SPE Newsletter

SPE(I), Vadodara Chapter
July 2026 Issue: 3/2026

JAY JAGANNATH

WELCOME TO 2-DAY CONFERENCE ON

ELECTRICAL DESIGN, ENGINEERING, INSTALLATION AND POWER MANAGEMENT IN INDUSTRIES

AT FGI, GOTRI - SEVASI ROAD, GOTRI, VADODARA.

27 & 28 (TUESDAY & WEDNESDAY) OCTOBER 2026

The Society of Power Engineers (India)
Vadodara Chapter (Estd. 1996)
414-415, Wing-B, Monalisa Business Centre, Near Saptarshi Samanvay
Manjalpur, Vadodara-390 011
spevadodara01@rediffmail.com & social.spevadodara@gmail.com
web site: www.spevadodara.in M – 9328658594

Facebook Whatsapp LinkedIn Instagram Telegram

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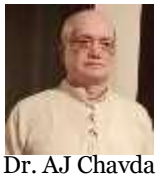
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CHAIRMAN'S DESK

Dear Members,

It gives me a great pleasure to be with you through this medium regularly every quarter.

The SPE had arranged a very good conference on the Power Transmission Lines on the 5th and 6th November 2025. It was a great success. Inspired by that conference the SPE arranged another conference on the Design, Engineering, Construction, operation, maintenance of thermal power plants in the month of May 2026. It was a well-attended conference with plenty of food for thought presentations by various institutes and organisations.

In between we had some good technical monthly lectures. The most prominent being the one on the Smart engineering for a sustainable future through innovation and digitalisation on the 7th March by Dr Vijay Shah, Global Expert on R and D, ABB India Ltd. He gave us an idea of how the global warming is causing havoc and what smart and digital measures we have to take to improve the working of all equipment and other systems in general.

We have moved to our new Office in Manjalpur and thanks to the team effort of all we have a well-furnished and a fully functional office with the AC, Wi Fi, computer, and a large TV screen to help the EC and AC members to see all the reports, financial statements, correspondence etc.

We need to increase our membership, the participation from our members in various programs conducted by the SPE, arrange good monthly lectures etc. to improve the working of the SPE further.

We are planning to arrange another conference on industrial electrification. By conducting such Conferences on different topics regularly we are adding to our knowledge, and also creating an opportunity to those who have the expertise to share their knowledge and thoughts. It will also improve the financial strength of the SPE. Our target is to increase the corps amount to Rs.70-80 Lakhs by additional earning from these conferences. We have a long way to go but drops make an ocean.

Monsoon is nearing and the general forecast for the whole nation is not encouraging. It is going to be a tough year ahead if monsoon fails. Let us hope for the best.

The last AGM of the Chapter was held on 21st Jun 2025. I am happy to note that members have re-elected myself to the Executive Committee for 3 years and that the Executive Committee in turn has elected me as a Chairman for the year 2026-27. This all shows the affection and faith of the members in me.

Thank you all members, AC, EC and Patron members for supporting me and guiding me to carry out my activities as the Chairman of the SPE for the last 3 years.

Er. MR Tilwalli

EDITORIAL

Solar Hour Rebate

Dear Readers,

Gujarat Electricity Regulators have made considerable change by extending Solar hours' timings for state owned utilities further by 2 hours. The earlier timing of 11:00 Hrs. to 15:00 Hrs. are now set to 11:00 Hrs. to 17:00 Hrs. effective from April-2026. This benefits consumers as the electricity consumption from Dist. Utility during solar hours attracts rebate of Rs. 0.60/unit. This benefit is available to HT categories and LT Residential consumers; Non-Residential consumers having installed Smart meter with postpaid billing feature also.

This endeavor of Regulators will create win-win situation for DISCOM as well as Consumers. The DISCOMs smart meter roll out program will get accelerated as Regulators have made it mandatory to install smart meter for all LT categories in order to avail Time of Use (TOU) rebate on energy charge. Further, due to excess solar generation in summer, utilities resorts to solar curtailment to maintain grid stability despite RE projects are considered for MUST RUN status. It is also the intent of Dist. Utilities to encourage consumers to reschedule electricity consumption during solar hours and thereby offering some rebate on it. This move will also support Utilities to avoid RE curtailment. Installation of smart meter in pre-paid mode attracts two types of incentives to LT consumers viz. Reduced Energy charges and TOU-Rebate on consumption during solar hours whereas installation of Smart Meter in Post payment mode attracts TOU-Rebate only. This provides considerable relief for residential consumers as effective energy charge reduces approximately by 17% having 300 units bi-monthly consumption.

Most consumers are unable to take benefit of rebates offered on consumption during solar hours since they are unaware of this rebate being offered to them. Dist. utilities are also not taking any interest to make consumer aware about these provisions. Even today, some of the state-owned utilities have shown inanimate approach in passing credit of rightful TOR-rebate to HT consumers since Apr-2025. This has resulted in huge legitimate amount of HT consumers lying with Dist. Utilities for a long time. Members having installed smart meter at their residence may take benefit of reduced tariff by shifting their consumption during solar Hours.

Our **Chapter** had organized, much needed **2-Day Conference** exclusively on **"Thermal Power Plants"** on 21st & 22nd May 2026 @ Vadodara. The conference received overwhelming response from the GENCOs, industries, consultants, academia. The well renowned speakers had discussed various topics covering Renovation, Modernization and condition monitoring of TPS switchyard, Vibration Analysis, Design and Engineering of TPP, Reduction in Auxiliary Power consumption, Construction and Projects Management in TPP, Automatic Gain Control in TPP and such other important topics. Delegates gained much needed exposure of prevailing technology in TPP and clear their views during the interaction with speakers in conference. The proceeding of the conference is also available on our website for the reference of members.

Coincidently, on first day (21st May) of conference, India recorded daytime all-time high-power demand of 270.732GW at 15.47 Hrs. and Thermal generation at the time was 171.818GW i.e. 63% of electricity demand was fulfilled by Thermal Generation. It is well said that RE is main batsman scoring runs and Thermal is playing multifold role like wicketkeeper, fielder and 12th man of Team and to schedule a match we need all of them.

Enjoy the rain but stay alert and safe during monsoon season.

Er. Umesh Parikh

CHAPTER'S ACTIVITIES

- On **21 & 22 May 2026,** the **Chapter** jointly with **GSECL**, organised a **2-Day Conference** on **"Design, Engineering, Erection, Testing, Commissioning, Operation & Maintenance of Thermal Power Plant"** at Federation of Gujarat Industries Auditorium, Gotri-Sevasi Road, Gotri, Vadodara.

  The report of the same is brought out in this issue.

- On **21 Jun 2026,** the **Chapter's 30th AGM** was held at Vakal Seva Kendra, Sayajigunj, Vadodara.

  The report of the same is brought out in this issue

Er. VB Harani
Secretary

FUTURE EVENT

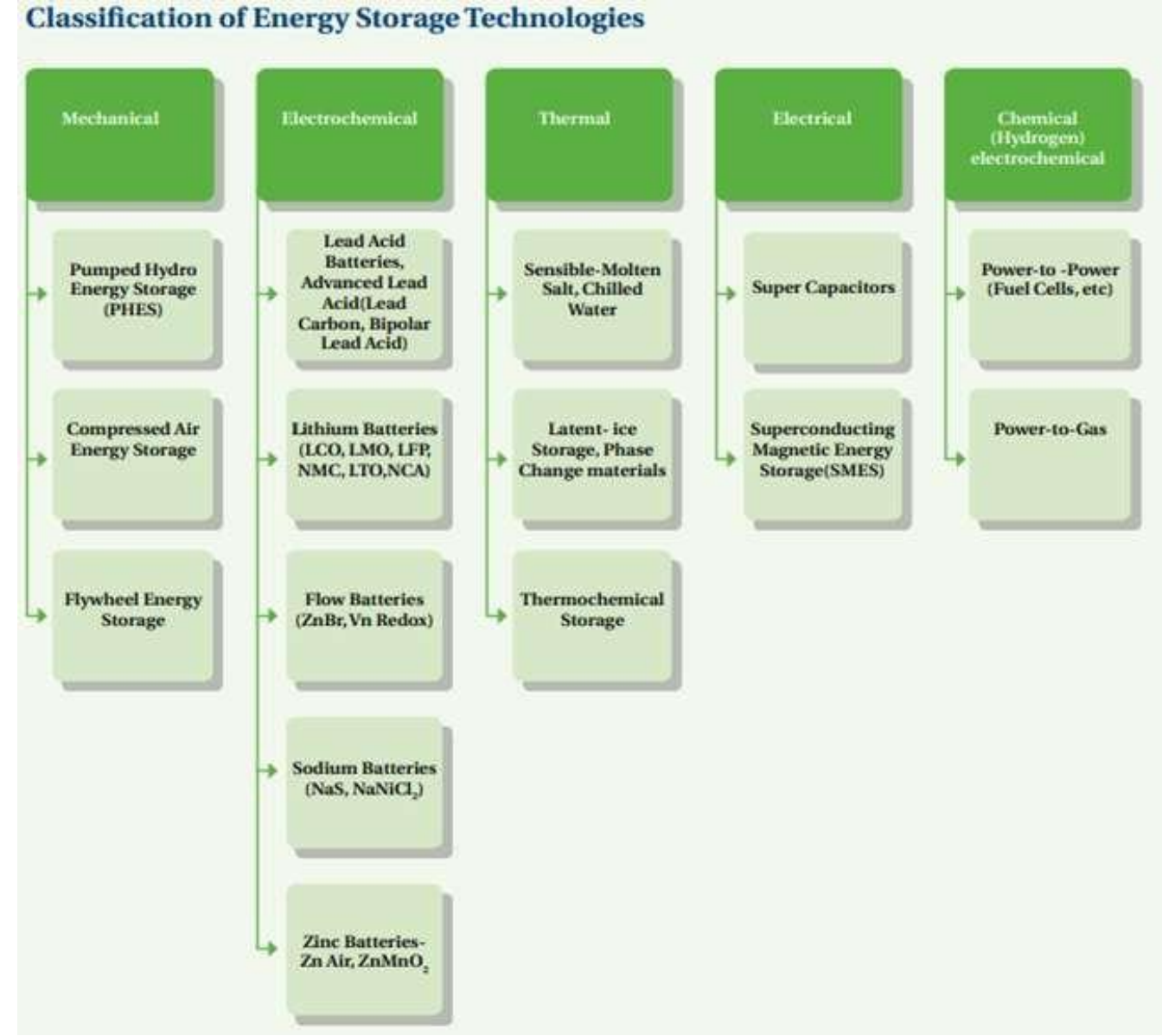
The **Society of Power Engineers (India) Vadodara Chapter,** jointly with **Federation of Gujarat Industries,** Vadodara and Knowledge Partner **Electrical Research & Development Association**, Vadodara, is organizing a **"2-Day Conference** on **"Electrical Design, Engineering, Installation and Power Management in Industries"** on **27-28 Oct 2026** at FGI Auditorium, Gotri-Sevasi Road, Gotri, Vadodara.

