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Publisher's letter

Narendra Modi-led government is set to present its first Union Budget after re-election in the recently concluded 2019 Lok Sabha elections. The power sector is keeping its fingers crossed on whether the government will be able to carry out the necessary mid-course correction measures to facilitate the much-needed boost to the sector.

Renewable industry remains at the limelight for quite a while now. As the country targets to achieve 175 GW generation capacity by 2022, renewable energy initiatives are taking centre stage. However, experts believe, this industry may gradually fade away if issues like delaying payments and reducing profitability are not addressed in time.

Nikunj Ghodawat, Chief Financial Officer, CleanMax Solar suggests that the Centre should formalise power ministry's recommendation to the RBI to categorise renewable energy into a separate segment and remove priority sector lending limit for the sector to ensure higher credit financing availability whereas Radhika Choudary, Co-Founder and Director, Freyr Energy recommends income tax benefits for a customer to go solar.

According to industry estimates, the electrical equipment industry is facing slowdown in few product segments, due to lack of demand and increasing imports that has touched around US$ 10.24 billion in 2018-19. Amid this backdrop, industry body IEEMA has urged the government to increase the competitiveness of the domestic electrical equipment industry by reducing the cost of manufacturing.

Hope the Budget announcements will give a much-needed breather to the power sector as a whole.

Do send me your comments at miyer@charypublications.in

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Green signal for EVs

Globally, electric mobility is all set to transform the transportation industry like never before. Keeping pace with the changing global trends, India is gearing up to welcome more and more electric vehicles (EVs).

Of late, to escalate the adoption of EVs in the country, NITI Aayog, the government think-tank proposed that after March 31, 2023, only electric 3-wheelers would be sold and, after March 31, 2025, all new sales of 2-wheelers below 150 CC would be electric (with lithium ion or other advanced battery chemistry only). Further, to encourage EV purchases, the Road Ministry announced exemption of road tax for all EV registrations.

Meanwhile, the FAME II (Faster Adoption and Manufacturing of Electric Vehicles) scheme was announced in March this year to catalyse the market for faster adoption of EVs. The scheme incentivises the purchase of 10 lakh electric 2-wheelers, 5 lakh e-rickshaws and 7,090 e-buses. Also, an allotment of Rs 10,000 crore was announced as incentives for various categories of EVs.

However, charging remains the biggest deterrent to potential EV buyers in India. Experts believe that setting up of adequate battery swapping stations across the country will ease the EV transition. Battery swapping enables replacement of a depleted lithium-ion battery with a fully charged one in few minutes. The industry body FICCI has urged the government to incentivise battery swapping stations as it is being given to EV charging stations under FAME II.

The end-user industries are also expressing their commitments towards successful adoption of EVs. In a recent move, the Walmart-controlled e-commerce giant Flipkart has announced an aggressive plan to replace its entire delivery fleet with EVs and accordingly 40 per cent of replacement is targeted by March 2020.

So, I wouldn't be wrong in saying that, the nation is on the brink of a 'green' mobility revolution. ■

Subhajit Roy
Group Editor

Electrical India

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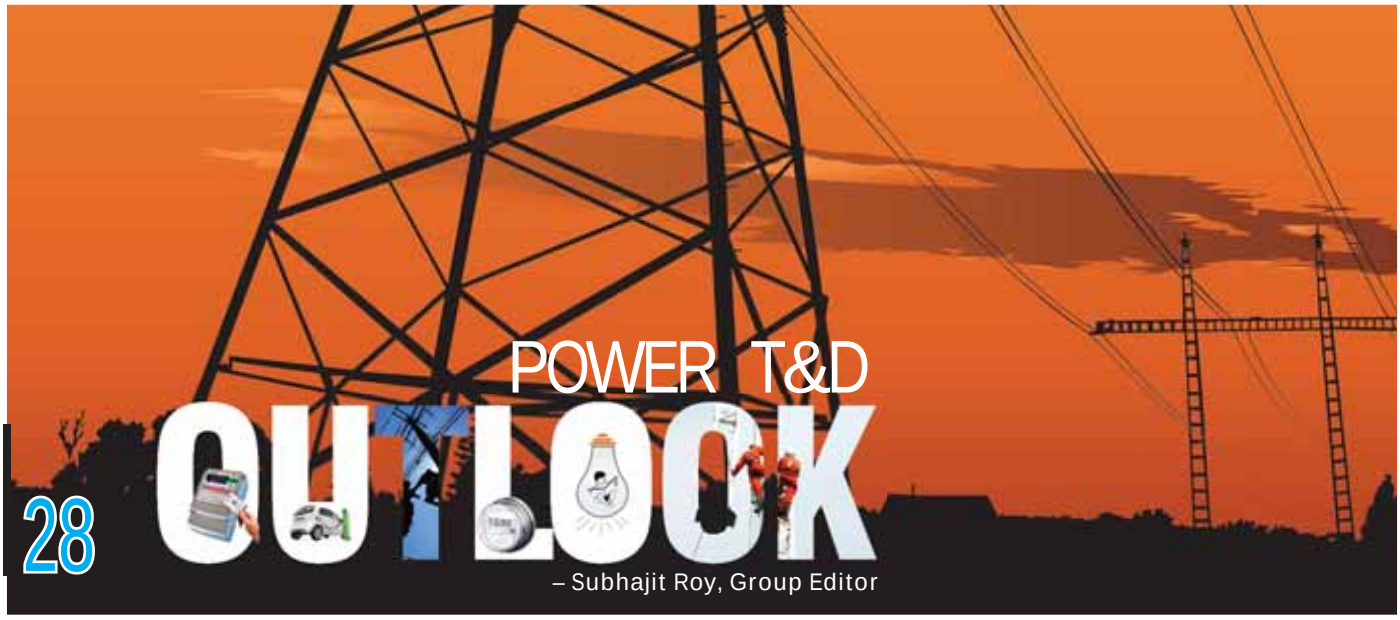

Regulars

POWERGRID signs MoU with Energy Management Centre-Kerala

Power Grid Corporation of India Limited (POWERGRID) has signed MoU with Energy Management Centre (EMC), Kerala to have long term association in the areas of energy efficiency and sustainable energy.

It is a red-letter day in the history of both organisations as POWERGRID becomes the first ever CPSE to sign MoU with EMC, Kerala in the area of energy management. EMC, Kerala was established in the year 1996 under the Department of Power, Government of Kerala as a state designated agency for promoting energy conservation and energy efficiency in the state of Kerala.

POWERGRID will dedicate its expertise to support the initiatives in the areas of energy efficiency in power distribution, energy efficiency in process industries, demand side management programmes, sustainable energy and any other area of mutual interest through its highly qualified technical manpower pool in rational mechanisms towards overall improvement of the power scenario in Kerala through this MoU. The MoU was signed by Sanjay Garg, Executive Director, POWERGRID and K M Dharesan Unnithan, Director, Energy Management Centre, Kerala in presence of other senior officials from POWERGRID and EMC, Kerala at Thiruvananthapuram.

PFC inks an MoU with Ministry of Power

Power Finance Corporation Ltd (PFC) has signed a performance-based 'Memorandum of Understanding' (MoU) with Ministry of Power, Government of India detailing various targets to be achieved by PFC during FY 2019-20.

The MoU has been signed by Ajay Kumar Bhalla, Secretary (Power), Government of India and Rajeev Sharma, CMD, PFC in presence of various senior officials of MOP and PFC. The MoU contains various parameters relating to financial viz., revenue from operations, operating profit as percentage of revenue from operation.

EESL pact with Gujarat Gas to reduce energy costs

Energy Efficiency Services Limited (EESL) has signed an MoU with Gujarat Gas Limited, an Indian natural gas distribution company of Gujarat State, on 24th June 2019. Under this MoU, the company will be responsible for reducing energy costs and enabling access to uninterrupted power, cooling and heating.

In a statement, EESL said, "Our MoU with Gujarat Gas Limited can unlock Gujarat's potential for trigeneration, a highly environment-friendly technology. It will reduce energy costs by 35-40 per cent and enable access to uninterrupted power, cooling or heating. Using up to 80 per cent of input energy (vs 40 per cent for conventional gensets), trigeneration is ideal for industries with large-scale power, heating and cooling needs (e.g. hospitality, health, IT). It will support increased share of natural gas in India's energy mix.'

REC pact with National Association for Blind

REC Limited, a Government of India Navratna enterprise, through its CSR arm, the REC Foundation, signed a Memorandum of Agreement (MoA) with the National Association for the Blind (NAB) to provide it with financial assistance worth Rs 1.34 crore. The agreement aims to support the project under which holistic education and rehabilitation services are provided to children with visual impairment. This is done by initiatives like providing teaching aids, infrastructural development, etc. at NAB's R K Puram campus, Delhi.

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The Oberoi, Gurgaon and Trident, Gurgaon introduce 100% Solar Power

Taking a step towards a greener future, The Oberoi, Gurgaon and Trident, Gurgaon have introduced solar power to fulfill the electricity needs of both hotels. A captive power plant in Balasar, Haryana will generate 7.5 MW of electricity to meet the energy demands of the two hotels.

The solar power plant has been equipped with Polycrystalline technology and is spread over 25 acres with 27,000 solar panels installed, the plant's performance ratio is determined to be 76.50 per cent. The Oberoi and the Trident in Gurgaon aim at reducing CO2 emissions by 12,344 tons per year.

Talking about the initiative, Abhishek Panshikar, General Manager, The Oberoi, Gurgaon, says, "We are proud that our Gurgaon hotels are now operating on 100 per cent solar power. This is our small way of giving back to Mother Nature and providing our guests a sustainable luxury experience."

Amit Khare, General Manager, Trident, Gurgaon, says "Surveys have shown that guests prefer to stay in environment friendly accommodations. This is equally an important priority for us. With this in mind, our guests will be pleased to know that they are now staying in a hotel that is fully powered by solar energy."

Adopting renewal energy like solar power will help resolve many environmental challenges.

IEEMA extends support to restore power in cyclone-hit Odisha

All members of IEEMA stood with people of Odisha with a commitment to take up on priority any assistance which the State Government and Power Utilities needed for faster restoration of the electrical infrastructure. Supreme & Co along with other members of IEEMA have supported the restoration work. India's first indigenously developed Steel based ERS tower by Supreme & Co Pvt. Ltd was used to substitute the wrecked 132 kV towers between Lilo and Puri-Samkuha. This enables charging between Puri Grid and Samkuha Grid to transfer bulk load of 70 MW.

The team overcame some of the challenges successfully at harsh site condition of scorching heat, inaccessible site location with other technical challenges of stringing and clearance. Harish Agarwal, IEEMA President and Supreme CEO, has deputed an exclusive emergency response team of engineers for successful execution of project. His attitude towards the community service at such natural calamity could make such challenging task on ground swiftly. His team members have restored the tower in five hours using ERS structure. This swift restoration has been possible with smooth co-ordination among planning and execution team.

POWERGRID, NTPC MoU to set-up pan-India power distribution venture

An agreement has been signed between NTPC Limited and POWERGRID for setting up National Electricity Distribution Company Ltd. (NEDCL) - a pan-India power distribution firm in an equal joint venture through JVC on 50:50 equity basis. "The main aim is to undertake the business for distribution of electricity in distribution circles of India and related activities," Powergrid said in a tweet.

According to the MoU signed on 21st June 2019 in New Delhi, the new public sector unit will focus on aggregating electricity demand in the country and cater to it and may also take over weak electricity distribution utilities. It will comprise of cadre on deputation from other public sector units and is being set up at a time when the state-owned distribution companies (Discoms) are struggling with their finances on account of losses and borrowings. In such a situation, a national electricity distribution company can procure electricity at competitive rates and help address the issue of stressed assets in power generation.

Srei, PFS join hands to facilitate financing in energy value chain

Srei Infrastructure Finance (Srei), one of India's largest holistic infrastructure institutions, announced that it has signed a Memorandum of Understanding (MoU) with PTC India Financial Services (PFS) to facilitate financing, syndication, and advisory services in the fast-growing energy value chain across industries in India.

Commenting on this occasion, Rakesh Kumar Bhutoria, CEO, Srei, said, "India is on the threshold of a decisive moment in its growth path. To sustain its growth India needs to invest more in its infrastructure. Srei has been contributing to the nation building process in a meaningful way for the past three decades. Our partnership with PFS underlines our unflinching commitment towards building a better India through varied financing solutions and advisory services. We are working with best in class domestic and international capital providers like PFS to meet the funding needs of our clients."

Dr Pawan Singh, MD & CEO, PTC India Financial Services, said, "Our philosophy is 'Association Relationship and Communication', therefore, we have entered this MoU. We look forward to working together with Srei and contribute to the growth of infrastructure sector and the cause of nation building."

Fortum's deal with Hindalco targets NOx reduction in power plants

Fortum, a Finnish clean energy company signed its first commercial project with Hindalco Industries Limited. The project is aimed at NOx reduction through combustion modification on one of the 150 MW boilers located at the Aluminium Smelter Unit in Mahan, Singrauli district in Madhya Pradesh. The modification will enable the power plant to comply with the tightening restrictions on nitrogen oxide emissions to 290 mg/Nm3 from current levels in the unit. The timeline for completion of this project is mid February 2020.

Sanjay Aggarwal, Managing Director, Fortum India said, "The government, among other things, has defined new NOx emission levels for thermal power plants in India to be achieved by 2022. To pave the way forward, we are extremely proud of this association with Hindalco Industries which reflects Fortum's strong commitment to the Indian market. We are hopeful that this partnership will be a long standing one," he further added. Juha Suomi Area Director, Asia, Fortum eNext said, "Nitrogen oxides acidify nature and weaken air quality in cities. Like in most sectors, the advent of technology has been beneficial for overcoming challenges. In fact, it has been instrumental in making thermal power generation acceptable in this changing energy landscape.

Sterlite Power doubles power transmission capacity in Lucknow

Sterlite Power has achieved yet another significant milestone with the successful uprate and commissioning of five, 132 KV lines in the heart of Lucknow.

The project was completed in record time, doubling the transmission capacity of these five existing lines without any major change to existing infrastructure. These lines, which normally carry 80-85 MW load, will now be able to carry a load of over 160 MW after the uprate. Manish Agarwal, CEO, Solutions Business, Sterlite Power, said, "Our solutions of upgrade and uprate of transmission lines solve key constraints around time, space and capital. These solutions have the potential to solve transmission congestion challenges in all states including Uttar Pradesh towards ensuring 24/7 reliable power." All urban transmission lines running through Lucknow were feeding substations of important areas. These lines were over 40 years old and passed through densely populated settlements. With growing population and development, ground clearances were not enough to match transmission requirements. With exponential growth in demand for power, transmission congestion challenges also manifested in excess load, leading to frequent power outages.

Suzlon maintains market leadership in FY19

Suzlon Group announced its fourth quarter (Q4 FY19) and annual audited results for financial year 2018-19 (FY19).

J P Chalasani, Group CEO, said, "We continued to maintain market leadership and deliver highest installations amidst a prolonged and challenging industry transition to the bidding regime. The achievement demonstrates our strong technical and project execution capabilities and over two decades of experience in the Indian market. We continued our excellent track record in operation and maintenance service by achieving 97.48 per cent machine availability, highest till date. FY20 is expected to be a relatively high volumes market with Central and State-level auctions in India. We are geared to capitalise on growth with our superior technology, vertically integrated operations and best-in-class services. We will continue our R&D efforts and remain at the forefront of developing technologically advanced and innovative wind turbines."

Kirti Vagadia, Group CFO, said, "The wind sector continues to witness impact of the prolonged transition phase which is also reflected in our FY19 performance. We remain committed to debt reduction, cost optimisation across the board and execution of our order book. We remain highly focused on ramping up execution in the coming quarters."

Centuary Mattresses commissions solar plant at its manufacturing unit

Centuary Mattresses has announced the commissioning of 240 KW solar system installation at its Kazipally Plant. Freyr Energy, one of India's solar providers, was the preferred partner for this implementation.

Centuary wanted to make sure that it functions as a responsible business. They considered solar for energy generation. Professionalism, absolute focus on quality, and being upfront about all costs made them choose Freyr Energy.

Freyr Energy had commissioned a pilot project of 25KW at Centuary's Kazipally plant. Subsequent to the successful trial run, an additional 215 KW solar power plant was installed in March 2019. With this installation, Centuary is expected to eliminate approximately 329 tons of greenhouse emissions. Uttam Malani, Executive Director, Centuary Mattresses said, "I am positive about the wise choice we have made by partnering with Freyr Energy and look forward to installing solar panels at our other plants too". Saurabh Marda, Managing Director, Freyr Energy said, "We value Centuary Mattresses as an esteemed customer and applaud them for engaging with renewable energy."

Siemens builds 9000 HP propulsion system to boost Indian Rlys' electrification

Siemens is equipping Indian Railways 9000HP electric locomotive with the first indigenously-designed and produced integrated propulsion system and steel tank transformer. The propulsion equipment is completely designed, built and manufactured in India. The high-power equipment will improve haulage capabilities, average speed and utilisation of rolling stock assets.

This propulsion system is uniquely designed to suit requirements of the 9000HP locomotive. Indian Railways is upgrading its electric locomotives from 6000HP to 9000HP as part of its rail electrification initiative.

Siemens is supplying high power traction converters, motors, drive

systems and steel tank transformer, which will be part of the propulsion equipment for 9000HP freight and passenger locomotives. The advanced technology aims to save traction energy cost, thereby reducing carbon emissions. Chittaranjan Locomotive Works (CLW) has pre-commissioned this indigenous 9,000HP electric locomotive and trial runs will commence soon.

Siemens sells electric aircraft-propulsion business to Rolls-Royce

Siemens and Rolls-Royce signed an agreement at the International Paris Air Show in Le Bourget (France) for the sale of Siemens' eAircraft unit. Through its Vision 2020 company strategy, The company's business with electric and hybrid-electric systems for aircraft will have substantially better growth perspectives with new owners closely connected to the aerospace industry. Closing is subject to the usual conditions and is expected to take place in late 2019.

"Our eAircraft team, under the leadership of Frank Anton, has made aviation history several times in the past ten years," said Roland Busch, CTO and COO of Siemens AG. "With Rolls-Royce, we've found a perfect home for this business and have placed its expertise in the hands of one of Airbus' close partners."

Siemens eAircraft develops electric and hybrid-electric propulsion systems for the aerospace industry. At locations in Munich and Erlangen (Germany) and Budapest (Hungary), the unit has been cooperating with partners like Airbus to create prototypes for propulsion systems. To further drive the technology, eAircraft entered a development partnership with Airbus in 2016. Siemens has been researching and developing electric aircraft propulsion systems for about ten years, setting several records along the way.

Hindustan Platinum acquires ABB Humacao, Puerto Rico manufacturing plant

Hindustan Platinum, a refiner and manufacturer of precious metal products and services announces the asset purchase of ABB's Humacao electrical contacts manufacturing plant in Puerto Rico, hence strengthening its international footprint. The deal is expected to close in August 2019. Over the last 58 years of progressive approach and innovative spirit, Hindustan Platinum has had rapid strides of growth, winning confidence of customers globally. The addition of the Humacao Plant is of critical strategic interest to Hindustan Platinum Electrical Contacts Division as it is going to be the second electrical contacts manufacturing facility (besides the one in Navi Mumbai, India) that will cater to the growing demand of the North American and Latin American markets.

Ashish S Choksi, Executive Vice President, Hindustan Platinum said, "This step forward by Hindustan Platinum is expected to have a great deal of synergy from the enhanced competitive positioning in terms of geographical footprint, customer base and range of solutions for electrical contact industry that will be available from both the facilities. Our greatest asset has always been our people who drive excellence through the organisation. We believe the addition of the Humacao Plant will give us a great opportunity and ability to integrate and align people, best technology, skills and processes, which will get reflected in the success of reaching our stated goal in the contacts business."

World's biggest offshore wind turbine heading to UK for testing

GE Renewable Energy has confirmed that the Haliade-X 12 MW nacelle and 107-metre long blade will be shipped to the UK as part of an advanced technology testing program that will focus on enhancing the Haliade-X platform before it enters into serial production in 2021. The Haliade-X nacelle comparable to six Double-Decker London buses, along with the world's longest blade will be transported from GE's production facilities in Saint-Nazaire and Cherbourg (France) to ORE Catapult's testing facilities in Blyth in the North East of England in the months to come.

The Haliade-X 12 MW nacelle will undergo a program that will replicate real-world operational conditions to reduce the time required to validate performance and reliability. In addition, the 107-meter LM Wind Power blade will undergo a full range of advanced testing procedures (including static and fatigue) to fully demonstrate the blade's ability to withstand peak wind conditions and to simulate the blade's readiness for years of operation at sea.

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Hanergy Teams Up with USGBC to Boost Global Development of Green Buildings

Hanergy Thin Film Power Group announced that it has recently inked a strategic cooperation agreement with US Green Building Council (USGBC) on May 14th to jointly foster the application of thin-film solar power products and technologies in buildings globally.

Under the agreement, two parties will conduct research, impart education and training, execute marketing activities and promote the certification of standards such as LEED, SITES and PEER around the globe.

Zhang Bin, Executive Director and Senior Vice President of Hanergy Thin Film Power Group, said, "LEED's mission is to let everyone experience green buildings, which is in line with Hanergy's green ecological building development concept."

With thin-film solar technologies, Hanergy has developed several innovative BIPV products including HanWall, HanTile and HanBrick, which bring considerable environmental, economic and social benefits.

"Hanergy's BIPV products are innovative materials for the development of green buildings. Newest version of LEED emphasises performance by using building technologies to help fulfill prerequisites and credit requirements," said Mahesh Ramanujam, President and CEO of USGBC.

ABB wins transformer order for off-shore wind project in North Sea

ABB has won an order from MHI Vestas Offshore Wind to supply its reliable, energy-efficient and compact WindSTAR transformers for installation in wind turbines in the North Sea. The order was booked in the second quarter of 2019.

Under the project, 100 transformers manufactured in ABB's transformer factory in Vaasa, Finland, will be supplied for Moray Offshore Renewable Power's Moray East offshore wind project. The windfarm will have a capacity to generate 950 megawatts (MW) of renewable wind power in Moray Firth (an inlet of the North Sea), 22 kilometers off the coast of Scotland. The farm will be capable of providing enough clean energy to power up to a million households and could save up to 3.3 million tons of carbon dioxide every year, compared to coal generation.

The 295 square kilometer windfarm will contain enormous wind turbines – up to 204 meters tall to the turbine's blade-tip, each with the capacity to generate 9.5 MW of electricity at 66 kilovolts. This will be made possible by ABB's WindSTAR transformers that are compact enough to be placed inside the wind turbine. They will increase the voltage of the turbine-generated electricity to enable efficient transmission with reduced losses.

UNDP, IRENA join forces to advance low-carbon energy transition

The United Nations Development Programme (UNDP) and the International Renewable Energy Agency (IRENA) announced a global partnership to accelerate low-carbon energy transition and offer concrete steps to achieve sustainable development. Under the cooperation, the organisations will explore joint initiatives aimed at accelerating the implementation of the Agenda 2030 and stimulating renewable energy investments in developing countries.

