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PUBLISHER'S LETTER

Hello and welcome once again to *Electrical India*. Well, with the arrival of monsoon in most parts of the country, it's a welcome relief to many who were sweltering under scorching heat.

To beat the heat, in summer especially, more and more people across the country use air conditioner. Though the share of our citizens with ACs is very low, its growing fast, especially with rising income making it more 'buyable' and also rising temperatures making it a necessity. Last week's advice by the power ministry, on the basis of a study conducted by BEE, to set the default setting in ACs at 24°C has created a row in the country.

The question is: should the government do that? Well according to me, the answer is Yes, the government can decide that. The decision, if implemented, could only strike a balance between energy conservation, thereby releasing less CO_2, and thermal comfort, though 24°C may not be comfortable for every person.

Already the world is facing an environmental crisis. And its all because of use of excess energy, which we have done in the past 150 years. If the temperature is set at 18°C and the outside temperature is above 36°C, then the electricity required will be lot more than when you set the thermostat in the AC at 24°C. Because if the difference between temperature desired and outside temperature is huge, the system will consume more electricity to cool the room. At 24°C, it not only saves the already scarce energy that we have but also reduces the electricity bill. Let me tell you it's comfortable to be at 24°C and good for the health.

But then, as Sir Thomas Browne coined the word, "Charity begins at home." Let the government in good faith also come out with a report of all the ministers' and senior government officials' electricity bills for the last five years, both Central and State. Hong Kong government way back in 2004 had directed all government buildings to set as standard indoor room temperature during summer at 25.5°C for four years. But they did not impose it on the people first but had said such a measure by government will give a clear message to the public that they were taking a lead in minimising electricity use. Even in Hong Kong, there were different opinions and scepticism about its implementation. Here too, the war of words will only increase. With everybody's effort, distributed from public down to each household, we can make a difference.

Hope you enjoy reading this issue as much as we have been bringing it to you. Do send in your comments to me at miyer@charypublications.in

Mahadevan.

Publisher & Editor-In-Chief

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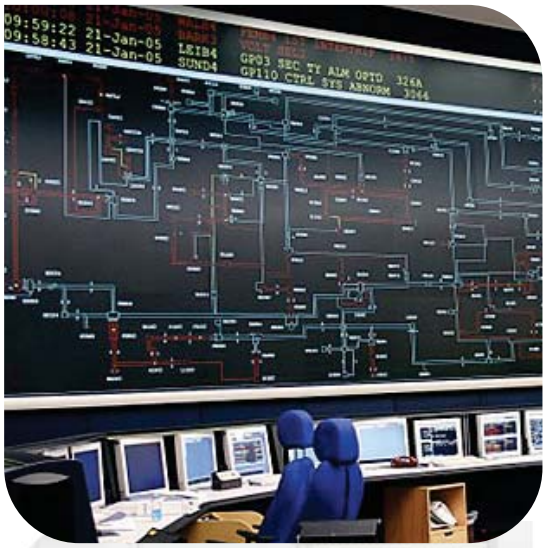
SCOPE



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WAGO Pvt Ltd

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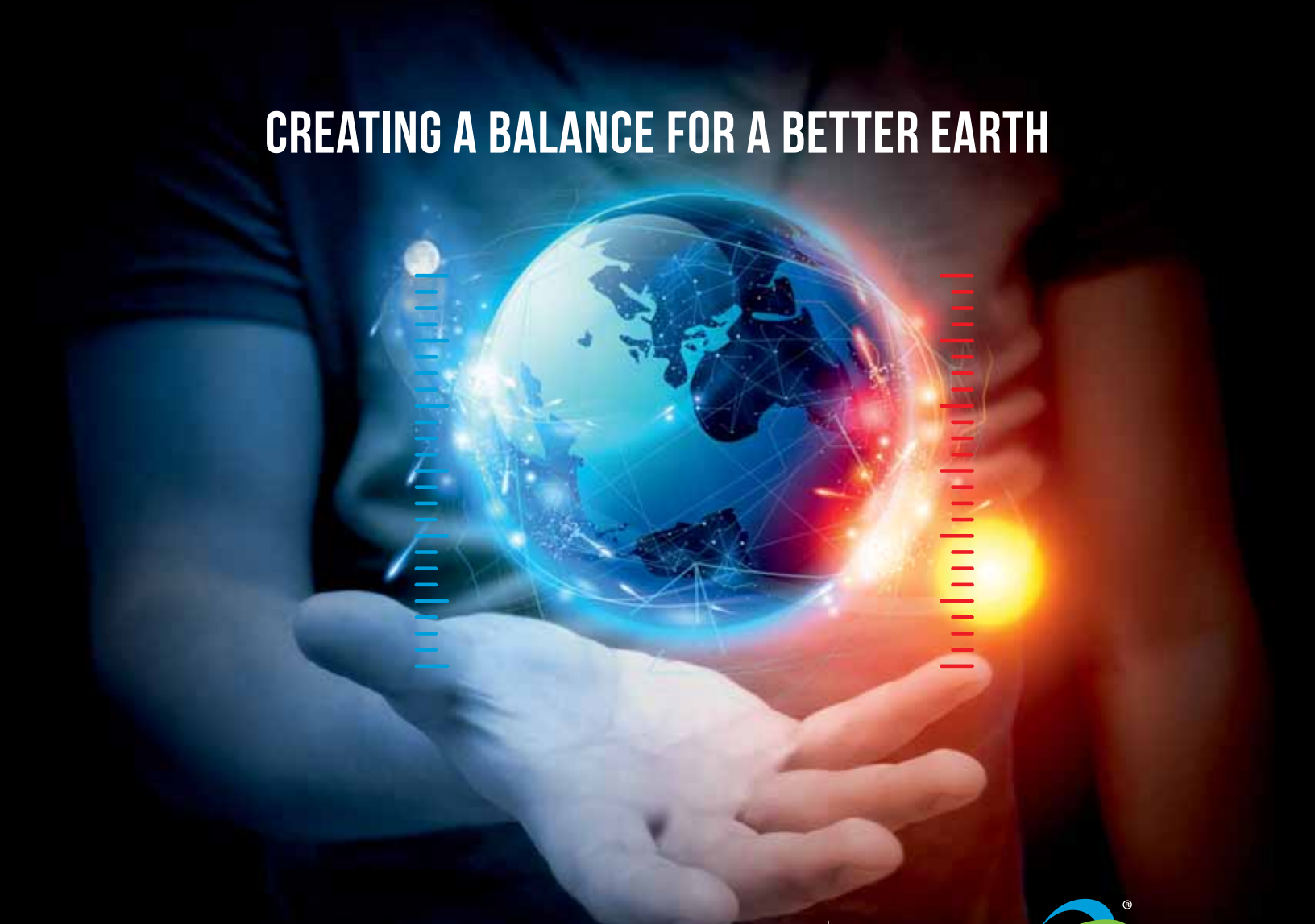
CREATING A BALANCE FOR A BETTER EARTH



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Telangana Govt Adopts E-Mobility Programme with EESL

Energy Efficiency Services Limited (EESL), a Super Energy Service Company (ESCO) under the administrative control of Ministry of Power, Government of India, signed an agreement with the Greater Hyderabad Municipal Corporation (GHMC), to lease out electric vehicles and install electric vehicles (EV) chargers at its offices.

The vehicles would be procured by EESL under the Government of India's National E-Mobility Programme and will be supplied at a monthly lease rental Rs. 22,500 per car, inclusive of maintenance expenditure.

This will not only reduce the costs of hired cars, but also substantially reduce emissions. Dignitaries present at the signing of the agreement included: Kalvakuntla Taraka Rama Rao, Minister for Municipal Administration & Urban Development, Industries & Commerce, Government of Telangana; and Shri Erik Solheim, Executive Director, United Nations Environment Programme and Renu Narang, Director (Finance), EESL. Marking the beginning of e-mobility in the historical city of Hyderabad, Shri Kalvakuntla Taraka Rama Rao flagged off the EVs here.

Speaking on the occasion, Minister Kalvakuntla Taraka Rama Rao said, "The city of Hyderabad is India's innovation hub, and is capable of setting an example for electric mobility adoption. It is our vision to achieve a sustained and phased migration to electric vehicles in Telangana. Our agreement with EESL will be instrumental in meeting the state's E-Mobility vision. We look forward to the GHMC EV programme as a successful pilot initiative to not only transform mobility, but also create the infrastructure for EV manufacturing as another economic opportunity."

PM Advises Meter Manufacturers to Scale Up Production

The Power Minister advised the manufacturers to scale up the manufacturing of smart prepaid meters as the demand would be huge in coming years. The Minister also advised the officials of the Ministry to consider making smart prepaid meters mandatory after a particular date.

"In next three years metering will go smart prepaid and gone will be the days of bills reaching your house. So, need of the hour is to scale up manufacturing of smart prepaid meters and to bring down their prices," said R K Singh, Minister of State (IC) for Power and New & Renewable Energy. Singh was addressing a meeting of meter manufacturers called by the Power Ministry.

This will revolutionise the power sector by way of reduced AT&C losses, better health of DISCOMs, incentivisation of energy conservation and ease of bill payments etc. Further, it will generate skilled employment for the youth.

The meeting discussed various aspects of smart meters e.g. BIS certification, compatibility with RF/ GPRS, harmonisation with existing digital infrastructure etc. It was also agreed that all technical aspects will be further deliberated into in consultation with meter manufacturers, DISCOMs and system integrators.

A K Bhalla, Secretary, Power; Sanjiv Nandan Sahai, Additional Secretary; Arun Kumar Verma, Joint Secretary, Ministry of Power were among the officials present from the Central Electricity Authority, PFC, REC, EESL and meter manufacturers.

50 MW Solar Project of NHPC in TN Synchronized with Grid

50 MW Solar PV Project of NHPC located in Theni/ Dindigul district of Tamil Nadu was successfully synchronised with the grid in March in presence of the commissioning team consisting of senior officers from TANGEDCO and NHPC project officials. The power station has generated 6.87 MU upto 15.04.2018.

