in high pressure power plant units with two recent case studies which might have led to shutdown of plant, illustrating its critical role in crisis mitigation and complex issue diagnosis, emphasizing its importance in power plant operations.

Innovative tools & Techniques and new O&M practices

Deepak Kumar Dash, Angesh Dewangan, Sourjya sarkar

GMR,Warora

Innovation is the ability to see change as an opportunity – not a threat with new creative technique. Growth and development in India is governed by the new innovative ideas for betterment of any system. Thermal Power Plant being Energy Intensive Industry, new innovative tools & techniques are need of this hour for reliable and sustainable power generation with continuous improvement. GWEL always look forward for adopting such new techniques and providing the platform for creating & identifying innovative ideas and to demonstrate for it's business excellence. Key Words: Water Scada, Resin, Six Sigma Tools, bimetallic corrosion and hydrazine. Introduction: GMR Warora Energy ltd (GWEL) is a 2×300MW Coal based Thermal Power Plant at Warora in Maharashtra. Water is one of the main input material. Water is utilized for Industrial & domestic purpose. Industrial water is mainly utilized for Cooling Tower make-up & DM Water production. Brief of Water Treatment: - Water Source: - Water Source is Wardha River. Water is pumped from Wardha river by River Water Pumps to Raw Water Reservoirs. Pretreatment: - Water from reservoir is pumped through Raw Water Pumps & passes through aerator. After aerator, water goes to RGSF (Rapid Gravity Sand Filter). RO-DM Treatment – From RGSF, Water is treated in sequence-MGF-UF-RO-1(1A/1B)-RO-2(RO2A/2B)-Mixed Bed DM Storage Tank for DM Water Production. As per ZLD Scheme, RO-1 is utilized for DM Water generation by using clarified raw water from RGSF as input along with same is utilized for Cooling Tower Make-up water generation by using Cooling Tower Blowdown as input. Problem Description: • Case - I :- Specific water consumption was on higher side (Last Yr - 2.39 m3/MWh against the limit of 3) due to various category of water is used at various point. This was creating chronic problem for identifying the increased water consumption at which section due to multiple users in the system. • Case - II :- The non-regenerated type resin of stator column was discarded periodically after getting exhausted. Around 250 kg of stator resin was generated as waste on yearly basis. • Case - III :- Increasing cost of the boiler water chemical i.e, Hydrazine and it's consumption quantity was also high.

UNDERSTANDING THE CRITERIA AND FACTORS AFFECTING QUALITY OF WET FGD GYPSUM

RADESH KUMAR, DR.MANISHA RAJPUT

NTPC,Unchahar

Changing policies, socio-economic environments and tough challenges have made it inevitable to incorporate technologies that keep NTPC at forefront of the energy sector. One such technology is Wet FGD for combatting SOX emissions (to meet the Statutory norms of SOX limit of 100 mg/NM3 in flue gas of any new Coal fired unit setup after 2017 and below 600 mg/NM3 for the older units)1. As per Central Electricity Authority's (CEA) FGD implementation plan, FGD has been planned for 161 GW capacity of various thermal power stations in India. NTPC Unchahar has marked a milestone by adopting the Wet FGD system for its Stage-IV (500 MW unit #6) in 2022. For FGD Stage-I (2X210MW), Stage-II (2X210MW) & Stage-III (1x210MW) first of its kind Combined Absorbers are also under installation and commissioning phase.

Limestone is the main raw material being used as scrubber reagent in the WFGD system which reacts with SOX in Flue Gas and Gypsum is produced as a byproduct. The percentage of Calcium carbonate in Limestone determines the quality of Gypsum. Other parameters like coal, makeup water, Flue gas flow, operation of FGD also affect the quality of Gypsum. Based on the experiences of Trial & commissioning and PG test of Wet FGD Stage-IV (1x500 MW unit#6), the focus is to understand the criteria and factors, especially about Limestone that will affect the quality, efficient production, and sustainable use of FGD Gypsum. With war footing installation and commissioning of FGD units under way across NTPC, both consumption of Limestone and production of FGD Gypsum will increase substantially in future. Hence, it's essential to understand factors affecting optimization of FGD Gypsum production and other criteria affecting its quality.