"The latest evidence shows that renewable energy sources will increasingly form the backbone of our global energy system, making it imperative to better support countries in making the transition to renewable energy sources and in realising the multiple benefits they offer," said UNDP Administrator Achim Steiner. "This partnership does just that by uniting IRENA's technical expertise on renewable energy with UNDP."

The falling cost of renewable energy means renewables are now frequently the cheapest source of new power generation, according to a new IRENA report. Furthermore, jobs in the sector continued to show growth in 2018. IRENA's most recent jobs data shows due to more and more countries manufacturing and installing renewables, renewable energy employment reached eleven million people worldwide in 2018.

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Markus Rocca Appointed as Director of Business Development, EMEA


Markus Rocca

Hammond Power Solutions (HPS) is pleased to announce the appointment of Markus Rocca as Director of Business Development, EMEA, effective from 3rd June 2019.

Markus has worked for HPS in Europe, where he was our Director of Sales since November 2017. He has a Bachelor's Degree in Business and Industrial Engineering from the Karlsruhe University of Applied Science, and he will work on developing new business in EMEA for HPS related to products manufactured in North America and India. Markus' knowledge of building demand for HPS products and his previous skills will be an asset to the HPS Marketing team. His ability to facilitate long term business relationships and his passion for success will further support our growth in the EMEA region.

R P Singh Gets extension as CMD of POWERGRID


Ravi P Singh

The Ministry of Power has extended the tenure of Ravi P Singh, Director (Personnel) as Chairman cum Managing Director (CMD) POWERGRID for a period of six months w.e.f. 21.04.2019 or till the appointment of a regular incumbent.

He is a mechanical engineer from NIT, Allahabad in first class with honours and Post Graduate Diploma in HR from AIMA, New Delhi. He has previously held the positions of Executive Director (Eastern Region-II) and Executive Director (Human Resource Management and Corporate Communication) in POWERGRID. Singh has over 35 years of work experience in the power sector handling various multi-disciplinary functions like HR, telecom, contracts, materials, planning, monitoring and transmission system construction/O&M. Prior to joining POWERGRID in 1991, Singh has worked for 10 years in NTPC.

Thomas Wittek Appointed as R Stahl India MD & Board Member


Thomas Wittek

R STAHL AG, one of the manufacturers of premium quality flame and explosion proof products, has appointed Thomas Wittek as Managing Director and Board Member of R STAHL, India, effective 1st March, 2019. Thomas Wittek succeeds Joerg Fitzek, who will continue his association with R STAHL India in the capacity of Regional Sales Director. In his new role, Thomas Wittek will be responsible for leading several strategic growth initiatives in India and the APAC region. He will directly report to Dr Mathias Hallmann, CEO of R STAHL AG. Thomas Wittek has held several leadership roles for more than 20 years and has a proven track record of establishing sustainable and profitable businesses. Before joining R. STAHL, he has worked with several privately-owned companies and large multinational business conglomerates across Europe, Far-East Asia & the Indian subcontinent. His most recent role was with a major tier-2 automotive supplier in India as their CEO.

Thomas Wittek adds, "I am confident India's growth potential and economic opportunities will surpass that of most emerging markets and I am excited to build R. STAHL India as a Centre of Competence to support the APAC region, Middle East & Africa".

Thomas Wittek will successfully lead and further develop R. STAHL India with his experience, knowledge and energy and will strive to help our customers achieve continued success.

Anil Chaudhry gets Horasis-KPMG Indian Business Leader Award

Schneider Electric, a company in digital transformation of energy management and automation, announced that Anil Chaudhry, Zone President and Managing Director, has been conferred the Horasis-KPMG Indian Business Leader of the Year award for 'Business Transformation'. The award ceremony was held in Segovia, Spain at a function that saw participation of a galaxy of business leaders and global corporates.

A veteran of the energy and automation sector, Chaudhry was recognised for the outstanding work done in the field of energy and infrastructure segment. A strong votary of usage of technology and smart grid initiatives with extensive learning of digitisation, Chaudhry has played a pivotal role in transforming India's rapidly expanding power sector with a focus on providing access to energy for all.

Speaking on the side-lines of the Horasis India Meeting in Segovia, Spain, and after the award ceremony, Anil Chaudhry, Schneider Electric India – Zone-President and Managing Director, shared, "I am extremely honoured and humbled to receive the Horasis Award. This acknowledgement is a testimony of Schneider Electric's commitment to energy efficiency across the globe and particularly in an emerging market like India. Aligned with the company commitment to provide access to energy, we at Schneider Electric we will continue to be a part of the journey to 'Make New India, Energy Positive'."

Lighting for Scottish Parliament Debating Chamber gets IALD Award of Merit

Luminaries of the lighting profession gathered at the elegant Crystal Tea Room in Philadelphia, PA USA on 22 May to honor the winners of the 36th Annual International Association of Lighting Designers (IALD) International Lighting Design Awards. Twenty-three projects from 12 countries were on display—including exteriors, interiors, workspaces, museums, hospitality sites and a place of worship. This year's winners represent some of the most innovative and inspiring architectural lighting design work found anywhere in the world.

The lighting design for the Scottish Parliament Debating Chamber in Edinburgh, Scotland UK by KSLD | EFLA Lighting Design took home an IALD Award of Merit. The soft light that lends a healthy glow to parliamentarians and visiting guests comes from the geometric, visually interesting LED lights gracing the entirety of the chamber.

Judges called these bespoke LED lights a "technically brilliant solution" to the challenge placed before KSLD—how to light a room that functions effectively as a TV studio and an accessible public space.The first step was eliminating the old metal-halide lights as they were expensive, difficult to maintain and obsolete. New HDTV cameras require upgraded lighting to meet broadcasting standards. With a mere six weeks to develop and install the lighting design, KSLD completed multiple site trials and time-lapse daylight studies to determine that the best solution, and one that would honor Enric Miralles' original architecture, was a custom suspended luminaire.

The design integrates suspensions and concealed wiring into the complex ceiling structure. The new LED arrays have custom aluminum extrusion, bespoke precision turning, multi-axis adjustment, acrylic design, stringent output targets, individual controllability, deep dimming, HD broadcast compatibility and an extended lifetime. Based on where current members of parliament are seated as well as glazing studies of the windows and considerations of where fixed louvres can be placed, a diagram was created to manage the placement of all the bespoke LED arrays. The layout and heights appear random, but achieve the necessary lighting distribution.

Indian Electric Bus Market to Reach 7,187 Units by 2025

To deal with the growing concerns related to environmental degradation, the government has planned to roll out fleets of electric and hybrid buses, and has taken initiatives to encourage electric bus manufacturing within the country.

The Indian electric bus market is projected to reach 7,187 units by 2025, growing at a CAGR of 53 per cent during 2019–2025, according to a report by P&S Intelligence.

In recent years, the Indian Government has planned several funding schemes and policies related to electric bus and its charging station, primarily to address the issue of rising pollution levels across the country with the introduction of alternative fuel vehicles (AFVs). Many public transport agencies have signed contractual orders with electric bus manufacturers for the procurement of electric buses. During the forecast period, the market is projected to follow the same tendency as electric bus manufacturers are scaling up their production and offerings.

On the basis of vehicle type, the Indian electric bus market is categorised into battery electric bus (BEB) and hybrid electric bus (HEB). Of these, in terms of volume, the BEB category is expected to continue dominating the market during the forecast period. Higher government support for these buses, coupled with declining prices of lithium-ion (Li-ion) batteries is expected to benefit the market during the forecast period.

Based on length, the Indian electric bus market is categorised into electric buses of less than 10 meters and electric buses of more than 10 meters. Between these two, the less than 10 meters category recorded higher sales volume in the market, with more than 60 per cent share in 2018. Length agnostic subsidy led to the preference for smaller size buses by State Road Transport Undertakings (STUs) in the country.

According to industry experts, the average price of Li-ion battery cells for large order declined from around USD 1000/kWh in 2010 to around USD 333/kWh in 2018. As battery accounts for around 25–40 per cent of the electric bus manufacturing cost, the declining prices of batteries would help bus manufacturers to keep the prices of electric buses under check. Furthermore, it is expected that the cost of electric vehicles including buses, would come down due to increasing operational efficiencies. As in the case of internal combustion engines (ICEs), whose costs have been reduced with decades of experience, the electric vehicle's cost too will also continue to fall with technical advancements, operational efficiencies, and economies of scale, benefiting the Indian electric bus market during the forecast period.

The Indian electric bus market is primarily driven by the government's strict emission norms and regulations, and support in the form of subsidies and grants. Also, to deal with the growing concerns related to environmental degradation, the government has planned to roll out fleets of electric and hybrid buses, and has taken initiatives to encourage electric bus manufacturing within the country. The Ministry of Urban Development has recently launched the Green Urban Transport Scheme (GUTS) with the aim to reduce carbon emissions from the public transport vehicles in the country. The Ministry proposed an USD 3.6 billion (Rs. 250 billion) grant for the development of electric vehicles for public transport in the country.

Competitive Landscape

Olectra Greentech and Tata Motors Limited are the two important players operating in the Indian electric bus market. Other major players in the market include Ashok Leyland, JBM Auto (operates with its joint venture partner Solaris Bus & Coach SA), Optare PLC, Deccan Auto Limited (in technical association with Zhongtong Bus Holding Co. Ltd.), and Volvo Eicher Commercial Vehicles.

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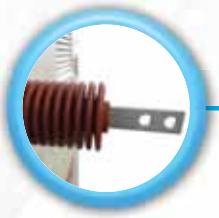

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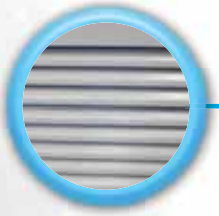

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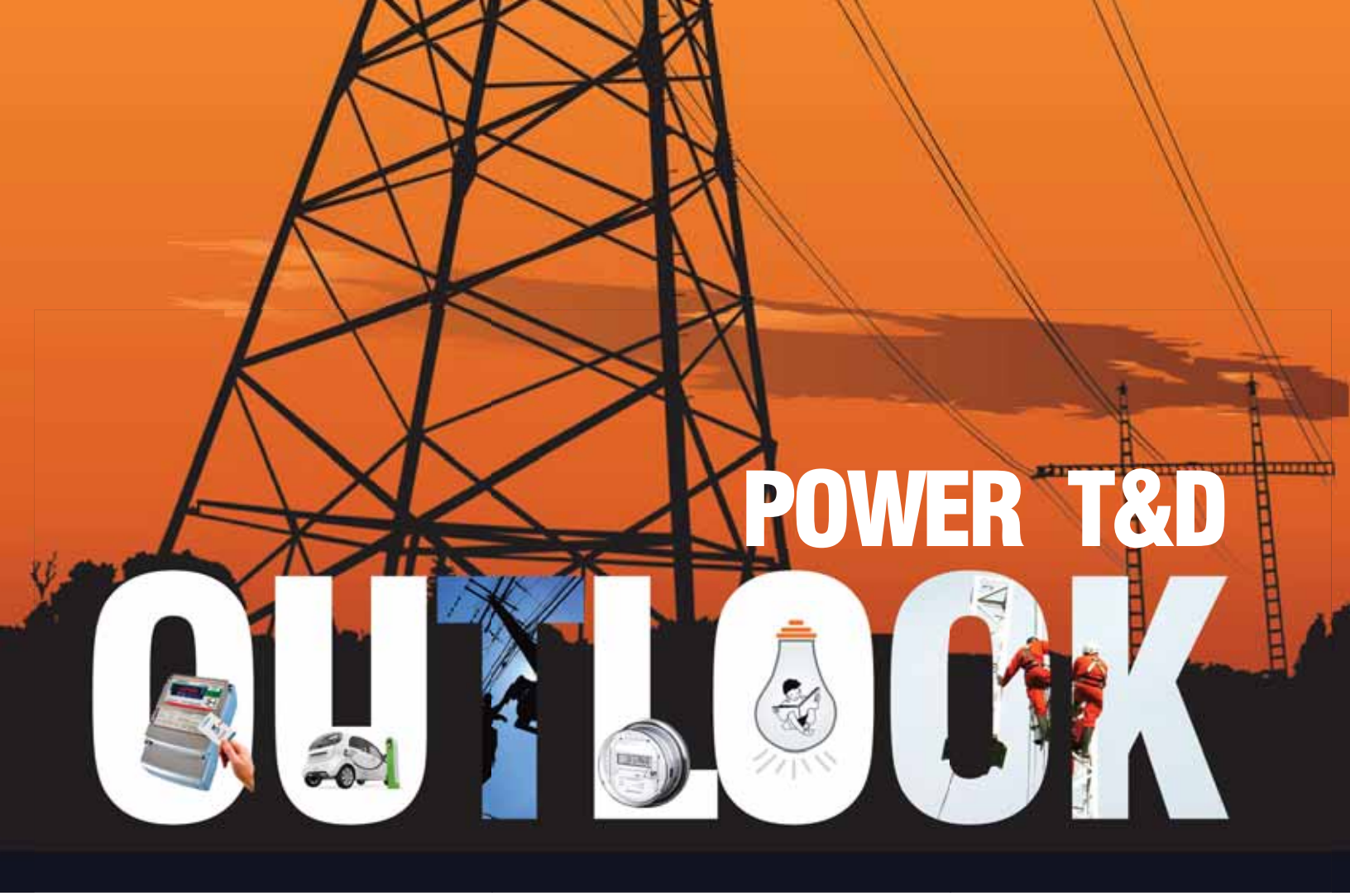

The power T&D market in India is undergoing a significant change that has redefined the industry outlook.

By Subhajit Roy, Group Editor

The power sector in India is going through rapid transformation with an aggressive push to increase energy generation. The country plans to add 131.31 GW of power generation capacity during 2019 to 2022. Recently, in a written reply to Rajya Sabha, Power Minister RK Singh informs, based on the present preparedness of projects, the power generation capacity addition during 2019 to 2022 is likely to be 1,31,316 MW. It is to be noted that as on 31st May 2019, India's total installed power generation capacity was 3,56,817.6 MW. The increased power generation capacity will seek upgradation of transmission and distribution (T&D) infrastructure.

Sharing his outlook on power T&D market in India, Harish Agarwal, CEO of Supreme & Co. Pvt. Ltd., said, "T&D market will change significantly in nature. After successful implementation of Saubhagya, the market will now comprise of corridors for renewal integration, automation, reconductoring and smart or prepaid metering. These will also be a large market for innovative product line – narrow base towers, monopoles, insulated crossarms, HTLS conductors and ERS etc." Mr Agarwal is also the President of IEEMA and VP of CIGRE India. He informs, "We shall also see opportunities in distributed generation, energy storage, electric mobility or even possibly in E-highways. Innovation in technology and business model may be very disruptive. Industry upstream and downstream have to build robustness and resilience in their business process and products."

Table 1: Executive summary of Target and Achievement of Transmission Lines during 2019-2

As on 31-05-19

(All figures in circuit kms.)

Programme / Achievement		HVDC ± 800 kV				HVDC ± 500 kV				765 kV				400 kV				220 kV				Grand Total			
		Central Sector	State Sector	JV/Private Sector	Total	Central Sector	State Sector	JV/Private Sector	Total	Central Sector	State Sector	JV/Private Sector	Total	Central Sector	State Sector	JV/Private Sector	Total	Central Sector	State Sector	JV/Private Sector	Total	Central Sector	State Sector	JV/Private Sector	Grand Total
Programme 2019-20		0	0	0	**0**	0	0	0	**0**	2727	958	2334	**6019**	2239	3416	1143	**6798**	781	10023	0	**10804**	**5747**	**14397**	**3477**	**23621**
May/19	Programme	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	23	**23**	0	750	0	**750**	**0**	**750**	**23**	**773**
	Achievement	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	474	0	**474**	0	503	0	**503**	**0**	**977**	**0**	**977**
Upto May-19	Programme	0	0	0	**0**	0	0	0	**0**	577	416	557	**1550**	60	890	226	**1176**	0	1059	0	**1059**	**637**	**2365**	**783**	**3785**
	Achievement	0	0	0	**0**	0	0	0	**0**	53	0	0	**53**	0	494	0	**494**	0	904	0	**904**	**53**	**1398**	**0**	**1451**

Souce: CEA

However, CP Vyas, President – Electrification Business, ABB India observes: "We are likely to witness moderate traction in the power distribution sector in the medium term. The growth drivers will be increasing urbanisation, smart cities, utility services, and power requirements for expanding infrastructure. Another great catalyst of growth is the technology awareness and acceptance in this sector, which is creating a demand for advanced and sustainable technologies, be it in greenfield or replacement equipment and solutions."

He adds, "Digital technology in switchgears and relays, which optimise safety, reliability of distribution networks, modular, prefabricated structures like power distribution centres to render greater efficiency and reduce carbon footprint in management of infrastructure and outage optimisation."

Major Challenges

According to Mr Agarwal, the major challenges the T&D sector is facing today is in the distribution system. He said, "The distribution system suffers from the problem of low voltage, power theft and high energy losses. The problem of the losses and voltage drop in distribution feeders dependent on each other and varies with the pattern of loading on the feeders."

Mr Agarwal adds, "In the existing system, large capacity transformers are provided at one point and the connections to each load is extended through long LT lines. This long length of LT lines is causing low voltage condition to the majority of the consumers, power theft by hooking the lines, unauthorised connections and high technical losses."

In Mr Agarwal's opinion, to reduce distribution losses, to improve quality of supply and also to prevent theft of electrical energy, high voltage distribution systems (HVDS) are implemented. In HVDS scheme, long length LT lines are converted into 11 kV lines and thereby, installing the appropriate capacity distribution transformer as near as to the end and the supply is provided to the consumer.

To tackle the challenges in the power distribution sector, the government has put in place multiple initiatives. "Aggregate technical and commercial (AT&C) losses would be a key challenge, however with schemes like UDAY, it has been brought down to below 1 per cent. The UDAY scheme has also played a role to a limited extent in helping address the issue of financial health of DISCOMs," opines Mr Vyas. "Indian cities still have a lot overhead network and unsafe distribution, but with the government's focus on reducing distribution losses and infusing greater technology in the sector, cities are undertaking initiatives especially places of heritage, old quarters and of tourist interest like

We are likely to witness moderate traction in the power distribution sector in the medium term.

CP Vyas,
PRESIDENT – ELECTRIFICATION BUSINESS, ABB INDIA

Table 2: Progress of Transmission Sector in the Country up to May 2019

1. TRANSMISSION LINES (All fig. in CKM)

At the end of	± 800 kV HVDC				± 500 kV HVDC				765 kV				400 kV				220 kV				Grand Total			
	Central	State	JV/Private	Total	Central	State	JV/Private	Total	Central	State	JV/Private	Total	Central	State	JV/Private	Total	Central	State	JV/Private	Total	Central	State	JV/Private	Total
6th plan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	1831	4198	0	**6029**	1641	44364	0	**46005**	3472	48562	0	**52034**
7th plan	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	13068	6756	0	**19824**	4560	55071	0	**59631**	17628	61827	0	**79455**
8th plan	0	0	0	**0**	1634	0	0	**1634**	0	0	0	**0**	23001	13141	0	**36142**	6564	73036	0	**79600**	31199	86177	0	**117376**
9th plan	0	0	0	**0**	3234	1504	0	**4738**	751	409	0	**1160**	29345	20033	0	**49378**	8687	88306	0	**96993**	42017	110252	0	**152269**
10th plan	0	0	0	**0**	4368	1504	0	**5872**	1775	409	0	**2184**	48708	24730	0	**73438**	9444	105185	0	**114629**	64295	131828	0	**196123**
11th Plan	0	0	0	**0**	5948	1504	1980	**9432**	4839	411	0	**5250**	71023	30191	5605	**106819**	10140	125010	830	**135980**	91950	157116	8415	**257481**
12th Plan	6124	0	0	**6124**	5948	1504	1980	**9432**	25465	1177	4598	**31240**	92482	48240	17065	**157787**	11014	151276	978	**163268**	141033	202197	24621	**367851**
Plan Period 2017-22 (Up to Mar'2019)	6124	0	0	**6124**	5948	1504	1980	**9432**	33692	1512	6605	**41809**	101335	58238	21173	**180746**	11734	162552	1010	**175296**	158833	223806	30768	**413407**
Plan Period 2017-22 (Up to May-19)	6124	0	0	**6124**	5948	1504	1980	**9432**	33745	1512	6605	**41862**	101335	58732	21173	**181240**	11734	163456	1010	**176200**	158886	225204	30768	**414858**

Note : - The figure upto the end of 10th plan in for stringing progress including the lines not commissioned. Now only commissioned lines are reckoned. Accordingly the figure for 10th plan (end) may read as 187555 after adjusting with (-) 10852 Ckm.

Inter-regional Power Transfer Capacity (MW)	
IR at the end of 11th Plan	27,150
IR at the end of 12th Plan	75,050
IR addition in 12th Plan (up to March 2017)	47,900
IR Capacity Addition at the end of Plan Period 2017-22 (Till May 19)	24,000
Inter-regional Transmission Capacity at the end of Plan Period 2017-22 (as on May'19)	99050*

* 600 MW of 132 kV Inter-Regional power transmission capacity links which are operated radially from time to time is not added in the total.

hill stations to do underground cabling, install ring main units and compact substations, which not only improve the efficiency and safety but also leave the infrastructure less vulnerable to weather elements at a time of climate change."

He adds: "Timely execution of smart city projects will provide a significant catalyst to improvements in smart power distribution. Also, new trends like distributed generation of power including microgrids and the addition of renewable energy are some of the other factors, which also have a bearing on developing a seamless distribution network."

Innovative technologies contributing to sectoral growth

Distribution network remains at the core of power supply ecosystem. Many companies are developing and innovating best-in-class global technologies 'Made in India' to partner the building of a safer, sustainable and more reliable power distribution network in the country. A few examples would be equipment, which reduce footprint and space requirements. India has some of the world's most populous cities, each having close to 30,000 people per square kilometres. With such high population density, free space is clearly limited. "Prefabricated, modular solution of power distribution centers (PDCs), safeguard the distribution of power and bring footprint savings of up to 30 per cent," opines Mr Vyas. "The prefabricated modular nature of the PDC is an engineering innovation that optimises space, reduces construction time and resources, and enhances public safety."

Monitoring and diagnostics solutions provide a higher life expectancy and high energy savings of equipment and solutions for the customers. According to Mr Vyas, the focus on environment friendly solutions also entail an alternative to SF6 in medium voltage distribution equipment. SF6-free GIS solutions are innovatively designed to save on footprint and protect the environment. Smart solutions entail production in smart factories bringing all new digital experiences to customers. Solutions like auto recloser is one such innovation, which contributes to reliable power for consumers by maintaining uptime during majority of the fault cases. Thus, Mr Vyas observes, various automation solutions are continuously bridging the gaps between consumer and distribution infrastructure.