The solar project shall provide an annual generation of 105 Million Units with sale of entire power to TANGEDCO in accordance with the power purchase agreement. The project was executed on EPC basis with a time frame of 9 months. Domestically manufactured Solar PV modules are used for the project.

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'Indian Electrical Equipment Industry records a highest growth'

The electrical and industrial electronics industry has witnessed a record double-digit growth of 12.8% in 2017-18. Although higher imports still plague the industry but policy changes and various initiatives undertaken by the Government and industry are eventually showing signs of revival for the sector. The production and sales data are collected from its member organisations, which represent 90 percent of the entire sector.

Shreegopal Kabra, President, IEEMA, said, "A substantial improvement in growth was experienced in the 3rd and 4th quarter of 2017-18 which resulted in a sharp rise in the performance. During this period, the industry grew by 25% in Q3 and 14% in Q4. The astonishing growth of 12.8% is propelled by growth in segments like rotating machines by 12%, HT Motors 18%, cables 20% and Meters 28%".

The government is procuring smart and prepaid meters to be deployed across the country. It has urged electricity meter manufacturers to scale up production in India, as it plans to shift all connections to smart prepaid meters over the next three years.

POWERGRID Commissions 765kV Wardha – Nizamabad Line

POWERGRID has commissioned the 765 kV Wardha – Nizamabad D/C line along with the 765/400 kV Nizamabad GIS Substation well ahead of scheduled completion time of May, 2018. This system will facilitate import of power from Western Region mainly Chhattisgarh for which long-term access has been granted to Telangana. As per the desire of Chief Minister of Telangana, the project was fast-tracked and completed in a record time and fulfilled the commitment given to the state. POWERGRID wishes to place on record the excellent support rendered by the state and various districts administration to complete this project.

During this financial year, POWERGRID completed another major inter-regional link by commissioning the corridor of 765kV Angul – Srikakulam – Vemagiri D/C line facilitating the import of Eastern Region power into Southern Region in Jan 2017. With the commissioning of the above two links, an inter-regional power transfer capacity of 9000 MW is made available to the entire Southern Region. Apart from the above, a 400 / 220 kV Substation to evacuate power from Solar Park at N P Kunta was commissioned in a record period of seven months from handing over of land in this year. This has greatly boosted the renewable energy integration into the grid.

Govt Launches Campaign to Promote Energy Efficiency


R K Singh

R K Singh, Minister of State (IC) for Power and New & Renewable launched a campaign to promote energy efficiency in the area of air-conditioning. Speaking on the occasion, he said, "Every one degree increase in the air-conditioner temperature setting results in saving of 6 per cent of electricity consumed. Normal human body temperature is approximately 36-37 degree Celsius, but large number of commercial establishments, hotels and offices maintain temperature around 18-21 degree Celsius.

This is not only uncomfortable but is actually unhealthy. Setting the temperature in the range of 18-21 degree Celsius compels people to wear warm clothing or use blankets; therefore, this is actually wastage of energy. Some countries like Japan have put in place regulation to keep the temperature at 28 degree Celsius". Therefore, under the guidance of Ministry of Power, the Bureau of Energy Efficiency (BEE) has carried out a study and has recommended that the default setting in the air-conditioning should be at 24 degree Celsius. The new campaign will result in substantial energy savings and also reduce greenhouse gas emission. To begin with this will be an advisory to be issued to all establishments and manufacturers. Manufacturers are advised to keep the default setting of air conditioners at 24 degrees Celsius and also to carry out labelling indicating the optimum temperature setting for the benefits of consumers both from financial and their health points of view.

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Tata Power's 'Club Enerji' saves 4 MUs of Electricity in FY17-18

Club Enerji, Tata Power's nationwide resource and energy conservation movement has been relentlessly spreading awareness about resource conservation across the country with a strategic focus on national building throughout the years. Continuing with this momentum, Club Enerji has cumulatively sensitised people across six cities- Mumbai, New Delhi, Ahmedabad, Kolkata, Pune & Bangalore and saved around 4 MUs of electricity in FY17-18. Since its inception in 2007, Club Enerji has been active in over 500 schools and has created approximately 2,017 Energy School Clubs all over India. The club has now created around 2,55,783 Energy Champions and 2,98,468 Energy Ambassadors among school students. Club Enerji program has also completed 10 years.

Commenting on this success, Praveer Sinha, CEO & Managing Director, Tata Power said, "We, at Tata Power are extremely happy and proud to initiate the 'Club Enerji' movement and reach a significant milestone in driving the message of energy conservation across the country. "

Azure Power Wins Largest Solar Power Project (75 MWs) in NE India

Azure Power, one of India's leading independent solar power producers, announced that it has won the largest (75 MWs) solar power project in the North Eastern region of India. Azure Power will sign a 25-year Power Purchase Agreement (PPA) with Assam Power Distribution Company Limited (APDCL) at a weighted average tariff of INR 3.37 (~US cents 5.2) per kWh. The project will be developed by Azure Power outside a solar park and is expected to be commissioned in 2019.

Assam has seen a significant increase in power demand in recent years and has a shortage of electricity capacity. The state has a peak power deficit of 4.2% and energy demand growth was 9% during the year ending March 2018. APDCL currently serves a quickly growing consumer base of more than 3.3 million. Inderpreet Wadhwa, Founder, Chairman and Chief Executive Officer, Azure Power said, "We are pleased to announce our win in Assam and with this, we continue to demonstrate our strong project development, engineering, and execution capabilities. We are delighted to make this contribution towards the realization of our Hon'ble Prime Minister's commitment towards clean and green energy, through solar power generation."

Azure Power has been among the most active participants in solar power auctions since the beginning of the solar power market in India.

BHEL Wins EPC Orders of over Rs 125 Cr for SPV Plants

Bharat Heavy Electricals Limited (BHEL) has won two orders cumulatively valued at over Rs 125 crore, for setting up Solar Photovoltaic (SPV) Power Plants on Engineering, Procurement and Construction (EPC) basis, in Gujarat.

The first order for setting up a 20 MW SPV power plant has been placed on BHEL by Gujarat Alkalies and Chemicals Limited (GACL), while the other for setting up a 10 MW SPV power plant has been received from Gujarat State Fertilizers and Chemicals Limited (GSFC). Both the solar power plants will be set up at Gujarat Solar Park, Charanka, Gujarat. With these orders, BHEL's solar capacity under execution at Gujarat Solar Park has reached 120 MW while the company's solar portfolio has risen to 580 MW. The company is presently executing over 210 MW of ground-mounted and rooftop Solar PV projects across the country.

BHEL has been contributing to the national initiatives for developing and promoting renewable energy-based products on a sustained basis, since the past three decades.

The company has enhanced its state-of-the-art manufacturing lines of solar cells and solar modules. In addition to this, space-grade solar panels using high efficiency cells and space-grade battery panels are also being manufactured by BHEL at its Bengaluru plant.

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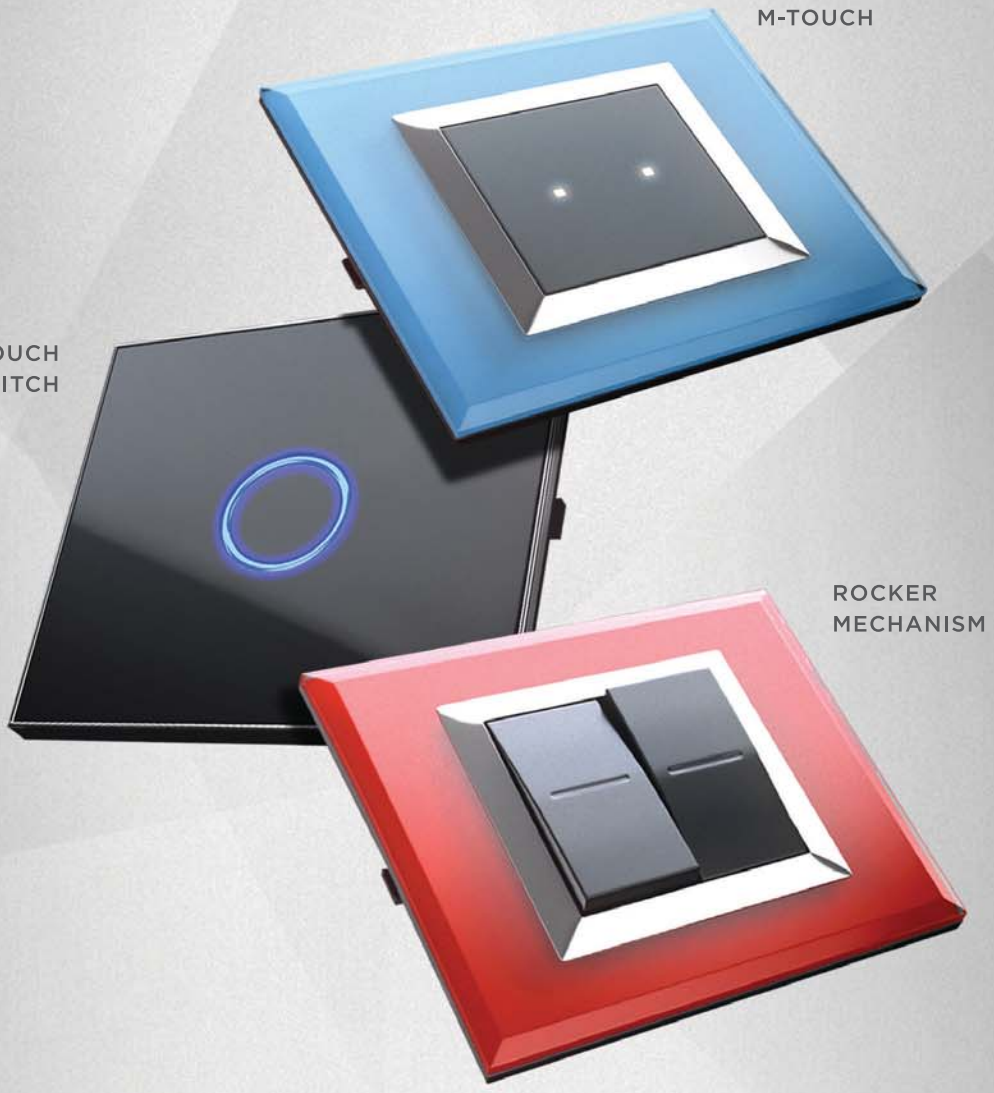

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Vikram Solar Commissions 10 MW Solar Project in Itarsi

Vikram Solar, one of the leading module manufacturer's and solar EPC players of India, commissioned a 10 MW Solar Power Project for Bharat Electronics Limited at the Ordnance Factory, Itarsi in Madhya Pradesh.