The intention of this Conference is to upgrade the knowledge of the participants regarding the Industrial Electrification, Application of Automation, Use of SCADA, Power System Study, R&M of various equipment in Industry etc. The aim of the Conference is to share the experience of experts from various Industries and Distribution Utilities with the participants.

The SPE (I) Vadodara Chapter, therefore, deemed it fit to organize a Conference on this topic. The Speakers in this Conference are likely to be renowned **Practicing Engineers** from **Power Industries**, **Utilities, Equipment Manufacturer**s, **Academy**, **Private Sector**, **EPC & Other Companies** (**Civil, Mechanical, Electrical, Computer** and **Instrumentation**), **Consultants** etc. About 200 delegates are likely to participate in the conference from different parts of the country. They may include **MNCs**, **Power Generating Companies, Captive Power Plant Holders**, **EPC Contractors, Consultants**, **Small Scale Industries** involved in manufacturing Activities, **Industrial Equipment Manufacturers, Consultants, Academician** and **Individuals.**

ENERGY STORAGE TECHNOLOGIES:

To match the demand and generation of electricity a flattering the curve of demand / generation is the need of today. Now a day, there are various technologies in use for energy storage during non-demand period and releases the same during peak hours. The various technologies for Energy Storage Schemes are discussed below:



1. **Mechanical Storage** includes Pumped Hydro Storage (PHS), Compressed Air Energy Storage (CAES) and Flywheels:

- **Pumped Hydro Storage (PHS)** stores electrical energy as the potential energy of water. Generally, this involves pumping water into a large reservoir at a high elevation—usually located on the top of a mountain or hill. When energy is required, the water in the reservoir is guided through a hydroelectric turbine, which converts the energy of flowing water to electricity. PHS is often used to store energy for long durations for use in a future period. Global PHS capacity is over 180GW. Potential available in India for PHS, assessed by Central Electricity Authority (CEA), is more than 96.5GW. However, at present, total installed capacity of pumped

hydro is about 4.8GW that consists of nine plants. Additionally, two projects of 1080MW capacity are now under construction (Tehri – 1,000MW and Koyna - 80MW). Also, four projects with cumulative capacity of 2,600MW (Kundah– 500MW, Malshej Ghat- 700MW, Humbali- 400MW and Turga- 1,000MW) are under planning stage. However, at a given point of time, many of these assets are either under maintenance or are on water 'release only' mode as they are linked to irrigation department and pumping is a secondary function. Hence the full capacity of PHS is seldom realized in India.

- **Compressed Air Energy Storage (CAES)** converts electrical energy into compressed air, which is stored either in an underground cave or above ground in high-pressure containers. When excess or low-cost electricity is available from the grid, it is used to run an electric compressor, which compresses air and stores it. When electrical energy is required, the compressed air is directed towards a modified gas turbine, which converts the stored energy to electricity. A recent advancement that is maturing through research and development by several startups is storage of the heat produced during the compression. This type of CAES does not use natural gas to reheat the air upon decompression and is therefore emissions-free, as well as more efficient overall. Similar to pumped hydro, CAES systems are used for storing energy over longer periods. Secondly, similar to pumped hydro storage, a natural CAES plant would require a cavern. Hence, CAES systems are limited in nature with restricted availability of natural caverns.

- **Flywheel Energy Storage (FES)** store electrical energy as the rotational energy in a heavy mass. Flywheel energy storage systems typically consist of a large rotating cylinder supported on a stator. Stored electric energy increases with the square of the speed of the rotating mass, so materials that can withstand high velocities and centrifugal forces are essential. Flywheel technology is a low maintenance and low environmental impact type of energy storage. In general, flywheels are very suitable for high power applications due to their capacity to absorb and release energy in a very short duration of time. Globally, total installed capacity of grid scale FES systems is 975MW, mainly for frequency regulation applications. Other popular applications are in transportation and rotary UPS13 key application in India. Typical Flywheels run 15–30 min but recent developments in power electronics have increased the duration of flywheel up to 4 hours.

2. **Electrochemical Storage** includes various battery technologies that use different chemical compounds to store electricity. Each of the numerous battery technologies have slightly different characteristics and are used to store and then release electricity for different durations ranging from a few minutes to

several hours. There are two main categories of batteries: (1) Traditional solid rechargeable batteries where the chemical energy is stored in solid metal electrodes, and, (2) Flow batteries where chemical energy is stored in varying types of flowing liquid electrolytes kept in tanks separate from the actual electrochemical cells.

A. Rechargeable Batteries

- **Lead Acid batteries** have been in commercial use in different applications for over a century. Lead acid is the most widely used battery technology worldwide. High performance variations of lead acid batteries are classified as advanced lead acid and are known to have a longer life.
- **Advanced Lead Acid batteries** are of two types, namely Lead Carbon type and Bipolar Lead Acid type. Lead Carbon type uses carbon additives to improve the energy density, cycle life and better charging-discharging properties than the lead acid type. Its key applications include frequency regulation in solar farms and has an installed capacity of 27.398MW globally.
- **Bipolar Lead Acid Battery** has bipolar plates and eliminates the high current density seen around the terminals in the conventional design. In the bipolar design, each point on an electrode is in contact with the current collector. This type has higher specific energy and energy density, ~ 40% lesser footprint (compared to monopolar type) and recyclable materials.
- **Lithium Ion Batteries (LiB)** are lightweight and have high energy density. They are particularly suited for portable applications (electric vehicles and electronic devices). There are many possible variations depending on the internal chemistry: Lithium Cobalt Oxide (LCoO), Lithium Titanate Oxide (LiTO), Lithium Manganese Oxide (LiMnO), Lithium Iron Phosphate (LiIP), Lithium Nickel Manganese Cobalt Oxide (NiMnCoO), and Lithium Nickel Cobalt Aluminum Oxide (NiCoAlO). In recent years, it witnessed rapid progress in the research and development leading to a steep price reduction as the manufacturing and installations have scaled up. A key inflexion point that tilted the benefits towards LiB is the increasing energy densities compared to lead acid batteries. As on 2017, the cumulative global manufacturing capacity of LiB has crossed 100GWh a year and is expected to surpass lead acid battery market soon. Sustained interest in the electric vehicle space has created an increased demand for lithium batteries and the global capacity is expected to be 4 times the current state by end of this decade.
- **High Temperature Sodium**: This type of battery is made from inexpensive, non-toxic materials. The battery operates at a high temperature (above 300°C) and has been shown to have a long cycle life. Two types are Sodium Sulphur (NaS) and Sodium Nickel Chloride ($NaNiCl_2$) are under these categories.
- **Sodium Sulphur (NaS)** is manufactured with molten sodium and liquid Sulphur enclosed in a cell container usually cylindrical in shape and enclosed in a steel casing. One Japanese company is the only manufacturer for this battery. By 2018, 195MW of NaS batteries were installed globally. Key application includes spinning reserve, frequency regulation, and energy time shift and transmission congestion relief. In India, NaS battery was trial tested by NTPC, for its feasibility in Indian grid

conditions in a solar system.

- **Sodium Nickel Chloride (Na-$NiCl_2$)** operates at a lower temperature with molten sodium as cathode, NaAlCl4 as electrolyte and nickel chloride as anode. Major applications include black start, renewable energy time shift, and frequency regulation. Zinc-based Batteries combine zinc with various chemicals and are earlier in their development stage than some of the other battery technologies. Historically, Zinc batteries were not rechargeable but developers are overcoming challenges to produce fully rechargeable Zinc-based chemistries. This technology is known for being lightweight, low cost, and non-toxic.
- **Zinc Air Battery** also known as Zinc Air fuel cells functions by oxidizing Zinc with Oxygen, and the reaction rate is controlled by controlling air flow. It comes in both rechargeable and non-rechargeable forms. Applications include vehicle propulsion and grid storage. This battery is in test trial stage, with a few projects announced in the US.
- **Zinc Manganese Battery:** One manufacturer has recently developed a rechargeable $ZnMnO_2$ battery with 2-8 hours discharge duration. These batteries are safe and nontoxic without lead, heavy metals or flammable electrolytes which is expected to be cheaper replacement for LiBs. Energy densities of different batteries are shown in Fig.-5. Higher energy density batteries are more suitable for transportation applications due to their compactness and lower weight.

Fig.-5

B. Flow Batteries:

- **Flow batteries** differ from conventional batteries as that energy is stored in the electrolyte (the fluid) instead of the electrodes. The electrolyte solutions are stored in tanks and pumped through a common chamber separated by a membrane that allows for transfer of electrons—flow of electricity— between the electrolytes. For flow batteries VRB and ZBB (zinc bromine), only electrolyte weight and volume is considered. Energy Storage System Roadmap for India: 2019-2032.
  - There are many different types of flow batteries, of which at least three varieties are currently commercially available: vanadium redox flow batteries, Zinc-Iron flow batteries, and Zinc-Bromine batteries. Variations such as Zinc-Iron flow batteries and Hydrogen-**b**romine flow batteries are also under development.
  - This technology has reached commercialization globally with 326 MW of grid connected flow batteries across 108 projects till 2018.

- This technology has reached commercialization globally with 326 MW of grid connected flow batteries across 108 projects till 2018.
- In India, the technology adoption is limited to test-trials. A 30kW Vanadium Redox battery was installed in 2015 for a microgrid. Also, at IISc, Bangalore, a new type of flow battery called the soluble lead acid flow battery is under technology development.

3. **Thermal Energy Storage** includes ice-based storage systems, hot and chilled water storage, molten salt storage and rock storage technologies. In these systems excess thermal energy is collected for later use.
   - **Sensible Heat Storage**: Available energy is stored in the form of an increase or decrease in temperature of a material, which can be used to meet a heating or cooling demand. Few existing variations of this technology are: Molten salt storage (generally coupled with Concentrated Solar Power (CSP) plants), hot water storage and chilled water storage (designed to serve households or a community).
   - **In Latent Heat Storage**, energy is stored in a material that undergoes a phase change (transition between solid and liquid) as it stores and releases energy. Examples include ice storage tanks for domestic or industrial cooling applications.
   - **In Thermochemical Storage**, reversible chemical reactions are used to store thermal energy in the form of chemical energy. The available variations are currently in initial developmental stage.
4. **Electrical Storage Super capacitors and Superconducting Magnetic Energy Storage (SMES)** systems store electricity in electric and electro-magnetic fields with minimal loss of energy. A few small SMES systems have become commercially available, mainly used for power quality control in manufacturing plants such as microchip fabrication facilities. These technologies are ideal for storing and release high levels of energy over short bursts.
5. **Chemical Storage** typically utilizes electrolysis of water to produce hydrogen as a storage medium that can subsequently be converted to energy in various modes, including electricity (via fuel cells or engines), as well as heat and transportation fuel (power–to-gas).
   - **Electrolyzes (Power to Gas):** Excess electrical energy can be utilized by these systems for electrolysis of water to produce hydrogen (H_2) and oxygen (O_2). The stored hydrogen may be used directly as fuel for heating applications or in fuel cells. Electrolyzes are unidirectional devices only allowing storage of energy.
   - **Fuel Cells**: Chemical energy stored in fuels (ethanol, hydrogen or natural gas) can be converted to electrical energy. Several variations exist such as SOFC (solid oxide fuel cells), PEM (proton exchange membrane), and PAFC (phosphoric acid fuel cells). These systems can be used for stationary storage or transportation applications.