There are also smaller distributed generation models of microgrids MGS 100, which are being incorporated as a localised power generation and distribution model to provide greater and equitable access to energy.

According to government data, of the 26.30 million households targeted under the Pradhan Mantri Sahaj Bijli Har Ghar Yojana or Saubhagya got electricity connections, 99.93 per cent, or 26.28 million households, have got electricity connections as on 21st May 2019. Now, the new government at centre targets to provide reliable, sustainable and affordable 24X7 electricity to all. However, in order to achieve 24x7 power for all, a robust Indian power transmission system is essential. In

Continued on Page 32

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this context, attempts have been made to review the relevant aspects related to optimal economic planning of transmission lines. Supreme & Co. Pvt. Ltd. has developed Emergency Restoration System (ERS) that is used in case of any line reconductoring or re-routing. There are enormous benefits of ERS since such lightweight and can be erected in any kind of soil. Unlike the old restoration techniques, the line is restored and charged within few hours by using our ERS and thus prevent a huge financial loss of the utilities. Thus, it can be concluded that Supreme's emergency restoration technique is a unique solution to cope up with the emergencies caused by the natural calamities as well as for line uprating, claims Mr Agarwal.

Conclusion

The power T&D market in India is undergoing a sea change as the country is committed to provide reliable, sustainable and affordable 24X7 electricity to all. Also, as the focus on renewable energy resources is ever increasing, the T&D sector is in pursuit of better efficiencies and more suitability.

Of late, in a major decision to facilitate the solar and wind energy projects, the power ministry has approved the formation of a three-member Dispute Resolution Committee to consider the unforeseen disputes between solar or wind power developers and SECI or NTPC, beyond contractual agreement.

"The issue was considered and it was felt that there is need to erect a transparent, unbiased Dispute Resolution Mechanism, consisting of an independent, transparent and unbiased Dispute Resolution Committee (DRC), for resolving the unforeseen disputes that may arise in implementation of contractual agreements and also for dealing with issues which are beyond the scope of Contractual Agreements between solar power developers or wind power developers and SECI or NTPC," an official statement issued by MNRE had said earlier. This move is expected to bring in efficiencies in resolving the sectoral disputes pertaining mostly to time request extensions along with various other common issues being faced. Therefore, it is expected to play a crucial role in easing solar and wind power project implementations, thereby driving renewable energy sector's growth.

After successful implementation of Saubhagya, the market will now comprise of corridors for renewal integration, automation, reconductoring and smart or prepaid metering.

Harish Agarwal,
CEO, SUPREME & CO.,
PRESIDENT OF IEEMA &
VP OF CIGRE INDIA

Further, the growth in renewable sector will push the demand for reliable, stable transmission systems to deal with the intermittent nature of renewable energy sources. Also, the advent of net metering and policy thrust on electric vehicles are all set to change the dynamics on electricity transmission.

India's power distribution segment continues to struggle by issues like inadequate tariff hikes, high T&D and AT&C losses, inadequate and untimely subsidy disbursements. In 2015, the Narendra Modi-led government had launched the Ujwal DISCOM Assurance Yojana (UDAY) to turn around the financial health of struggling state DISCOMs. Though the scheme has shown some remarkable results in few states, it is yet to make significant impact across the country. As a result, at the end of FY19, losses of the DISCOMs have shown over 40 per cent growth and reached to the tune of Rs 21,658 crore.

On this note, in an aim to manage the challenges being faced by state-owned DISCOMs, the two state-run power giants — NTPC and PowerGrid Corporation of India Limited (PGCIL) — have signed an agreement to set up a joint venture National Electricity Distribution Company Limited (NEDCL). "The objective is to undertake the business for distribution of electricity in various states and union territories of India and other related activities," PGCIL said in a statement. NEDCL, the 50:50 joint venture DISCOM, is being touted as the 'gamechanger' and is expected to address issues like power theft and other roadblocks.

Open Access with Blockchain enabled Smart Metering

Blockchain technology is expected to extend the benefits of investments in renewable energy microgrids and a change of ecosystem to the consumers through open access.

Earlier, since Independence, the Indian power sector was dominated by state- and centrally-owned vertically integrated utilities. When the Indian economy opened up in the early 1990s, large-scale liberalisation and industrialisation led to a rapid increase in the demand for power. To meet this demand, the quantum of investment needed grew exponentially and could no longer be supported by the government. Hence, power generation was de-licensed and opened to private investment in 1991, resulting in Independent Power Plants (IPP). After five years, the focus shifted to unbundling of the State Electricity Boards (SEBs) to ensure better returns from the generation and transmission businesses.

In 1998, the Electricity Regulatory Commission Act was notified, that laid down provisions for establishing independent regulatory commissions at the state and central levels to regulate electricity prices. Eventually, the Electricity Act 2003 was formulated to address the changing needs of the power market. The Act focused on two elements: (a) "development of a competitive power market with transparent market-driven pricing mechanism that offers the consumers enough options to

choose from", and (b) "provide the right policy, legal and regulatory platform to the consumers for exercising their choice." Based on these two core agendas, the Electricity Act 2003 has six major themes: (i) Reorganisation of the state owned vertically integrated electricity boards, (ii) Delicensing of power generation to enable higher investments, (iii) Trading and market development, (iv) Tariff and subsidies, (v) Consumer interest, and (vi) Open Access.

Promoting competition in the electricity sector is one of the cornerstones of the Electricity Act, 2003. In the spirit of encouraging competition, the central and state governments initiated various reform measures such as open access for consumers above 1 MW of load, competitive procurement of power, and competition in power transmission and distribution franchisee initiatives. To this end, State Electricity Regulatory Commissions (SERC) have been given the mandate to monitor and regulate state power utilities as well as power markets with a view to ensure power availability at competitive rates to all consumers.

However, the roadmap and implementation of open access to consumers, remained an area of discussion and debate. It is believed that open access - the last of the challenges can be effectively met with blockchain enabled smart metering, the revolutionary new concept discussed here.

Competition in Generation and Transmission segments

Post-liberalisation and following de-licensing, to attract significant investments from the private sector, a number of fiscal and financial incentives were offered under various schemes such as Mega Power Policy and tax holiday. After enacting the Electricity Act 2003, the Ministry of Power came out with competitive bidding guidelines for procurement of power, which allowed price discovery through market-based mechanism. This ensured a level ground for both private and public generation companies presenting them equal opportunities to access the market and more importantly, it ensured competitive prices to benefit the consumers.

Soon after, similar competitive bidding guidelines were put in place for enabling competition in power transmission as well and more than a dozen inter-state transmission projects were awarded under the competitive bidding regime. A number of states, too, embraced competitive bidding in power transmission to

enable private sector investments in the sector. Thanks to competition in generation and transmission, today, distribution companies and open access consumers have the option of buying power from any generation company located at any place in the country that offers favourable prices.

Competition in Indian distribution segment

The Electricity Act, 2003 laid down the foundation for introducing competition at the consumer end through open access and provision for parallel licensees. However, in sharp contrast to generation and transmission sectors, private participation in the Indian electricity distribution sector has been very limited and the spirit of competition still at the nascent stages.

Issues plaguing consumer choice

Parallel Licensee Regime

The parallel licensee regime insofar as it requires distribution licensees in an area to distribute power "through their own distribution system within the same area" has potential adverse consequences on tariff. Each distribution licensee investing in its own network leads to replication of network and, as capital investment is a pass-through expense, it pushes up costs or tariffs for the end consumers.

Open Access

Open access has not taken off very successfully even though all states have put in place regulations for open access for consumers above 1 MW of load. Operationalisation of open access has its own share of problems as detailed in the following sub-section. Pure play privatisation has had limited success in metros like Delhi, Mumbai and Kolkata. Distribution companies in some states are now adopting the distribution franchisee model which is showing signs of being a viable model to enable competition and investments in distribution sector. But the market today needs another reforms initiative, targeting end consumers of electricity. Blockchain can fill this void.

Roadmap of Open Access

In November 2011 the Ministry of Law and Justice, Government of India expressed its interpretation on the provisions of Electricity Act 2003, that consumers above 1 MW shall be deemed to be open access consumers and that SERCs can no longer continue to regulate the tariff for supply of electricity to any consumer of 1 MW and above. The need for discussion on introducing retail competition in electricity started gaining ground in light of this interpretation of the Act. There are various reasons that may be identified for the lacklustre operationalisation of open access in India, as briefly set out below:

- Power deficit scenario: The country's power deficit scenario makes the power market a seller's market that is not very conducive to open access buying of power. With power demand greater than supply, the non-regulated prices of electricity (through trading or discovered in power exchanges) remain high, thereby, eroding the extent of savings in power purchase cost envisaged through open access.
- Lack of regulatory consistency in determining wheeling charges and cross subsidy surcharge: There is no consistency in regulatory philosophy followed by state regulators in determination of wheeling charges and cross subsidy surcharge (paid by open access customers to distribution licensees). Due to unavailability of voltage wise data on cost of supply and distribution losses, state regulators have to allocate costs and losses between the wheeling and retail supply functions on the basis of assumptions.
- Conflict of interest: Existing distribution licensees are wary of losing their high-paying and cross subsidising consumers and hence, resist the concept of open access. Thus, conflict of interest is a major impediment in operationalisation of open access.
- Inadequate infrastructure: Another key issue impeding open access is the lack of adequate transmission and distribution infrastructure leading to congestion in the network. This requires heavy investment in not only transmission but also the distribution (wire) network but the most distribution utilities are too cash-strapped to make adequate investments in infrastructure.
- Lack of consumer awareness: Consumers, especially, smaller commercial or industrial users, are often at a loss about the process of open access along with specifics such as which trader or generator to approach, how to tie up power, prevailing market rates of buying power, etc. Consumers also fear the repercussions they may face from the distribution utility in terms of denial of technical support (such as repair of line breakdowns), denial of standby power in emergency, etc.

Continued on Page 38

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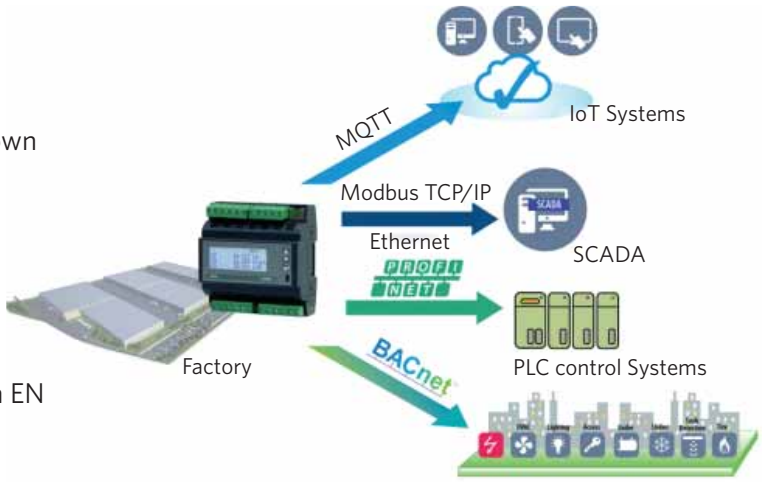

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Open Access in a MicroGrid using Blockchain based Smart Metering

Lack of Regulatory Consistency in Open Access Charges

In October 2018, the Gujarat Electricity Regulatory Commission (GERC) issued an order stating that an additional surcharge of Rs 0.44 (~0.6¢)/kWh will be applicable over the half-year ending March 2019 for consumers availing power through open access from any source other than their respective distribution companies (Gujarat Urja Vikas Nigam Limited i.e. GUVNL's DISCOMs).

For renewable energy sources, the surcharge will not apply if the open access is utilised for captive consumption. However, if the open access is being utilised to perform third party sale of energy generated from renewables, then the surcharge will apply.

Earlier, the Uttarakhand Electricity Regulatory Commission (UERC) had issued the terms and conditions of intra-state open access for the year 2018 under which the agency introduced a cross-subsidy surcharge for open access consumers.

On the other hand, recently, the Maharashtra Electricity Regulatory Commission (MERC) rejected the proposal made by Maharashtra State Electricity Distribution Company Limited (MSEDCL) to approve the levy of additional surcharge (wheeling charges) for rooftop solar projects in the state.

Thus, different SERCs have varied views on open access and the levy of surcharge on it. There is a need for a uniform methodology for the determination of various charges such as open access charges, cross-subsidy surcharge and additional surcharge across the country. This will also help in the growth of renewable energy generating sources.

Need to Promote Renewable Energy

India is the third largest emitter of greenhouse gases in the world, and if India continues with the current mix of fuel sources, the impact on world environment would be devastating. To address this grim situation, the government made plans to install 175 GW of additional renewable capacity by 2022, of which 100 GW would be solar. Coupled with a drop in the average price of solar electricity below that of its coal-fired counterpart, it is anticipated a good future for solar if the producers are given adequate opportunities to sell their surplus power. New concepts in energy trading and metering such as blockchain represent such opportunities.

What is a Blockchain?

Blockchain is a distributed digital transaction technology that allows for secure data storage and execution of smart contracts in peer-to-peer networks. The first blockchain was developed in the financial sector to serve as a basis for the cryptocurrency 'Bitcoin'.

New applications add to the technology's core functionality – decentralised storage of transaction data – by integrating mechanisms that allow for the actual transactions to be effected on a decentralised basis. These mechanisms, called 'smart contracts', operate on the basis of individually defined rules (e.g. specifications as to quantity, quality, price) that enable an autonomous matching of 'distributed providers' with their 'prospective customers'.

Open Access using Blockchain

Blockchain can serve the power industry with its potential to unleash an energy revolution in which both utilities and consumers can produce and sell electricity. The smart home appliances connected to an energy trading platform could continuously look for the best offer

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and automatically shift to a new energy provider through a smart contract. This experience allows the customers to interact from their home or office directly to the energy sellers. Blockchain offers a reliable, low-cost technique to record and validate financial or operational transactions across a distributed network with no central point of authority. Similarly, the producer-consumers or "prosumers" can sell their surplus energy to other customers in the network directly through contracts established and validated through Blockchain.

Blockchain is a foundational technology that can be used to create new business models and underpin business, economic, and social infrastructure. While many blockchain use cases have been proposed for the energy industry, the one gaining the most traction at present is peer-to-peer (P2P) power trading, where owners of small-scale generation can sell excess generation directly to other consumers.

Today, centralised control of distributed energy resources (DER), such as solar generation, restricts to whom and when DER owners can sell their energy back to the grid. A blockchain-enabled P2P model allows much greater flexibility and could be a powerful enabler for a customer-centric transactive energy regime.

The smart contracts don't have billing components around it and hence there are no infrastructure losses or accounting losses in the system. The "prosumers" can set personal preferences for the distribution of the energy they produce. One might decide to sell his excess energy for maximum profit, while another could choose to donate a portion to low-income consumers.

To support the development of blockchain-based solutions for the energy sector, numerous organisations have set up laboratories to build new blockchain applications such as distributed ledger solutions and its use-cases. These new applications when successfully adopted on a mass scale would have profound impact on the business models of the entire energy sector value chain.

How Blockchain works?

- Blockchain keeps a record of all data exchanges — this record is referred to as a "ledger" in the cryptocurrency world, and each data exchange is a "transaction". Every verified transaction is added to the ledger as a "block".
- It utilises a distributed system to verify each transaction — a peer-to-peer network of nodes.
- Once signed and verified, the new transaction is added to the blockchain and cannot be altered.

Buying and Selling Power using Blockchain

The blockchain technology (BCT) offers the following benefits in the electricity sector:

- Customers can turn into service providers by selling surplus energy produced through solar rooftops; opens up entrepreneurship avenues for many.
- Process of energy generation and distribution becomes more direct between suppliers and consumers requiring minimum interface and no middlemen. This will, among other things, reduce bills.
- Eliminates scope for any error or manipulation of the bill amount.

Using BCT, one can sell the surplus power generated from his solar rooftop to a neighbour rather than to the grid without the involvement of any middleman, including a discom. All this can be done in a completely decentralised system, automatically balancing demand and supply and transacting against a set of pre-coded set of rules.

Uttar Pradesh came forward to implement blockchain technology for renewable energy generation and supply. Critics believe that executing the idea might not be that easy in UP which had not been able to fully operationalise the open access system (where buyers have a choice) even 15 years after it was provided in the Electricity Act. They feel that UP needs to tackle various legal and regulatory issues before the blockchain idea is put to practice.

The UP Electricity Regulatory Commission (UPERC) feels otherwise and organised a conference in October 2018. UP plans to produce a lot of solar power that would make it the greenest pasture for investment in renewable energy and distribution sector. Hence, BCT is expected to play a significant role in extending the benefits of these investments and a change in ecosystem to the consumers.

Blockchain enabled Smart Meters

Implementation of the idea requires smart meter technology and blockchain with inbuilt smart contract functionality. These blockchain-enabled smart meters know when to buy and sell power and record all the transactions between various households. The

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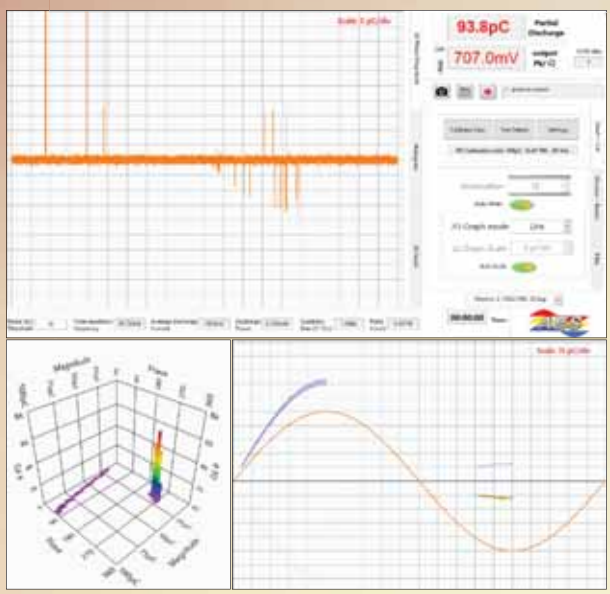
Partial Discharge Measurement System



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payments, too, are made in a secure and decentralized setup without any intermediary.

Segregating Wire Business from Retail Business for Open Access

The reason why open access has not been able to take off in India can be traced back to the fact that distribution companies in India manage businesses of two different natures – wire business and retail business. The wire business by nature is a monopolistic and regulated-return earning business. Retail supply, on the other hand, is more conducive to providing consumer choice in the form of multiple suppliers, as it involves the purchase of electricity in bulk from generators and selling it to consumers, apart from customer service, billing, and collection of charges from consumers.

In a market structure, wherein the wire business as well as retail business are handled by a single distribution company, conflict of interest makes the distribution company wary of losing its retail segment to competition. Hence, the scope for introducing open access and retail competition is limited in this scenario. To overcome this issue, it is pertinent to segregate the wire business and retail business. In such a market all wire businesses will serve as common carriers and will be paid a reasonable regulated rate of return on their investments. The additional surcharge of Rs 0.44 (~0.6¢)/kWh that GERC has set for consumers availing power through open access could cover the charges of the wire business - namely that of the respective GUVNL's DISCOMs.

The retail business could be made open to multiple companies operating in the same area, with end consumers having the choice to choose their retailers based on price and service quality. Retail competition is expected to enhance operational and cost efficiencies, and give the end consumer more choice. Cost efficiency is achieved as competitors try to reduce input costs, and operational efficiency is focused upon as performance becomes a major criterion for consumers exercising their choice amongst various suppliers. Competitive power retailers would buy electricity from generators or in the wholesale market and package it to meet varied consumer demands. Their commercial viability would depend on their ability to meet consumer preferences and, in the face of competition, this is expected to result in lower retail prices (as competitive suppliers cut margins) and greater effort by competing retailers on increasing efficiency and consumer welfare.

Therefore, by introducing competition in retail supply and making sure that the market functions well within the defined set of rules, market competition is expected to ensure service quality as well as appropriate pricing. Bringing in user choice through competition also helps in redefining the regulator's role from being a price-setter to that of a monitoring body and arbitrator. In a competitive framework, the regulator's role would be to establish guidelines or rules for the competitive retail market and strictly monitor the market for compliance, instead of fixing tariffs for every service.

Conclusion

Blockchain is in its early stages for energy and new crypto technology applications and advancements are regularly occurring. In the energy industry, big changes in open access are expected over the next few years as more and more companies are doing blockchain Proof of Concept (PoC), creating a business case and building a startup team for this disruptive technology.

To promote renewable DERs, it is necessary to create an open access ecosystem using blockchain enabled smart meters. Small pilots need to be implemented and tested. Private energy players should be given an opportunity by providing essential infrastructure like micro grids, smart meters and a blockchain platform. They can then act as an aggregator to connect all energy producing points in a village or a community along with the energy consumers together over the distributed blockchain platform. Such a move would promote competitive pricing and make energy more accessible for everyone in the grid. One would notice that utility operations, business models and organisation structure are being made flexible to adapt to fast changing circumstances brought about by the new applications around blockchain technology. Regulators, policy makers and utilities are eagerly watching the developments in this space closely, since now they all believe that blockchain technology can truly make open access a reality.

Dr. Vithal N. Kamat

Director,
Centre for Apparent Energy Research,
Anand

DISCOM Health Card

Improvement in operating efficiency, timely pass-through of cost variations to the consumers, financial discipline in realising subsidy payments and dues from government departments remain crucial for achieving a sustainable improvement in DISCOM finances.

State-owned distribution utilities (DISCOMs) remain as the weakest link in the power sector value chain, thus, adversely affecting the demand prospects for the power generation companies as well as delaying in making payments on the power purchase dues. This is owing to their weak financial profile caused by high operating inefficiencies reflected from high AT&C losses (aggregate technical and commercial losses) and inadequate tariffs and subsidy in relation to the cost of supply. So, the government launched the Ujwal DISCOM Assurance Yojana (UDAY) in November 2015 with an objective of a financial turnaround of state-owned DISCOMs. Apart from an improvement in the operational efficiencies of DISCOMs and a reduction in the cost of power purchase, the scheme envisaged a significant state government support, mainly in the form of taking over of 75 per cent of the DISCOM debt (50 per cent in H2 FY2016 and 25 per cent in FY2017) by the respective state governments. State governments in 27 states and 4 UTs signed MoUs with the Ministry of Power for implementation of the scheme. Of this, debt restructuring was undertaken in 15 states, with bonds worth Rs 2.32 lakh crore, which have been issued by states towards refinancing the debt of the DISCOMs. This in turn has improved the DISCOMs' liquidity profile to some extent and reduced their book losses.