This is a captive power plant, and the power generated through this will be used by Ordnance Factory Itarsi. Apart from installation, Vikram Solar will also provide Operations and Maintenance (O&M) service to the plant for a period of 10 years from the date of commissioning.

Rohit Dhar, Director of Sales-EPC, Vikram Solar, shared on the occasion, "This is yet another milestone for us and an addition to our country's greener future. The large expanse of black soil in the area posed a challenging environment to work during the monsoon. We understand that no project is without its set of challenges."

It is a 10 MW plant project and has 35,360 modules powering the whole unit. Vikram Solar has a prestigious 750 MW (commissioned + under execution) EPC capacity. With proven capacity to handle utility scale projects (130 MW for NTPC at Bhadla-Rajasthan, 80 MW for GIPCL at Charanka, Gujarat, 40 MW for IL&FS at Kachaliya, Madhya Pradesh), innovative projects (India's first floating solar), and airport installations (Calicut, Kolkata, Kochi) Vikram Solar is contributing to the growth of Indian solar revolution.

NTPC to Use Treated Sewage Water

NTPC, India's largest power generating company will use treated sewage water at its Dadri Power Station. This is in line with the tariff policy amendment by Ministry of Power, which requires mandatory use of treated sewage water from Sewage Treatment Plant (STP) of municipal body for thermal power plant located within 50 kilometre radius of the STP.

As a part of its corporate ethos, NTPC aims at utilization of waste water to ensure a sustainable ecological balance by minimizing waste and reusing treated wastewater at its power stations. NTPC has always made a pro-active approach towards environment, adoption of latest technologies, and continual environment conservation.

Company signed a Memorandum of Understanding (MoU) with Noida Authority for the supply of 80 MLD treated sewage water to NTPC Dadri plant. The project is expected to get completed in next three years.

Riello Power to exhibit at IPLEX 2018

Riello Power, one of the top UPS manufacturers, is all set to participate in the upcoming India International Plastics Exposition exhibition scheduled to be between 3rd and 6th in Hyderabad. The IPLEX 2018 is the 9th edition and is being held at the Hitex Exhibition Centre, Hyderabad. The renowned exhibition is supported immensely by the industries across India and globe.

The IPLEX happens in the major cities of southern India and focusses on to build the opportunity to expose and reap the benefit of globalisation. This also benefits all the industries connected with plastics industry and boost the image of their products and brand.

The exhibition primarily focuses on the plastics processing that provide opportunities for the manufacturers of processing machinery, auxiliary equipment and finished goods to showcase their capabilities and widen their market base.

Riello Power is going to participate at the exhibition with indoor booth number F25 at hall number 3. Through the exposition Riello will display its innovative products for plastic industry.

The team of UPS experts will be available for hands-on discussion with various customers in manufacturing and industrial sector, the company informs.

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Wärtsilä Introduces New Hybrid Solar PV & Storage Solution

The technology group Wärtsilä introduces a new hybrid solar PV and storage solution. Wärtsilä Hybrid Solar integrates solar PV generation and storage to deliver true renewables as baseload solution that is not only climate-friendly, increases resilience and efficiencies but can be supported by a power producer's existing grid infrastructure.

Hybrid Solar will allow utilities to transform the efficiency and reliability of their systems with an adaptable solar PV power plant that can support its baseload needs," said Magnus Miemois, Director, Hybrids, Wärtsilä Energy Solutions. "As our global energy ecosystem evolves, Hybrid Solar represents a ground-breaking approach to power generation." The IEA estimates that by 2040, total global generation capacity will increase by 60 per cent, and renewable energy sources, like solar, wind and hydro, will make up more than 45 per cent of that total.

Solar Industries India ties-up with EURENCO

SOLAR Industries, India's largest manufacturer of explosives and initiating systems, and EURENCO, the European leader in energetic materials, announced a strategic partnership agreement to supply of Explosives, Propellants, Transfer of Technology projects and to a common offer for the Bi-Modular Charge System (BMCS) project in India during the EUROSATORY 2018 exhibition held in Paris-Villepinte on June 11-15, 2018.

SOLAR and EURENCO signed a preliminary Memorandum of Understanding (MoU) as far back as July 2016 to evaluate various cooperation options, including the BMCS project. With the strong will to reinforce their cooperation to address the Indian Army's needs and future developments including export options, the two companies confirmed the strategic partnership for the supply of Propellants, Bombs, Ammunition filling and Modular Charges technologies under the 'Make in India' policy for the private sector.

Siemens Gamesa to Supply 70 Wind Turbines to Three Projects

Siemens Gamesa Renewable Energy (SGRE) will supply three onshore wind farms in Norway including 70 units of its Onshore OptimaFlex wind turbines. The SWT-DD-130 turbines will each feature a rated capacity of 4.2 MW and a 130-meter diameter rotor. All turbines will be installed on steel towers with 125 meter hub heights. The project sites with 15, 18 and 37 units are located in the Bjerkreim and Ha municipalities – approximately 50 kilometers south-east of Stavanger. A 25-year full service agreement with a yield-based availability warranty secures the long-term performance of the wind farms.

Owner and long-term operator of the wind farm trio is Hamburg based Luxcara, a leading asset manager for renewable energy investments for institutional investors. The installation of the 76MW-Skinansfjellet project, the 63MW-Gravdal wind farm and the Eikeland-Steinsland project with over 155 megawatts – a combined rating of 294 MW and collectively known as the Bjerkreim cluster – will start in spring 2019 with completion planned for autumn 2019. "We are very happy to be able to rely on Siemens Gamesa as such an experienced partner in the Nordics for our largest wind project so far", says Dr Alexandra von Bernstorff, Managing Partner of Luxcara. Siemens Gamesa is executing the projects in close collaboration with Luxcara and the Norwegian developer Norsk Vind Energi.

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Cree Revamps LED Bulb Line

Cree has revamped its complete line of consumer LED bulbs, including more than 30 products ranging from A-Lamps and candelabras to reflectors and downlights. Developed with consumers preferences in mind, the upgraded line is engineered to work better and last longer, with light that delivers exceptional colour quality. The launch comes in conjunction with The Home Depot's recently redesigned bulb aisle that aims to help consumers easily navigate, understand and choose LED light bulbs.

"The new line of bulbs delivers the best value for consumers who are looking for long-lasting, true-to-colour LED lighting that will enhance their home," said Phil Primato, senior marketing manager of Cree. "We have simplified our packaging into an easy-to-understand white box that explains the value of exceptional lighting."

Cree's LED bulbs can improve the appearance of home décor, increase comfort and even affect mood. For homeowners looking to modernise their space through a remodel or gain more light in their home, it is as easy as changing the light bulbs. The entire line of these high-quality bulbs includes over 90 colour-rendering index (CRI) light, making the hues in your home appear more vibrant, rich and natural.

Deco Lighting launches 'Power over Ethernet' Technology

Deco Lighting introduces DECO PoE (Power over Ethernet) integrated technology, debuting in the Vector interior architectural luminaire. According to the company, DECO PoE, powered by Molex's NCS Network, will bring a newly-conceptualised system to commercial building spaces that provide easier installation and smarter building monitoring than static LED lighting fixtures.

Intended to simplify the way lighting systems connect to an IP-based infrastructure for smart control, DECO PoE introduces a new paradigm where energy-saving LED luminaires evolve into a service and become an Internet of Things (IoT) building asset that can be controlled synergistically with other building functions. Integrating Deco's Vector luminaire with next-generation NCS networked lighting controls, transforms the lighting fixture into a beacon for data collection and a center for distributing energy, environmental, and occupancy information.

Ben Pouladian, President and Co-Founder at Deco Lighting says, "We believe that the next generation of luminaire selection begins with the CIO or CTO of every organisation because lighting is no longer a binary product that simply produces light."

IRENA Welcomes EU's Decision on RE Target

Adnan Z Amin, Director-General of the International Renewable Energy Agency (IRENA) has welcomed the European Union's (EU) decision to increase its renewable energy target from 27 per cent to 32 per cent by 2030, highlighting that the move reinforces the EU's position at the forefront of energy transformation and reflects the new economics of renewable energy. Responding to the announcement made by the European Commission, Amin said, "The EU's decision to increase its renewable energy target from 27 per cent to 32 per cent by 2030 is a move that consolidates Europe's position at the forefront of the global energy transformation and establishes a positive decarbonisation pathway in line with its commitments under the Paris Agreement.

"It is also recognition that the new economics of RE have propelled it to the forefront of energy policy and investment decision making as governments around the world look to address long-term climate and economic agendas. Our RE roadmap analysis, delivered to the European Commission earlier this year, identified that higher shares of renewable energy in the EU were cost-effective and would have a net positive economic impact. This ambitious and achievable new strategy will drive significant additional investment activity, creating thousands of new skilled jobs and improving health and well-being."

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Anil Kumar Jha Takes Over as Chairman, CIL


Anil Kumar Jha

Anil Kumar Jha took over as Chairman-cum-Managing Director of Coal India Limited (CIL). Prior to the assumption of CIL's apex post, Jha headed Mahanadi Coalfields Limited (MCL) – the second largest coal producing company among all CIL's subsidiaries - since 1 November 2015 as CMD.

He succeeds Suresh Kumar, Additional Secretary, Ministry of Coal who was vested with the additional charge as Chairman of CIL. Jha, a Post Graduate (M Tech) with Distinction in Mine Planning & Design from Indian School of Mines, Dhanbad began his career in 1983 in Central Coalfields Ltd. He had held many important assignments and senior positions in CCL. He was also General Manager, Argada.

