

# NTPC Transactions on Energy Research (NTER 2025)

S. Shaswattam · Anil Kumar Das ·  
Subrata Sarkar · Prahlad Halder  
Editors

# NTPC Transactions on Energy Research (NTER 2025)

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*Celebrating 50 Glorious Years of NTPC Ltd.*



*NTPC Energy Technology Research Alliance  
(NETRA)*

*The R&D Wing of NTPC*

## Preface

This open access volume titled “**NTPC Transactions on Energy Research (NTER 2025)**” is a curated collection of our in-house technical papers, covering a broad spectrum of energy topics from thermal power plants to renewable energy.

NTPC being the largest power utility of India and NETRA at its forefront for the applied R&D projects & technology, the articles in this volume provide valuable insights into current research and initiatives focused on renewables, sustainable power generation, high availability and reliability of the power plants and technological solutions for climate change mitigation. Managing the output side (flue gas, CO<sub>2</sub>, coal ash) of power plant is becoming central for sustaining the fossil-fuel based power generation.

This volume covers diversified areas of critical topics, including methods for CO<sub>2</sub> capture and utilization to produce value-added products, the use of low-grade flue gas heat for water desalination, study on elemental mapping in fly ash, and innovative strategies for utilizing fly ash in resource generation. Acknowledging the growing importance of alternative energy sources, the volume also includes technical papers on solar thermal applications for space heating, advancements in hydrogen compression, and steam-enhanced gasification of municipal solid waste (MSW).

A central theme of this volume is the maintenance of power plant availability and reliability, with emphasis on condition assessment and failure analysis of various power plant components. This includes evaluation of SA213 T91 tube welds using the Magnetic Coercive Force (MCF) technique and failure analysis of boiler tubes & other power plant components. Additional contributions focus on the characterization of transformer oil and an innovative low level silica pretreatment for demineralization plant performance, mapping of chlorine distribution in Indian coal, and the use of artificial neural networks (ANN) for predictive maintenance in Distributed Control Systems (DCS) and Programmable Logic Controllers (PLC), reflecting the growing integration of AI in power plant monitoring and diagnostics.

This publication owes its success to the dedication of many individuals. We extend our sincere appreciation to all contributing authors and reviewers for their invaluable time, commitment and efforts in making this premier issue a success. We also acknowledge the contributions of the NETRA team members, with a special mention of NETRA Executives Dr. Aditya Ravindra Gokhale & Dr. Sameena Naaz Malik for their roles during the publication process.

We are confident that the insights shared herein will inspire future research, drive innovation, and advance our technological understanding within the energy sector.

Shaswattam  
Executive Director-NTPC and Head of  
NETRA

# Introduction

NTPC is India's largest integrated power company with a vision to accelerate India's growth and energy transition. It has diversified into different areas of energy domain: power generation (thermal, hydro, solar, wind, biomass), coal-mining, power trading, etc. and aspires for sustainable business practices with emphasis on innovation & learning. As a leading player in the world energy sector, NTPC recognized the potential of cutting-edge technology in further improving its performance & efficiency and established NETRA (NTPC Energy Technology Research Alliance) in 2009 with its focus on technologies such as Carbon Capture, Utilisation and Storage (CCSU), Energy Storage, Green Hydrogen, Ash & Water Management. It also provides Cutting edge Advance Scientific Services to its stations and other Utilities in the fields of Metallurgy & Failure analysis, Non-Destructive Evaluations (NDE), Corrosion, Coal & Combustion, Electrical, Ash Utilisation, Water Chemistry and Tribology etc.

Various research projects have been taken and are underway, both at NTPC stations and NETRA premises, for validating the design & concepts for further upscaling them to a larger scale for sustainable operation of existing power stations, while accommodating the large-scale entry of renewables. Apart from in-house development of innovative technologies and solutions, NETRA has been at forefront in collaboration and networking with various prestigious national and international academic and research institutions to harness the specialized knowledge and expertise available with these institutes. NETRA is also instrumental as an important member in various committees on policy formulation for energy transition in India.

NETRA places great emphasis on knowledge dissemination through regular publications of technical papers, books, reports, and journal including presentations in various conferences, workshops, and national level committees. This open access volume "NTPC Transactions on Energy Research (NTER 2025)" is compilation of the in-house technical papers by NTPC researchers & scientific personnel on diverse important topics related to energy domain providing glimpses of efforts towards climate change mitigation and high-impact scientific services in Indian perspective.