Despite these measures, the median cost coverage ratio (ratio of revenues collected and the aggregate expenditure incurred by a DISCOM) for distribution segment continued to remain less than one, though improving from the levels seen during FY2013-FY2016. This is because of the slow improvement in lowering the AT&C loss levels and inadequate tariffs approved by the regulators in relation to the cost of supply for the DISCOMs. Also, the inadequate implementation of fuel and power purchase cost adjustment (FPPCA) framework by distribution utilities in many states have also adversely affected the credit profile of the distribution utilities. The UDAY MoUs set the AT&C loss target to be reduced to 15 per cent by FY2019 for most of the states, with some states being provided additional time to meet this target. As per UDAY website, the AT&C loss levels continue to remain significantly high in several states as compared to the target fixed. Furthermore, the loss levels in some of the states remain largely the same as against the loss reported in FY2015.

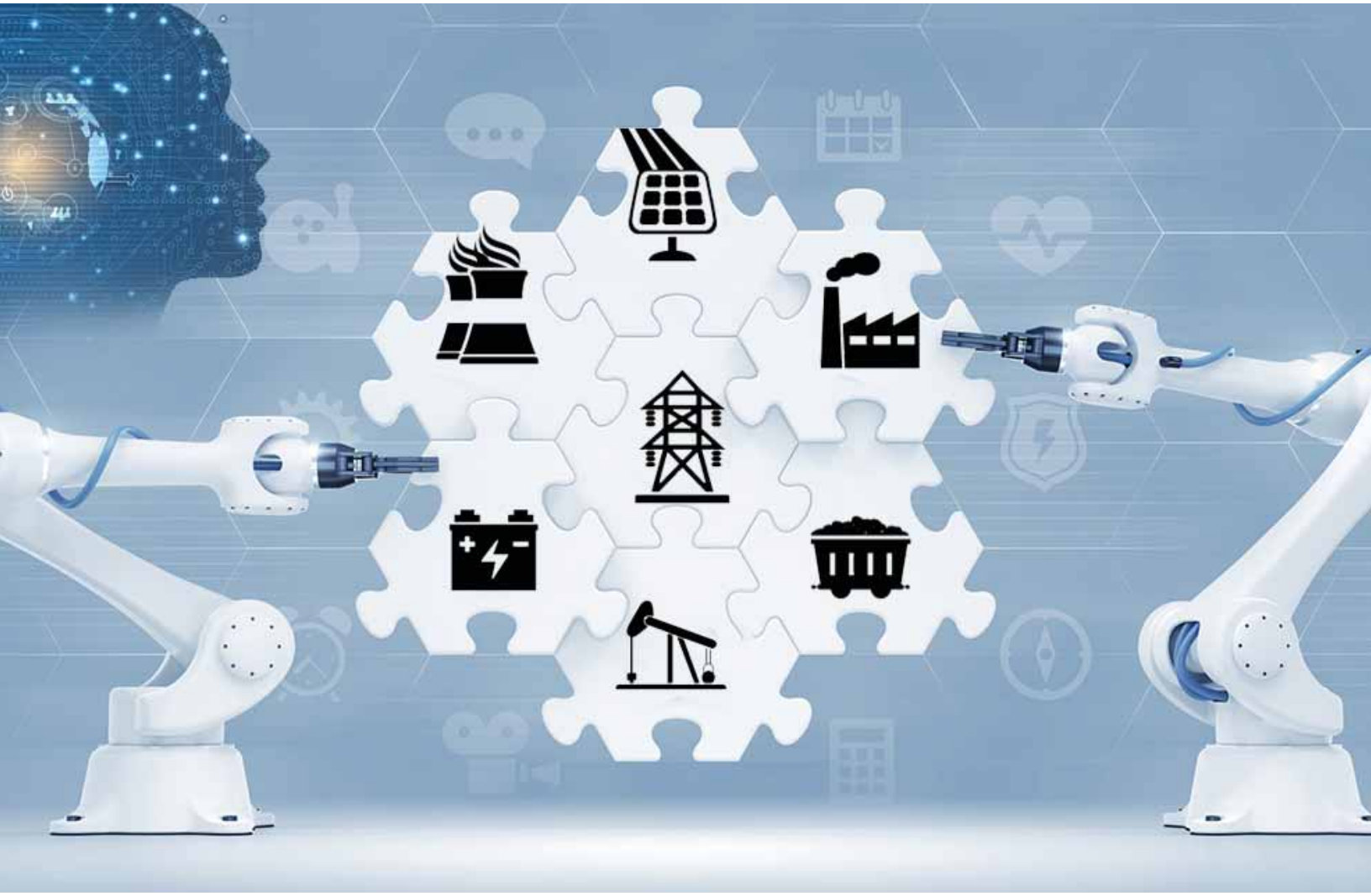
Another aspect of the UDAY scheme was the timely filing of tariff petitions by the DISCOMs and the issuance of tariff orders by the State Electricity Regulatory Commissions (SERCs). However, the tariff hikes proposed by the DISCOMs and approved by the SERCs for the past two to three years have remained lower than what was agreed under the UDAY MoUs, leading to a persistent gap between the average tariff and the average cost of supply, though reducing from the earlier

years. The median tariff hike for the DISCOMs at the all India level has reduced from 8 per cent for FY2015 to 4 per cent for FY2016 and FY2017 and further to 3 per cent and 1 per cent for FY2018 and FY2019 respectively. The tariff hike is likely to remain subdued for FY2020 as well, given the limited or no tariffs hikes approved so far. This, along with the relatively high AT&C loss levels, is likely to slow down the process of financial loss reduction for the DISCOMs. This is also reflected in the delays in realising payments from the state distribution utilities for the power generating companies.

In this context, the distribution segment needs another round of intervention to improve the operation efficiency and achieve a sustainable financial improvement of the DISCOMs. As proposed in the amendments to tariff policy, the central government must enforce measures such as installation of pre-paid meters by the DISCOMs, which would improve billing and collection efficiency. In addition, the AT&C losses higher than a certain level (say 15 per cent) should not be allowed for determination of retail tariffs, thus forcing the DISCOMs to improve their efficiencies. Further, the state government and DISCOMs must consider the distribution franchising mechanism for improving billing and collection efficiency and controlling power theft, especially in high loss areas. Also, the state governments must ensure timely payments of electricity dues by the government departments. In addition, the direct benefit transfer (DBT) mechanism may be looked at as a viable option for subsidy payments. This is in view of the rising dependence on subsidy for state DISCOMs and delays in realising the same from the state governments. Overall, improvement in operating efficiency, timely pass-through of cost variations to the consumers and financial discipline in realising subsidy payments and dues from government departments remains crucial for achieving a sustainable improvement in DISCOM finances.

Sabyasachi Majumdar

Senior Vice President & Group Head - Corporate Ratings, ICRA Ltd



INTELLIGENT AUTOMATION DRIVING EFFICIENCY FOR ENERGY & UTILITY COMPANIES

"The sector must focus on quick wins in core functions such as forecasting, yield optimisation and complaints management."

The global energy and utilities sector is making increasing use of intelligent automation, including a significant rise in the use of Artificial Intelligence (AI) since 2017, but executives are underestimating its full potential with large scale projects taking a back seat, according to new research from the Capgemini Research Institute.

The "Intelligent Automation in Energy and Utilities:The next digital wave" study found that nearly

half of respondents have under-estimated the benefits they derived from their intelligent automation initiatives, while only 18 per cent of organisations are deploying quick-win use cases, and just 15 per cent of those surveyed said their company is deploying multiple intelligent automation use cases at scale.

The report highlights that the traditional energy and utilities business model is under pressure worldwide, with technological changes and increased competition making their presence felt. It cites that automation and AI will also be instrumental in helping these companies to meet climate change goals and the growing demand for clean, cheap, reliable energy.

The report also shows significant regional and sub-sector disparities in the scaling of automation:

- In the United States, 23 per cent of energy and utility companies have deployed intelligent automation initiatives widely at scale, as have 16 per cent in both France and India, compared to just 8 per cent in the UK.
- Meanwhile, a fifth (20 per cent) of oil and gas executives reported multiple use cases at scale, compared to just 6 per cent from water companies.

While the sector is deriving significant value from intelligent automation compared to other industries, scaling, seizing quick-wins and overcoming the critical digital skills gap will be key to bringing it into the mainstream.

Key findings

Key findings of the study, which surveyed 529 leaders at manager level or above in energy and utility companies, include:

Intelligent automation is delivering significant benefits to the sector

The report finds that the sector is already seeing significant value from automation, in terms of boosting operations, top-line growth and engaging customers, compared to other industries. A consistently higher percentage of executives in the energy and utilities sector said they'd achieved benefits from their intelligent automation initiatives compared to the response for 'all sectors'. Example areas of benefit included:

- 40 per cent of executives said they had seen an increase in operations quality (30 per cent for all sectors)
- 45 per cent had seen an increase in inbound customer leads (27 per cent for all sectors)
- 81 per cent had improved the

Figure 1: Percentage of executives saying that they achieved operational benefits from their intelligent automation initiatives (top three benefits ranked)

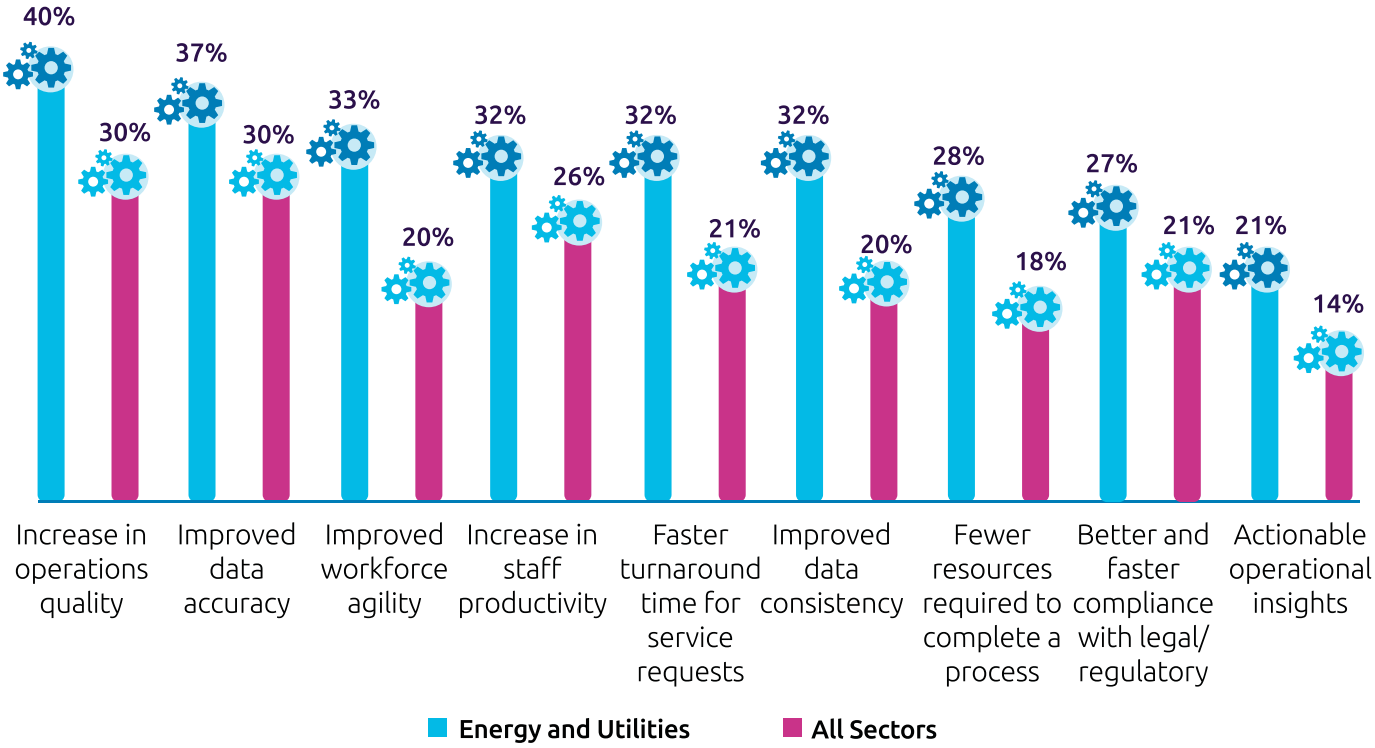
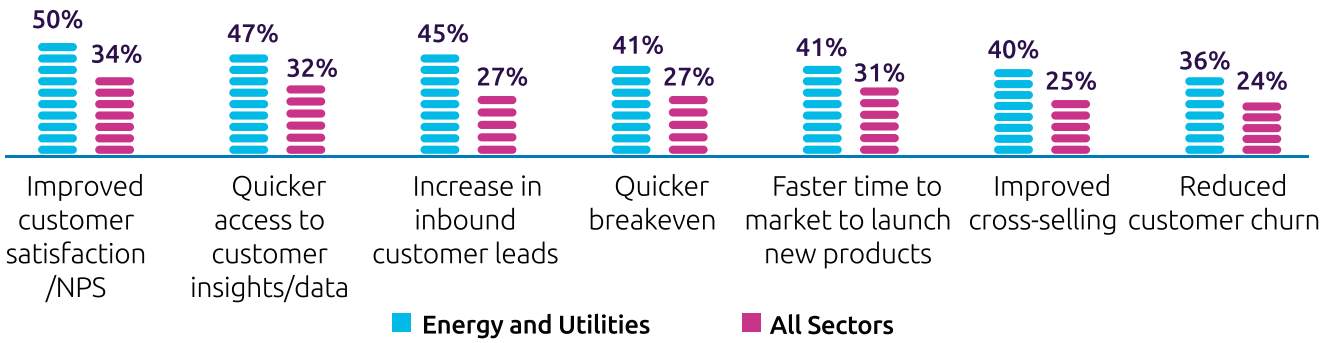


Figure 2: Percentage of executives saying that they achieved revenue growth benefits from their intelligent automation initiatives (top three benefits ranked)



customer experience through faster responses (60 per cent for all sectors)

- 78 per cent saw a reduction in the number of processes relating to queries and purchases (61 per cent for all sectors)
- 32 per cent had seen an increase in staff productivity (26 per cent for all sectors).

In terms of the benefits, 47 per cent have underestimated the cost savings, 48 per cent the customer satisfaction, and 45 per cent the impact on net and incremental revenue.

Abhijeet Bhandare, Chief Automation Officer at GE Power, explains, "We have a very clear filtering criteria defined for automation use cases. We have close to 200 automation ideas in the pipeline, and on average about 50 per cent to 60 per cent of them will be rejected. It is important to focus your attention on the remaining 50 per cent, as they will give you the most value. And you must have the right criteria – whether it is value, efficiencies, cost savings or the opportunity cost. Organisations should focus on quality over quantity of use cases."

80% of organisations are missing out on quick wins for critical use cases

In core functions, only 18 per cent of energy and utility organisations are deploying quick-win use cases (those that are low on delivery complexity but high in terms of benefits achieved such as forecasting, energy trading, yield optimisation, grid behaviour interfaces and complaints management). Instead, just over a third of the energy and utility organisations (38 per cent) are focusing their efforts on use cases that are easy to implement but which have a low-benefit upside.

Business related challenges and skills gap hamper deployment at scale

While overall adoption of AI has matured in the sector, with the majority (52 per cent) of respondents having deployed a number of use cases (compared to 28 per cent just deploying pilots two years ago), only a small minority (15 per cent) of executives said their company was deploying multiple intelligent automation use cases at scale.

Business-related challenges were cited by respondents as barriers to scaling including a lack of co-ordination across different business units (37 per cent), a lack of leadership commitment (35 per cent), and an organisational reticence to experimenting with technology that could replace human workers (34 per cent).

Many executives also pointed to a shortage in skills as a challenge. A majority (55 per cent) cited a lack of talent skilled in automation technologies, with 47 per cent identifying limited efforts to reskill employees, 42 per cent the difficulty of retaining employees with the right skills, and 41 per cent employee resistance to learning new skills.

Philippe Vié, Global Head of Energy & Utilities at Capgemini, comments, "The energy and utilities sector is already seeing the difference that intelligent automation can make in improving business efficiency, customer satisfaction, and revenue. Executives are quite rightly making the deployment of automation one of their top priorities."

He adds, "Now the focus must shift to the factors that will enable the scaling of multiple use cases including an investment in specialist talent, more integrated co-ordination between business units, and a stronger commitment from leadership. Having tasted the benefits of automation, energy and utility companies must now redouble their investment to reap the full rewards."

Leveraging Power of IoT to Smart Cities

In smart cities, from traffic to security surveillance, from water distribution to electricity theft, from pollution control to waste management, are aimed to be powered by IoT, leveraging devices, sensors and real-time apps.

Life has indeed become 'smarter' with smartphones entering everyday life of citizens. Today netizens live in a data-driven world powered by the Internet of Things (IoT), Big Data and Artificial Intelligence (AI). Real-time apps and sensors have brought information at fingertips while ensuring smooth and convenient living for a large part of the population. As Gartner predicts, 70 per cent of the world population will be staying in cities by 2050, which is evidently going to put pressure on its resources, infrastructure building, security management, energy requirement and all related functions. To ascertain that the city-life runs smoothly, the power of technology is something to look forward to.

At the intersection of technology and citizen services, concept of smart cities has emerged, where data-driven technology, surveillance and information sharing are used to monitor, maintain and improve infrastructure and services. In smart cities, from traffic to security surveillance, from water distribution to electricity theft, from pollution control to waste management are aimed to be powered by IoT, leveraging devices, sensors and real-time apps. It would also accumulate data of everyday happenings and analyse them to arrive at day-to-day solutions for the urban problems, improvement opportunities, better execution of services, monitor, manage and upgrade infrastructure, maintain standard and quality of public life.

As estimated by a NASSCOM report, by 2020, India will be having 2.7 billion connected devices. This would include a rise in number of IoT enabled systems. So far, security is definitely one area, where urban India has considerably adopted IoT in recent times. With crime rates rising in every sphere, citizens are increasingly finding it comfortable to have their home, academic institutions, offices, shops under CCTV surveillance and stay connected for information. Similarly, administration also monitors roads, public places and festivals to pull down the crime rates and keep the city secured. Indian video surveillance market has shown a growth rate of 27 per cent in the last few years and reached Rs 5,467 crore in 2017-18, as estimated by Dataquest. It is further projected to grow at over 10.5 per cent CAGR by 2024. Determining flood or drought situations are also being aimed at. With IoT, solar energy-driven smart street poles can be used in sourcing information on flood situation, thereby, helping in relief work.

But beyond this, there are various other areas where IoT can work wonders. Let us take the case of water distribution. With groundwater in India reaching alarmingly lower levels every single day, 54 per cent of India's total area is facing crisis. NITI Aayog's 2018 Composite water management report predicts a scary situation of public water supply, sufficient only to meet half the projected demand by 2030, leading to severe water crisis as well as an estimated loss of 6 per cent GDP. Here, IoT can be of immense help as they can track leakages and wastage through real-time trackers and sensors, analyse the data and provide information to respective authorities to provide solutions on time. Also monitoring of the infrastructure for maintenance and wastage of water can be done and the data can be passed on to related administrative departments for immediate and necessary action. The proposed IoT enabled water management systems can capture and share daily water usage patterns, the state of water level and water overflow or leakage control. Thus, optimal and intelligent water distributions can be achieved if these systems are adopted.

Same holds for electricity management too! Cities in India mostly suffer from irregular distribution of electricity, a major cause of which is electricity theft through illegal tapping, meter bypassing etc. According to a survey in 2015 by Outlook, India accounts for the highest electricity theft, amounting to a loss of about Rs 13,250 crore in the total loss of Rs 56,492 crore globally. The present measuring system doesn't provide real-time data and hence, it is difficult to track theft of electricity. A proposed IoT-enabled system, smart energy meters and sensors are put to use to measure the real-time power transfer and power consumption data, the difference of which therefore is the amount of theft. The smart energy meter device calculates the everyday consumption of electricity in homes, businesses and institutions and reports the usage data to the related administrative department through IoT. In another system, an infrared (IR) sensor can be used to sense power tripping due to electricity theft and the connected surveillance camera can help identify people illegally approaching near electricity poles. Thus, an abnormal consumption can easily be tracked, and theft can be prevented too.

As the trend goes, year after year, people keep migrating to the cities and thereby, making urban life crowded. Population being a core issue for India since long, the challenge for administration and civic authorities has always been efficient management of the city and its infrastructure as well as distribution of public goods and facilities. With constantly expanding internet access and digital boom surrounding urban life, the challenges are slowly being put to ease and smart cities are, thus, being created one after another. IoT, Big Data and AI can be put to use to play an enormous role in all these situations, by constant monitoring through connected devices and sensors and analysing the data for smooth management of the city.

However, we need to leverage the power of IoT for ourselves better. We need to move beyond mere dashboarding function to realise the value of being connected and the power of predictive information that comes with it.

So far it's mostly on paper, barring few segments of daily life, where IoT is being considerably applied. Desired results can only be achieved when the proposed systems can actually be put to work. This is what urban India looks forward to now, earnestly.

Pankaj Goyal,

Vice President – EcostruXure, Schneider Electric India

SMART GRID EMPOWERING SMART CITY

Smart grid and related enhancements are the important aspects of smart city, allowing for better usage of data analytics for outage management to improve the reliability and overall availability of the grid to customers.

Smart city is defined as one that has an effective plan and projects in at least five of the eight functional areas of energy, buildings, mobility, technology, infrastructure, healthcare, governance, and citizens. Each of these key parameters has specific components that define the 'smartness' of a city, and all of them commonly involve the ability to harness various available digital technologies to develop intelligent designs thereby, creating a sustainable or future-ready city.

With the ever-increasing world population and growing urbanisation, it is imperative to create livable, sustainable cities for the future. According to the United Nations, currently more than half of the world's population resides in cities, and by 2050 nearly two third of the world's population is expected to live in cities. The benefits of developing sustainable smart cities are well-understood globally. These include reducing the carbon footprint in urban agglomerations with the adoption of greener technologies across energy, mobility, buildings, and infrastructure and bringing about improvements via smart solutions in public infrastructure planning, safety, health, and governance to aid in the economic growth of the cities. The Government of India launched the Smart Cities Mission on 25 June, 2015, with the objective to promote sustainable and inclusive cities providing core infrastructure, good quality of life for citizens, a clean and sustainable environment and smart solutions.

Smart grid and related enhancements are the important aspects of smart city, allowing for better usage of data analytics for outage management to improve the reliability and overall availability of the grid to customers. The bi-directional grid allows the flow of data and electricity both ways between the producers and consumers to create a truly resilient grid that can adapt to change in demand and provide an appropriate response. Further, making way for large-scale distributed energy with the help of renewables like solar rooftops can be a game changer with consumers transitioning to be "Prosumers," cities can sustainably produce clean energy closer to where it is needed. Lastly, with the help of smarter, reliable, resilient and distributed energy driven grids, better integration of new technologies such as electric vehicles will make way for a truly sustainable smart city with a multitude of opportunities.