Jha, a Post Graduate (M. Tech) with Distinction in Mine Planning & Design from Indian School of Mines, Dhanbad began his career in 1983 in Central Coalfields Ltd. He had held many important assignments and senior positions in CCL. He was also General Manager, Argada. Jha had a 14-year stint in Central Mine Planning & Design Institute (CMPDI) - the Ranchi based consultancy arm of CIL. For a while he worked as Director (P&P) in MOIL Limited where he was the Nominated Owner and Head of Production, Planning, Projects, Quality Control and Mine Safety Divisions. Jha has over three decades of experience under his belt in mine planning, production, management supervision, direction and control of underground as well as open cast coal mines.

Dr InderJit Singh Becomes Coal Secretary


Dr InderJit Singh

Dr. InderJit Singh, assumed charge as Secretary, Ministry of Coal on 14th June. He took over the charge of Secretary which fell vacant after superannuation of Susheel Kumar on 30th April this year. In the interim, Secretary Mines, Anil G Mukhim had been holding additional charge as Secretary, Coal.

Prior to this appointment as Coal Secretary, Dr Singh was posted as Secretary (Coordination) in Cabinet Secretariat. Dr. Singh is a Ph.D in Economics from Punjab University. In the past he has also held positions in Ministry of Commerce, MNRE at the Centre and other significant portfolios in the State cadre.

BHEL Appoints New Director (Industrial Systems & Products)


S Balakrishnan

On his appointment as Director on the Board of Bharat Heavy Electricals Limited (BHEL), S Balakrishnan, 57, has assumed charge as Director (Industrial Systems & Products) of the Public Sector Engineering and Manufacturing Enterprise.

Prior to this, as Executive Director, he was heading the Heavy Power Equipment Plant (HPEP), Ramachandrapuram - one of the major units of BHEL at Hyderabad. Earlier, he was heading the company's Industrial Products (Electrical & Mechanical) business at Industry Sector, Delhi, as General Manager In-charge.

Balakrishnan is a Mechanical Engineering graduate from University of Indore, Madhya Pradesh and acquired his Masters Degree in Stress & Vibration Analysis from Bhopal University. He started his career with BHEL as Engineer Trainee in 1982 in the company's Trichy unit and subsequently moved to BHEL, Bhopal, where he worked in various capacities in the areas of A.C. machines, nuclear turbines and transformers at BHEL's Bhopal Plant.

Balakrishnan brings with him 35 years of diverse experience in the areas of electrical machines, transformers, gas turbines, steam turbines, pulverisers, heat exchangers, oil rigs, etc.

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Upside Energy Wins Prestigious 2018 Ashden Award

Ten innovative organisations have been chosen from across the globe as the best in sustainable energy. Ashden works to encourage the growth of sustainable energy to tackle climate change and bring social and economic benefits to millions.

Upside Energy aims to reduce stress on the National Grid through its cloud-based Virtual Energy Store.

This aggregates flexible demand from systems such as domestic energy storage, heat pumps, electric vehicles and uninterruptable power supplies, which it sells to the National Grid, network operators and energy suppliers to help balance supply and demand. System owners and Upside Energy share in the revenue created.

The Virtual Energy Store helps the grid to cope with more renewable energy capacity, and shift electricity usage from peak to off-peak periods, reducing the use of some of the UK's oldest, most polluting and expensive power stations. Upside Energy is the winner of the UK Impax Ashden Award for Energy Innovation.

Solis Tek Digital Lighting Bags Award for Indoor Lighting

Solis Tek, a vertically integrated cannabis technology innovator, manufacturer and distributor, announced that its Digital Lighting System was awarded the Most Efficient Indoor Light Systems at Terpenes and Testing World Conference 2018.

Solis Tek offers an extensive line of digital lighting equipment and accessories to help achieve higher yields and maximise quality. Solis Tek lighting products include complete light system fixtures, controllers, digital ballasts, reflectors, CMH double ended lamps, digital splitters, accessories and digital controllers.

Schneider Electric Products Get Recognition

Schneider Electric, the global specialist in the digital transformation of energy management and automation, announced that it has been named a multiple award winner by the Plant Engineering Product of the Year Awards program. Its EcoStruxure Power Monitoring Expert received the program's superlative Grand Award, given to the new product that received the highest number of votes among all 15 categories, while the PROficient for Consulting Engineers Program won gold in the Productivity & Training category and the Altivar Process 680 (ATV680) Low Harmonic Process Drive won bronze in the Electric Motors & Drives category.

EcoStruxure Power Monitoring Expert is a complete supervisory software package for power management applications. The software collects and organizes data gathered from the customer's electrical network and presents it as meaningful, actionable information via an intuitive web interface. Users can then share information with key stakeholders or across their entire operation to influence behavioral changes and reduce costs. This enables users to improve operational efficiency and reduce energy-related costs, ensure electrical network reliability, and optimize equipment utilization and the cost of operations. EcoStruxure Power Monitoring Expert received the 2017 Grand Award after receiving the most votes from Plant Engineering readers, making it the only product this year to receive such an honor.

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Power Transformer Market worth US$ 29.91 Bn by 2020

The growth is due to the increase in HVDC transmission projects mainly in the Asia-Pacific region. HVDC, EHV, and UHV projects being undertaken for reducing transmission losses during transmission over large distances is the major growth driver of the large power transformer market.

Power transformer market is projected to reach a value of US$ 29.91 billion by 2020, from an estimated US$ 20.71 billion in 2015 at a CAGR of 7.6 per cent from 2015 to 2020. Increasing energy demand coupled with rising electrical infrastructure projects would drive the demand for power transformers. Apart from this, the replacement of aging infrastructure in North America and Europe and increasing rate of installation of green transformers are driving the power transformer market.

Although the market size of the medium power transformer segment is large, yet the growth of the large power transformer segment is higher. This is due to the increase in HVDC transmission projects mainly in the Asia-Pacific region. HVDC, EHV, and UHV projects being undertaken for reducing transmission losses during transmission over large distances is the major growth driver of the large power transformer market.

Oil-Cooled Power Transformers Dominate Power Transformers Market

The oil-cooled power transformer segment occupies a larger market size as it is considered a safer option while handling high voltages. And, with increasing number of high voltage transmission projects being undertaken, the demand for oil-cooled power transformers is expected to be higher than air-cooled power transformers.

Asia-Pacific: Largest Market for Power Transformers

The power transformer market is driven by increasing global energy consumption; to fulfill this, new T&D lines are being installed. Moreover, investments being made by governments in electrical infrastructure projects have also gone up, further aiding in the growth of the power transformer market. Asia-Pacific is the largest market for power transformers, and its demand in the region is mainly driven by extensive T&D network expansion projects in developing countries such as India and China.

The report covers major market players such as ABB (Switzerland), Siemens (Germany), Crompton Greaves (India), and General Electric (U.S.) among others. These companies together occupy about half of the power transformer market.

The size of the overall market has been determined by forecasting techniques based on the power transformer demand in different regions, which has been validated through primary sources. The market data is available from 2013 to 2020 with CAGR from 2015 to 2020. This report analyzes various marketing trends and establishes the most effective growth strategy.

Source: Marketsandmarkets

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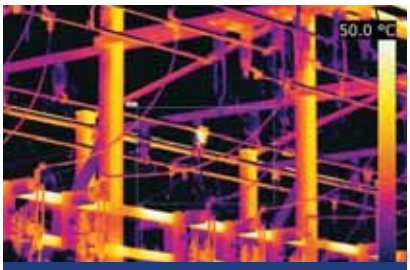

Substation Thermal Image

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Smart Monitoring

An in-depth analysis on how IoT based monitoring system enhances performance of distribution transformers.

Picture Courtesy: https://commons.wikimedia.org

Transformers at substation near Denver International Airport, Colorado

The power sector in India is going through a transformation. The electricity generation from conventional sources during 2017-18 was 1206.306 billion unit (BU) as compared to 1160.141 BU generated during 2016-17, representing a growth of about 3.98 per cent. Further, the conventional generation target for the year 2018-19 has been fixed as 1265 BU i.e. growth of around 4.87 per cent over actual conventional generation of 1206.306 BU for the previous year (2017-18). India is likely to attract a massive investment of Rs 11,55,652 crore in power generation sector in the five-year period between 2017 and

2022 in setting up projects across thermal, hydro, nuclear and renewables segment.

A robust and efficient power transmission and distribution (T&D) infrastructure is imperative for effective transfer of power from generation source to the consumption points or demand centres. As of now, India's T&D infrastructure is inadequate and lacks efficiency at many points. Thus, it is imperative to expand and enhance the existing T&D infrastructure to transmit the power generated efficiently to consumer points. Transformers are critical components of the power generation and T&D network that are used to change voltage in the process and hence play a critical role. Hence, regular monitoring of transformers is essential to achieve their desired performance with optimum efficiency and reliability. Here we analyse how Internet of Things (IoT) based monitoring system enhances performance of distribution transformers.

IoT enables safe transformer operations

The modern transformers are loaded with SCADA connected instruments which can be easily hooked up to smartphones for activating alarm and trip contacts and also with substation control rooms for emergency stoppage of main line power in the event of any unlikely situation.

"Typically, with economic development and continuous city size expansion across length and breadth of the country together with encroachment of existing towns and metros, we find distribution transformers are the closest to human interface. IoT control of these transformers through local substation can aid monitoring and safety of such essential devices. In fact, this is one of the agendas being discussed in smart city projects in India and abroad. It not only helps reducing power interruption and diversion at right moment but also saves the electrical networks from any such damage," said Sanjib Mitra, Country Head and Sr VP – Transformer Division, Electrotherm (India) Ltd.

IoT helps in remote monitoring of transformers

Distribution transformers are one of the most important equipment in power network. As a large quantity of transformers distributed over a wide area in power electric systems, the data acquisition and condition monitoring become challenging. IoT can play a critical role in monitoring and controlling of distribution transformers. Operation of distribution transformers under rated condition assurances their long life. However, their life is significantly reduced if they are subjected to overloading condition, regular unbalanced loading, non-maintenance of silica gel, oil level, and oil and insulation degradation, resulting in sudden failures and loss of supply to a large number of customers thus affecting system reliability. In transformer monitoring system four sensors for monitoring are used that is voltage sensor, current sensor, temperature sensor and oil level sensor.