PROCEEDINGS OF 30TH ANNUAL GENERAL MEETING HELD ON 21 JUN 2026

As decided, the 30th AGM of the SPE(I) Vadodara Chapter was organized on 21 Jun 2026 at 17.00 hrs. at Vakal Sewa Kendra, Opp. Vadodara Stock Exchange, Beside Parsi Agyari, Sayajigunj, Vadodara**.**

Beginning of Session

The following business was transacted.

Due to the lack of quorum at the scheduled time, the members present left the venue and reassembled at the same place after half an hour and carried on the AGM business.

Executive Members on Dais

L to R **Er. SP Trivedi**-Jt. Secretary, **Er. VB Harani**-Secretary, **Er. MR Tilwalli**-Chairman, **Er, YV Joshi**, Vice-Chairman, **Er. SMS Baxi**-Finance Secretary, **Er. Yatin Pathak**-Jt. Finance Secretary

The members present in the house observed 1-minute silence to pay their respect to the members who left for their heavenly abode during the year. It is heartrending to note that during this year, SPE (I), Vadodara Chapter has lost 10 members who departed for their heavenly abode. They are:

1. **Er. Jagdishbhai C Shah**
2. **Er. Pravinchandra R Navadia**
3. **Er. Bhupendrakumar C Gajjar**
4. **Er. Rameshchandra K Kothari**
5. **Er. Kanubhai R Panchal**
6. **Er. Mrunal K Das**

We respect their valuable contribution/ support to SPE(I) Vadodara and preserve their memories.

Welcome address by the Vice-Chairman

The **Vice-Chairman** of the **Chapter**, **Er. YV Joshi w**elcomed all the members and invitees. He further expressed his gratitude for the efforts and support given by members of

Er. YV Joshi
Vice-Chairman
delivering
Welcome address

EC, AC and Patron Members and Life Members. Further, **Er. Joshi** thanked the members and well-wishers who extended their financial help (directly or indirectly) in the form of donation or advance for purchase of new premises and also in the various conferences conducted during last year.

Address by the Chairman

Er. MR Tilwalli
Chairman,
delivering
address

The **Chairman** of the **Chapter**, **Er. Mohan R. Tilwalli,** addressed the members present in the AGM. He highlighted the progress of the **Chapter** during the year. He pointed out that last year was a landmark year for our

Chapter. We purchased another office premises of our **Chapter** at Monlisa Business Centre, Manjalpur Vadodara. This is the biggest achievement for the entire Society of Power Engineers (I), Vadodara. He informed that the Student Chapter for the benefit of students has been opened in SVIT Vasad. Other chapters at Bharuch, Godhara and SRICT-Valia are in pipeline. The **Chairman** thanked the members who extended their financial help (directly or indirectly) and well-wishers in the form of donation or advance for purchase of new premises. He informed the members for the grand success of various conferences like LV-MV Switchgears, Waste to Energy and Transmission Line. With the grand success the **Chapter** could generate surplus amount which was utilized in repayment to the borrowers. He further expressed gratitude for the efforts and support by members of EC, AC and Patron Members and Life Members.

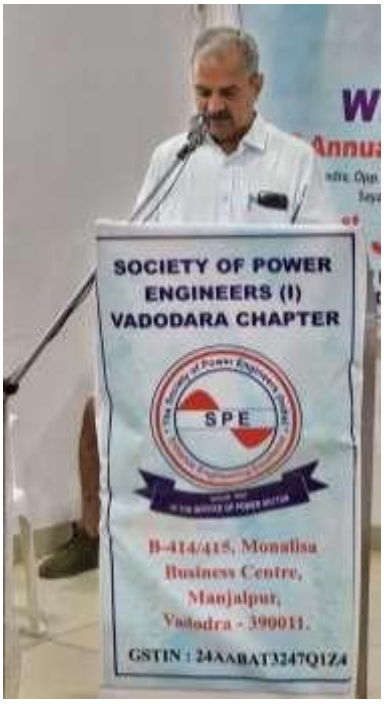
The agenda of AGM was pursued as follows:

1. **Confirmation of Minutes of last AGM held on 30 Jun 2024.**

   Minutes of last AGM was already circulated through SPE NEWSLETTER Jul-2024 issue. However, Secretary of the Chapter, **Er. VB Harani** read out the minutes of last AGM held on **30 Jun 2024**. The minutes were approved by the house as presented.

2. **Presentation of Secretary's report**

A) It gives me great pleasure to welcome you to the **30th AGM** of **Vadodara Chapter**. During this period, the Chapter has made a reasonable progress even with difficult situation. During the period from last AGM to this AGM, total **16 Life Members** are registered**.** Thus, total registered members of SPE (I) Vadodara Chapter as on **21 Jun 2026** are **2481** out of which there are **645 Life Members.** The Institutional Members of the Chapter are **7. Vadodara Chapter did following activities.**



Er. VB Harani
Secretary
presenting the
report

B) Under the leadership of **Er. Keyur Nanavati** (MD–ETP Earthing), new Chapter at Surat is founded on **12 Jul 2025**. SPE (I) with a Conference on "Building India's Smart and Sustainable Grid: Innovations, Challenges & Opportunities". **Er. Rajeev Singh** (Dir. Energy–CBIP), **Er. PC Garg** (Ex–Chief of CTU). **Er. AB Choudhary** (CEI) and **Er. SK Negi** were the VIPs who graced the occasion. On special invitations **Er. SM Takalkar** and **Er. YV Joshi** remained present and shared the dais.

C) On **29 & 30 Jul 2025**, the **Chapter,** jointly with Gujarat Energy Development Agency (GEDA), organized a **2-Day Conference** on **"Waste to Energy for Clean Environment"** at FGI Auditorium, Sevasi-Vadodara.

D) On **03 Aug 2025**, the **Chapter** organised **29th AGM** at Velchand Benkar Vidhyarthi Ashram Auditorium, Karelibaug, Vadodara.

E) On **28 Aug 2025**, the **Chapter,** jointly with IE (I) Vadodara, arranged a lecture on **"Role of Engineers in creating Sustainable and Self Reliable India".** The eminent speaker was

Er. Deepak Gadia. Members of SPE (I) Vadodara Chapter attended the Lecture.

F) On **03 Oct 2025**, the **Chapter** organized Satyanarayan Pooja as a part of celebration of Foundation Day. The pooja was performed at the Office of SPE (I), Vadodara Chapter. About Sixty Members and their spouse attended pooja. The members and their family availed Prasad and greeted each other. The pooja was performed by **Er. Pradip P Shah**, Jt. Secretary and his better half.

G) On **06, 06 & 07 Nov 2025**, the **Chapter** organised a **1-Day Tutorial** and **2-Day Conference** on **"Design & Construction of Transmission Line"** at FGI, Sevasi, Vadodara.

H) On **14 Dec 2025**, as a part of **"Energy Conservation Day",** the **Chapter,** jointly with IE (I) Vadodara organised a lecture session on "**Energy Conservation–Tools and Techniques for Engineers"** at Vasvik Auditorium. The eminent speakers were **Dr. Monika Shah**, Prof. - Navrachana University and **Er. Bhavesh Mehta** (IGBC fellow).

I) On **24 Jan 2026,** the **Chapter,** jointly with the **IE(I)** Vadodara and in association with **Poornawad Institute of Life Engineering (PILE) and Poornawad Life Foundation** organised a lecture cum award ceremony as a part of the **"12th Dr. RP Parnerkar Poornawad Award for Excellence in Engineering & Technology 2025"** at Vasvik Auditorium. **Er. Gautum Talati** an eminent veteran Civil & Structural Engineer of Vadodara was awarded for his great contribution in Power Sector and Civil Engineering.

J) On **07 Mar 2026,** the **Chapter,** jointly with the **IE (I)** Vadodara organised a lecture on **"Smart Engineering for Sustainable Future through Innovation and Digitalization",** to commemorate **World Engineering Day**, at Vasvik Auditorium. Key Note Speaker **Dr. Vijay Shah**, Global Expert on R&D, ABB India Ltd. delivered talk on the subject.

K) As one of the activities of SVIT-Vasad **Student Chapter** 1-Day Seminar on "Industrial Safety" was scheduled on 9 Apr 2026. Following Topics were covered during the Seminar:

1. **General Safety** by **Er. PA Shah**
2. **Electrical Safety** by **Ms. Hetal Prajapati**
3. **Chemical Hazards and Safety** by **Er. KG Shah**
4. **Behaviour Based Safety** by **Er. DD Kothari**
5. **Safety Tools & PPEs** by **Ms. Binal Modi**

L) On **21 & 22 May 2026,** the **Chapter** jointly with **Gujarat State Electricity Company Ltd.** (GSECL) organized **2-Day Conference** on "**Design, Engineering, Erection, Testing, Commissioning, Operation & Maintenance of Thermal Power Plant"** at Federation of Gujarat Industries, Gotri-Sevasi Road, Sevasi, Vadodara (Gujarat). The event was attended by about 150 delegates

M) Sad Demise of our Life Fellows / Members:

It is heartening to note that during this year, SPE (I), Vadodara Chapter has lost members who departed for their heavenly abode. We respect their valuable support and preserve their memories.

3. Presentation of Accounts (Balance Sheet and Income & Expenditure and Budget) of the Chapter for the year 2025-26:

Er. SMS Baxi Finance Secretary presenting the Annual Accounts and Budget

The provisional Accounts of the Chapter for the FY 2025-26 was circulated. The Secretary Finance of the Chapter, **Er. SMS Baxi** presented the Balance Sheet and Income & Expenditure in brief and ledger-wise in particular. Further, he gave conference-wise income and expenditure with surplus amount. Members appreciated his efforts for making more detailed accounting. The accounts were approved in AGM unanimously. **Er. Yatin Pathak,** Jt. Finance Secretary displayed the accounts in details with the help of Power-Point Presentation.

4. **Presentation of Budget (Expected Income and Proposed Expenditure) of the Chapter for the year 2026-27:** The annual Budget for the financial year 2026-27 was circulated along with AGM notice. The Secretary Finance of the Chapter **Er. SMS Baxi** explained probable income, proposed expenditure and excess income over the proposed expenditure for the year 2026-27. The budget was approved unanimously.