A smart grid necessitates the need for a change in the mindset of traditional power utilities to closely align with requirements of the future smart cities. Power utilities globally are adopting new business models and changing their ways of doing business to address emerging opportunities of the new energy world. For example, Germany's biggest power company, E.ON. In 2014, E.ON announced that it would spin off its centralised power

assets to make itself a distributed utility and embrace the "new world" of energy. Johannes Teyssen, E.ON's CEO and Board Chairman described the move as, "We have now come to the conclusion that it will become increasingly difficult for a company with a broad portfolio to be successful and grow in both the new and the conventional energy world." E.ON believes that the conventional energy world will continue to exist and to offer well-positioned companies attractive opportunities. However, the new energy world—encompassing sustainable solutions, autonomous and proactive customers, renewables, distributed energy, energy efficiency, and local energy systems—offers considerable growth potential. Frost & Sullivan's 2025 Smart Grid analysis suggests there would not be a complete transformation to smarter grids worldwide, but processes would have gained pace with substantial changes in specific areas of grid automation and demand-side management. Some notable elements listed below are central to how a smart grid will empower a future smart city.

1. There will be increased penetration of distributed energy resources. The share of fossil fuel-based centralised power generation will continue to decline, and self-generation will be widespread. Especially in smart cities, electricity from prosumers such as businesses, households, commercial establishments, will be comparable or even cheaper than utilities, making them reliable and secure in the face of natural calamities and more importantly, beneficial economically and environmentally.
2. Grid automation will be a key growth area of smart grids that will be greatly beneficial for future smart cities. Information and communication form the foundation of distribution grid automation. Sensing and monitoring devices implementing features of new communications architecture, real-time state estimation and predictive systems, advanced control systems to optimise performance, asset management and work management systems. These will further help integrate with intelligent monitoring systems, customer information systems, and forecasting tools to help optimise investments and maintenance, providing the basis for asset management, efficiency, reliability, quality, and security.
3. Changing the role of distribution utilities will become evident with a shift toward smarter grids. Distribution utilities will provide a wide range of new value-added functions to smart city consumers – shifting away from the traditional role of power supply and grid maintenance to providing flexible services, load-balancing, financing or operating or maintaining energy storage and EV infrastructure, etc.
4. Microgrids will be an integral part of smart grids, making smart cities more resilient to natural calamities and vagaries of climate change. These will be powered by distributed generation resources, smart sensors, data management and analytics, advanced electronics, energy storage, and information and communication technologies.
5. Penetration of smart meters to rise exponentially in grids across smart cities, Meter Data Management (MDM) and Meter Data Analytics (MDA) will be key to derive further value from smart meter installations. These provide add-on capabilities for data processing, analyses and reporting trends.
6. Demand side management and demand response will enable smart city consumers and households to be active participants in the smart grid.
7. Cloud services will encourage new business models, starting with a ready adoption of cloud-based solutions to facilitate B2B, C2B, and C2C transactions. Pay-as-you-use, no upfront CAPEX, percentage profit sharing and similar business models will emerge as part of smart grids supporting smart cities.
8. Smart grids of the future will see increased market integration; there will be more cross-border exchange as well as the integration of intraday markets for electricity trading – many consumers of future smart grids are likely to enjoy the freedom to trade electricity from/between multiple sources. Further technologies such as Blockchain are expected to offer institutions and smart grid customers a transaction platform where one can trade with another directly without the need for a centralised system.

Supreeth Srinivasa Rao

Principal Consultant, Industrial Practice,
Frost & Sullivan

Transformer Oil & its Evolution

The article gives a glimpse of types of transformer oils and its tests.

Transformer oil is a mineral insulating or cooling oil derived from crude petroleum. It is a mixture of various hydrocarbons consist partly aliphatic compounds (open chain compounds) with the general formula - C_nH_{2n+2} and C_nH_{2n}.

Types of Oils Used

Mineral oil and Synthetic oil are the majorly used transformer oil.

Mineral Oils

These are the petroleum products, like Naphthenic based transformer oil and Paraffinic based transformer oil. Naphthenic based transformer oils are known for their heat distribution, which is one of the main problems with transformer. This also has a good flowing feature under low temperature and it is wax-free. These type of oils are better for low-temperature. Even though it oxidises easier, the product formed by this process (i.e sludge) is soluble. Hence, it won't obstruct the cooling system of the transformer.

Paraffinic based transformer oil is obtained from paraffinic crude oil using solvent separation methods. This is known for its good thermal and oxidation durability and good high temperature viscosity feature. Because of its high viscosity index due to the presence of wax, though the oxidation rate is lower than the naphthenic oils, the precipitant or the sludge is formed due to the oxidation. This might become an obstruction for the heat dissipation. Since the rate of oxidation is low, cost effectiveness and availability, this oil is widely used in India.

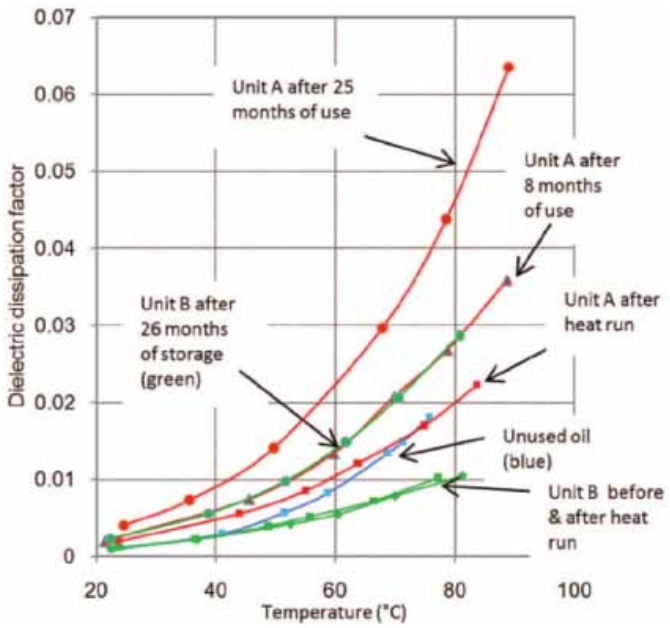


Figure 1

Synthetic Oils

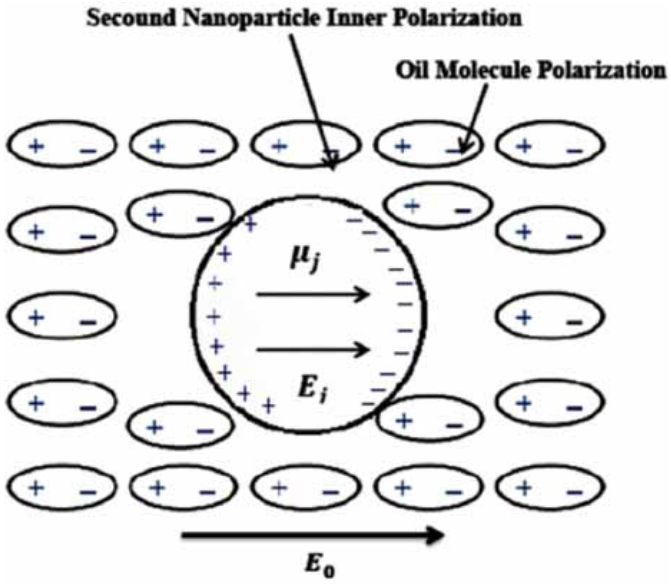
Synthetic oils which are generally silicone based were popular in the middle of 70s. This is generally used in the fire-prone area because of its fire-retardant properties. It also has few problems of low heat dissipation and high moisture absorbing capacity. It is also costlier than mineral oil.

Transition from Conventional Oils

Petroleum based oils are actually very effective as a transformer oil. However, due to high flammability, a small leakage can easily catch fire. This is one of the reasons why synthetic oils are used in fire-prone areas. And also the fire codes require these transformers to be non-flammable or a dry type transformer, if they happened to use it inside the residential buildings.

Mineral oil is hazardous directly for human and the environment. This is mostly available as the by-product of refining crude oil to make gasoline and other petroleum products. This mainly consists of alkanes and cycloalkanes. And its poor biodegradability makes it a potential long term pollution for the environment. And also these are classified under carcinogenic substance by the World Health Organization.

Figure 2: Use of Nanoparticles



Alternative to Mineral Oil

There are few alternatives to these mineral oils. Some of them are Pentaerythritol tetra fatty acid, natural and synthetic esters.

Some of the advantages when compared to mineral oil are:

- Low volatility
- High fire point, so that it can be used in high-fire-risk places
- Lower pour point
- Greater moisture tolerance
- Improved function at high temperatures
- Non-toxic
- Bio-degradable.

Silicone based oils are even less flammable but they are not only expensive than esters but also less bio-degradable. Researches are going on in the usage of vegetable based oils like coconut oil. But it is found as unsuitable for the cold climatic condition and also for voltages over 230kV. From the figure 1, one can also say that the dissipation factor is reducing over the period of time which is not as usual as in the case of other transformer oils.

Use of Nanoparticles

In most of the applications, nano-technology is the ultimate answer for its sensitivity. There had been some literatures on nanoparticles of titanium oxides and iron oxides in transformer oil applications. The maximum enhancement of BDV has been observed by using these particles which is achieved by adding different type of oxides into the promising ester fluids to make it even better than before by which the efficiency can be increased. Many oils contain certain aromatic compounds (closed chain or ring compounds) related to benzene, naphthalene and derivatives of these with aliphatic chains. Good transformer oil must insulate and prevent flash over on the exposed parts within the equipment and it must effectively transform the heat from the core to the radiating surface. The transformer oil with high dielectric strength is always considered for application in which it is used.

Transformer Oil Tests

The following tests are performed to determine the quality of transformer oil:

- Dielectric Strength
- Moisture
- Acidity
- Interfacial Tension
- Dielectric Dissipation Factor Test for Corrosive Sulphur in Oil
- Test for Oxidation Stability
- Specific Resistance (Resistivity)
- Flash Point
- Pour Point
- Viscosity
- Sludge Test

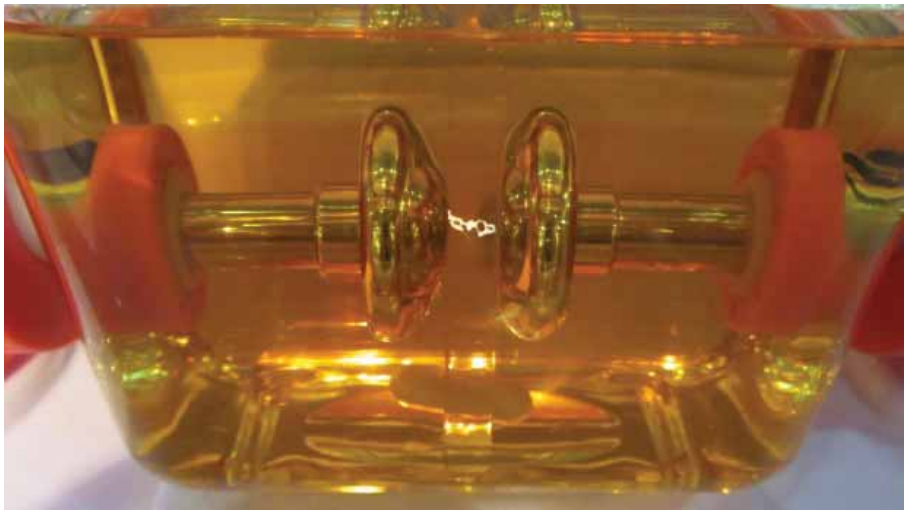


Figure 3: Dielectric Strength Test

Continued on Page 58

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- CRGO Steel Laminations
- Evaluation of Solid Insulating Materials (Paper/Pressboard/Laminated Wood and boards/Cork sheets/etc.)
- Transformer Oil (New & In-service) & Dissolved Gas Analysis (DGA)

Testing Capabilities:

All tests as per IS:1180-2014

Routine Test

- Routine tests as per IS 2026

Type Testing

- Lightning impulse test as per IS 2026 (Part 3)
- Temperature-rise test as per IS 2026 (Part 2)
- Short-circuit withstand test as per IS 2026 (Part 5)
- Pressure Test

Special Test

- Determination of sound levels as per IS 2026 (Part 10)
- Short-circuit withstand test as per IS 2026 (Part 5)
- No load current at 112.5 percent voltage
- Paint adhesion tests. The test is performed as per ASTM D3359 (Standard Test Methods for measuring adhesion by Tape test)
- BDV and moisture content of oil in the transformer (IS 335)

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Continued from Page 56

Figure 4: Transformer Oil Treatment

- Dissolved Gas Analysis (DGA).

Dielectric Strength Test

An increasing AC voltage of rated frequency is applied to the electrodes which are immersed in the testing oil (with the gap of 2.5 mm), approximately at the rate of 2 kV/Sec, starting from zero up to the value which produces breakdown. The test kit will have provision for automatic switching off of the supply voltage within 0.02 second. The test shall be repeated six times on the same cell filling and the arithmetic mean of the results is noted as the electric strength or BDV (Break Down Voltage) of the oil under test. The test shall be conducted in a dry place free from dust and voltage applied every time after disappearance of any air bubbles. The time intervals shall be five minutes, if the disappearance of air bubble cannot be observed.

Transformer Oil Treatment

Solid materials and water molecules are removed from the transformer oil using centrifugal separators. Apart from the above process, de-aeration, filtration and dehydration are also carried out to enhance the quality of the transformer oil. In small transformers, purification of oil is done directly by removing the oil and cleaning the equipment. Once cleaning is completed, oil is transferred using filter plants. For large transformers, without removing the oil, it is made to circulate through the purifier. This process is done without energising the transformer.

Inhibitors

To extend or delay the process of oxidisation, substances like Ditertiary Butyl Para Cresol (DBPC) are used. This process is called 'inhibiting an oil'. By this process, the life of the oil can be extended by three to four times of the actual period. Infrared spectroscopy, gas chromatography or thin layer chromatography is used to detect the presence of DBPC in the oil.

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Rishabh Instruments
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Narendra Goliya, Chairman, Rishabh Instruments sheds light on evolutions in Indian Testing & Measurement market, impact of IoT, Indian electrical T&M markets and many more in an email interaction with Electrical India.

Being a pioneer in the field of test and measurement segment, what kind of evolutions have you witnessed in the Indian T&M industry?

India is slowly progressing from price to features to specifications to reliability to safety and the market is maturing at all levels of the test and measurement industries. The era started with measurement and display of electrical parameters (single or multiple) which now has shown motion towards concerns on power quality. Parameters like harmonics, events such as voltage sag, swells or interruptions, flicker etc are now a point of concern and a new scope of measurement, display and record (time-based with user's discretion or choice).

The Government has come up with the requirements for limiting the harmonics in the system and just like few years ago the government made rules for incentive and penalty for controlling power factor; it is time to make similar incentive and penalty rule for exceeding and controlling the harmonics.

Next evaluation will be in terms of data communication from the test and measurement instruments such that you are able to transmit the data to the cloud and manipulate the data to be able to input power quality.

Rishabh has been a leading player in Test and Measurement (T&M) from 1997. The company has witnessed substantial evolution in the products meant for power sector since its inception. Innovation is the key focus of Rishabh instruments wherein Rishabh had unique product features like automatic blocking system in digital multimeters, rotating jaw – a patented technology for digital clamp meters, operations in a live substation of 400kv with Rishabh's Insulation testers, latest development of Bluetooth communication and android app for multimeters promoting wireless communication and safe operation.

Out of the few products mentioned above, Rishabh has come up includes 5kv Digital Insulation Tester. The product is extremely suitable for field-testing and has proven operation in switchyards where the induction voltage field up to 600V is present. We have plans to come up with more products required by power sector to cater to the requirements of similar sectors, become a prominent player, and provide next generation equipment or instruments for future needs. We continue to lead innovations in all aspect of design and manufacture of instrument.

The advancements in IoT have transformed several sectors in the country. Do you think the IoT will transform T&M sector too?

Yes. IoT will transform the T&M industry because

all data will be now sent to the cloud and processed against preset algorithms to give alarms to the user or the controller. Industries will move from intermittent measurement to continuous measurement and transmit this resolution so that users are able to control parameters within the set limits and to take corrective action even before the permanent damage is done to the equipment connected to the grid. Already Rishabh makes multimeters which have a Bluetooth connection and this will now change to sim card where readings can be directly stored and processed even on the Internet.

What are the emerging sectors where the demand for T&M instruments is growing fast?

After the traditional areas of maintenance of machines, white boards, telephone networks, generation and distribution devices demand will now shift to continuous monitoring of the health of transmission and distribution network so that user becomes aware even before this disturbance cause permanent damage to the equipment connected to this load.

Monitoring of ruler networks specially that renewable energy sources are connected (solar wind) has become an important area of T&M instruments.

Fibre optic cable has been layered all over and therefore ensuring Fibre Optic Meters, Wave Form Generator and OTDR demand is growing up. Also, T&M instruments are being popularly used in nonfunctional applications such as measurement of sheet, thickness, contamination in polluting industries etc.

What are your plans for expansion and investments in terms of product development or new technology adoption in order to fulfill the demand of the industry?

We continue to develop better meters with more features but compact design to fulfill the industries demand. Instruments are required with higher bandwidth, optical parameters, insulation measurement capabilities, earth resistance testers. T&M instruments are prone to misuse both on the electrical side and mechanical side in terms of vibration shock and thermal. Hence, we design and developed FP65 multimeter which can withstand such abuse in the field. Our existing multi meters are also designed with such reliability.

What kind of post-sales support do you give?

One of the most important requirements is calibration and repair services. All T&M instruments must be calibrated from time to time. We conduct calibration camps in many of the sites in India. People need application support to find the right product for the right usage. People expect us to give application nodes for innovative application where this product can be used.

What is your take on manufacturing activities in the country? Has 'Make in India' started to deliver?

Make in India is one of the colossal campaigns taken by the Government of India. I think it will lead to an increase in exports and manufacturing providing many new opportunities to the young blood in India. It will boost the economic growth in India along with GDP and will solve the employment issues faced by the young generation. It also fosters the entrepreneurial skills within India and many potential business amateurs are turning into successful entrepreneurs. There is a lot of work being done on innovation on both the technology side and business side.

IoT will transform the T&M industry because all data will be now sent to the cloud and processed against preset algorithms to give alarms to the user or the controller.

Make in India creates a higher brand value of Indian products in the international markets. Already, Rishabh has started leveraging the same, as the export business of Rishabh comprises of 60 per cent of the overall business of the company. It conjointly says that all the foreign companies have to have their 60 per cent manufacturing set up in India. Indian products will also have global level specs and

will comply with all international products available in the market with neck-to-neck match to the global players.

In India, around 98 cities and towns are in the blueprint to transform as Smart Cities. There is huge scope of opportunities for the industries in India to play a catalyst role for this enormous transformation of cities. Rishabh mainly deals in electrical sector and under Smart City initiative; the major transformation would be with electrical grids, energy conservation initiatives, energy utilisation and other such crucial factors. Rishabh has good opportunities with these government initiatives as we are already into the industrial control products and T&M instruments.

The new government policies like Start up India, Make in India, Clean Energy, and UDAY will accelerate the growth in this sector with a good pace and would form a sustainable roadmap for this sector. At the same time, it would be prudent to have realistic energy price levels for the Non-Conventional energy sources to sustain the business model.

What is your vision for T&M industry for 2019-20?

The T&M industry will grow at least 15 per cent in the coming year in that new products such as for measuring parameters rather than electrical such as optical will become more popular. Demand for high end multimeters being able to measure up to a bandwidth 100 KW – 200 KW.

Multimeters and clamp meters having all the facilities of the multimeters with the clamp will become more popular. Coming years should also see insulation testers which can withstand magnetic fields generated by 400 kv lines in the 5 kv and 10 kv sector. Analog products are nearly out and only digital multimeters, clamp meters, insulation testers. Humidity and wind speed measurement will replace the analog meters. More foreign players will be interested in coming to Indian market which has a continuous growth.