Smart grid, the next generation electric power system, is actual way of digital transmission of electricity. It is digital technology that allows resourceful two-way communications between utility and customers. "Using smart grid-based sensors like current, voltage and temperature sensors along with IoT embedded wireless communication protocol enables real time monitoring of power line parameters like voltage, current and temperature. These sensors qualify the remote monitoring of equipment such as

IoT control of these (distribution) transformers through local substation can aid monitoring and safety of such essential devices.

Sanjib Mitra, Country Head and Sr VP – Transformer Division, Electrotherm (India) Ltd.

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Anil Kadam, GM - Business Development, Solution Architect, Schneider Electric.

The challenge in the distribution transformers, especially with the utilities is to invest in a physical asset at remote location for live monitoring.

Divyansh Kohli, Executive Director, NDL Power Limited

transformers and power lines. They improve the performance and extending the life of grid components to ensure a safe and reliable operation of the electricity network. This system also helps to identify problems before any shattering," explains Anil Kadam, GM - Business Development, Solution Architect, Schneider Electric while commenting on how IoT based monitoring system enhances performance of distribution transformers.

Divyansh Kohli, Executive Director, NDL Power Ltd also opines, "T&D system is one of the most highly value and asset dependent systems and with the IoT integrations to the distribution transformer, the most effective value addition shall be accumulation of live date, which in-turn support the condition and performance monitoring along with analytics."

However, Kohli points out: "The challenge in the distribution transformers, especially with the utilities is to invest in a physical asset at remote location for live monitoring."

NDL has introduced an IoT enhanced transformer analytical and diagnostic system named 'maxfree analyst' which is a proprietary system that collaborates all the testing data, right for commissioning to periodic oil diagnostics and electrical test. With IoT, it can monitor (which is a separate module attached to the transformer) and record the live performance and loading parameters to generate and conduct detailed analysis and diagnostics for the transformer assets.

Conclusion

Transformer being the heart of power transfer and the most essential electrical device in a power generation and T&D network, it needs a healthy and safe product life cycle. Monitoring of such essential devices is of course beneficial to avoid any sudden power cut and to avoid accidental blackouts. Any such abnormalities may lead to fatal accidents of major nature depending on the size and vicinity of the running transformers. IoT is the answer to handle all such latent threats, concludes Sanjib Mitra of Electrotherm (India) Ltd.

EV demand to help power utilities earn $11 bn in revenue: ASSOCHAM – EY study

The overall electricity demand from electric vehicles (EVs) in India is projected to be around 79.9 gigawatt hours (GWh) by 2020 and is expected to reach 69.6 terawatt hours (TWh) by 2030, noted a recent ASSOCHAM-EY joint study.

"The overall EV demand is expected to help utilities earn an estimated US$ 11 billion (INR700 billion) in revenue by 2030," according to the study titled, 'Electrifying India: building blocks for a sustainable EV ecosystem,' jointly conducted by The Associated Chambers of Commerce and Industry of India (ASSOCHAM) and Ernst & Young LLP (EY).

The report added that increasing adoption of EVs across India will be instrumental in transforming the country's power sector. "The surge in electricity demand from EVs will help recover the slow demand growth."

It also said that arrival of electric mobility is expected to help the P&U (power and utilities) sector realise net cost and revenue benefits from both demand and the supply side.

Further highlighting the impact of EVs on Indian power sector, the report noted that it will help the country in achieving carbon emission reduction targets.

"By 2030, EVs are expected to reduce emissions by 40-50 per cent, compared to ICE (internal combustion engine) vehicles in an aggressive renewable energy scenario," it said.

However, the report added that even if the grid continues to be coal heavy, emissions are likely to reduce by 20-30 per cent. It also said that power and utilities sector in India is undergoing rapid transformational developments—reducing dependence on imported coal, rising energy independence with renewables, reducing plant load factors (PLFs) and national grid integration to name a few.

The ASSOCHAM-EY study suggested for a national regulated rate that can be applicable to all charging stations across India considering that government is in discussion to standardise charging infrastructure development in India, besides many norms are proposed to standardise the market, but they are still in the planning stage. Additionally, EV charging tariffs are regulated at some locations, while tariffs are not fixed at other locations.

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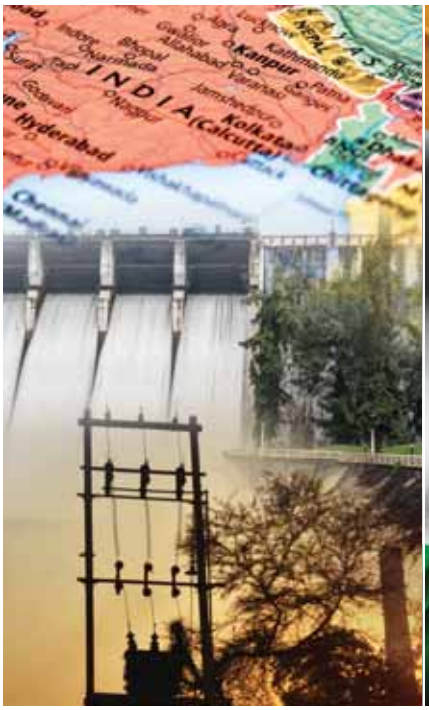

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SAFETY INSIDE

Best ways to test transformer oil

Testing of oil plays a vital role in keeping transformers running efficiently and effectively. Here's a comprehensive analysis on the different ways to test transformer oil.

Picture Courtesy: SRL OIL & GREASE

Oil is an integral part of transformers and plays a critical role in keeping a transformer running efficiently. Transformer oil is also known as mineral insulating oil and it serves as liquid insulation in electrical equipment and also dissipates heat of such equipment. All winding and core are fully immersed in the oil inside the equipment. The transformer oil also prevents direct contact of atmospherics oxygen to avoid any type of oxidation. It can be said that the transformer oil is life line of equipment.

Analysis of transformer oil enables operators to determine whether it is working at its best and detect possible problems before they result in costly downtime, repairs and loss of production. According to SK Jain, Director, Powerlink Oil Refinery Ltd, "It is very essential to monitor the quality of transformer oil and needs to be tested regularly as per standard laid down under various test methods. These all tests are conducted under various standards for each parameter."

Divyansh Kohli, Executive Director, NDL Power Ltd, believes: "Transformer oil analysis is the most effective method to detect incipient faults and monitoring a transformer's condition and its most important credit is that it is non-destructive analysis. Moreover, the analysis is conducted in live transformer condition."

Continued on Page 32

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Continued from Page 30

Alok Agarwal, Chairman, IEEMA, Distribution Transformers Division opines that several factors need to be considered while selecting the best suitable way for transformer oil testing. "Budget, volume of samples to be tested and the need for real-time continuous monitoring are the most critical factors," he explained while accepting that cost is generally the first consideration.

Most effective method to determine transformer condition

Oil is the one element that surrounds the transformer body and is in contact with all the elements. Transformer unlike any other asset is a static equipment and therefore has a very minuscule operator feedback. "Transformer oil analysis is by far the most effective method to determine transformer condition and to predict and prevent failure with highest success rate," Kohli observes.

Oil in a transformer works for two essential function: Dielectric property and cooling property. IS 335 defines and explains about it. Both the properties are equally important and essential for a transformer to live and work healthy. The oil property is generally tested at laboratories available across India. It is done on sampling basis and does not take much time. "It is advisable to take sample oil from transformers as a part of routine maintenance and keep a chart for noting values for monitoring and analysis. The breakdown voltage (BDV) gradually goes down with time when transformer is in use. Once in a year oil should be filtered to arrest dissolved moisture," suggests Sanjib Mitra, Country Head and Sr VP – Transformer Division, Electrotherm (India) Ltd. He adds, "Dissolved gas analysis (DGA) is used for oil property checks at site to avoid poor oil performance on a longer period."

However, Kohli of NDL Power Ltd suggests that a few points the consumers should understand before conducting the oil analysis:

- **The testing parameters and its significance of analysis:** Most engineers only conduct OST which only observe the oil condition and some add DGA. However, there are several other parameters in transformer oil analysis that surpass the abilities of electrical diagnostics only after understanding its significance shall one add the parameters.

Budget, volume of samples to be tested and the need for real-time continuous monitoring are the most critical factors.

Alok Agarwal, Chairman, IEEMA, Distribution Transformers Division

Transformer oil testing is a proven capital loss prevention technique which should be a part of any condition-based predictive maintenance program.

Anil Kadam, GM - Business Development, Solution Architect, Schneider Electric.

It is very essential to monitor the quality of transformer oil and needs to be tested regularly as per standard laid down under various test methods.

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Sanjib Mitra, Country Head and Sr VP – Transformer Division, Electrotherm (India) Ltd.

- It is utmost important to entrust a laboratory for oil testing. Not only shall the laboratory be NABL or ILAC accredited, but it should be specific to transformer diagnostics. There are several generic laboratories in India that also document transformer oil analysis. But apart from the

Continued on Page 34

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Continued from Page 32

quality or understating the critical elements of analysis, they fail in diagnosing a problem or incipient failure by interpretation of the data.

- The reliability managers should first develop and then strictly follow the schedule of testing oil to ensure accurate condition monitoring.
- **Sampling of oil:** It is very important to have a true sample to get accurate results. ASTM or IEC guided syringe sampling from transformer oil analysis is recommended.

Transformer oil testing: A proven capital loss prevention technique

Transformer oil testing is a proven capital loss prevention technique which should be a part of any condition-based predictive maintenance program, advocates Anil Kadam, GM - Business Development, Solution Architect, Schneider Electric. He said, "This early warning system can allow maintenance management to identify maintenance priorities, plan work assignment schedules, arrange for outside service, and order necessary parts and materials. The whole process can turn predictive."