5. **Proposal for the approval of Auditor Company for the year 2026-27:** The Finance Secretary **Er. SMS Baxi** proposed the name of Chartered Accountant Company **M/s Mahajan Doshi & Associates, Old Padra Road Vadodara** as an Auditor for the financial year 2026-27. The house approved the proposal unanimously.

6. **Meritorious Awards to Life Members for their Excellence Work in Power Sector and Society if any:** The **Chapter** received four proposals to give meritorious award to our Life Member. The same were approved by Executive Committee Members. The following four awards were presented:

(i) An Engineering Excellence Award 2026

was given to **Dr. Satish H Chetwani** of ERDA, by **Er. MR Tilwalli**, Chairman, SPE(I) for his Engineering work in Electrical for long period of **20** years including his Research work in Rotating Machines, Transformers, Diagnostics, Renewable Energy and Product Development. The citation was read out by **Er. (Ms.) Sangita Godkhindi**.

(ii) An Engineering Excellence and Social Service Award 2026 was given to **Er. YV Joshi** Free Lance Consultant and Vice-Chairman, SPE(I) for his remarkable work in Engineering by **Er. MR Tilwalli,** Chairman, SPE(I). On Social front, he has been working very actively for a sect called "Poornawad". The sect is a group of intellectuals working for humanity and life science. The citation was read out by **Er. SM Godkhindi.**

(iii) An Engineering Excellence Award 2026

was given to **Dr. Anil S Khopkar** of ERDA for Developing High Voltage Calibration facility, Designing / Developing HV testing and HV Partial Discharge Testing Laboratory, Developing Site Laboratory for Electrical Utility for testing of Cable, Conductors, Insulators, Polymer Insulators, Transformers etc. by **Er. GV Akre**, Patron, SPE(I). The citation was read out by **Er. Mohan Tilwalli.**

(iv) An Engineering Excellence and Social

Service Award was given to **Er. Sameer S Gaikwad** free Lance Consultant for his remarkable work in engineering in India as well as abroad by **Er. YV Joshi,** Vice-Chairman SPE(I). He is fond of Cycling. He has published a book on his parikrama experience titled "Narmada Parikrama a Solo 2,600kM Parikrama Guide to the Heart of India". The citation was read out by **Er. Shailesh Modi** of ERDA. **Er. Sameer S Gaikwad** also handed over a copy of his book to Chairman, SPE(I) Vadodara for the benefit of members.

6. Felicitating the Life Members / Fellows who have completed 65 years as on 20 June 2026.

During the AGM business following Life Members were felicitated for completion of 65 Years of their life. The members were felicitated by Chairman and Vice-chairman.

Er. Ketan Shah

Er. Bihag Majmudar

Er. Ramesh P Shah

Er. Jignesh J Oza

Er. Shailesh P Trivedi

Er. Pramod M Kamble

Er. Himanshu D Joshi

Er. Keyur Thakkar

August Audience during AGM

7. Open House Session

With the permission of Chairman an **Open House Session** was conducted in which following suggestions / opinions received:

1. **Er. JC Marathe** suggested to encourage the student members for their start up and develop their ideas by paying incentives.

2. **Er. Mrugen Mehta** suggested to felicitate the members who complete their age of 80 years.
3. **Er. Sameer Gaikwad** suggested to update web site and link activities of our SPE with social medias.
4. **Er. GV Akre** suggested to arrange competition for students and issue certificate which will be useful for their future. A cell of Experts shall be formed to carry out these activities.
5. **Er. NG Yadav** suggested to restrict the age of candidate contesting the EC member to 70 years so that young engineers will be encouraged or motivated to take active part in activities of the **Chapter**.
6. **Er. YK Sharma** requested to use various digital platforms and social media for the activities of the Chapter.
7. **Dr. Namra Joshi** suggested to become members of various technical institutions including IEEE, IISc, BIS etc. so that members and students can avail the benefits of updated standards and technologies.
8. **Er. SM Takalkar** suggested to give a letter of appreciation to our earlier Auditor M/s Niraj Majmundar & Associates, FF-127, Panorama Complex, Race Course, Vadodara.
9. **Er. Robert Meckwan** suggested to give more information in our web site including membership form, up-coming & past events, monthly lectures on web etc.

8. Vote of Thanks

Er. SP Trivedi, Jt. Secretary presented **Vote of Thanks** to all members, volunteers and persons who worked / assisted directly and indirectly for great success of the event. He also thanked the donors, all EC and AC and patron members for their valuable support in the activities of SPE (I) Vadodara. He also thanked IE (I) Vadodara Local Centre Officers, Caterers and many others who extended their assistance / contribution for AGM.

9. Election of EC Members

Er. J D Tamhane, Polling & Returning Officer made all arrangements to conduct the Election for 4 posts of Executive Members for the years 2026-27, 2027-28 and 2028-29. He conducted the election activity with the assistance of **Er. PA Shah, Er. SM Godkhindi, Er. HM Solanki, Shri Bharat Chauhan, Er. DP Modi and Er. SG Prasad.** Polling & Returning Officer read out the proceedings of the election as under.

Against 4 (four) posts, following 6 (six) nominations forms were received as candidates for EC Members and accepted:

10. **Er. RM Athavale**
11. **Er. VB Harani**
12. **Er. YV Joshi**
13. **Er. MR Tilwalli**
14. **Er. NP Shah**
15. **Er. RS Shah**

Er JD Tamhane and his team nicely conducted the election process. After completion of Election process, the following 4 (four) members declared Elected as **Executive Members** for the period **2026-2029** by election officer.

1. **Er. VB Harani**
2. **Er. YV Joshi**
3. **Er. MR Tilwalli**
4. **Er. NP Shah**

Newly elected EC Members as above were felicitated. Chairman expressed his gratitude towards efforts by **Er. JD Tamhane** and his team for their services in the process of election.

10. The Closing of AGM

The AGM ended after recitation of the National Anthem. The entire event was anchored by **Er. PA Shah,** LM & Advisory Committee Member. The AGM ended with a delicious dinner.

BRIEF REPORT OF 2-DAY CONFERENCE ON

"DESIGN, ENGINEERING, ERECTION, TESTING, COMMISSIONING, OPERATION & MAINTENANCE OF THERMAL POWER PLANT"

The Vadodara **Chapter** of SPE (I) jointly with Gujarat Energy Development Agency, Gandhinagar organized a **2-Day Conference on "Design, Engineering, Erection, Testing, Commissioning, Operation & Maintenance of Thermal Power Plant"** on **21, 22 May 2026** at FGI, Vadodara.

More than 150 delegates from all over the country participated in the Conference. The delegates hailed from **GSECL**, **NTPC**, **Adani Power Ltd.**, **Durga Infra Mining**, **Maruti Clean Coal**, **PC Patel Mahalaxmi Infra**, **ERDA**, **Jay Ranchhod Transport**, **Gallantry Industries**, **TCR Advance**, **HPCL** Mumbai, **Imco Overseas Pvt.**, **GPCL**, **NTPC**, **Utilities** and also **Experts** from Academic Institutions and Thermal Power Plant Ancillaries & Auxiliaries Manufacturers / Suppliers.

The inaugural function of Conference was presided over by **Er. Somesh Bandopadyay**, MD, GSECL; **Er. DH Vasava**, ED GSECL; **Er. PH Rana**, Ex. GUVNL & Patron Member of SPE; **Dr. Satish H Chetwani,** ERDA; **Er. SM Takalkar** Conference Coordinator; and **Er. Mohan Tilwalli,** Chairman- SPE(I) Vadodara.

A welcome speech was delivered by **Er. Mohan Tilwalli,** Chairman-SPE(I), Vadodara. He welcomed the Guest of Honors, Dignitaries on dais, Platinum Sponsors, Silver Sponsors, Advertisers, Well Wishers, Delegates, Authors, Invitees, Committee Members, Members of SPE(I) etc. He also informed about the Conference journey right from the initiating to the day of Conference. He also stated that more than 34 papers are contributed and 30 papers are selected for presentation in the Conference. He appreciated that 150 delegates from all part of the country are participating in the Conference. Lighting of Lamp was performed by dignitaries on the Dais along with by Digital Ganesh Stuti.

In his address as a Guest of Honor, **Er. Bandopandhyay** highlighted the importance of the Conference arranged by SPE(I) Vadodara on such an important topic of Thermal Power Plant, which is useful for engineers working in the Thermal Power Plant and also Central as well as State Utilities, CPPs & IPPs, Manufacturers / Suppliers of Auxiliaries & Ancillaries and construction of Thermal Power Plant including main plant, balance of plants. **Er. PH Rana** shared his views and experience on the importance of Conference for Academicians, practicing Engineers, Utilities and Consultants.

The unveiling of Proceedings was done by Dignitaries on dais.

The proceedings of 2-Day Conference was compiled by **Er. NV Rede, Er. PA Shah, Er. SMS Baxi, Er. RM Athavale** and **Er. YV Joshi.** The Sponsors, Well Wishers and Advertisers were felicitated by the dignitaries on dais.

The inaugural session of the Conference ended with Vote of Thanks by Er. VB Harani, Secretary, SPE(I)-Vadodara. He thanked Guests, Platinum Sponsors, Advertisers, Delegates, Authors, Invitees, Committee Members, SPE(I) Members, Catering Contractor, FGU & its Staff, Social Media and all persons who have assisted SPE(I) directly or indirectly to make this event with great success.

At the end of inaugural session, a digital National Anthem was recited.

There were seven Technical Sessions during 2-Day Conference.

Day I

Session - I

Session Chair: Dr. SH Chetwani

Paper - 1 Feasibility Studies and Project Planning of Thermal Power Plant
Author: Er. KC Yadav, Retd. CE(Civil) GSECL

Paper - 2 Vibration Severity of Rotary Equipment (Motor) and Case Studies
Authors: Mr. Robert Macwan, Mr. Umesh Soni, Dr. Anil Khopkar
ERDA-Vadodara

Paper - 3 Grounding Risks and Hidden Electrical Hazards in Generating Stations
Author: Er. DB Gour, etp Earting-Surat

Paper - 4 Renovation, Modernization and Condition Monitoring of Thermal Power Station Switch Yard
Author: Er. SM Takalkar, MD-TPECPL

The questions/answers were taken at the end of the session. There was very good interaction amongst participants and concerned author of the paper.

Session - II

Session Chair: Dr. Anil S Khopkar

Paper - 5 Design & Engineering of Thermal Power Plant, Main Plant and Balance of Plants (BoP)
Author: Er. DJ Parmar, GSECL

Paper - 6 Gujarat Power Sector in a Net-Zero 2047 Scenario Demand, Resource Adequacy and the Strategic Role of Concentrated Solar Power
Author: Er. Nilesh Bidarkar, GSECL

Paper - 7 Renewable Energy Integration and Thermal Flexibilization Costs: Evidence from GSECL Thermal Power Plants
Authors: Er. Rutvij Patel, Er. Kandarp Mistry, Er. Nilesh Bidarkar

The questions/answers were taken at the end of the session. There was very good interaction amongst participants and concerned author of the paper.