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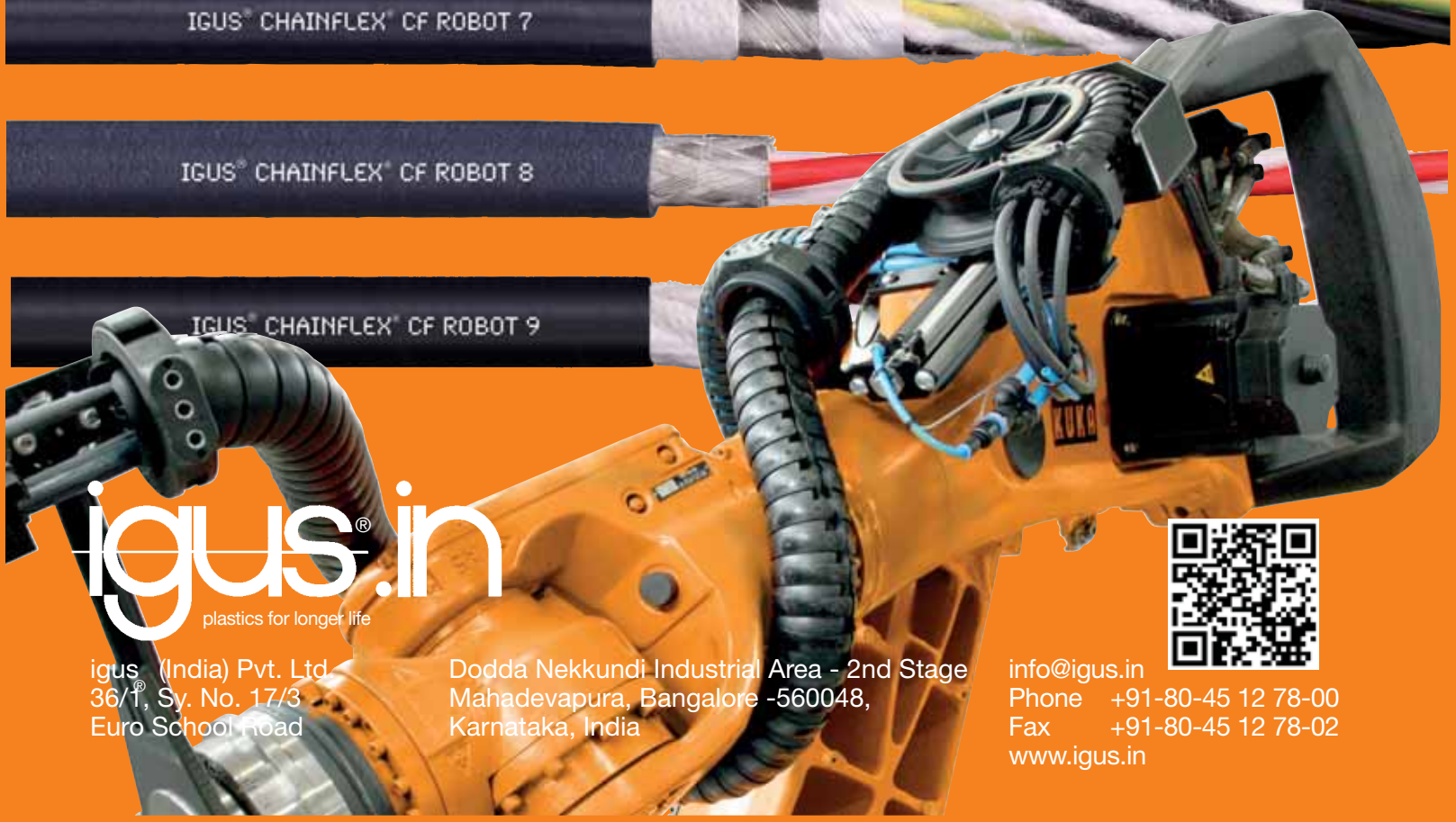

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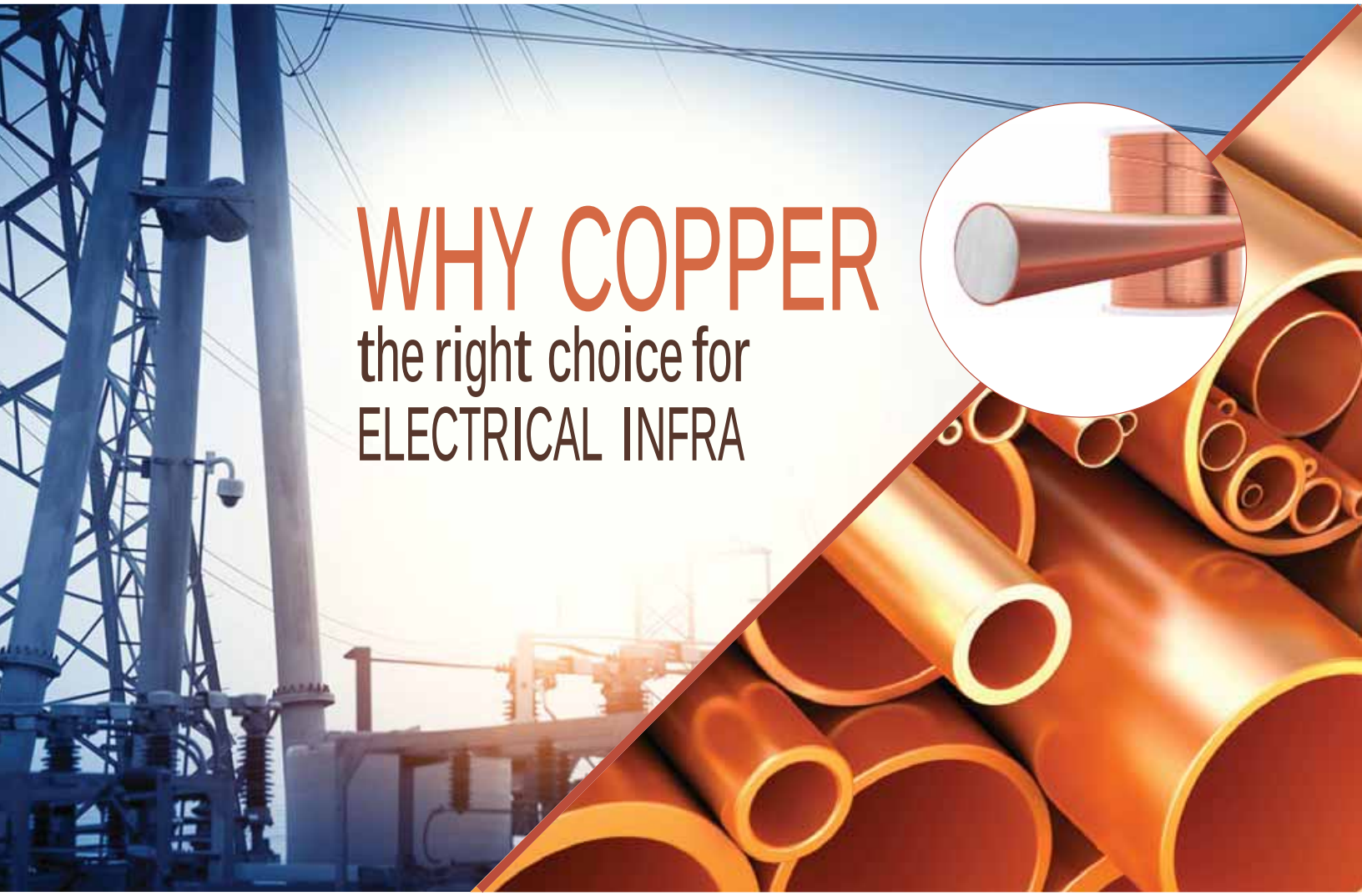

WHY COPPER
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The electrical infrastructure that India needs must be built through copper power cables.

Electricity is the backbone of modern society. It is a most elementary ingredient that enables human progress. Over the past few years, India has emerged as one of the world's fastest growing major economies and access to reliable electricity is fundamental to the development of the country. India must therefore invest in improving the quality of its electrical infrastructure to ensure that it is able to sustain its growth.

Need to invest in quality electrical infrastructure

India is progressing fast and availability of reliable electricity is fundamental to ensuring continued growth. To sustain its growth, India will need to invest USD 4.5 trillion over the next 25 years, in developing its infrastructure. While the Government of India is taking every possible initiative to meet the infrastructure needs of the country, there is a need for a collective push and increased investment in the sector.

As India faces steep electricity demand growth rates and with government's willingness to modernise the nation, India's power

sector is also undergoing rapid transformation. India has set for itself, ambitious targets for improving access to utilities and services to improve the ease of living of its citizens.

As India grows and marches towards the achievement of these goals, the country's per capita consumption of electricity will rise. Per capita electricity consumption in India grew at a CAGR of 9.63 per cent between 2005-06 and 2015-16 to 1075 KWh, powered by rapid growth in Gross Domestic Product (GDP). What's more, India's per capita energy consumption is expected to double in the next six years.

So understandably, India is going to invest big sums to ramp up infrastructure in key areas such as housing, renewable energy, power generation, transmission and distribution, railways and metro rail systems, and smart cities.

Under the Pradhan Mantri Awas Yojana (Urban), the Government of India plans to invest 203,752 crore rupees to build 37.45 lakh homes in 7,474 projects in 4,320 cities. The government plans to invest Rs 203,979 crore rupees on building 99 smart cities.

India has invested USD 10 billion to set up and expand metro rail systems in various cities. The country is expected to spend an additional USD 20 billion on metro rail systems over the next five years.

Indian Railways plans to spend USD 142 billion by 2021 to modernize and expand capacity. The country has robust investment plans for its power sector also. By 2030, India is expected to spend one trillion US Dollars on ramping up capacity in its power sector. The International Energy Agency (IEA) estimates that India would invest about USD 845 billion in T&D (transmission and distribution) networks between 2015 and 2040 to ensure universal access to power.

India aims to install renewable energy generation capacity of 227 GW by 2022, which will require additional investment of USD 52 billion in the next two years, making India one of the top three countries investing in renewable energy.

We must make no mistake that for all this progress to take place, India needs to create safe, reliable, efficient and high-quality electrical infrastructure that is able to support the country's economic growth for years to come.

to Insurance Regulatory and Development Authority (IRDA) data, fire losses accounted for over half of the claims lodged with general insurance companies in 2011-12.

The situation gets worse as India has extremely low penetration of insurance. Overall insurance penetration in India reached 3.69 per cent in 2017 from 2.71 per cent in 2001. It is therefore critically important for India to have reliable electrical infrastructure that inhibits instances of fire.

By investing in quality electrical infrastructure, India would be able to avoid these problems and eliminate these risks. Robust electrical infrastructure will form the foundation for the country to grow and prosper.

> "India is going to invest big sums to ramp up infrastructure in key areas such as housing, renewable energy, power generation, transmission and distribution, railways and metro rail systems, and smart cities.

India is prone to electrical fires

According to data from National Crime Records Bureau, a total of 113,961 people lost their lives due to fire accidents from 2010 to 2014. This is an average of 62 deaths a day. During these years, the number of deaths due to electric short circuit were about 7,743 or 7 per cent of all the deaths. By comparison, in the United States, in 2017, an average of nine people lost their lives each day in incidents of fire.

India loses property worth crores to fires every year. According

Power cables are an integral part of electrical infrastructure. These are cables that are used to conduct large volume of current to support electrical flow to residential and commercial buildings and industrial installations.

India needs to adopt copper power cables on a large scale to create high quality electrical infrastructure. Copper power cables are able to bear much greater thermal and electrical stresses, they have much higher resistance to corrosion and wear and tear, when compared with aluminium power cables. In

short, copper power cables offer safety, reliability and lend electrical efficiency to installations.

Infrastructure backed by copper power cables functions seamlessly and with great reliability for years together. Copper power cables also return much more than their initial cost, over the lifetime of a project.

To ensure reliable access to electricity, decision makers in India need to focus on this strategic area (use of copper power cables) as investments made here would deliver immense and long-lasting benefit.

Using copper power cables would help improve power quality in the country. Copper power cables are suitable for a variety of electrical applications and are used with great success in industries like oil and gas and shipping, apart from metro railways and solar energy generation projects.

Copper has a fine combination of electrical and mechanical properties. It is the ideal conductor for a large country like India where the variation in temperature is very high from 0-degree C to 47-degree C.

The use of copper in power cables significantly helps in preventing loose contacts. Copper has the much better connectivity at terminations and joints. Loose contacts are a major cause of electrical faults in railways, industries and at power utilities. Copper power cables have long life and help achieve reliable power throughout the life cycle of a project. It is best to deploy copper power cables in densely populated areas and at public places as they are able to perform under great electrical and thermal stresses.

Copper has a high melting point and is the best electrical conductor after silver. This is why copper power cables are ideal for use in industrial and residential applications. Loss of human life is the biggest loss and is irreplaceable. Bulk of the fires that take place in India are electrical in nature. And these are preventable. India needs to build better electrical infrastructure. And adopting copper power cables is an integral part of this effort.

Gap between international electrical standards and Indian electrical standards

The Indian power sector has come a long way since the laying down of the basic framework in 1910 right up to the Electricity Act of 2003, which brought about necessary changes to an evolving sector. The Act introduced and brought provision on open access, power trading, regional/national electricity market, independent system operator, delicensing of generation, performance-based regulation, anti-theft etc.

To govern the sector better and to address its requirements, the Electricity Amendment Bill, 2014, is under consideration and inputs are being sought by the power ministry. The bill provides for 'Smart Grid', which it says is an electricity network that uses information and communication technology to gather information and act intelligently in automated manner to improve the efficiency, reliability, economics, and sustainability of generation, transmission and distribution of electricity.

This necessitates the need to bridge the gap between the electrical standards in India and those in developed markets. The electrical standards in the country must be of international quality with better enforcement of these standards.

Across the world, most of the developed countries have standards that mandate the use of copper power cables in the interest of maintaining quality and system integrity.

Just like it has done in other fields, India must benchmark itself with the best in the world, when it comes to creating standards for electrical infrastructure. We need to come up with standards that mandate the widespread adoption of copper power cables in electrical infrastructure. This will ensure that the foundation of our electrical infrastructure is strong and is able to support India's growth for several decades to come.

Apart from batting for a change in standards, I would stick my neck out and say that there is a need to change the culture as per which projects are awarded in this country. Agencies that award projects need to reward quality of inputs and workmanship and knowhow and experience, at the time of awarding projects. They need to move away from the practice of awarding projects to the lowest bidder. Such a change will be seminal and will really go a long way in ensuring that India creates high quality electrical infrastructure that is safe, reliable and energy efficient.

Deepal Shah

Country Representative – India, Pfisterer

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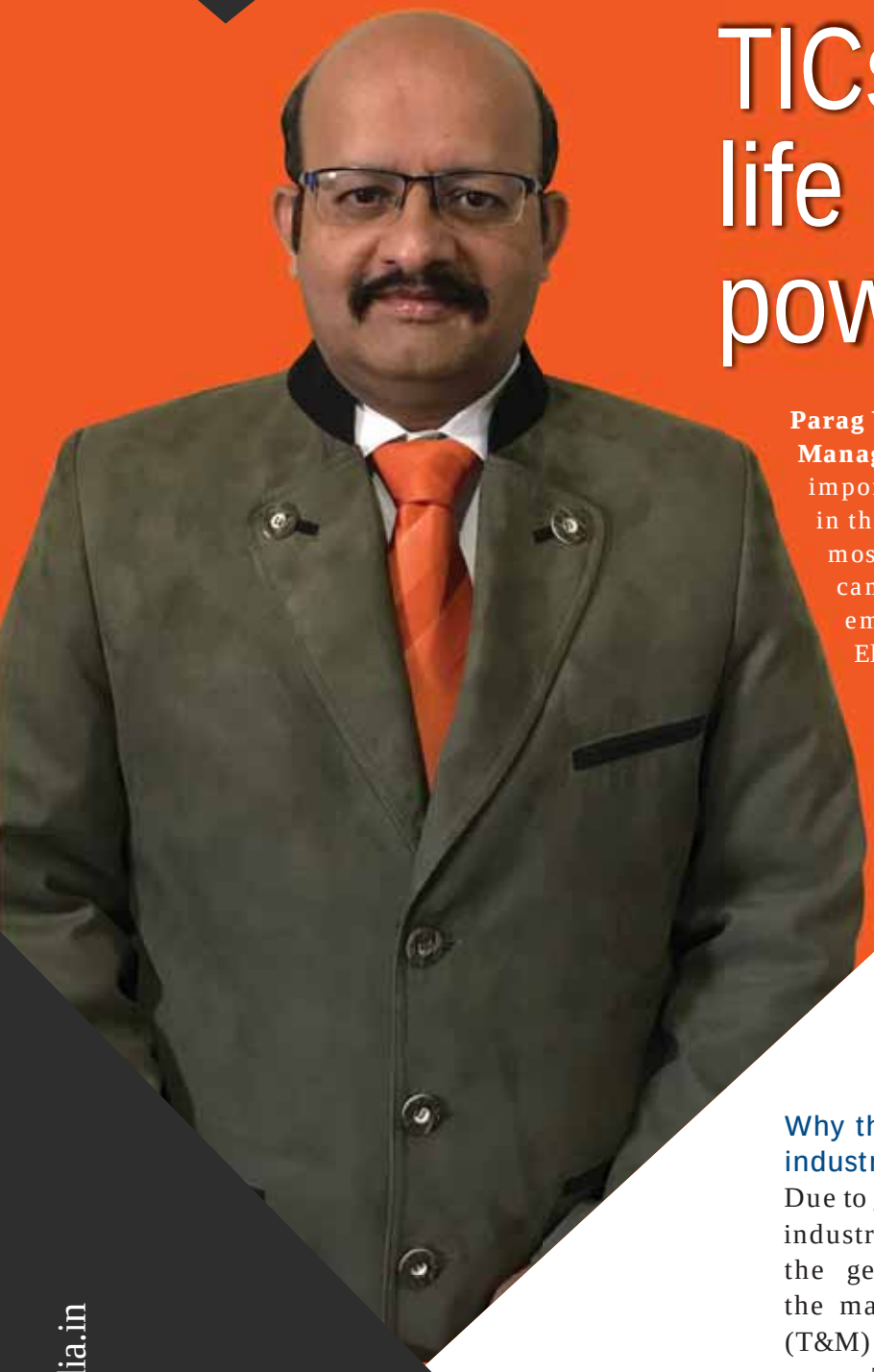

TICs enhancing life of thermal power plants

Parag Yelegaonkar, Business Development Manager, Testo India talks about the importance of thermal imaging cameras in the power sector, his company's most advanced thermal imaging cameras, and more in an email interaction with Electrical India.

Why thermal imaging is important in electrical industry?

Due to growth in demand for electricity in domestic, industrial sector and corresponding growth in the generation, transmission and distribution, the market for proper Testing and Measurement (T&M) equipment continues to grow at a steady pace. The awareness and trend of predictive maintenance and health monitoring of electrical equipment has become the most significant part of the electrical industry and thus, thermal imaging cameras become so necessary as they ensure better availability and efficiency of the electrical assets.

While talking about the technical aspect or the process, when electrical energy flows in an electrical

Some of the unique features of Testo Thermal Imagers are:

High resolution and image quality:
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Automatic setting of emissivity: The testo ε-Assist function automatically sets the emissivity and temperature of the measurement object, thus, facilitating precise thermography.

Objectively comparable images: Testo ScaleAssist adapts the thermal image scale to the inner and outer temperatures of the measurement object, and the difference between them. This ensures comparable and error-free thermal images of the thermal insulation behaviour of a building.

circuit, there is conversion from electrical energy to thermal energy. As resistance to the flow of electrical energy increases, surface temperature of component increases as well as a result additional infrared energy is emitted from the surface of the object and the thermal camera detects this deviation.

What types of electrical equipment can Thermal Imaging Cameras (TIC) survey?

Thermal imaging cameras basically work on the thermal profiling principle and detect any thermal anomaly or temperature difference over a surface. Thus, it can be used for thermal inspection of multiple electrical components such as substation equipment like transformers, circuit breaker, CT / PT / isolators, capacitor bank, lighting arrestors, transmission line. They have applications for distribution panels, switchgears, circuit boards, wire lines and many more.

General problems occurred in electrical system for which thermal inspection can be used include poor connections, corrosion, harmonics, component failure, excessive loads, unbalanced loads, mechanical failure etc.

What is your most advanced Thermal Imaging Cameras in this segment?

Our latest solution to the industry is the new range of Thermal Imagers with smartphone integration designed to deliver networked thermography mostly used for predictive and preventive maintenance in the electric sector. The unbeatable price-performance ratio of the models testo 865, testo 868, testo 871 and testo 872 clearly show that top quality 'Made in Germany' product and an attractive price are not mutually exclusive.

What are its unique features?

Testo Thermal Imagers become first choice of the end users and distributors due to German engineering and its unique features at an affordable price. Testo instruments are rugged and most suitable for the extensive field use even in harsh environments. Due to its user friendliness, it becomes choice of unskilled people or beginners as well.

What are its particular applications in power sector?

Power sector plays a very crucial role in the industry and one cannot afford to experience a shut down or higher lead time of the power plants and grid failure. Many a time, maintenance engineers encounter problems like power losses, system failures and at worse even accidents, which are uninvited and unforeseen.

Thermal imagers are very important for the enhancement of life of any power plant. Right from the beginning i.e. installation phase thermal imagers can be used for setting up benchmark parameters and for all kinds of troubleshooting jobs. Consider the power generation phase of a power plant where a small lapse in preventive and predictive maintenance can lead to highly unsafe conditions. Most importantly, in power transmission and distribution (T&D) segment like, the electrical connection points and insulators for overhead power lines in substations or the overhead power lines in high-voltage systems, switchyards and transmission lines (up to point of coupling) must be regularly checked for routine maintenance for thermal anomalies detection purposes. For inaccessible locations testing and checking can be done by thermal inspection as a predictive maintenance tool from a safe distance, without endangering the user or without needing a shut down the entire power transmission network.

Considering the rapid growth in power segment and electrical equipment manufacturing the potential is very huge.

Testo India provides testo 885 and testo 890 high end thermal imagers that can be used to conduct thermal inspections in transmission lines and switchgears, up to 765KV voltage level, using a super telephoto lens with correspondingly high resolution, conveniently from the ground. Along with that a very advantageous feature of 'site recognition' is also available in the IR soft software of this thermal imager. Continuous thermal inspection becomes a mandate for the entire Power sector & that's where Testo extends its support and expertise to the industry and its users.

What kind of market potential do you envisage for Thermal Imaging Cameras?

Considering the rapid growth in power segment and electrical equipment manufacturing the potential is very huge. All power transmission utilities including PGCIL, State TRANSCO, GENCO and DISCOM provide the largest share of opportunities to these products. Also, the industries associated with the manufacturing of power transformers, switchyard equipment have high requirements for thermal imagers. With the kind of features and application areas that our thermal imagers carter to, we are very positive about the future of our instruments.

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Wireless Power Transmission via Solar Power Satellite

The article presents a review of recent researches in the field of wireless power transmission and also about the solar energy conversion technology by satellite to microwaves using an external device called magnetron. The methods applied for wireless power transmission are also discussed.

Electricity is the most versatile and widely used form of energy. The global demand for electricity is continuously growing. Of the total generation worldwide, more than 60 per cent of energy is generated using coal-fired station resulting in carbon dioxide emission threatening the global warming. To mitigate the consequence of climate change, generation systems need to undergo significant changes.

One of the major issues in power system is the losses occurring during the Transmission and Distribution (T&D) of electrical power. The percentage of loss of power during T&D is approximated as 26 per cent. The main reason for power loss during T&D is the resistance of wires used in grid. According to the World Resources Institute (WRI), India's electricity grid has the highest T&D losses in the world – a whopping 27-40 per cent. Tesla had proposed methods of transmission of electricity using electromagnetic induction.

Tesla had always tried to introduce worldwide wireless power distribution system. But due to lack of funding and technology of that time, he was not able to complete the task. Research is being going on and recent developments have been observed in this field. Despite advances, wireless power transmission has not been adopted for commercial use.

Highlight of a wireless transmission in 1891 in Tesla's "Experimental station" at Colorado is shown in figure 1.

In 1899 Sir Nicolas Tesla and Heinrich Hertz powered a fluorescent lamp keeping it 25 miles away from source. Wireless power transmission experiments were conducted at Warden Clyffe tower. High frequency current, of a Tesla coil, could light lamps filled with gas (like neon). In this method, a closed circuit is made using transmitter, ionized path between upper atmosphere and transmitter, second ionized path connecting receiver. The circuit back to the transmitter is completed through the earth. High potential is maintained at transmitter and receiver end as well. A high potential transmitter transmits an electromotive impulse through the ionized path to the upper atmosphere where it ionizes the air and this air between the transmitter and receiver would conduct like a neon tube.

Warden Clyffe tower was designed by Tesla for trans-Atlantic wireless telephony and also for demonstrating wireless electrical power transmission today.

Methods of Wireless Transmission of Electrical Power

Induction

The principle of mutual induction between two coils can be used for the transfer of electrical power without any physical contact in between. The simplest example of how mutual induction works is the transformer, where there is no physical contact

between the primary and the secondary coils. The transfer of energy takes place due to electromagnetic coupling between the two coils.

Electromagnetic Transmission

Electromagnetic waves can also be used to transfer power without wires. By converting electricity into light, such as a laser beam, then firing this beam at a receiving target, such as a solar cell on a small aircraft, power can be beamed to a single target. This is generally known as "power beaming".

Evanescent Wave Coupling

Researchers at MIT believe they have discovered a new way to wirelessly transfer power using non-radiative electromagnetic energy resonant tunneling. Since the electromagnetic waves would tunnel, they would not propagate through the air to be absorbed or wasted, and would not disrupt electronic devices or cause physical injury like microwave or radio transmission. Researchers anticipate up to 5 meters of range.

Electrodynamic Induction

Also, known as "resonant inductive coupling" resolves the main problem associated with non-resonant inductive coupling for wireless energy transfer; specifically, the dependence of efficiency on transmission distance. When resonant coupling is used, the transmitter and receiver inductors are tuned to a mutual frequency and the drive current is modified from a sinusoidal to a non-sinusoidal transient waveform. Pulse power transfer occurs over multiple cycles. In this way, significant power may be transmitted over a distance of up to a few times the size of the transmitter.