He adds, "The transformer's fluid not only serves as a heat transfer medium, it also is part of the transformer's insulation system. It is therefore prudent to periodically perform tests on the oil to determine whether it is capable of fulfilling its role as an insulant."

Some of the most common tests for transformer oil are: Dissolved gas in oil analysis, screen tests, water content, metals-in-oil, and polychlorinated biphenyl. The various test methods are explained here:

Test methods

American Society of Testing and materials (ASTM), Indian Standard (IS), British Standard (BS) and International Electro technical Committee (IEC) are widely accepted standards worldwide. In India, major test methods are adopted as per IS-335 and IS-1866 for acceptance of new oil as per agreement with seller and purchaser and maintenance and supervision of electrical equipment in service. Sampling of liquid oil for carrying out the various test is also very important and Bureau of Indian Standard (BIS) recommends and publishes standard for sampling (IS-6855). The sampling of transformer oil for testing from container or equipment should be as per this standard to get proper and correct results, recommends Jain.

Testing a new transformer oil

For new transformer oil, certain tests are to be carried out such as appearance, flash point, pour point, viscosity, breakdown voltage, acidity, neutralisation value, power factor and water contents etc. which is called routine tests. Other tests are long duration test such as corrosive sulphur, oxidation and ageing tests which are helpful to determine the oil life in equipment. As per Jain, all these tests should be kept within the acceptable limits as agreed upon under various standards.

Tests on transformer oil in service

In service transformers, oils are subjected to normal deterioration due to the equipment conditions. The oil darkens in colour and its acidity begins to increase. All these changes may have effect on both solid and liquid insulating material. There are different best ways for carry out the tests on transformer oil in service. "Field test-cum-onsite testing are usually limited to visual inspection such as colour, appearance, breakdown voltage and neutralisation value. The complete examination is only possible to fix the appropriate action to ensure the reliable operation of equipment," informs Jain. He further points out, "The laboratory tests merely seek to establish the quality of transformer oil for long life of equipment and tests include are breakdown voltage, flash point, power factor, resistivity, water contents and presence of sediments and sludge."

Conclusion

As testing of oil has become a critical component in order to achieve optimum efficiency and reliability of any transformer, there should be a system in place to ensure that the testing is timely carried out and records are maintained. Also, as no "one-size-fits-all", the end-user must select the most suitable testing methods considering affordability, cascading impacts of downtime in case of failure, and volume of samples to be tested.

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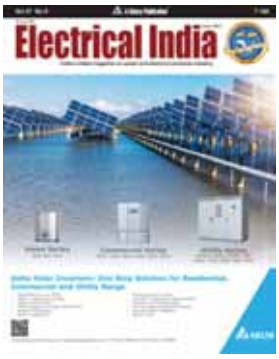

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The Quest for Gold

Here's the story of Sweden's waste-to-energy revolution and what India can learn from it.

Waste to Energy Power Plant, Vasteras, Sweden

Picture Courtesy: https://inhabitat.com

Finally the day has come for the people of Maharashtra to celebrate! The state government's decision to ban plastic items with effect from 23rd June is being applauded widely. According to the estimates, more than 25,000 tonnes of plastic waste are generated in India every day out of which around 17,000 tonnes are made up of plastic bags. Putting ban on use of plastics and its successful implementation is a key step to tackle with the menace of plastic waste. Apart from Maharashtra, 24 other Indian states

and UTs have already imposed some sort of ban on plastics.

Globally, curb on use of plastics has been identified as a priority in the way of solid waste management. It has been estimated that India generates over 150,000 tonnes of municipal solid waste daily basis out of which only 83 per cent of waste is collected and less than 30 per cent is treated. Despite announcing several policy measures, India's battle against solid waste remains grim. According to the World Bank, India's daily waste generation will reach 377,000 tonnes by 2025. So, immediate action towards effective solid waste management is need of the hour.

In this context, we all should take a look at what Sweden has done! The country that was once struggling to manage its waste, is now managing waste of other countries as well and earning revenues apart from generating energy from the waste. For a developed economy like India, it's like finding opportunities even in waste. However, it's all about be a changemaker by becoming a foresighter!

Sweden that was burdened with around 461-kgs of waste produced by its every citizen, is setting up an example for the rest of the world by bringing in "recycling revolution". Today, around 99 per cent of all household waste is recycled in one way or another. It means, merely 1 per cent of Sweden's household waste ends up in landfills. Out of around 4.4 million tonnes of household waste produced by the country every year, more than 2.3 million tonnes are converted into energy by waste-to-energy process at incineration plants. According to the Huffington Post, power produced via waste-to-energy provides approximately 950,000 homes with heating and 260,000 with electricity, across Sweden.

> According to a World Bank study, the waste produced by cities around the globe will be enough to fill a line of rubbish trucks 3,100 miles long every day.

Even the efficiency of waste management has reached to a such level, that the country is now managing waste of other and generating revenues. As per the official site of Sweden, in 2015, the country imported 2.3 million tonnes of waste from, among others, Norway, the UK and Ireland.

Statistics

Top producers of waste

Country	MSW generation (kgs per capita per day)
Kuwait	5.72
Antigua and Barbuda	5.50
St. Kitts and Nevis	5.45
Guyana	5.33
Sri Lanka	5.10

Sources: www.investopedia.com

Top producers of waste in the developed world

Country	MSW generation (kgs per capita per day)
New Zealand	3.68
Ireland	3.58
Norway	2.80
Switzerland	2.61
United States	2.58

The Indian Scenario

According to Energy Alternatives India (EAI), about 55 million tonnes of municipal solid waste and 38 billion litres of sewage are generated in the urban areas of India, every year. In addition, large quantities of solid and liquid wastes are generated by industries. Further, with rapid urbanisation, waste generation in India is expected to witness exponential growth.

Most wastes that are generated, find their way into land and water bodies without proper treatment, causing severe water pollution. They also emit greenhouse gases like methane and carbon dioxide and add to air pollution. Any organic waste from urban and rural areas and industries is a resource due to its ability to get degraded, resulting in energy generation. According to the Ministry of New and Renewable Energy (MNRE), there exists a potential of about 1,700 MW from urban waste and about 1,300 MW from industrial waste.

Realising this opportunity, the agencies across the country are promoting the concept of waste-to-energy rigorously. In March last year, North Delhi Municipal Corporation (NDMC) launched India's largest waste-to-energy plant at Narela-Bawana. The

The 'Trash' Facts

- The US is the world's biggest producer of trash generating 624,700 metric tonnes per day.
- New York is the world's most wasteful city, generates 33 million tonnes waste per year.
- Mexico City generates the most trash after the New York region, 12 million tonnes per year.
- India ranks 10th when it comes to the generation of municipal solid waste; produces 1,00,000 metric tonnes of waste per day.
- Mumbai produces the fifth most waste of any megacity; generates 11,000 tonnes of trash per day.

project is designed to use 2,000 metric tonnes of waste every day to generate 24 MW of energy.

Of late, Maharashtra is taking lead in the field of waste-to-energy conversion. On the eve of World Environment Day, the Navi Mumbai Municipal Corporation (NMMC) has commissioned its first-ever waste-to-energy plant on 5th June. The gasifier plant built on Turbhe landfill ground can generate around 25 kW of electricity and will be used to light up three high masts, conference hall and other lights on the site.

Further, the Municipal Corporation of Greater Mumbai, also known as Brihanmumbai Municipal Corporation (BMC), has an ambitious plan of starting a waste-to-energy plant at Deonar dumping ground. The country's cash rich municipal authority targets to process its tonnes garbage daily to generate 10 MW of electricity. Though these are a very few and small steps, but of course at the right direction. Once such plants are set up across the country, India can surely replicate the 'Sweden story' by turning waste into energy!

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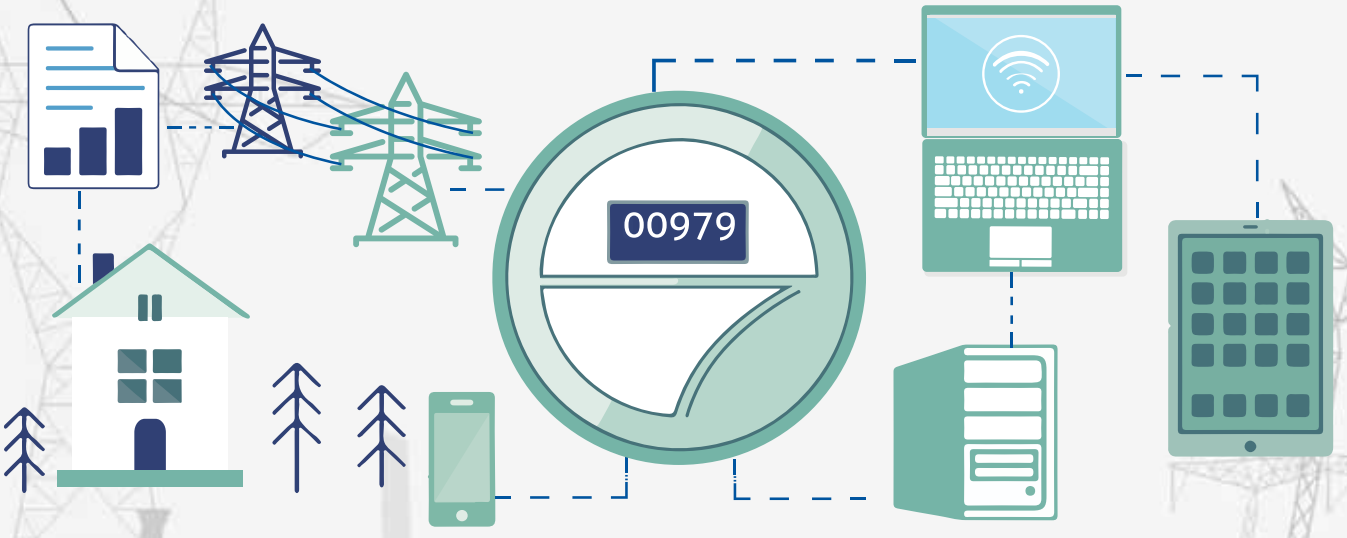

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Smart Transformer for Smart Grid Operation

As an integral part of the Smart Grid, smart transformers work independently to constantly regulate voltage and maintain contact with the smart grid in order to allow remote administration if needed and to provide information and feedback about the power supply and the transformers themselves.