Session -17: Digitalization & IT

O&M Strategies for cost management

Rajkumar Natra, Harikrishna Boddala

Fluent Grid, Hyderabad

This research addresses the critical need for advancing Operation and Maintenance (O&M) Strategies at NTPC Ltd through the development of a novel solution by implementing the advanced forecasting model for schedule generation and Optimum Coal required at Pit Head and Non-Pit Head Plants. Leveraging two years of historical data by day wise, encompassing parameters such as Declared Capacity, Schedule Generation, Allocation, Energy Charge Rate (ECR), Energy Met, Planned Outages, the study applies machine learning models, specifically SVR, Random Forest, XG Boost, and Long Short-Term Memory (LSTM). XG Boost emerges as the most promising solution for forecasting schedule generation. Applied algorithms on the forecasted SG and Specific Coal Consumption results to give the optimum coal required at each plant. This research stands as a testament to the potential of cutting edge machine learning techniques in optimizing partial Outages and plan the resources, thereby aligning with O&M Strategies for cost management at NTPC Thermal plants. This framework can be further improved for block wise forecasting.

Digital Transformation of Lube oil management system (LOMS) and Value creation by Lube oil consumption Optimization

Suman Kumar Singh, Pawan Kumar Hassani, Boddeti Janardhan

NTPC, Vindhyachal

Generally, lubrication management is defined as a complete list of all oil and grease lubricated equipment with an appropriate product recommendation listed next to each component. While there can be no doubt that making sure the right product is selected for the right application is critical, there is so much more to lubrication management than product selection. NTPC VSTPS is the largest power plant in our country with installed capacity of 4783 MW of power generation combining thermal (4760 MW), Hydro (8 MW) and RE power thru Solar Plant of (15 MW). It has total 3312 no of equipment of all types requiring lube oil solutions for their healthy running in the plant. Therefore, need was felt to come up with a solution for efficient management of Lube Oil in our plant. There has been a growing trend in establishing lubrication management programs across industries, looking at the trend we at NTPC VSTPS also chalked out a program to implement Lube Oil Management System (LOMS) and digitalise the existing system to reap in the benefits of IT enablement. Our mission was to Implement the appropriate technology solution for Lube Oil Management for Lube Oil Cell (O&M Department) with the objective of Automation of Lube

Oil requisition & issuance process and extending MIS available at figure tips to the process owner and optimize the consumption. With the implementation we aspired to achieve following with focus on core values of our company: Safely & Timely delivery of lubricants and fulfilment of requirements (Safety, Time, Customer Focus, Innovation). Handling with right tools (safety) Optimization of consumption and preventing wastage through MIS (cost effective and environment friendly). Sending waste oil to central store for recycling (environmentally friendly) Adoption of innovative digital platform for fast delivery and communication (Innovation) For a lubrication management program to be effective, all these areas were assessed, and improvements made to bring current practices in line with industry best practices. The LOMS is an approach to assessing the strengths and weaknesses of a plant lubrication program and charts a course for ongoing, sustained improvements.

DIGITALIZATION OF PERIODIC ASH DYKE INSPECTION BY CROSS FUNCTIONAL TEAM THROUGH MOBILE APP

SG Dhabu, K Nagarjuna

CC-EOC (Station Engineering)