Session - III

Session Chair: Er. Samir Chaudhari

Paper - 8 Contract Labour Information Management System (CLIMS)
Author: Mr. Devansh Shah, GSECL

Paper - 9 Bare Inspection of Package Boiler & Fit for Services Inspection of Pressure Vessel
Authors: Mr. Robert Macwan, Mr. Umesh Soni, Dr. Anil Khopkar
ERDA-Vadodara

Paper - 10 Modelling and Analysis of Duct Path using Computational Fluid Dynamics Estimation of Pressure Loss in Flue Gas
Authors: Mr. Arunesh Dwivedi, Mr. Shubham Kumar, Mr. Kuldeep Ruparelia
ERDA-Vadodara

Paper -11 Auxiliary Power Consumption Reduction in Coal Fired Thermal Power Plants,
Author: Er. Awdhesh Kumar Singh
Freelance Consultant

Paper - 12 Boiler Remaining Life Assessment (RLA) & Condition Assessment Comprehensive Approach
Authors: Er. Nikhil Sabhaya, Er. Deepak Chandarana
TCR Advanced Pvt. Ltd.-Vadodara

The questions/answers were taken at the end of the session. There was very good interaction amongst participants and concerned author of the paper.

DAY II

Session - IV

Session Chair: Er. KC Yadav

Paper -13 Role of Instrumentation & Control in Thermal Power Plants and Recent Advancements
Authors: Er. Aditya Bhatt, GSECL
Er. SMS Baxi, TPECPL

Paper -14 Construction and Project Management in Thermal Power Plants
Author: Er. DJ Parmar, GSECL

Paper - 15 Significance of Pole Slipping Protection for Generator and Protection Setting Guidelines
Authors: Er. Shailesh Modi
Dr. Anil Khopkar
ERDA-Vadodara

Paper - 16 Feasibility Assessment of Fast Motor Bus Transfer for Critical Motor Loads using EMTP Simulation
Authors: Er. Chinmay Jani
Er. Sumit Mehta

Paper -17 Use of Pipe Conveyor System in Transportation of Minerals in the Mining Sector
Author: Er. Hitesh H Gulbani

The questions/answers were taken at the end of the session. There was very good interaction amongst participants and concerned author of the paper.

Session - V

Session Chair: Er. Awdhesh Kumar Singh

Paper - 18 Automatic Generation Control in Thermal Power Plants
Author: Er. Arvind Anurag Tripathi

Paper - 19 Safety Standards & Regulations including Electricity Safety
Author: Er. Samir A Chaudhari
Adani Power Ltd.

Paper - 20 Energy Analysis of 800MW Super Critical Coal Fired Thermal Power Plant
Authors: Er. Kuldeep Ruparelia
Er. Arunesh Dwivedi
ERDA-Vadodara

Paper - 21 Coal Size and its importance in AFBC Boiler Operation
Author: Er. Devpalsinh Gohil

Paper - 22 Cables in Power Station
Author: Ms. Bhavika Jhanwani

The questions/answers were taken at the end of the session. There was very good interaction amongst participants and concerned author of the paper

Session - VI

Session Chair: Er. PH Rana

Paper - 23 Statutory Requirement for Safety Training Thermal Power Plant which is the Value not just Priority
Authors: Mr. SV Sapre,
Gujarat Safety Council
Er. PA Shah, TPECL

Paper - 24 High Voltage Gas Insulated (HV-GIS) Technology
Author: Er. Anil C Shah, Ex. GSECL

Paper - 25 Feasibility and Project Planning of Thermal Power Plant
Author: Er. Jay Parmar

Paper - 26 Power Trading and LPS Rules
Author: Er. Kalpendra Rathaur

Paper - 27 Fuel Management
Author: Er. DJ Chaudhary
The questions/answers were taken at the end of the session. There was very good interaction amongst participants and concerned author of the paper.

Session - VII

Session Chair: Er. YV Joshi

Paper -28 Renovation & Modernization of GSECL Thermal Units
Author: Er. JK Sandhi

Paper - 29 Advance Steam Chemistry
Author: Er. DS Gamit, Chief Chemist
Ms. KL Parmar - GSECL

Paper - 30 Environmental Norms & Compliance
Author: Er. Rina Parmar – GSECL

The questions/answers were taken at the end of the session. There was very good interaction amongst participants and concerned author of the paper.

The Open House was conducted by **Er. PH Rana, Er. SM Takalkar, Er. YV Joshi** and **Er. VB Harani.** The participants as well as authors of the paper appreciated the event and suggested to organize such events for power sector at an interval. The delegates expressed satisfaction for good hospitality provided by the Chapter, conference material and conducting the conference in best manner.

The power point presentation was compiled **Er. PA Shah, Er. Shailesh Modi, Er. Yatin Pathak** and **Mr. Ajit Karode**-TPEC. All the technical sessions were conducted nicely and smoothly by the team.

The logistics during technical sessions were provided by **Er. VB Harani, Er. RM Athavale, Er. SMS Baxi** and **Er. DD Kothari.**

The conference ended with vote of thanks by **Er. YV Joshi** which was followed by National Anthem.

Er. YV Joshi thanked the following:

- **Platinum Sponsors** – Gujarat State Electricity Corporation Ltd. (GSECL), Adani Power Ltd.
- **Silver Sponsors** – Durga Infra Mining Pvt. Ltd., Electrical Research & Development Association (ERDA), Maruti Clean Coal and Power Ltd., National Thermal Power Corporation Ltd. (NTPC), PC Patel – Mahalaxmi – Simplex Consortium Pvt. Ltd.
- **Knowledge Partners** - Institution of Engineers (India), Vadodara Local Centre.
- **Invitees**
- **Well Wishers** – ETP Earthing & LPS Solutions Pvt. Ltd. and Jay Ranchhod Transport.
- **Advertisers** – TCR Advanced, Gallantry Industrial India Pvt. Ltd., IMECO Pvt. Ltd.
- **Delegates**
- **Guest of Honors**
- **Committee Members**
- **Staff Members of SPE(I) office and FGI**
- **Authors of Technical Papers**
- **Print & E-Media**
- **Printers**
- **Stationery suppliers**
- **Kit supplier**
- **Audio-Visual Media providers**
- **Catering Services**
- **FGI & its Management/Staff**

****

Feedback from participants:

I have attended the programme for two full days and found it very interesting and informative as well. It was full with very important, updated intricate technical objective details which could successfully engage the most of the audience for the two full days. Although the 10-minute time limit for the sessions was too short and it resulted in shortening of interesting Q & A sessions, compressed important information and data by the speakers could make its best use to the benefit of the members. Conspicuous presence of young speakers including the women folk with detailed execution level important issues made the conference more interesting. Many members have felt that

that such seminars/conferences should be arranged at least once a month. I also wish that the sessions need be at least of 20 minutes duration so that the speakers could do justice to the subject and the Q&A sessions. The whole program went well by full hearted contribution by all members who supported it to achieve best out of limited time and timely action deserving appreciation.

Er. PR Mehta
Retd CE (P&P), GEB
LM SPE(I) Vadodara

Since I am from Power Station and Fuel Management, I have thoroughly enjoyed and found that it was need of time. Papers and presentation given by Engineers covered all most all the aspects from green field project planning to completion and operation, Maintenance of power plant specifically in the Era of dominance of Renewable Energy and joint co-existence of thermal & RE in Grid with stability and economically. Power trading is also one of the most important aspects. Good operation and Maintenance policy, R & M of old power plants, testing, safety aspects, labour and workman rules.

Covered almost all the aspects in depth and deliberation. Modern practice various challenges and way forward in above aspects presented by young generation and seniors were of high quality and latest information. I really congratulate to SPE(I) Vadodara Chapter and GSECL, one and all made this conference very successful and interesting.

Er. Himanshu D Joshi
Retd. CE(Gen), GSECL
LM SPE(I) Vadodara

It is very much significant that conference on Thermal Power Plant was initiated on International Tea Day and ***'Chhay pe badhiya takniki charcha huyi'*** and conference concluded on Sherlock Holmes Day who had investigative and analytical brain to resolve suspense thrillers while we power engineers have similar investigative and analytical brain and utilize it to resolve mal operation and malfunction of plant equipment's for safe, smooth and efficient running of plant.

Team SPE deserves big applause for grand success of conference.

Er. Mrugen G Mehta
LM SPE(I) Vadodara

2-DAY CONFERENCE AT A GLANCE

BEGINNING OF THE EVENT

Dignitaries on Dais
From L to R **Er. PH Rana, Er. DH Vasava, Dr. SH Chetwani, Er. Somesh Bandopandhyay, Er. MR Tilwalli, Er. SM Takalkar**

Lighting of Holy Lamp
L to R **Somesh Bandopandhyay, Er.DH Vasava, Er. PH Rana, Er. SM Takalkar, Dr. SH Chetwani, Er. MR Tilwalli**

WELCOME ADDRESS
Er. MR Tilwalli,
Chairman, SPE(I)-Vadodara
Welcoming all and Informing about the Conference journey

FLORAL WELCOME OF DIGNITARIES

Er. PH Rana Welcoming Er. Somesh Bandopandhyay

Chairman, SPE Welcoming
Dr. SH Chetwani

Chairman, SPE Welcoming
Er. DH Vasava

Chairman, SPE Welcoming **Er. PH Rana**

Chairman, SPE Welcoming
Er. SM Takalkar

ADDRESS BY GUESTS OF HONOUR

Er. SM Takalkar speaking about the Conference

Er. PH Rana sharing his views and experience on the importance of Conference

Er. Somesh Bandopandhyay

Er. SH Chetwani

Er. DH Vasava highlighting the importance of the conference

Release of Proceedings

L to R **Er. PH Rana, Er. DH Vasava, Dr. SH Chetwani, Er. Somesh Bandopandhyay, Er. MR Tilwalli, Er. SM Takalkar**

FELICITATION OF SPONSORS, WELL WISHERS AND ADVERTISERS

Chairman, SPE felicitaing **Er. DH Vasava**, ED, GSECL

Chairman, SPE felicitating **Er. Samir Chaudhari** of Adani Power

Er. PH Rana felicitating **Er. KC Yadav** of Durga Infra

Er. DH Vasava felicitating **Dr. Anil S Khopkar and Er. Shailesh Modi** of ERDA

Chairman, SPE felicitating **Er. DB Gour** and **Er. Keyur Nanavati** of Earthing & LPS Solution

Chairman, SPE felicitating **Er. Nikhil Sabhaya** and **Er. Deepak Chandarana** of TCR Advanced

ENERGY ANALYSIS OF 800MW SUPERCRITICAL COAL-FIRED THERMAL POWER PLANT

Er. Kuldeep Ruparelia, Certified Energy Auditor, ERDA, Vadodara, kuldeep.ruparelia@erda.org
Er. Arunesh Dwivedi, Accredited Energy Auditor, ERDA, Vadodara, arunesh.dwivedi@erda.org

ABSTRACT

Coal-fired thermal power plants remain central to India's electricity generation, contributing nearly 70% of total output despite the rapid growth of renewables. Modern supercritical units of 660–800MW capacity face new operational challenges such as flexible & rapid load ramping, two-shifting, low load stable operation, AGC and ancillary service participation, which increase heat rate deviations, equipment fatigue, and cycling losses. Plants also faces the challenges from availability of fuel with high ash content, lower GCV and variable moisture and quality; along with efficiency challenges.