# Contents

|                                                                                                                                                       |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Utilization of CO <sub>2</sub> for Methanol Synthesis from Coal-Fired Power Plant .....                                                               | 1   |
| <i>Swapnil Patil, Ankit Gupta, Sahil Chopra, Subrata Sarkar,<br/>and S. Shaswattam</i>                                                                |     |
| Experimental Investigation of CO <sub>2</sub> Sequestration in Fly Ash and Lime<br>Composites via Mineral Carbonation: A Lab-Scale Study .....        | 15  |
| <i>Gaurav Richhariya, Sunit Kumar Singh, Pranay Sharma, Aarti Sharma,<br/>G. D. Vani, Ch. Srinivasu, and Anil Kumar Das</i>                           |     |
| Failure Analysis of Spillway Gate of a Hydro Project - A Metallurgical<br>Perspective .....                                                           | 29  |
| <i>Deepak Kumar Gope, Anand D. Varma, Anil Kumar Das,<br/>and Prahlad Halder</i>                                                                      |     |
| Failure Investigation of Boiler Tubes Failed Due to Thermal Fatigue<br>and Corrosion Fatigue .....                                                    | 38  |
| <i>Aditya Gokhale, Deepak Kumar Gope, Prahlad Halder,<br/>Anil Kumar Das, and Anand D. Varma</i>                                                      |     |
| Visual Appearance of Waterwall Tube Failures Due to Hydrogen Damage<br>Mechanism in Coal Fired Power Plants .....                                     | 50  |
| <i>Deepak Kumar Gope, Anil Kumar Das, and Prahlad Halder</i>                                                                                          |     |
| Coercivity Measurement as a Tool for Assessing the Quality of Post Weld<br>Heat Treatment of T91 Boiler Tubes .....                                   | 61  |
| <i>Avijit Mondal, Anil Kumar Das, Satish Chand, Sandeep Kumar,<br/>and Chandra Bhushan Kesari</i>                                                     |     |
| Industrial RO Membrane Based Demineralization Plant Performance<br>Optimization - An Innovative Low Level Silica Pretreatment Approach .....          | 79  |
| <i>Narendra K. Soni, T. N. Seetharaman, M. M. Dastagir, and B. Srinivas</i>                                                                           |     |
| A Comparative Electrical and Physicochemical Parameter Study for Fault<br>Analysis and Health Assessment of Transformers through Insulating Oil ..... | 93  |
| <i>Sujit Kumar Guchhait, Shyam Khatana, Rajendra Kumar Saini,<br/>and Anil Kumar Das</i>                                                              |     |
| Solar Thermal-Based Desalination Using Non-Imaging Evacuated Tube<br>Collectors with Compound Parabolic Concentrator .....                            | 105 |
| <i>Ankit Gupta and Swapnil Patil</i>                                                                                                                  |     |

|                                                                                                                                             |     |
|---------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Design and Development of 10 kWh Solar Thermal Space Heating<br>with Thermal Energy Storage .....                                           | 119 |
| <i>Ankit Gupta, Neeraj Goswami, Subrata Sarkar, and S. Shaswattam</i>                                                                       |     |
| Metal Hydride-Based Hydrogen Compressor for Hydrogen Microgrid .....                                                                        | 135 |
| <i>Shanta Kumar, Vinod Kumar, Ajay Kuntal, Yashwant Kumar Saini,<br/>Prabhat Ranjan, and Manish Sonker</i>                                  |     |
| Microgrid: A Blueprint for Decentralized Energy Systems .....                                                                               | 158 |
| <i>Shyam Manohar Gupta, Abhinav Ashish, Ravi Kumar,<br/>and Partha Mukherjee</i>                                                            |     |
| Steam-Enhanced Gasification of Municipal Solid Waste (MSW)/Refuse<br>Derived Fuel (RDF) .....                                               | 167 |
| <i>Shanta Kumar, Rajesh Deshpande, Yashwant Kumar Saini,<br/>Jitendra Patidar, Manish Sonker, and Subrata Sarkar</i>                        |     |
| Predictive Maintenance of Distributed Processing Unit (DPU) Failures<br>in DCS and PLC Systems Using Artificial Neural Networks (ANN) ..... | 188 |
| <i>Nitin Trivedi</i>                                                                                                                        |     |
| From Waste to Resource: Elemental Characterization of Fly Ash Using<br>EDXRF .....                                                          | 210 |
| <i>Sunit Kumar Singh, G. D. Vani, Pranay Sharma, and Anil Kumar Das</i>                                                                     |     |
| Harnessing Indian Coal Fly Ashes for Rare Earth Elements Recovery:<br>A Review .....                                                        | 221 |
| <i>Akanksha Aggarwal, Raj K. Tripathi, A. Lakshman Kumar,<br/>Pranay Sharma, and Anil Kumar Das</i>                                         |     |
| Geospatial Mapping of Chlorine in NTPC-Linked Coalmines .....                                                                               | 236 |
| <i>Aarti Sharma, Gaurav Richhariya, Pranay Sharma, and Anil Kumar Das</i>                                                                   |     |