Ash dyke safety is paramount and cannot be compromised. In the past, ash dyke breaches have happened mainly due to charging the lagoon above free board level and charging the lagoon without completion of water escape structures and raising works or due to neglecting the indications given by dyke. As per NTPC Operation Guidance Note "Guidelines for Ash Dyke Management in NTPC Stations", periodic inspection is to be done by a cross functional team of the station. Presently, the inspection of ash dykes is done by way of manual data filling in a standard format, followed by signatures by the cross functional team (CFT) members in rotation, then initiating for approval of report (in some stations) and finally sharing of signed and approved inspection report. This process is taking considerable time and sometimes precious time is lost for critical corrective actions. Sometimes the pictures are required for better understanding of the criticality of issues, which are obtained from site only after seeing the inspection report further adding to time. There are sometimes different interpretations of some observation by members of CFT. To facilitate the ash dyke management group at site in ensuring real time flow of data captured and to eliminate subjectivity in the interpretations of observations, a need was felt of a mechanism for the above-mentioned inspection with a facility to upload reports along with captured photographs. Accordingly, a mobile app has been designed to replace the manual mode & facilitate the inspection procedure including instant report generation and submission.

Data Analytics to boost availability of Dry Ash Conveying System

Ankit Chawre, Amrit Bal, Shubham Shrivastav

Adani, Tirora

Availability of dry ash conveying system is one of the major challenges in coal-based power plants. This paper presents a comprehensive analysis of dry ash system and its challenges. The analysis of various parameters and defects such as leakage type, spot, frequency is carried out using statistical modelling techniques. A comprehensive model is developed based on predictive modelling using Poisson's distribution. This model helped us in optimizing the maintenance planning process. The dashboard provides recommendations for the right locations for dry line replacement and rotation of pipeline aiming to reduce the magnitude of dry line replacements which improves availability, reliability and reduce the maintenance cost.

It was anticipated that there may be a substantial margin for decreasing system downtime and increasing dry ash conveying system availability. Other than this APC and water consumption were other saving in Key Performance Index (KPI). The number of defects in dry ash conveying line were 1621 and availability of dry ash conveying line in last fiscal year (FY) was 92.79 % which resulted in replacement of 758 meters of dry ash conveying line and expenses of 62.8 lacs INR in attending the leakages & defects to maintain seamless and smooth operation of system.

DIGITALIZING OPERATIONS: BEST PRACTICES IN GWEL THERMAL POWER PLANT FOR LOGBOOK MANAGEMENT

Mr. Ibrahim Shaikh, Mr. Nitin Chandrashekhar Hajbe

GMR WARORA ENERGY LTD

As the energy sector embraces digital transformation, it becomes imperative for GWEL Thermal Power Plants to adopt cutting-edge practices in the digitalization of main plant and BOP area logbooks. GMR Warora Energy ltd (GWEL) is a 2×300MW Coal based Thermal Power Plant at Warora in Maharashtra. In GWEL Main plant desk and field operator, BOP area Logbooks maintained for ensuring the safety, efficient, and reliable operation of power plant. Here are key aspects highlighting the importance of these logbooks.

Brief of logbooks: -

1. Operational Documentation-for Real Time Records
2. Safety and Compliance-Essential for regulatory audits

3. Troubleshooting and maintenance
4. Communication and shift handovers
5. Training and Knowledge transfer
6. Data for Performance analysis
7. Historical reference
8. Decision making support.

Digitalization of all Operation Logbooks: To overcome Traditional logbook challenges, The GWEL operation team successful transform from traditional logbooks to digital. This paper Present about best practices employed in GWEL for the seamless integration of digital logbooks for all main plant operations.

Session -18: Energy Policy

Power Sector Scenario till 2032 and Flexibilization Requirements from Coal based Thermal Power Stations: NTPC Approach for navigating the challenges flexible operations

GS Rao, Sanjeev Kumar Singh, Iqbal Abdulla Hakim

NTPC,COS-SIIS

India has an installed capacity of 425.5 GW with Solar and Wind contributing 27%. The National Electricity plan 2023 prepared by the central electricity authority, envisages that by 2032, the Solar and Wind contribution in the installed capacity shall increase to 54%. This huge capacity addition shall entail large flexibilisation requirements from the conventional coal-based power stations. The current paper showcases that by 2032, the coal plants across the country shall have to achieve the technical minimum load of 44% to meet the country's demand needs without RE curtailment and without resorting to two shift operation.