Exergy analysis, based on the Second Law of Thermodynamics, provides a more realistic measure of plant performance by identifying where useful work potential is destroyed due to irreversibility. This study presents a detailed heat–mass–exergy analysis of an 800 MW supercritical coal-fired plant using reconciled field data from distributed control systems and local instrumentation. A rigorous iterative methodology was applied to ensure closure of mass, energy, and exergy balances across turbine extractions, heater drain cascades, deaerator, condenser, and boiler feed systems.

The present study paper focuses on detailed heat-mass-exergy analysis of an 800MW supercritical coal fired thermal power plant operating under actual field conditions. The study has been carried out using real operating data collected from the Distributed Control System (DCS) performance monitoring systems, and local instrumentation installed across the plant as well as setting up temporary portable instruments. A rigorous iterative methodology has been adopted for reconciliation of turbine extraction flows, heater drain cascades, deaerator balance, condenser balance, boiler feed pump recirculation, gland steam system interaction, and overall steam-water cycle closure.

The study proposes an optimization framework prioritizing combustion control, air ingress minimization, soot blowing effectiveness, and LP heater overhauling. The methodology offers a practical tool for diagnostics, operational optimization, and energy auditing in large coal-based thermal power stations.

1. INTRODUCTION

The performance of coal-based thermal power plants has traditionally been assessed using first-law (energy-based) methods, which ensure conservation and balance closure. However, these approaches do not capture the degradation in energy quality that occurs within various components of the cycle. As a result, they cannot fully identify the true thermodynamic losses or provide a reliable basis for optimization.

Exergy analysis, grounded in the Second Law of Thermodynamics, addresses this limitation by quantifying the useful work potential of energy streams and measuring irreversibilities in each process. Exergy is destroyed whenever combustion, heat transfer across finite temperature differences, throttling, friction, or mixing losses occur. Thus, exergy provides a direct measure of thermodynamic imperfection and highlights where useful work potential is lost.

In large regenerative thermal cycles, this distinction is critical. For example, while the condenser rejects vast amounts of low-grade heat, its exergy contribution is minimal compared to the high-quality electrical energy produced at the generator terminals.

Energy analysis captures this difference, offering a more realistic assessment of component performance.

Second-law efficiency, or exergy efficiency, further strengthens this perspective by evaluating how effectively a component utilizes the available work potential. For turbines, it reflects the conversion of steam exergy into mechanical work; for boilers, the conversion of fuel chemical exergy into steam exergy; and for heaters or condensers, the degradation associated with heat transfer and mixing.

By directly linking energy destruction to entropy generation, energy analysis provides deeper insight into performance limitations and optimization opportunities than conventional energy analysis. It complements rather than replaces first-law methods, ensuring both conservation and quality assessment. Together, these approaches enable a comprehensive and realistic evaluation of thermal power plant performance.

The physical exergy of a flowing stream is expressed as:

$e=(h-h_0)-T_0(s-s_0)$ --- equation (1)

Where

e = specific exergy (kJ/kg)
h = specific enthalpy (kJ/kg)
h_0 = reference enthalpy (kJ/kg)
s = specific entropy(kJ/kg.K)
s_0 = reference entropy (kJ/kg·K)
T_0 = ambient reference temperature (K)

For turbines, second law efficiency represents the effectiveness of converting available steam exergy into mechanical work. In boilers, it reflects the effectiveness with which fuel chemical exergy is converted into useful steam exergy. Similarly, for regenerative heaters and condensers, second law analysis provides insight into the thermodynamic degradation associated with heat transfer and mixing processes.

2. IMPORTANCE OF EXERGY ANALYSIS IN THERMAL POWER PLANTS

Traditional performance evaluation of thermal power plants relies on heat rate, efficiency, and energy balance calculations. While these methods are useful for operational monitoring, they cannot reveal the true causes of thermodynamic degradation. Energy analysis treats all forms of energy equally, failing to distinguish between high-quality work and low-grade heat.

Energy analysis, by contrast, evaluates both the quantity and quality of energy. It identifies where useful work potential is destroyed due to irreversibility such as combustion losses, heat transfer across finite temperature differences, throttling, pressure drops, moisture formation, and mixing. This makes exergy analysis a far more realistic tool for diagnosing inefficiencies and prioritizing optimization.

Key advantages of exergy analysis includes identification of irreversibility pinpoints components with the highest exergy destruction, such as boilers and condensers; optimization prioritization establishes a rational basis for focusing on the most thermodynamically significant losses; detection of hidden inefficiencies reveals performance issues not apparent in conventional energy balances, such as heater drain mismatches or condenser vacuum deterioration; and complementary insights works alongside energy analysis to ensure conservation while exposing quality degradation.

3. MEASUREMENT AND CALCUALTION METHODOLOGY

The objective of the methodology was to develop a thermodynamically consistent and field-reconciled representation of the complete steam–water cycle of the 800MW supercritical unit. Since plant instrumentation is subject to uncertainties such as

sensor inaccuracies, calibration deviations, and operating transients, direct use of raw DCS data often leads to imbalances in cycle calculations. To overcome this, an iterative reconciliation approach was adopted to achieve closure of mass, energy, and exergy balances.

The reconciliation process involved sequential determination of turbine extraction flows, regenerative heater drain cascades, Deaerator and Hot well mixing balances, Condenser closure and Boiler feed pump recirculation and team–water cycle convergence.

Actual operating temperatures, pressures, and flows were obtained from plant instrumentation, supplemented by portable measurements. Special emphasis was placed on regenerative feed heating systems, as even minor deviations in drain enthalpy or condensate entropy can lead to unrealistic exergy destruction values. Multiple iterations were performed to reconcile extraction flows, drain temperatures, and feed water enthalpy rise across individual heaters. The reconciled model was accepted only after satisfying the following criteria:

1. Closure of overall steam–water mass balance
2. Closure of individual component energy balances
3. Positive exergy destruction values for all components
4. Consistency with actual plant operating conditions
5. Physically meaningful regenerative heater behavior

This iterative methodology ensured a reconciled and physically consistent representation of the plant cycle, forming the basis for accurate exergy destruction and second-law efficiency calculations. The reference parameters measured for calculation of Exergies and Energy balances are as follows:

Parameter	Value
Ambient dry bulb temperature (DBT)	28.4^{0}C
Relative humidity (RH)	54.90%
Atmospheric pressure	1.013bar(a)

Table-1 Reference parameters (ambient parameters) for exergy calculation

Equipment	FW/ Condensate flow	FW inlet Temp.	FW outlet Temp.	Steam Pressure	Steam Temp.	Steam Flow	Drain Inlet Temp.	Drain Outlet Temp.
	TPH	^{0}C	^{0}C	kg/cm^2(g)	^{0}C	TPH	^{0}C	^{0}C
HPH-8	2462.27	259.2	293	83.6	400.4	288.22	--	283.0
HPH-7	2462.27	212.4	259.2	62.3	344	240.72	283.0	230.7
HPS-6 +DHS	2462.27	191.5	300.2	24.4	465.1	101.19	230.7	196.8
LPH-4	1765.81	129	149	4.5	262.5	63.9	--	149
LPH-3	1563.34	80	129	2.3	191	138.56	149	129
LPH-2	1563.34	67	80	- 0.483	83.5	38.19	129	82.85
LPH-1	1563.34	54	67	-0.752	66.5	38.5	82.85	67.05
Deaerator	2462.27	149	187.3	11.5	364	126.33	--	--

Table-2 Parameters of Feed Water and condensate heaters

Flow parameters (TPH)	Value
Main Steam Flow	2452
Feed water Flow	2462.27
CRH Flow	1975.92
HRH Flow	1980.41
BFP Recirculation	228.05
GSC Recirculation	37.1
SH Spray	160.8
RH Spray	4.49
Boiler Blowdown	10.27
LP Exhaust to condenser	1335.53
TDBFP Steam Extraction	144.65
Gland Steam Extractions	0.701
Coal Flow	471.58

Table-3 Flow of various streams after carrying out heat mass balance iterations

The parameters of turbine are as follows:

Section	Pressure	Temp.
HP Turbine Inlet	249.45 kg/cm²(g)	568°C
CRH	61.87 bar(g)	344.6°C
HRH	58.31 bar(g)	593.5°C
IP Turbine Exhaust	4.5 kg/cm²(g)	262.5°C
LP Exhaust-1	0.091 bar(a)	44.3°C
LP Exhaust-2	0.125 bar(a)	50.6°C

Table-4 Parameters of Steam Turbines

The gross power generation was 790MW and the net power generation was 759.34 MW. The boiler flue gas parameters were observed as follows:

Parameter	APH inlet	APH outlet
Flue gas temperature	344.5°c	136.5°C
O_2 concentration	2.95%	5.80%
CO_2 concentration	16.05%	13.20%
Hot secondary air temp.	30.8	304.5
Hot primary air temp.	31.4	298.5

Table-5 Parameters of Air Pre-Heater

Flue gas temperature observed across flue gas path are as follows:

Flue gas path location	Temp.^{0}C
Super heater platen inlet	1240
Finish RH inlet	1000
Finish SH inlet	910
LT RH inlet	740
Economizer inlet/LT RH outlet	484
Economiser outlet/APH inlet A	339
Economiser outlet/APH inlet B	350
Economiser outlet/APH inlet average	344.5

Table-6 Parameters of Flue gas path

The ultimate analysis of coal was observed to be:

Coal ultimate analysis parameter	Value
Carbon, C	40.34 %
Hydrogen, H	2.61 %
Oxygen, O	**10.72 %**
Sulphur, S	0.8 %
Total moisture	10.8 %
Ash	33.76 %
GCV	3,850 kcal/kg

Table-7 Ultimate analysis of Coal

4. CALCULATED PARAMETERS

Based on the data measured and calculations carried out, the performance parameters normally considered for analysis of a power plant are as follows:

Parameter	Value
Boiler heat input	2109.29 MW
Boiler heat absorbed (Main Steam)	1460.64 MW
Re-heater heat absorbed	346.04 MW
Total heat supplied to cycle	1806.68 MW
Gross generation	790.00 MW
Net generation	759.34 MW
Gross turbine heat rate	1967.92 kcal/ kWh
Net turbine heat rate	2047.38 kcal/kWh
Net unit heat rate, fuel basis	2382.39 kcal/kWh
Net efficiency (First law)	35.999 %

Table-8 Calculated Performance Indicators of Power Plant

The component of Boiler performance are as follows:

Loss Component	Loss %
Dry flue gas loss	4.53
Loss due to H_2 in fuel	3.97
Loss due to moisture in fuel	1.82
Loss due to moisture in air	1.58
Loss due to unburnt in ash	0.62
Loss due to blowdown	0.11
Loss due to sensible heat in ash	0.35
Radiation, convection and miscellaneous loss	1.5
Total losses	14.48
Boiler efficiency	85.52

Table-9. Losses occurring in Boiler

The exergy parameters and second law efficiency of turbine system are as follows:

Turbine	Exergy In MW	Exergy In MW	Steam Exergy Drop MW	Shaft Power MW	Exergy Destruction MW	Second-law Efficiency
HP Turbine	1034.24	777.12	257.13	249.94	7.19	97.21
IP Turbine	819.33	464.23	355.1	336.62	18.48	94.80
LP Turbine-1	171.36	36.21	135.15	127.15	8	94.08
LP Turbine-2	171.36	43.7	127.66	124.81	2.86	97.76
Total main turbine train	2196.3	1321.26	875.04	838.51	36.53	95.83

Table-10 Energy destruction and second law efficiency of Turbines

The energy parameters of TDBFP Turbines are as follows:

Turbine	Steam Exergy In MW	Exhaust Exergy Out MW	Steam Exergy Drop MW	Useful Pump Work MW	Exergy Destruction MW	Second-law Efficiency %
TDBFP-A	19.9	2.42	17.48	11.68	5.8	66.81
TDBFP-B	19.72	3.06	16.67	10.98	5.69	65.88
Total TDBFP set	39.62	5.47	34.15	22.66	11.49	66.35

Table-11 Energy destruction and second law efficiency of Turbine driving feed water

The energy parameters of heaters, deaerators and condensers are as follows:

Heater	Energy Gain/Input, MW	Energy Destruction, MW	Second-law Efficiency %
HPH-8	54.17	2.2	96.10
HPH-7	61.79	5.91	91.27
HPH-6 + DSH	36.69	4.89	88.24
LPH-1	2.3	1.82	55.79
LPH-2	2.67	3.58	42.73
LPH-3	18.92	4.26	81.62
LPH-4	10.47	2.71	79.44
Deaerator	122.6	20.1	85.90
Condenser (Combined)	47.3	46.2	2.30

Table-12 Energy destruction and second law efficiency of feed water and condensate heaters and condenser

The exergy parameters of boiler system are as follows:

Component	Exergy Destruction / Loss MW	Second-law Efficiency, %
Boiler + Reheater overall	1103	48.4
Air Preheater	25.7	73.88

Table-13 Exergy destruction and second law efficiency of Boiler Components

The chemical energy of coal was calculated as 2147.93 MW. This leads to overall second law efficiency being 35.35%.

5. ANALYSIS OF CALCULATED PARAMETERS

The reconciled analysis indicates that the 800 MW supercritical coal-fired unit is thermodynamically performing reasonably well, but the dominant inefficiencies are concentrated in the boiler combustion and high-temperature heat-transfer regions. The biggest component of energy destruction is Boiler+Reheater, Turbine train, Condensers, Heaters and Deaerator. This is as per expectation because combustion is highly irreversible, high furnace temperature, high ash content and moisture content in coal and large temperature gradients being existing between flue gas and steam/water surfaces. The overall second law efficiency of turbine being 95.8% indicating good expansion process, no significant internal loss in turbines, no significant aging of turbines. The low value of second law efficiency in condenser is because it destroys low-grade thermal exergy by rejecting heat near ambient temperature. In case of heaters, the LPH-1 and 2 comes to be a weaker performing heaters. The possible causes may be lower extraction flow, air ingress in heaters or degraded heat transfer surfaces. The flue gas side exergy destruction indicates opportunity of combustion optimization, excess air control, air ingress reduction in APH and furnace heat transfer management.

6. CONCLUSION

This paper demonstrates that the maximum exergy loss is occurring in Boiler system and less exergy is lost in turbine cylinders**.** Based on the analysis carried out, the highest priority should be given to optimize combustion efficiency of the boiler by optimizing excess air supply, minimizing false air/air ingress in boiler system, maximize release of inherent chemical energy of coal by improving coal quality and fineness, improve soot blowing effectiveness. The medium priority should be given to performance improvement of LP Heaters 1 & 2, drain cascade; whereas the least priority should be given to work on turbine as the turbine train is performing comparatively well.

About Authors

Er. Kuldeep Ruparelia received his Bachelor's degree in Electrical Engineering from Gujarat Technological University and is a Certified Energy Auditor from Bureau of Energy Efficiency, Ministry of Power, Government of India and Lead Verifier for ISO 14064. He is currently associated with R&D and Expert Services division of Electrical Research and Development Association (ERDA), Vadodara and has practical experience of around 14 years in the field of power plant performance analysis, energy auditing, thermodynamic energy balance study and exergy analysis, boiler-turbine efficiency evaluation, and operational diagnostics of coal-based thermal power plants. He has carried out more than 80 energy audits in energy intensive industries and power plants. His research interests include performance of energy intensive processes and instruments, pinch technology, power system study, power system operation under ABT/DSM mechanisms.

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Er. Arunesh Dwivedi is Manager and Accredited Energy Auditor at the Electrical Research & Development Association, Vadodara. He obtained his M. Tech Honors in Energy Management from School of Energy and Environmental Studies (DAVV Indore), and BE Chemical Engineering from National Institute of Technology, Raipur. He is Accredited Energy Auditor from Bureau of Energy Efficiency, Government of India and Lead Verifier for ISO 14064. He has been working in Energy conservation field since last 19 years and conducted more than 300 energy audits of various process industries, cement sector and power plants. His professional interest includes Thermodynamics, Fluid Mechanics, Transport phenomenon, Heat and Mass Transfer, Process Optimization and Energy Conservation. He has also worked for process and energy optimization of Cement plants.

UNLOCKING INDIA'S EXISTING TRANSMISSION CAPACITY

Static Line Uprating Using Photonic Coating Technology

Er. Prasad Pachegaokar, VP (Business Development)
AssetCool India

Foreword

India's transmission network is undergoing rapid transformation driven by renewable energy integration, electrification, and rising peak demand. Grid Enhancing Technologies (GETs) can help utilities unlock additional capacity from existing infrastructure while deferring expensive network expansion.

Executive Summary

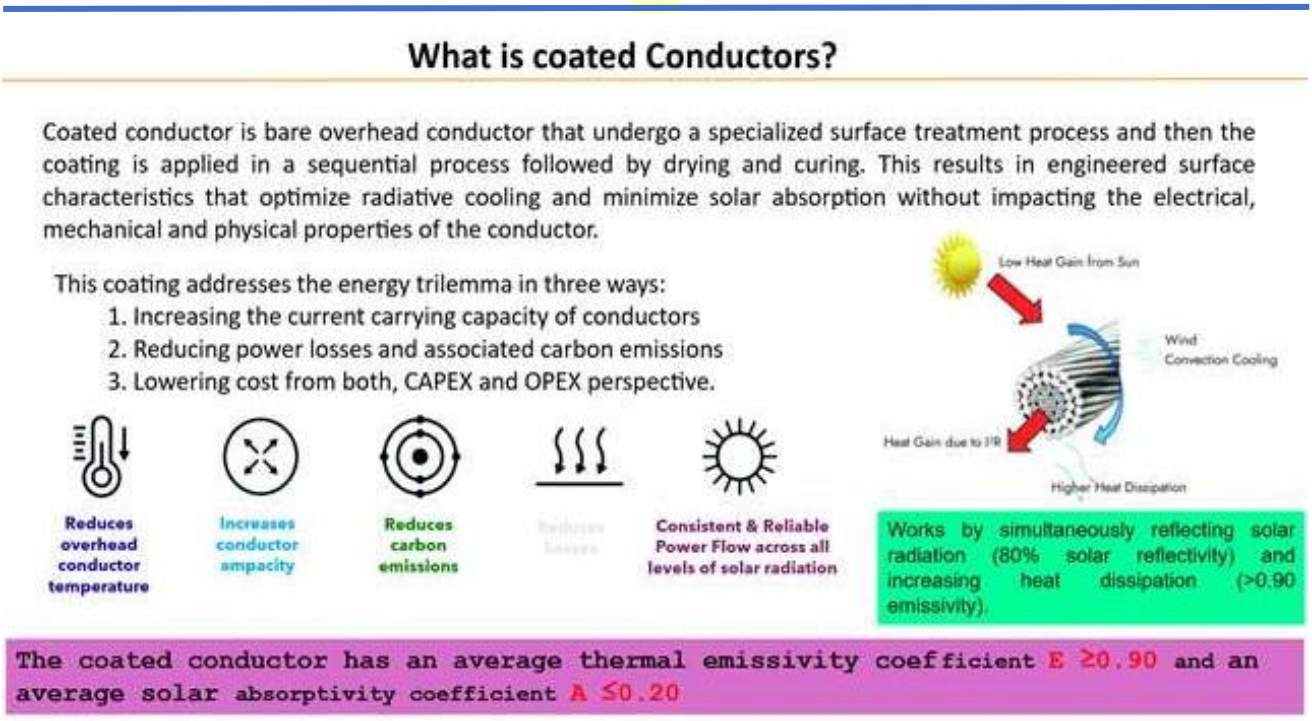
Static Line Uprating (SLU) modifies the thermal behaviour of existing overhead conductors through a spectrally selective photonic coating. By lowering solar absorptivity and increasing thermal emissivity, conductors operate at lower temperatures or carry additional current within allowable thermal limits. This paper presents an India-focused view of the technology, replacing overseas examples with a 400kV ACSR Moose case study.

India's Transmission Landscape

India is investing heavily in interstate and state transmission systems to support renewable energy, industrial growth and data-centre demand. Challenges include right-of-way constraints, long project lead times, environmental approvals and increasing loading of existing assets.

Grid Enhancing Technologies

Utilities are increasingly evaluating Dynamic Line Rating, advanced monitoring, reconductoring, HTLS conductors and Static Line Uprating. Each solution has strengths; SLU is intended to complement existing approaches by increasing usable thermal capacity without replacing the conductor.



AssetCool's Photonic Coating Technology

The coating is applied using robotic systems directly on existing conductors. It reduces solar heat gain and improves radiative cooling supporting increased ampacity and improved thermal performance.