380/110kV Transformator im Umspannwerk Kriegenbrunn

The Indian transformer industry has grown significantly since its inception five decades ago. Transformer manufacturers have also matured and demonstrated noteworthy technological advancements in recent years by developing equipment with the rating of 1,200 kV, the highest capacity power transmission system voltage in the world. There has been tremendous improvement in the specific design characteristics and properties of transformers over the past

decades. While the power ratings and voltage levels have increased, related parameters such as weight, losses and sound level have improved. These improvements have been achieved through the development and application of advanced materials and design tools.

In recent years, the changing dynamics of the power market across the world have put an additional demand for transformer technology. The complexity of the grid has increased manifold with the rapid growth in the generation, transmission and distribution segments. Additional factors driving technology developments in the transformer industry include increasing penetration of renewable energy sources, as well as the need to reduce transmission and distribution losses in order to address grid security and consumer safety concerns, and to maintain environmental impacts. In addition to efficiency, the requirement of shorter payback time is also influencing technical decisions, including design, choice of materials and maintenance strategies.

The distribution segment is also fraught with aging infrastructure, high network losses and poor financial performances. To address these challenges, it is critical to strengthen the performance of sub transmission and distribution network. Smart Grids are the new watchword. The notion of smartness comes from intelligence being embedded into the electrical network. This smartness generally is expected to enhance value for the end consumer through enhanced and convenient availability of electricity. The need and necessity for Smart Grid in India is well established. It is in fact all the more relevant to be smart about the usage of energy and electricity to deliver low cost electricity. As India moves towards increased globalisation and as the present government rises to the challenges and opportunities of the 21st century, smart grids are taking center stage in the process of delivering safe, convenient and affordable power to all citizens. Development of smart grid increases the demand of smart and advance transformers for power system.

A solid-state transformer with managerial role in the electric distribution grid is generally called smart transformer. As an integral part of the smart grid, smart transformers work independently to constantly regulate voltage and maintain contact with the smart grid in order to allow remote administration if needed and to provide information and feedback about the power supply and the transformers themselves. Through a process known as voltage optimisation, a smart transformer provides the exact amount of power that is needed, and responds instantly to fluctuations within the power grid, acting as a voltage regulator to ensure that the optimised voltage is undisturbed.

Need of Smart Transformer

Today's transformers include multiple intelligent electronic devices or control systems, which can assess the condition of the transformer system and make intelligent recommendations based on design and component data. With this, the operator can remotely monitor the behavior of the transformer core, windings, oil, tap changer and bushings, thereby, keeping a close watch on critical transformer components. Dynamic control of real and reactive power can optimise the efficiency of distribution systems, improve power quality in a more dynamic operating environment and limit fault current. Meanwhile, modeling and simulation can be applied to optimise current designs and explore new concepts that can facilitate system recovery in the event of failure. Modularised design components, standardisation and recovery concepts can help improve resilience.

Smart transformers directly reduce energy consumption. Therefore, it directly reduces greenhouse gas emissions as well. This makes them an important part of any energy retrofit or lighting retrofit. While smart transformers immediately reduce power consumption by providing a stable, optimal power supply that supplies electrical equipment with its ideal voltage, they also protect electrical equipment from power fluctuations – thereby, helping electrical equipment last longer. Additionally, through their smart grid connectivity, smart transformers can be administered dynamically, allowing facilities to monitor and manage the transformers directly during periods of power fluctuation, and helping them ensure that their

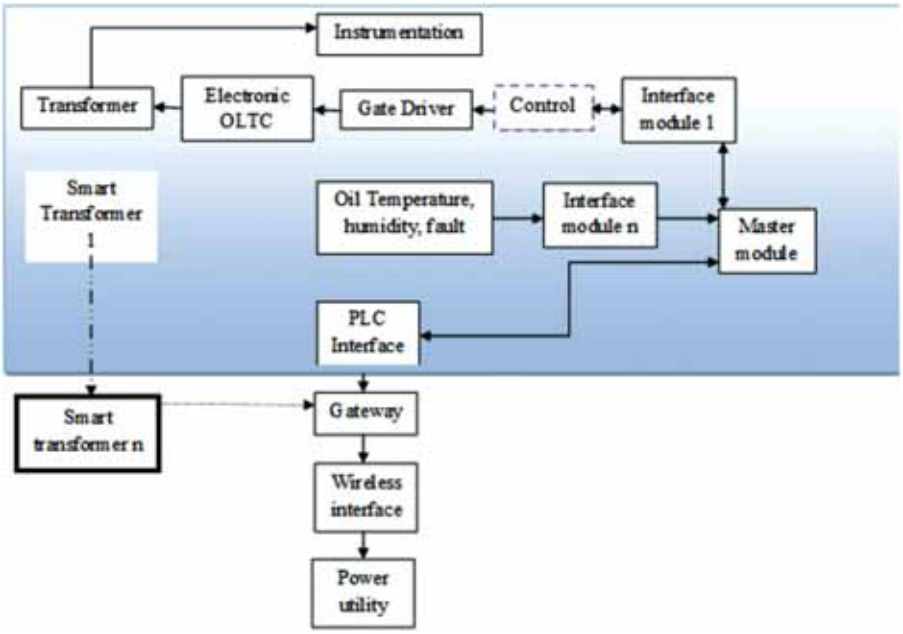

Figure 1: A typical smart transformer hardware control

power supply remains voltage optimised even when new demands are being placed upon it.

Most appliances are designed to work with a percentage of voltage away from the base. A smart transformer delivers voltage directly at the base, which means appliances work at their most efficient – they last longer and use less power. Smart transformers can help large commercial facilities use power more efficiently to save money, power and go greener. They have been successfully deployed to save energy for organisations. A smart transformer provides the exact amount of power that is needed, and responds instantly to fluctuations within the power grid, acting as a voltage regulator to ensure that the optimised voltage is undisturbed. STs are programmed to, as a default; provide voltage optimised power supply that directly addresses their facility's energy needs.

Characteristics of Smart Transformer

The basic requirements of smart transformer are cooling control tuned to load profile, voltage regulation, reliability, fault prediction – detection, energy efficiency and condition assessment. The smart transformers have some intelligence to meet the requirement of future power systems. Some important characteristics of smart transformers are as follows:

- They give exact amount of power that's needed and respond instantly to fluctuations within the grid
- Smart transformers act as a voltage regulator and it ensures that the optimised voltage is undisturbed, because they directly reduce energy consumption & greenhouse gas emissions
- Smart transformers immediately reduce power consumption by providing a stable, optimal power supply that supplies electrical equipment with its ideal voltage
- They also protect electrical equipment with its ideal voltage
- Smart transformers as a default, provide a voltage optimised power supply that directly addresses their energy needs.

Smart Transformer Hardware Control System

The set of hardware control blocks include smart transformers, instrumentation, control gate drives, electronic On Load Tap Changer (OLTC), transformer builds the voltage regulation block, which is also responsible for the secondary voltage regulation.

The interface module blocks are data converters, which convert variables and events of the control system – and send them to the master module. In the master module the data of all the interface modules are packed and sent to the Programmable Logic Control (PLC) interface which converts the data to be sent through the medium voltage line. The data coming from a set of transformers are received by the gateway block, which concentrates and sends them to the wireless interface. From this block, the data are sent to the power utility where it is received and processed. A typical smart transformer hardware control is depicted in figure 1.

Smart transformers when used at the PCC, it controls the active power exchange between a microgrid and the utility grid dependent on the state of both networks and other information communicated to the smart transformers.

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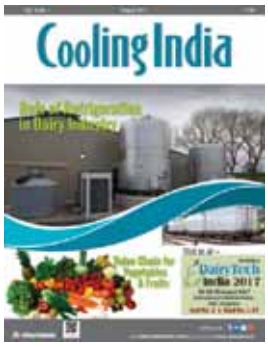

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To control the active power, the smart transformer uses its taps that change the microgrid side voltage at the PCC.

Role of Smart Transformer in Smart Grid

The role of smart transformer in smart grid operation is as follows:

- Smart transformers are controlled dynamically allowing facilities to monitor and manage the transformers directly during the period of power fluctuations – and helping them ensure that their power supply remains voltage optimised even when new demands are being placed upon it.
- The power transfer between a microgrid and the utility grid is actively controlled without the need for communication to all microgrid elements.
- Protect the power system from load disturbances by isolating source and load harmonics, transients and voltage sags.
- Enhance the power quality by summarising the loads to the mains with identical phase current even for unbalanced loads.
- Providing unity power factor with sinusoidal currents under non-linear loads.
- Coordinate fault re-closing over sub-grids zones when connecting to other smart transformers
- Accept direct connection to future medium voltage DC power transmission, low voltage DC grid, storage systems and renewable energy systems.

Transformers serve as a hub for collection and distribution of energy and are a key component of a successful transition to a smart grid. Some transformers are located where grid communication is mature enough to allow or require interaction, while others are not. Transformers used in power transmission are immediate candidates for integration into smart grid technology and immediately will benefit from reliability and efficiency improvements that result from some of the new online monitoring technologies. Transformers used mainly for distribution circuits probably will be affected more as the smart grid matures. Most of today's transformers are not ready for the smart grid because they were placed into service years before the age of interactive information transfer. Building the next generation of transformers will require incorporating remote monitoring of a wide range of transformer and system parameters.