NTPC has carried out several studies to study the impact of flexible operation on the health of the machines and quantify the costs associated with lower minimum load and increased ramps. Recent studies in Sep' and Oct' 2023 have been carried out at Dadri U6, Simhadri U2 and Mouda U 1. Moreover, studies have also been carried out with various international partners like J Coal, VGBE, GE, Siemens, Engie and others as detailed in the paper.

The challenges are being faced in the areas of Boiler, Turbine, Controls, Operations, and other areas. The challenges in India are different due to the unique quality of Indian coal and various design related challenges. The paper discusses the challenges and mitigation strategies for each area like Boiler, Turbine, Controls and Operations. Also, the current practices of dealing with the impending challenges in each of these areas is discussed.

An estimate is given for the costs associated with flexible operation. While the costs of flexible operation are unique for each machine and vary with the conditions at the station, the estimate arrived can act as a guiding document for arriving at the costs of flexible operation. Lastly, the three-pronged approach of NTPC based on technology upgrades, process improvements and people development are discussed to successfully navigate the challenging flexibilisation requirements.

Role of Flexibility in Thermal Plants for Energy transition

M Karikalchozhan, Nishant Kumar Sharma

NTPC, Corporate Planning

The electricity sector in India is undergoing a transformative shift towards cleaner and more sustainable energy sources, presenting a complex challenge of balancing reliability, affordability, and security. This research paper delves into the intricate dynamics of the evolving energy landscape, focusing on load profile analysis, flexible operation insights, and future actions for coal-based thermal plants. The analysis reveals that storage additions, including Pumped Hydro and Lithium-ion batteries, can mitigate the requirement for flexible operation, projected to reach approximately 1% (presently around 0.2%) by 2030. The study highlights the current high seasonality in electricity load, anticipating a shift as industrial loads increase, leading to a more stable trend in electricity demand throughout the year. Addressing future actions for coal-based thermal plants, the analysis assumes that all plants can engage in flexible operation. However, considering the aging infrastructure, particularly with 52 GW (20% of the total) expected to be over 25 years old by 2030, challenges may arise. Sufficient storage capacity, such as Battery Energy Storage Systems (BESS), proves instrumental in mitigating ramp rate requirements posed by older plants, while research and development efforts should focus on improving boiler response times for enhanced flexibility.

As India navigates its energy transition, this research provides valuable insights for policymakers, industry stakeholders, and researchers to strategically plan and implement measures that ensure a resilient and sustainable electricity sector. The findings underscore the importance of integrating advanced technologies, digitalization, and storage solutions to meet the dynamic demands of the evolving energy landscape.

Challenges with Biomass cofiring and enhancing the biomass cofiring in a coal based thermal power plant

V A Surendra, Vinod Daneliya, M Siva Prasad

NTPC,COS-OPERATIONS

In India Agriculture is considered to be the 'Back Bone' of the Indian Economy because it contributes 17% to the GDP. But at the same time stubble which is basically agriculture remains, also contributes majorly to the pollution. As per reports nearly 38% of pollution is contributed by stubble burning in NCR Region. In order to curb the pollution government has mandated to co-fire biomass pellets in coal based thermal power plants. The waste generated from agriculture shall no longer burned or left to rot on the fields, but converted into climate-friendly fuel for thermal power plants. Biomass is

being used as a blend in the form of pellets with coal in thermal power plants for power generation.

In order to address the issue of air pollution due to farm stubble burning and to reduce carbon footprints of thermal power generation, Ministry of Power (MOP) vide its policy on biomass utilisation for power generation had advised that all fluidised bed and pulverised coal units (coal based thermal power plants) except those having ball and tube mill, of power generation utilities, public or private, located in India, to use 5-7% blend of biomass pellets made, primarily, of agro residue along with coal.