Business Case

Compared with new transmission construction or full reconductoring, SLU can reduce

implementation time, avoid new ROW acquisition and support faster renewable integration. Project-specific economics should be evaluated for each corridor.

400kV ACSR Moose Engineering Case Study

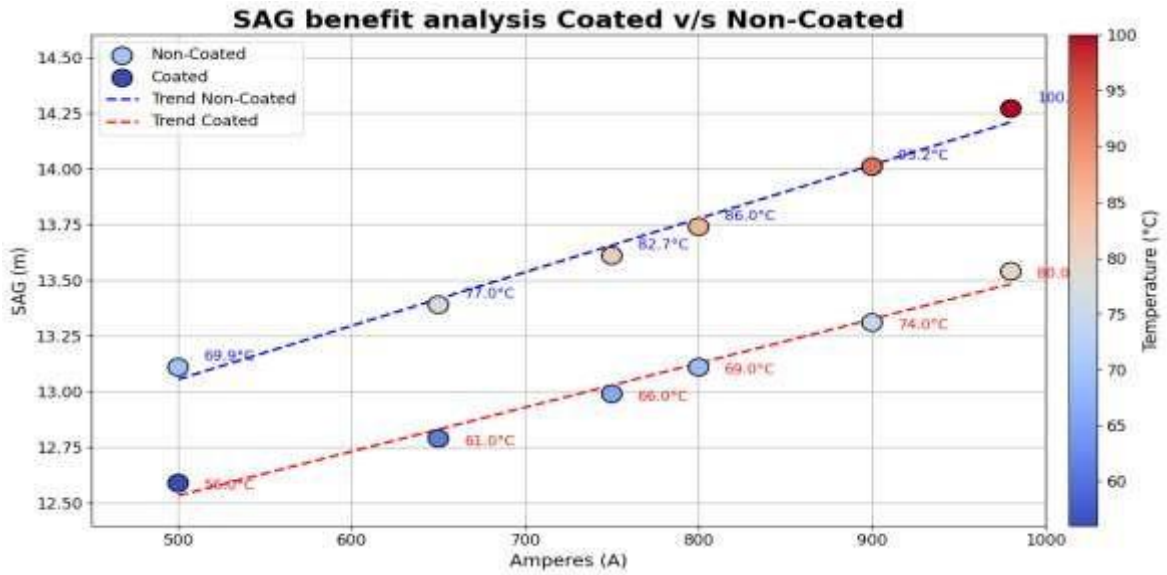
The engineering comparison supplied for this publication evaluates coated and non-coated ACSR Moose under IEEE 738 assumptions. The comparison indicates significant ampacity improvement, lower operating temperature and approximately 4–5% lower sag over the analysed loading range. These results demonstrate the potential of SLU as a practical capacity-enhancement option for Indian 400kV corridors.

Sr. No.	Description		Unit	ACSR Moose (Non Coated)	ACSR Moose (Coated)
1	Construction		**Nos/mm**	Al 54/3.53mm + St. 7/3.53 mm	Al 54/3.53mm + St. 7/3.53 mm
2	Reference Standard Specification		-	IS 398 Part 2	IS 398 Part 2
3	Nominal Diameter		**mm**	**31.77**	**31.87**
	Cross Sectional Area	Aluminium / Al. Alloy	**mm²**	528.5	528.5
		Steel Core	**mm²**	68.5	68.5
		Total	**mm²**	597.0	597.0
5	Nominal Weight	Aluminium	**Kg/kM**	1465.0	1465.0
		Steel Core	**Kg/kM**	539.0	539.0
		Total	**Kg/kM**	**2004.0**	**2011.0**
6	Ultimate tensile Strength		**KN**	**161.20**	**161.20**
7	DC Resistance at 20°C		**Ohm/kM**	0.0555	0.0555
8	Temperature coefficient for resistance		**/°C**	0.00403	0.00403
9	Maximum allowable operating temperature.		**°C**	85	85

Ampacity Comparison w.r.to ACSR Moose Conductor

	Current Carrying Capacity of Single Conductor in Amperes	Temp ^{0}C	ACSR Moose (Non Coated)	ACSR Moose (Coated)	% More Amp.
A	***Conditions for Calculations :*** *IEEE 738 :2006 Calculation Procedure. Ambient Temp = 45°C , Solar Absorption coefficient =0.8, Emissivity Coefficient = 0.45, Intensity of Solar Radiation = 1045 W/m2, Wind Speed = 0.56 m/s. for coated conductor conductor Emissivity - 0.9 Absorption Coefficient - 0.18*	65	354	730	**106.21%**
		70	502	826	**64.54%**
		75	614	911	**48.37%**
		80	706	988	**39.94%**
		85	786	1058	**34.61%**
		90	857	1123	**31.04%**
		95	921	1184	**28.56%**
		150			

SAG & Tension Comparison Conductor (SPAN = 400m)							
B	**Tension Consideration :** **1. Tension at 32°C & No wind ≤ 25% of conductor UTS.** **2. 32°C @ full wind (161.2 kg/m2) ≤ 8048 Kgs & not exceeding 70% of UTS of proposed conductor** **3. Sag (in meters) ≤ 13.26 metres (for ruling span of 400meters)**	**Amperes**	**ACSR Moose (Non Coated)**		**ACSR Moose (Coated)**		**% Less SAG**
			Temp (°C)	**Sag (M)**	**Temp (°C)**	**Sag (M)**	
		500	69.9	13.11	56.0	12.59	**-4.13%**
		650	77.0	13.39	61.0	12.79	**-4.69%**
		750	82.7	13.61	66.0	12.99	**-4.77%**
		800	86.0	13.74	69.0	13.11	**-4.81%**
		900	93.2	14.01	74.0	13.31	**-5.26%**
		980	100.0	14.27	80.0	13.54	**-5.39%**



Applications

Suitable applications include PGCIL and CTUIL interstate corridors, state transmission utilities, renewable energy evacuation, urban bottlenecks and high-ambient-temperature regions.

Pilot Deployment Framework

Select a pilot corridor, establish baseline thermal performance, apply coating, validate results and prepare a roadmap for broader deployment.

Frequently Asked Questions

Topics include durability, maintenance, compatibility with DLR, expected service life, inspection requirements, outage needs and comparison with HTLS conductors.

Conclusion

Static Line Uprating represents a promising Grid Enhancing Technology for increasing utilisation of existing transmission assets. It should be evaluated alongside conventional uprating solutions as part of a utility's asset strategy.

Representative Engineering Highlights

Parameter	Representative Result
Reference conductor	400kV ACSR Moose
Calculation basis	IEEE 738 methodology
Ampacity improvement	Up to ~106% at lower evaluated conductor temperature ~29% at 95°C
Sag improvement	Approximately 4–5% lower
Deployment	Existing corridor; no new ROW required

About the Author

Er. Prasad Vishwanath Pachegaokar, B.E. (Electronics), MBA (Finance), is a power transmission industry professional with more than two decades of experience spanning business development, technical services, product development, and strategic marketing of advanced conductor technologies. He currently serves as Vice President – Business Development for India on behalf of Assetcool - UK. Throughout his career, he has worked with leading utilities, transmission companies, and EPC contractors across multiple international markets and has actively contributed to the promotion and adoption of High Temperature Low Sag (HTLS) conductor technologies through technical presentations and published technical papers. His areas of interest include grid modernization, conductor innovation, power capacity enhancement, and transmission system efficiency.

A recognized industry professional, he has delivered technical presentations, contributed to customer awareness initiatives, and published technical papers on advanced conductor technologies. His interests include power transmission innovation, grid efficiency enhancement, HTLS conductors, and emerging technologies that improve power capacity and network reliability.

Mob: +91 9909020626
e-mail: prasad.pachegaokar@assetcool.com

MEMBERS IN NEWS

Er. Bankim P Soni, Retd. Addl. Chief Engineer (Engg.), GETCO and **Life Member & Advisory Committee Member** of **SPE(I) Vadodara** has been nominated by Govt. of Gujarat as an **Independent Member** for **State Level Committee** for implementation of **Tariff Based Competitive Bidding (TBCB)** in **Intra-State Transmission System (InSTS)** in state of Gujarat.

Congratulations to **Er. Soni !**

NEW LIFE MEMBERS

GR No.	Name	Grade	GR No.	Name	Grade
2482	Hardik Parekh	LM	2484	Siddharth Gaur	LM
2483	Dr. Mukeshkumar Sharma	LM			

COVER PAGE STORY

The **Ratha Yatra of Puri**, also rendered as the **Ratha Jatra** (Odia: ରଥଯାତ୍ରା, lit: **'Chariot Festival'** or **'Car Festival'**), is considered the oldest and largest Hindu chariot festival celebrated annually, on the bright half of the lunar month of Ashadh (June–July).

The Ratha Yatra is held at the city of Puri, in the state of Odisha, India and associated with the deity Jagannath (a form of Vishnu or Krishna). During the festival, three deities (Jagannath, his brother Balabhadra and sister Subhadra) are drawn by a multitude of devotees in three massive, wooden chariots on *bada danda* (the grand avenue) to Gundicha Temple, whereby they reside there for a week and then return to the Jagnannath temple. This return trip is referred to as the Bahuda Yatra. On their way back from the Gundicha Temple, the three deities stop for a while near the Mausi Maa Temple (Aunt's abode) and have an offering of the Poda Pitha, which is a special type of pancake supposed to be the deity's favourite. After a stay of seven days, the deities return to their abode.

The three chariots of Jagannath, Balabhadra and Subhadra are newly constructed every year with wood of specified trees like phassi, dhausa, etc. They are customarily brought from the ex-princely state of Dasapalla by a specialist team of carpenters who have hereditary rights and privileges for the same. The logs are traditionally set afloat as rafts in the river Mahanadi. These are collected near Puri and then transported by road.

The three chariots are decorated as per the unique scheme prescribed and followed for centuries stand on the Bada Danda, the Grand Avenue. The chariots are lined across the wide avenue in front of the temple close to its eastern entrance, which is also known as the Singhadwara or the Lion's Gate.

Around each of the chariots are nine Parsva Devatas, painted wooden images representing different deities on the chariots' sides. Each chariot has a charioteer (Sarathi) and four horses.

OBITUARY

Er. Kanubhai Ratanlal Panchal, Retd. Executive Engineer (Distribution), GEB and **Life Member** of SPE(I), Vadodara left for his heavenly abode on **22 Apr 2026**.

May God give peace to the departed soul and strength to his family members to bear the impact.

Er. Mrunal Kanti Das, Metallurgist, Ex. Head Metallurgical Section-ERDA, Vadodara, **Life Member** & former **Advisory Committee Member** of SPE(I), Vadodara left for his heavenly abode on **23 Apr 2026.**

May God give peace to the departed soul and strength to his family members to bear the impact.