Radio and Microwave

Power transmission through radio waves can be made more directional, allowing longer distance power beaming with shorter wavelengths of electromagnetic radiation, typically, in the microwave range. A rectenna may be used to convert the microwave energy back into electricity. Rectenna conversion efficiencies exceeding 95% have been realized. Power beaming using microwaves has been proposed for the transmission of energy from orbiting solar power satellites to Earth and the beaming of power to spacecraft leaving orbit has been considered.

Electrostatic Induction

Also, known as 'capacitive coupling' is an electric field gradient or differential capacitance between two elevated electrodes over a conducting ground plane for wireless energy transmission involving high frequency alternating current potential differences transmitted between two plates or nodes.

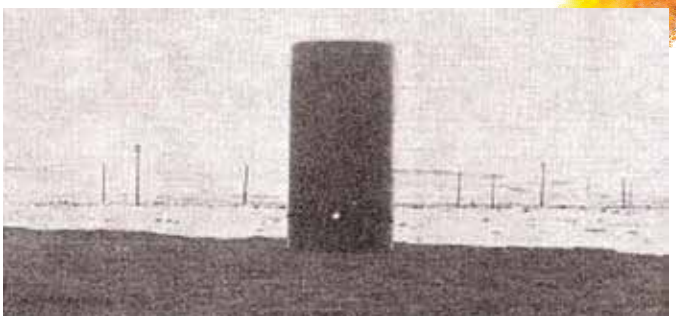

Figure 1: Tesla's Experimental Lamp

Current Technology in the Field Of Wireless Power Transmission

Microwave Transmitter

The most current research and proposals use microwaves as the frequency range of choice for transmission. At present an efficiency of 76 per cent is possible using current technology for microwave power transmission. For transmission efficiency, the waves must be focused so that all the energy transmitted by the source is incident on the wave collection device. Higher frequencies are also impractical because of the high cost of transmitters and the relative low efficiency of current optical and infrared devices.

The most common transmitters for microwaves are the travelling wave tube (TWT), klystron and magnetron. The TWT is far too expensive and power restrictive making it impractical for the task of power transmission. The klystron has been the DC to microwave converter of choice however it is also somewhat expensive. Many researchers are looking to use magnetrons instead because they are cheap and efficient. Magnetron frequency output is not as precisely controllable as the klystron or TWT but power transmission is more lenient to frequency fluctuations than communication systems are. One of the more common proposals would be for an array of magnetrons to be used as the transmitter. One of the main advantages to using many smaller magnetrons as opposed to a few klystrons is that 300 W to 1kW magnetrons are already mass produced for microwave ovens. The efficiency of magnetrons is inconsistently reported.

Use of Microwave Power Transmission in Solar Power Satellites (SPS)

Solar power generating satellites launched into space and transmitting power to Earth stations. This idea was first proposed in 1968 and all of the experiments

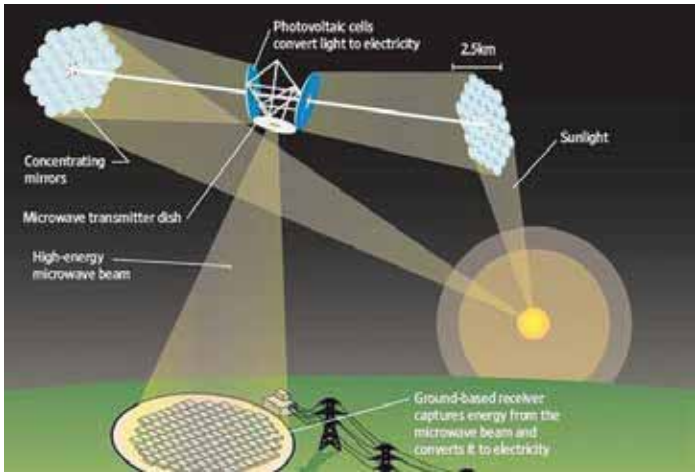

Figure 2: Solar power satellite

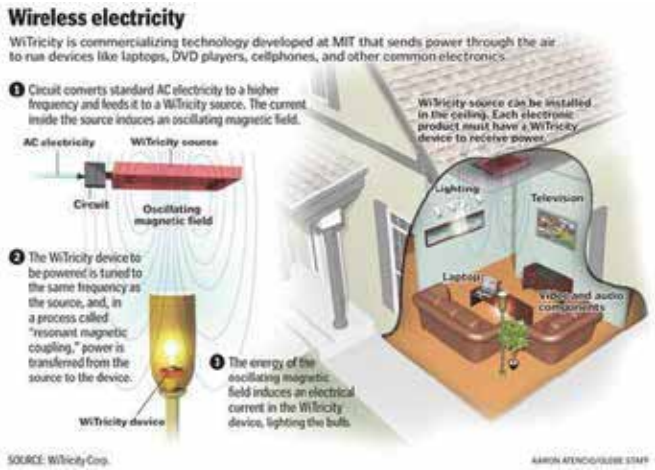

Figure 3: Overall picture of Wireless transmission

have only been carried out in terrestrial laboratories. The SPS satellites would be put in high earth orbit at geosynchronous location. This would allow them to receive light 99 per cent of the year. A large rectenna array facility will be built on the Earth to collect the incoming microwaves. To maintain a good lock on the rectenna, the satellite will need to be built with a retro directive transmitter which locks on to a pilot beam emanated from the ground station.

Since most of the research is done in the 2.4 GHz to 5.8 GHz range, there is some spectrum regulatory issues to deal with. Also since the retro directive antenna system is unproven, there is the health concern that the microwave beam could veer off target and microwave some unsuspecting family. However, a Japanese Government agency is planning to send up 10 to 100 kW low earth orbit satellite to prove its feasibility.

Figure 4: Transmission of electricity is occurring inspite of the obstruction in between them

Latest Invention & Experiments

WiTricity

The new technology called WiTricity is based on using coupled resonant objects. Two resonant objects of the same resonant frequency tend to exchange energy efficiently, while interacting weakly with extraneous off-resonant objects. After Nicolas Tesla, there was rebirth of this in 2007 by the team from Massachusetts Institute of Technology, who call their invention 'WiTricity'. In the first successful trial of its kind, the team was able to illuminate a 60-watt light bulb 7ft away. They simulated a transfer of 60W across two identical loops similar in dimension. The coils had a radius of 30 cm, with a cross section of 3cm and distance between the coils was 200m. Basic principle is two resonant objects of the same resonant frequency tend to exchange energy efficiently, while interacting weakly with extraneous off-resonant object

The investigated design consists of two copper coils, each a self-resonant system. One of the coils, attached to the power source, is the sending unit. The resonant nature of the process ensures the strong interaction between the sending unit and the receiving unit, while the interaction with the rest of the environment is weak.

Solar Power Satellite

Future suitable and largest application of the WPT via microwave is a Space Solar Power Satellite (SPS). The SPS is a gigantic satellite designed as an electric power plant orbiting in the Geostationary Earth Orbit (GEO). It consists of three segments solar energy collector to convert the solar energy into DC (direct current) electricity, DC-to-microwave converter, and large antenna array to beam down the microwave power

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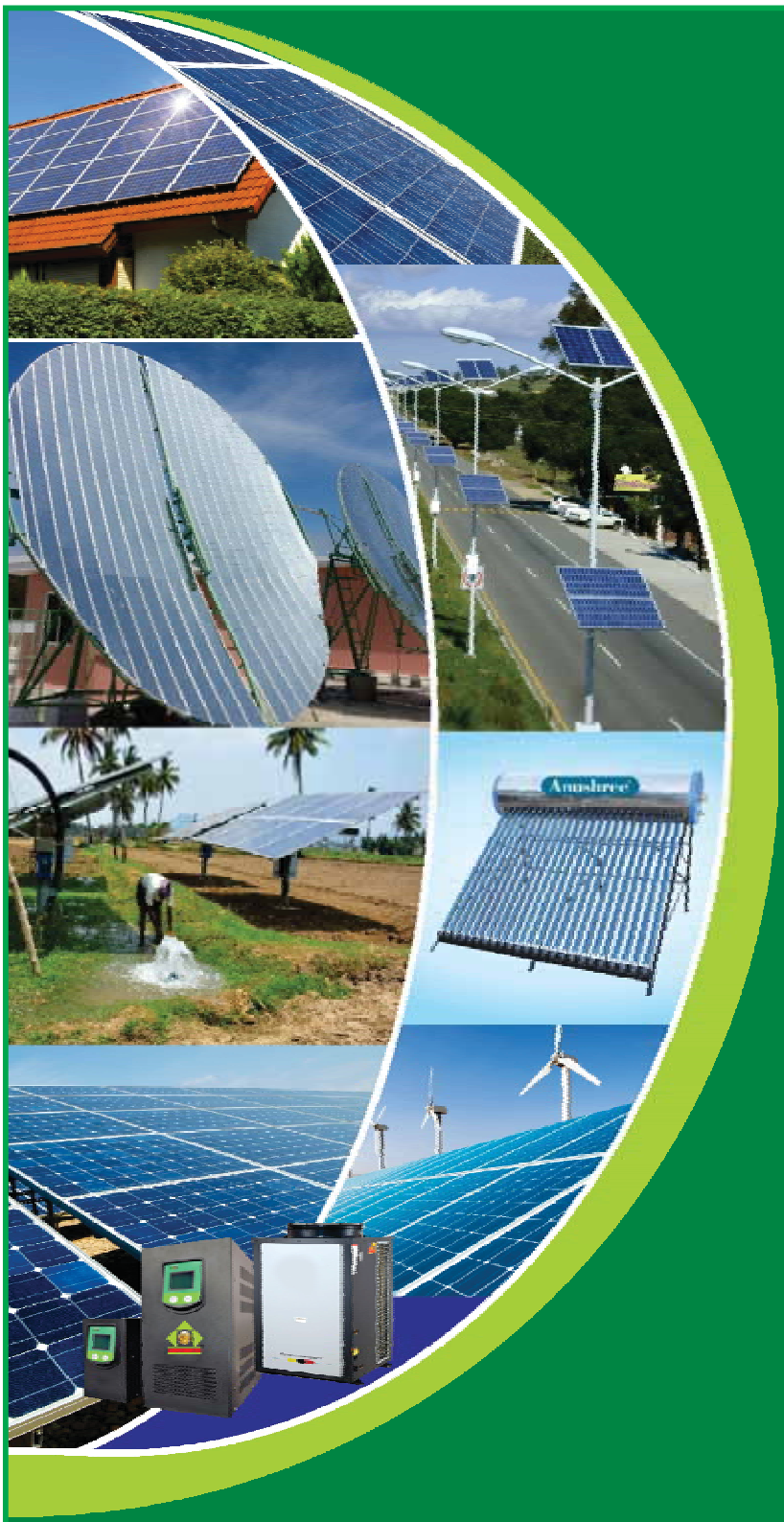

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Continued from page 74

Figure 5: Japan's wireless, power-generating, solar satellite in habitat

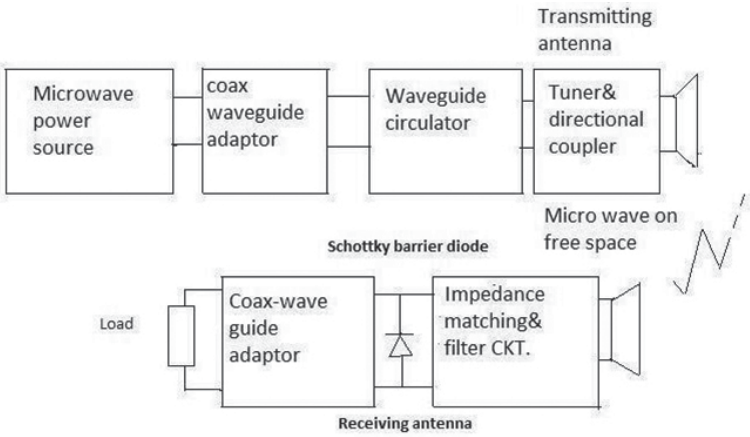

Figure 6: Functional Block Diagram of Wireless Power

to the ground. The first solar collector can be either photovoltaic cells or solar thermal turbine. The second DC-to-microwave converter of the SPS can be either microwave tube system or semiconductor system. It may be their combination. The third segment is a gigantic antenna array.

An amplitude taper on the transmitting antenna is adopted in order to increase the beam collection efficiency and to decrease sidelobe level in almost all SPS design. A typical amplitude taper is called 10 dB Gaussian in which the power density in the center of the transmitting antenna is ten times larger than that on the edge of the transmitting antenna.

The SPS is expected to realise around 2030. Before the realisation of the SPS, we can consider the other application of the WPT. In recent years, mobile devices advance quickly and require decreasing power consumption. It means that we can use the diffused weak microwave power as a power source of the mobile devices with low power consumption such as RF-ID. The RF-ID is a radio IC- tug with wireless power transmission and wireless information. This is a new WPT application like broadcasting.

Antennas for Microwave Power Transmission

All antennas can be applied for both the MPT system and communication system, for example, Yagi-Uda antenna, horn antenna, parabolic antenna, microstrip antenna, phased array antenna or any other type of antenna. To fixed target of the MPT system, usually large parabolic antenna selected in MPT demonstration in 1975 at the Venus Site of JPL Goldstone Facility and inground-to-ground MPT experiment in 1994-95 in Japan. In the fuel-free airship light experiment with MPT in 1995 in Japan, they changed a direction of the parabolic antenna to chase the moving airship. However, we have to use a phased array antenna for the MPT from/to moving transmitter or receiver which include the SPS because we have to control a microwave beam direction accurately and speedy. Power distribution at the transmitting antenna is given by $(1-r^2)$, where r is the radius of antenna.

The phased array is a directive antenna which generates a beam form whose shape and direction by the relative phases and amplitudes of the waves at the individual antenna elements. It is possible to steer the direction of the microwave beam. The antenna elements might be dipoles, slot antennas, or any other type of antenna, even parabolic antennas. In some MPT experiments in Japan, the phased array antenna was adopted to steer a direction of the microwave beam. All SPS is designed with the phased array antenna. We consider the phased array antenna for all following MPT system.

Japan wants to power up three million houses with wireless energy from space. They have serious plans to send a solar-panel-equipped satellite into space that could wirelessly beam a giga watt-strong stream of power down to earth. A small test model is scheduled for launch in 2015. To iron out all the kinks and get a fully functional system set up is estimated to take three decades. A major kink, presumably, is coping with the possible dangers when 1-gigawatt microwave beam aimed at small spot on Earth misses its target. The $21 billion project just received major backing from Mitsubishi and designer IHI (in addition to research teams from 14 other countries).

Wireless Power Transmission

Components of WPT system: The Primary components of Wireless Power Transmission are Microwave Generator, transmitting antenna and Receiving antenna (Rectenna).

Transmission System

In the transmission side, the microwave power source generates microwave power and the output power is controlled by electronic control circuits. The waveguide circulator which protects the microwave source from reflected power is connected with the microwave power source through the coax- waveguide adaptor. The tuner matches the impedance between the transmitting antenna and the microwave source. The transmitting antenna radiates the power uniformly through free space to the rectenna impedance matching is the practice of designing the input impedance electrical load output impedance to maximise the power transfer or minimise reflections from the load.

Magnetron

Magnetron is a crossed field tube which forces electrons emitted from the cathode to take cyclonical path to the anode. The magnetron is self-oscillatory device in which the anode contains a resonant RF structure. The magnetron has long history from invention by A W Hull in1921. The practical and efficient magnetron tube gathered world interest only after K. Okabe Average RF output power versus frequency for various electronic devices and semiconductors.

Recent Technologies

A microwave power transmission is suitable for a power transmission from/to moving transmitters or targets. Therefore, accurate target detection and high efficient beam forming are important. Retro directive system is always used for SPS. A corner reflector is the most basic retro directive system. The corner reflectors consist of perpendicular metal sheets, which meet at an apex. Incoming signals are reflected back in the direction of arrival through multiple reflections off the wall of the reflector. Van Atta array is also a basic technique of the retro directive system. This array is made up of pairs of antennas spaced equidistant from the center of the array, and connected with equal length transmission lines. The signal received by an antenna is re-radiated by its pair, thus, the order of re-radiating elements is inverted with respect to the center of the array, achieving the proper phasing for retro directivity. Usual retro directive system has phase conjugate circuits in each receiving or transmitting antenna, which plays same role as pairs of antennas spaced equidistant from the center of the array in Van Atta array. A signal transmitted from the target is received and re-radiated through the phase conjugate circuit to the direction of target. The signal is called a pilot signal. We do not need any phase shifters for beam forming. The retro directive system is usually used for satellite communication, wireless LAN, military, etc. There are many researches of the retro directive system for these applications. They use almost same frequency for the pilot signal and returned signal with a local oscillator (LO) signal at a frequency twice as high as the pilot signal frequency in the typical retro directive systems. Accuracy depends on stability of the frequency of the pilot signal and the LO signal. The retro directive system unifies target detection with beam forming by the phase conjugate circuits. There are some methods for target detecting with pilot signal which is separated to beam forming. We call the method 'software retro directive'.

Computer is usually used for the software recto directive with the phase data from a pilot signal and for the beam forming with calculation of the optimum phase and amplitude distribution on the array. In the software recto directive, we conform microwave beam freely, for example, multi-beams. On contrary, we need phase shifters in all antennas.

Conclusion

Wireless power transmission of electrical power can be considered as a large scope in future prospects of power generation and transfer. Solar power satellites are the future for supplying non- conventional energy. The various methods and aspects regarding wireless transmission of electrical power and the details of design of solar power satellite have been discussed. The evolution of the technology from the time of Tesla has been overviewed.

Image courtesy: Authors

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R V College of Engineering, Bangalore

Gagana P.,
Student, RV College of Engineering, Bangalore

Transformer condition assessment with an integrated test van

Commissioning tests and periodic on-site maintenance checks are essential for the safe and outage-free operation of power transformers and substations. A combination of routine electric tests and advanced diagnostic techniques in accordance with the IEC 60060-3, IEC 60076, IEEE Std. C57.12.00, IEEE Std. C57.152 - 2013, and GOST 11677-85 standards can be performed with a dedicated test system. These tests are also valuable in troubleshooting in case of an outage. Deterioration of electrical insulation can be identified with the high voltage insulation tests (insulation resistance, dissipation factor and capacitance measurement, dielectric frequency response). Mechanical damage due to the transport or the effect of faults, malfunctions and winding shorts are typically found using frequency response analysis, winding resistance measurement and onload tap changer tests. Confirmation of ratio, vector group, no-load and short-circuit losses is desirable after repairs to ensure that these have been carried out to a high standard. Oil samples are routinely taken for breakdown tests and gas analysis.

Performing all these tests on-site requires many different devices, each with its own test leads. Often such testing is time consuming and tricky because of the numerous test arrangements that have to be set up, and the need to climb repeatedly to the top of the transformer to change connections. The latter can easily lead to accidents during testing. A test van can easily accommodate all of the abovementioned methods and instruments, and organize them to provide an automated test flow. This article discusses a test van solution with centralized control and reporting software and a single connection to the test object, which is shared among instruments. Automated test circuit arrangement and switching processes to enable safe test flow are also provided.

Figure 1: Transformer test van with equipment rack and cable drum compartment

Upon completion of each measurement, results are automatically transferred into the test protocol. Database software allows calculation of the differences between measured values as well as comparison of measurement results with the nameplate and previous data. At the heart of the system is a switch box that provides automated (software-driven) selection of HV and LV methods and test schemes. This article describes test methods and report structures to show how testing time is reduced and human error avoided.

Measurement techniques provided

Four instruments are integrated into the core of the system:

1. Insulation tester (5 kV megohmmeter)
2. Capacitance and tan delta test set (exciting current)
3. Winding resistance
4. Turns ratio meters.

The test equipment is mounted in the rack as shown in Fig.1.

Cable drums of 30m length are located in the back of the vehicle. If this length is not enough, the instruments can be removed from the drawers and

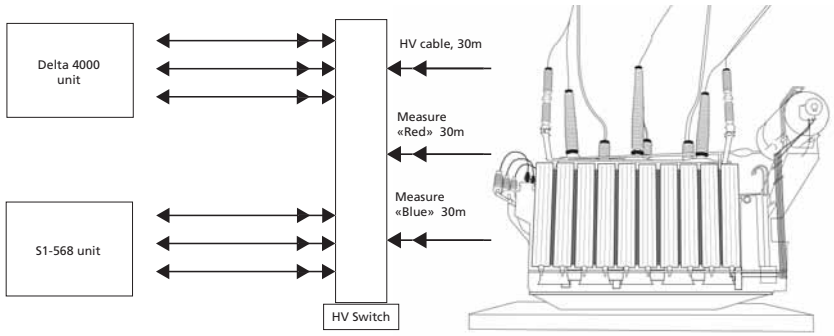

Figure 2: HV switch for switching between AC and DC insulation test sets

Figure 3: User interface for switchbox control

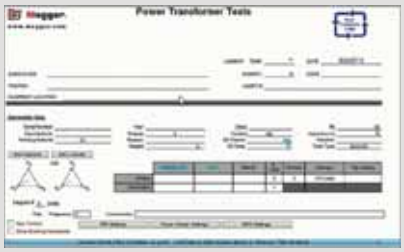

Figure 4: Report view provided by the software

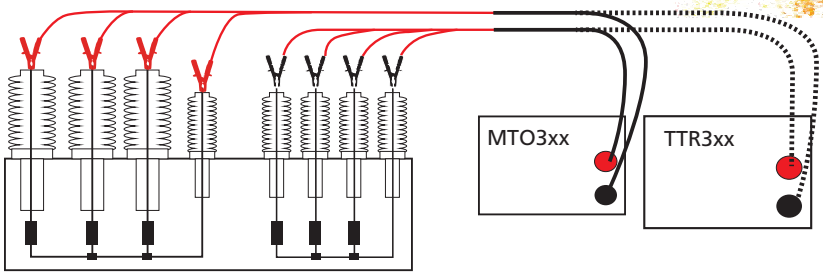

Figure 5: Lead set for LV measurements.

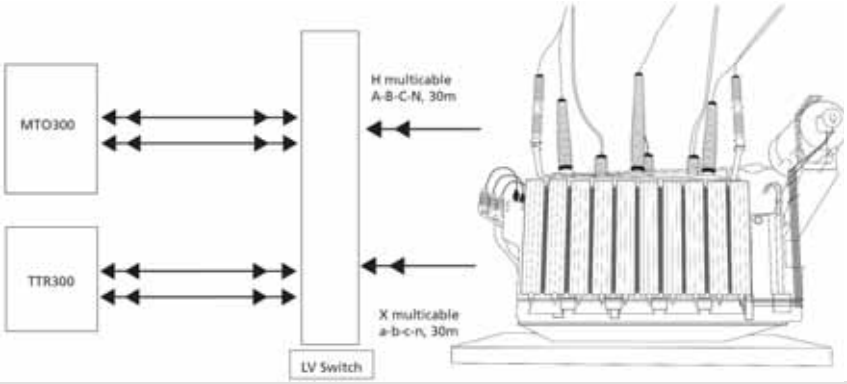

Figure 6: LV switch for switching between resistance and turns ratio test sets

used standalone with standard test leads.