In a step to establish safe co-firing of biomass, NTPC has issued one OGN on biomass pellet firing and established systems and procedures for co-firing biomass in its power plants where biomass is being cofired in safe manner with coal in the existing setup of equipment's without incurring any major changes in current setup, however certain measures were taken to fire the biomass pellets safely in mill. In order to address the issue of mill capacity shortfall and enhance the biomass cofiring, a study was taken up at one of the stations where mill inlet temperature was gradually increased in order to restore the mill capacity while biomass cofiring. Through this study, it was established that biomass cofiring can be very well done with Enhanced mill inlet temperature and during the test the mill could be run at nearly 80% of its rated capacity. And if 3-4 mills can be run in such a way, 5% cofiring can be very well achieved in any thermal power plant.

CARBON TRADING FOR ENERGY TRANSITION TOWARDS NET ZERO

Apoorva Prakash, Tushar Sinha ,D Lakshminarayanan

NTPC,NPGCL

With the passage of Energy conservation (amendment bill) 2022 in the Parliament and subsequent introduction of carbon credit trading scheme on June 28 2023 by MoP, India is all set to establish its Indian carbon market (IMC) which shall prove to be a corner stone in India's commitment to achieve its NDCs and NET ZERO commitment by 2070 taken at COP26 by decarbonizing economy by installing 500 GW RE and 50% of power generated would be from RE by 2030.

NTPC as on date has 73.8 GW installed capacity out of which 9.6% (7GW) is RE. NTPC envisages ambitious target to have 60 GW (46.15%) total installed capacity of RE by 2032. So, where does this carbon trading fit in? Cap and Trade mechanism envisaged for ICM, caps an organization's total emission by issuing permit and allows to trade its excess permits earned for emissions below its cap. Offsets can also be purchased for excess emissions. Each year the cap gets stringent and shrinking permits incentivizes organizations to decarbonize. Simple? But like all theories, the reality of achieving it is far more complicate! Low price of carbon in EU-ETS or ESCerts in India are hardly any motivation to effect any changes. This paper studies various measures taken by EU-ETS to stabilize carbon market over the period and how the same may be incorporated for a successful IMC. This paper suggests how NTPC can be poised to tap

the vast potential of ICM for decarbonization.

A successful setting of ICM would harness the magic of the market to unleashing those bullish spirits for decarbonization and would reduce the implementation cost of NDCs by more than half as much as $250 billion by 2030 and the same is true for NTPC RE missions.

India's Biomass Blueprint: Policy Formulation and Global Case Study Synthesis

Dharmesh Kumar Kewat, Abhinav Kumar

NTPC,Renewable Energy

As India grapples with an escalating energy crisis, characterized by the dwindling reserves of fossil fuels, burgeoning energy demand, and the detrimental socio-environmental repercussions of fossil fuel utilization, this paper embarks on an exploration of biomass as a potential cornerstone for future energy systems. The study delves into the merits, impediments, and potential solutions associated with the transition from fossil fuels to biomass, examining factors such as energy content, efficiency, availability, accessibility, cost-effectiveness, and socio-environmental impacts. Drawing on a diverse array of case studies from Brazil, Sweden, India, and China, where biomass has been effectively harnessed as a primary or significant fuel source, the paper underscores the pivotal lessons and factors gleaned from these experiences. The paper offers a comprehensive examination of the obstacles associated with expanding the implementation of crucial bioenergy applications. It evaluates potential sustainability considerations, emphasizing the importance of a policy framework that incorporates sustainability-driven goal setting and long-term planning. The analysis underscores the need for cross-sector coordination in the realm of bioenergy, advocating for sustainability governance reinforced by regulations and certification schemes. Additionally, the paper highlights the significance of aligning bioenergy policymaking with the Sustainable Development Goals (SDGs). The document concludes by presenting policy recommendations aimed at surmounting impediments to the widespread deployment of bioenergy.

Contact Us:

ips@ntpc.co.in

https://indianpowerstations.ntpc.co.in/

NTPC Limited

(A Govt. of India Enterprise)

Regd. Office: NTPC Bhavan, SCOPE Complex,
7, Institutional Area, Lodhi Road, New Delhi-110003

Website: www.ntpc.co.in