Optional further test capabilities can be added:

- Short circuit impedance
- Power loss for no-load and short circuit conditions
- Frequency response analysis
- Moisture assessment with the DFR technique
- Single-phase HV source up to 100 kV AC and 70 kV DC for withstand tests
- Oil breakdown test set.

Insulation testing

There is a need for preventative testing on transformers taken out of service. Most commonly, measurements of the insulation parameters of transformers and bushings are made with a megohmmeter and a dissipation factor (tan delta) test set. The results provide defined values for the insulation condition, which can indicate the presence of major defects, and in some cases, locate the defect origin. To measure the insulation resistance of power transformers a DC voltage of several kilovolts is used. Capacitance and dissipation factor measurements for winding insulation are conducted with an AC voltage up to 10 kV using circuit arrangements similar to those used for the DC insulation resistance measurements. This means that an HV switch can be used for commutating the test leads between the megohmmeter and the dissipation factor test set, as shown in Figure 2.

The user interface provided by the auxiliary software that controls the switch box is shown in Fig.3. The user works with two sets of test leads (for HV and LV testing). When the test leads have been connected to the test object as shown in Fig. 8, an instrument can be selected (powered on). The instrument is then controlled by a dedicated software package to perform tests, collect results and manage them within a database as shown in Fig.4.

Ratio testing and vector group verification for three-phase transformers

Transformer turns ratio tester and a transformer ohmmeter is deployed. Both devices share the same multi-core leads, so it is practical to develop an LV switch that allows the switching of test leads between these two instruments, as shown in Figures 5 and 6. The test leads (one multicore cable for the HV side and another for the LV side) are 30m long. Each has four Kelvin clamps with separate current and potential contacts.

This arrangement means that measurements are made with a four-wire circuit that compensates for lead length. Depending on the standards specified, the ratio measured during commissioning should not differ by more than 0.5% between windings or from the nameplate value. Simultaneously with the ratio testing, the instrument determines the vector group of winding interconnection in three-phase power transformers.

Winding resistance measurement

Winding resistance measurements should be performed for all tap positions.

Simultaneous connection to the HV and LV terminals allows the use of the dual-magnetization method. This is especially valuable with large transformers that have a delta connected LV side. The advantages of the dual magnetization method are shown in Figure 7. The core of the transformer is magnetized by the "effective flux", which is 10 times higher than the flux developed during a single LV side measurement. Typical test currents are between 0.1% and 5% of the rated winding current.

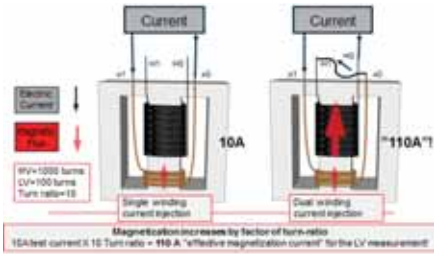

Figure 7: The effect of using the dual-magnetization method

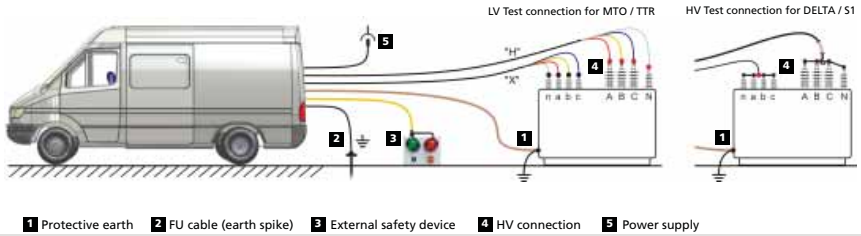

Figure 8: The Basic connection setup

Currents more than 10% of the rated value may cause heating, which could compromise accuracy. For comparison purposes, temperature correction can be performed using the formulas for copper and aluminium built into the software. For field tests, the values of the winding resistances in a three-phase transformer measured at the same taps and temperature should not differ by more than 1%between phases. Absolute readings after temperature correction should be within 5% of the values provided by the manufacturer. After finishing winding resistance testing, it is recommended to perform core demagnetization (or removal of remaining magnetization). The best transformer ohmmeters provide facilities for doing this.

Before measuring no-load losses or carrying out frequency response analysis on a transformer taken out of service, the core must be demagnetized to eliminate magnetization that may have been caused by interrupting the current at other than a zero transition. Demagnetization is accomplished by injecting into one of the HV windings a cyclic DC current flow of changing polarity with amplitude decreasing from maximum to zero, as shown in Figure 9.

Power loss measurement

No-load losses

No-load loss measurements are usually done during commissioning and after repairs on service aged transformers in order to identify an inter-turn shorts, core sheet shorts and core-ground faults. It is recommended that the no-load test is carried out at 380/220 V. The test voltage is applied to an LV winding, with the other windings left open. It is preferable to excite windings with phase-to-phase voltage of 380 V. This is because a phase-to-ground voltage could be subject to harmonics and would not be perfect sine curve, which could lead to inaccuracies in the results. It is acceptable to measure no-load losses at frequencies close to the rated value of 50 Hz (±) 3%. For aged transformers no-load losses are not specified in the standards, so when measuring at a frequency outside ±3% tolerance band there is no need to make corrections. For three-phase transformers the no-load loss is measured phase-by-phase. This allows the losses for the phases to be compared to reveal a faulty phase, and also allows the results to be compared with data provided by the manufacturer.

Short circuit losses

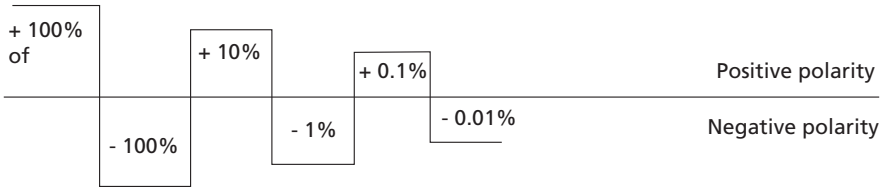

Figure 9: Demagnetization cycle

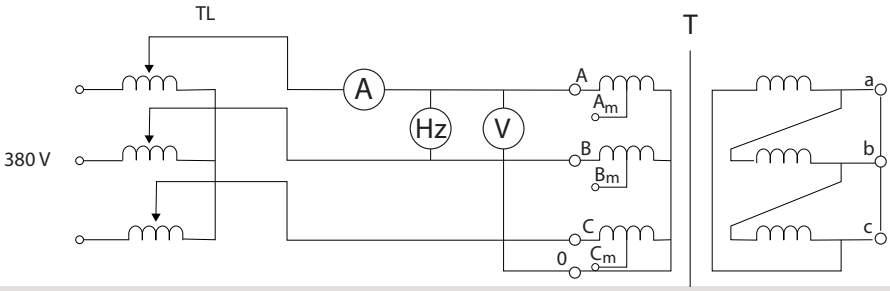

Figure 10: Circuit for short-circuit loss measurement

This test is used to determine the complex short circuit impedance (Zk) of transformers to identify possible deformations with winding damages due to through-fault currents. This information is derived from the comparison of the test results with the initial Zk value measured by the manufacturer.

The short circuit test is carried out with a low-test voltage (380, 220 V). The arrangement for short circuit testing on aged transformers is to excite the HV windings and short the LV side as shown in Figure 10. For three phase transformers, three-phase excitation is used, but current and voltage are measured in individual phases sequentially. Voltage and current values are measured along with frequency. Measured values for short circuit impedance should be corrected to line frequency test conditions. Condition assessment is done by comparing DZk with the maximum acceptable according to the standards.

For transformers and autotransformers equipped with an OLTC, the test involves measuring current and voltage at the nominal tap and two extreme taps. When testing at maximum tap, the regulating winding is also tested. When testing at minimum tap, the regulating winding is excluded. This helps to identify the faulty winding if the deviation against the reference exceeds the limits. During tests it is recommended to avoid frequent reconnection of shorts. For three phase winding transformers the following procedure is quite practical: HV-LV, MV-LV, HV-MV. To short the phases, flexible copper or aluminium wires are used. The cross-section of the wire must be at least 30% of the winding wire cross-section.

Conclusion

The transformer test van combines routine electrical tests and advanced diagnostic techniques to allow a complete transformer check in field. Field experience has shown that automated selection of the instrument and switching through all necessary test arrangements provides a substantial time saving – over 70% – as well as minimising the risk of accidents. The central computer collects all measurement results and the integrated database allows remote accessing, reporting and comparison of the data to the previous test results, eventually building a trend of transformer condition over time. Multiple field tests have proven that the measurement accuracy is in line with that achieved when using individual instruments. (Source: Megger India)

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Why Prequalification is becoming increasingly important

In order to select the new assets according to their technical feasibility before any pricing issues are evaluated, a prequalification process can be introduced that a manufacturer and their product have to undergo before applying for a tender.

At first glance, incorporating an additional step in the tender process does not make sense. However, a second view, with more detailed insight, establishes it is a very important step for efficient work practices and for increasing the quality of the assets. Many utilities struggle with the multitude of the manufacturers' devices. Before ordering new assets, they may publish a tender voluntarily or are required to publish a tender that describes the requirements which have to be fulfilled by the product. In order to select the new assets according to their technical feasibility before any pricing issues are evaluated, a prequalification process can be introduced that a manufacturer and their product have to undergo before applying for a tender.

Such a process segregates the technical requirements and the commercial interests. In addition, the technical requirements can be continuously checked, even if there is no tender published. After the manufacturer, has prequalified, they can apply for tenders within the next, for instance, 4 years without recertification as long as the main features of the product do not change in the meantime.

Important steps in a prequalification process

The prequalification procedure consists of several steps (fig 1). They are ordered in such a manner that the first steps deal with quite general issues that could be applied to all new assets, independent of whether they are transformers, circuit breakers or protection devices. The later steps are very specific and, in the case of protection devices for example, can describe the prequalification procedure for certain protective functions in detail (a distance protection device is used in this example).

- Application for prequalification: The manufacturer applies for prequalification for a certain product category. The utility informs them about the process, sends them the specification sheet and invites them to deliver the necessary documents.
- Check of suitability of manufacturer: The utility checks if the manufacturer is suitable in general, for instance, if they have technical support,

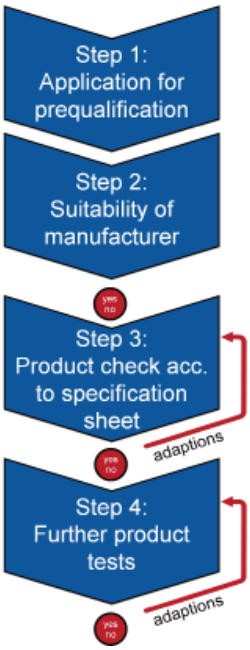

Fig.1 Steps of Prequalification

enough resources to produce the assets, or how long spare parts are available.

- Product check according to the specification sheet: The manufacturer returns the necessary documents (including features of the product, test results, etc.)
- Using a ranking system given by the specification sheet, the utility rates the product.
- Further product tests: For new manufacturers, the utility can initiate further tests according to:
  - o Commissioning guidelines of the utility
  - o IEC 60255-121
  - o IEC 61850
  - o Critical faults from the past
  - o Influence of CT saturation
  - o Performance with relays of other manufacturers.

How does this process deal with quality and efficiency?

For quality management, it is essential to document the process. This is also valid for the prequalification process which requires:

- Rules of procedure
- Application form for prequalification
- Eligibility requirements in general
- Installation of a scoring system
- Eligibility requirements for protection devices
- Process description in general
- Description of protection functions for 400-kV-network
- Description of protection functions for transformers
- Typical protection settings etc.

With a documented procedure, the comparison of assets from different manufacturers will be achieved. All assets have to undergo the same tests and from a technical point of view, the best one will be found. The tests in a prequalification procedure can be developed in a way which allows most parts to be used directly for any assets (same type of asset). This leads to shorter test times and with comparable results.

Requalification

The manufacturer is obliged to inform the utility about any changes of hardware and software. In addition, changes to the user software have to be indicated. If there are significant modifications, the utility can decide:

- If no technical check is needed
- If a technical check of the changed functions is needed
- Or if a complete check is needed.

This approach can also be used to keep the number of recertification procedures low.

Conclusions

This procedure has several benefits:

- It decouples the prequalification from the tender, no time pressure
- The utility knows that the product will work properly in the power system
- There is a clear ranking between the different products that passed the test
- The procedure can be out-sourced to an institute of certification
- The manufacturer can use the prequalification document for marketing issues.

The prequalification process can be applied to any type of asset used by a utility. The manufacturers and their new asset have to undergo numerous tests which will conclude with a prequalification certificate. This approach guarantees that only devices which are suitable for the utility are offered during the tendering process.

With experience from several projects in the field of prequalification, OMICRON can also be your partner in analysing existing procedures and setting up an optimised prequalification and certification procedure.

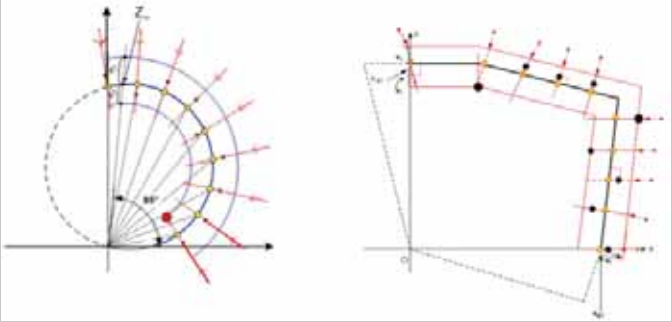

Fig.2: Test scenario for dynamic tests

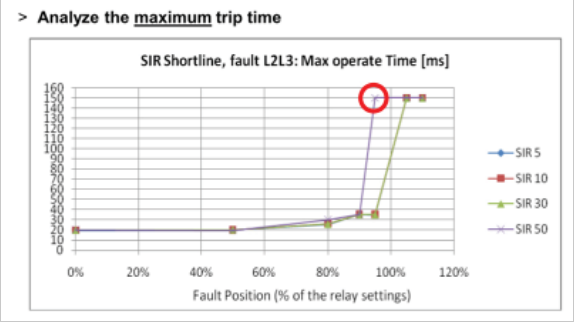

Fig.3: Test results for IEC60255-121 tests

Evaluate machine data with igus communication module

icom.plus module enables predictive maintenance with flexible data integration for high IT security

Being able to predict and plan maintenance is the goal pursued by igus with its smart plastics solutions. Intelligent sensors, for example, measure the wear of energy chains, slewing rings and linear guides. With the new communication module icom.plus, the customer can now decide in which form they would like to incorporate the acquired data from the sensors. From an offline version for restrictive environments up to the connection of the values to the igus server for automatic spare parts ordering, the user is free to integrate and read their data.

Under the name isense, igus carries sensors of various kinds that detect the condition of igus components such as cables or energy chains. They measure among other things the wear during the operation and alert the user early enough to plan repair or replacement. By networking with the icom communication module, the data is transmitted to an intelligent system. The module can be connected to all igus specific sensors. For example, with sensors for the measurement of abrasion, or the wear measurement of the pin-bore connection of the energy chain, as well as sensors for the detection of break and push-pull forces and for cable monitoring. Once the measured values from a sensor have been transferred to the icom module, they have to be "interpreted", i.e. understood in order to generate instructions from the same. So far, this has been possible via the connection to the igus cloud. Due to the increasing importance of IT security, however, many companies are increasingly relying on the development of their own SCADA systems, which is why igus has now advanced its data concentrator into icom.plus.

Flexible data connection

The icom.plus is programmed via igus online configurations with initial service life algorithms. The special feature: the new communication module can be operated offline upon customer request, after online installation without update function. In this "semi-offline" case, during an initial "learning phase", the device requires a temporary, short-term secured IoT access to the igus server to match the calculation algorithms to the actual motion and environmental profile of the customer application. In very restrictive areas, the update can also be performed from the beginning via a storage medium completely offline. In this way, the user can flexibly design the connection of the module and their data to establish a balance between maximising the runtime and IT security. The motion profile required for the calculation of the maintenance recommendation is read directly from the control system via the bus system of the machine. In the same way, the information about the number of days until the next recommended maintenance and freely definable warning messages about unusual changes in the sensor data are transferred to the PLC control.

Predictive maintenance

With the online connection of the icom.plus, a continuous matching of the service life statement with the igus cloud takes place in order to enable maximum system runtimes with minimal failure risk. The data in the cloud draws on the 10 billion test cycles of energy chains and cables performed in the company's own 2,750 square metre test laboratory, and thanks to machine learning and AI, igus can provide precise information on the durability of the solutions used and inform the user about a necessary replacement beforehand.

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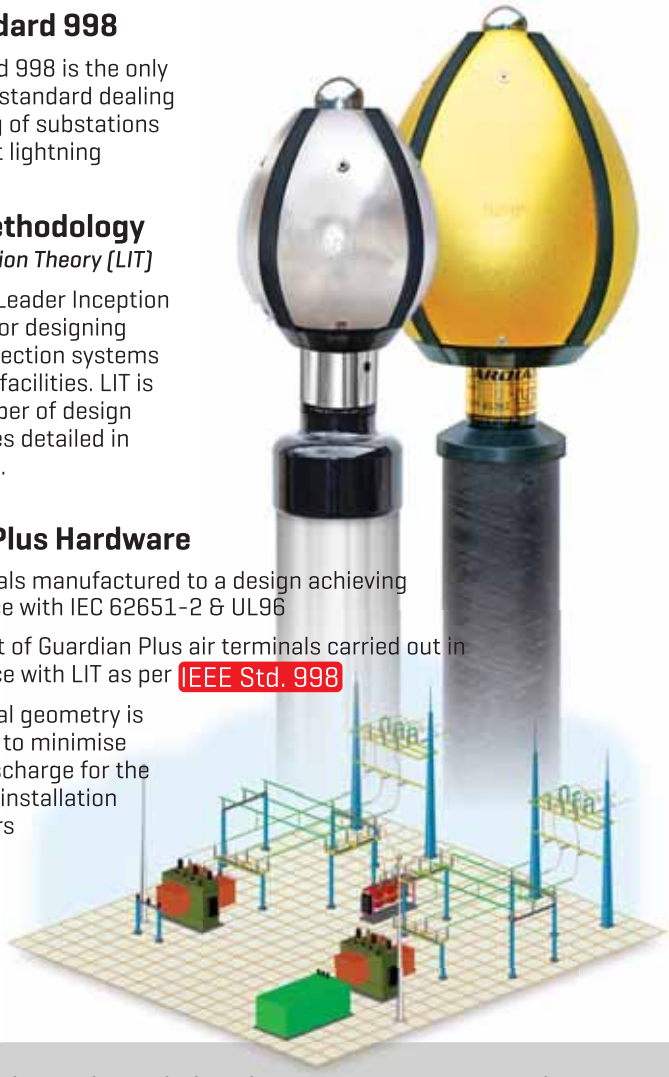

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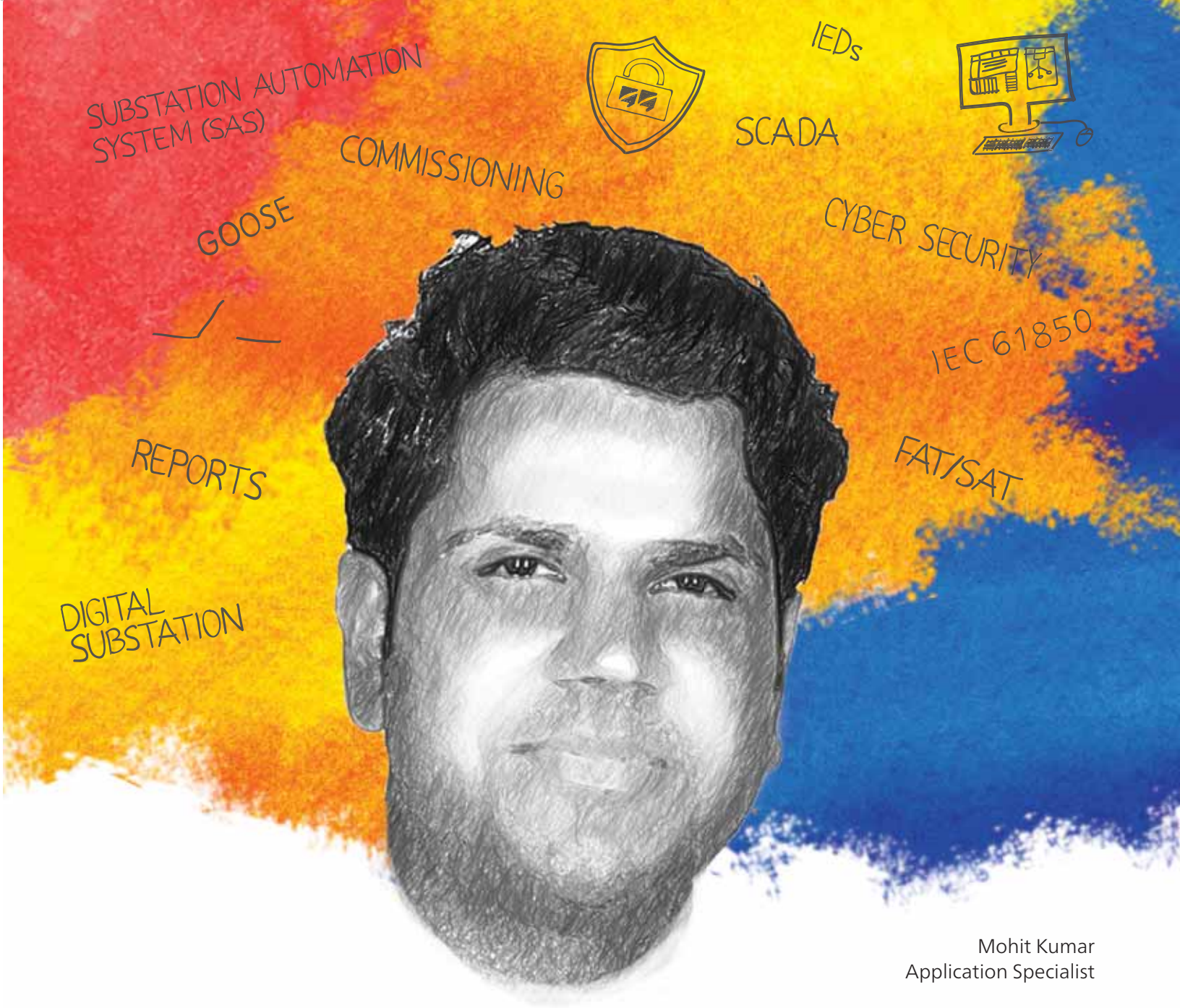

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