Monitoring Parameters

There is already an increased use of digital monitoring in transformers. Vital statistics such as temperature, pressure and vacuum levels are being collected and transmitted in real time to a central clearing house. Many transformer manufacturers are recognising this growing demand for online transformer monitoring products and diagnostic services and are investing in building them, especially for step-up transmission high-voltage transformers. These technologies will be critical for improving grid reliability and helping utilities avoid transformer failures and resultant blackouts. They also will reduce maintenance costs and defer capital expenditures by extending a transformer's useful life. Typical monitoring parameters for Smart Grid Integration are as given below:

i. Transformer tank pressure and vacuum,
ii. Oil and winding temperature,
iii. Pressure relief device operation,
iv. Sudden pressure relay operation,
v. Oil level,
vi. Water content in oil,
vii. Fans on/off operation indicator,
viii. Loss of control power indicator,
ix. Ambient temperature,
x. Input current and voltage,
xi. Output current and voltage,

Transformers in place already use smart devices for load switching. In the coming years, the move will be toward monitoring systems that promote transformer reliability. Ensuring reliability on the grid by replacing equipment before it fails and anticipating upcoming problems is on what transformer manufacturers will focus.

Benefits of Smart Transformers

The smart transformers are designed to monitor and manage power supply during fluctuations and ensure that it is voltage optimised even when new demands are being placed upon it. Other benefits and functions of smart transformers include:

- Protecting the power system from load disturbances by isolating the source from load

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- Providing unity power factor with sinusoidal currents under non-linear loads.
- Enhancing power quality by summarising loads to the mains with identical phase current even for unbalanced loads.
- Reducing grid losses and improving power supply reliability.
- Provides ability to utilise input or output in AC or DC power.
- Protects the load from power supply disturbances.
- Eliminates the tap changer requirement.
- Provides backup and reduces outages length.
- Control voltage and frequency levels will reduce the system losses.
- Provide reactive power compensation and system harmonic filtering.
- In substations, it could be used to feed control equipment or to feed DC micro grid.

As one of the main components in distribution stations, transformers fulfill an important task: They are responsible for the final customers being supplied with the correct voltage. Grid operators must, therefore, guarantee a low voltage supply within the allowed voltage band for every household. However, the rising in feed of renewable energies overstrain many transformer substations. Considerable voltage fluctuations are the consequence and can even lead to an infringement of the permissible voltage band. Increasing trend towards regulated distribution transformers in case of non-compliance with the voltage quality criteria due to the decentralised supply from renewable energies, grid operators are forced to a costly expansion of the distribution grid.

Green and Efficient Transformers

The goal of reducing the industry's carbon footprint has led to a rise in demand for energy-efficient transformers. Developed countries and emerging countries are focusing on developing new standards and adopting energy efficient equipment. The growing environmental consciousness has further pushed manufacturers to develop green transformers that are composed of biodegradable materials like ester fluids. Transformers can be filled with esters due to their higher flash points compared to mineral oil. This provides safety against fires, which are common in conventional transformers. Green transformers have additional features like hermetically sealed tanks, lower noise levels and reduced losses. Their uptake is expected to accelerate in the near future as utilities seek sustainable and safe solutions, particularly, in highly populated urban areas.

Conclusion

Smart transformers are intelligent enough to meet the requirements of upcoming power systems, which is why these will be highly popular in the future. The smart transformer can also help in overcoming several issues associated with distribution network and smart grid operation, which are difficult to deal with conventional off-load and on-load tap changer transformers, some of the attributes of smart transformers are reduction in grid losses and improved power quality and supply reliability.

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Innovative Current Transformer Testing

This article describes an innovative solution to test current transformers at all lifecycle stages by using a sophisticated testing method known as "the modeling concept".

After installation, current transformers (CTs) are typically used for 30 years. In order to guarantee a reliable and safe operation over the lifetime of the CTs, a high level of quality during the design phase, manufacturing process and installation is important. Therefore, several quality tests are performed from development to installation. After the installation CTs should be tested on a regular basis to ensure correct functioning over their entire lifecycle.

Several methods of conventional testing are possible:

1. The traditional way of testing a

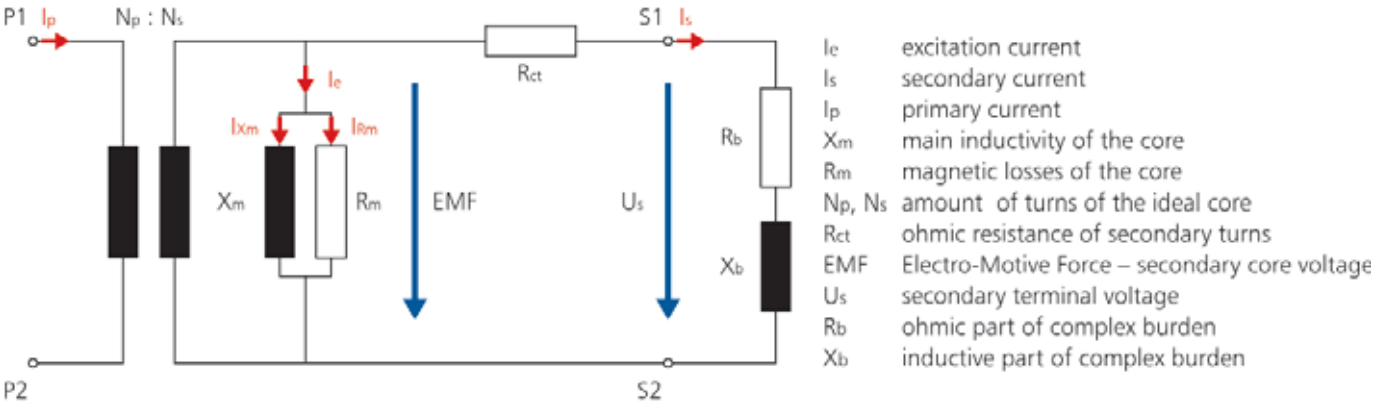

Figure 1: Equivalent circuit diagram of a real CT

CT is to apply a high current to the primary side and read the signals on the secondary side. By using different burdens or injecting overcurrents, various situations can be simulated and the signals on the secondary side can be measured and analysed. However, this method is time-consuming and material-intensive. Sometimes, it is not even feasible as very high currents are required, for example, for on-site testing of CTs designed for transient behavior (TP types) as they have very high knee-point values.

2. Another common testing scenario for CTs is injecting a defined testing voltage on the secondary side and reading signals on the primary side. Unfortunately, when using this method some parameters, such as accuracy and knee-point (excitation curve), can only be tested with limitations. This is due to the restrictions in accuracy caused by the very low signals in use and the maximum voltage of approximately 2 kV which can be applied to the secondary side of CTs. Other important parameters, such as the transient dimensioning factor, the accuracy limit factor, the safety factor, composite errors, time constancy, and many others, cannot be tested at all.

As both methods have limitations, another established approach to test CTs is by using a modeling concept.

Modeling Concept

The concept of modeling a CT allows for a detailed view of the transformer's design and its physical behaviour. The test device builds up a model of the CT by using initial data, measured during the test. Based on this model, the test device is able to calculate parameters such as the accuracy limiting factor (ALF) and the safety factor (FS) and simulate the CT's behaviour, for example, under different burdens, or with various primary currents.

It measures the transformer's copper and iron losses according to its equivalent circuit diagram (Figure 1). While copper losses are described as the winding resistance RCT, iron losses are described as the eddy losses or eddy resistance R_{eddy}, and hysteresis losses as hysteresis resistance RH. With this detailed information about the core's total losses, the test device is capable of modeling the CT and calculating the current ratio error as well as the phase displacement for any primary current and secondary burden.

Therefore, all operating points described in the relevant standards for CTs can be determined. The model also allows important parameters such as the

Figure 2: CT Analyser

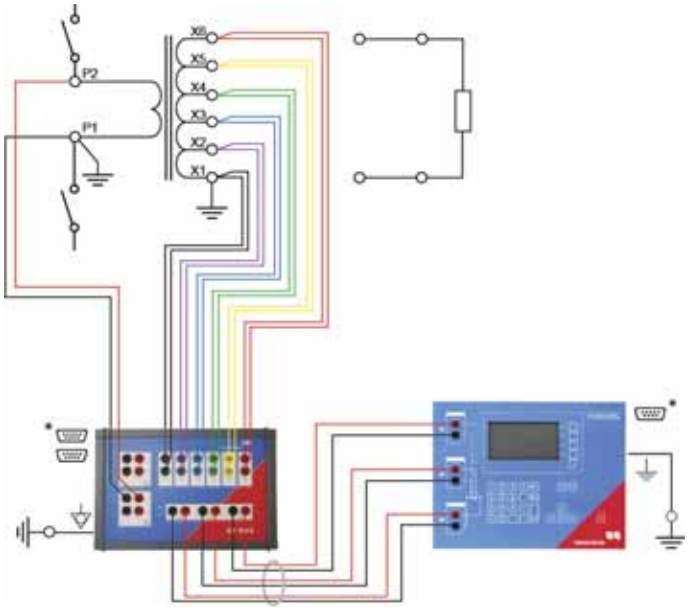

Figure 3: Connection example for a 6-tap CT

Figure 4: CT Analyser with CT SB2 attached

residual magnetism, the saturated and unsaturated inductance, the symmetrical short-current factor (overcurrent factor) and even the transient dimensioning factor (according to the IEC 60044-6 standard for transient fault current calculations) to be assessed.

The modeling approach is perfectly suited for tests from production to maintenance inspections.

With the CT Analyser, OMICRON developed the first test device using the above-mentioned modeling concept. The CT Analyser (Figure 2) is small, lightweight and conducts fully automated tests of CTs in less than one minute. For added operational safety, it uses only low-test signals of up to 120 V.

Using the modeling concept for testing CTs, the CT Analyser can offer an outstanding accuracy of 0.05 per cent in ratio and 1 min in phase angle deviation. This makes it the most suitable portable test device for testing metering CTs up to accuracy class 0.1.

The accuracy of the CT Analyser is verified by several metrological institutes such as the PTB in Germany, KEMA in the Netherlands and the Wuhan HV Research Institute in China.

The CT Analyser can also test CTs for residual magnetism and automatically demagnetises the test object when the test is complete. Additionally, it can be used as a multimeter with AC/DC current and voltage sources for manual tests, such as L, Z, R, ratio, polarity and burden. For VTs, the CT Analyser can perform ratio measurements of inductive voltage transformers.

Testing of Multi-ratio CTs

For automated testing of multi-ratio CTs with up to six tap connections (X1 to X6), the CT SB2 Switch-Box is available as an accessory to the CT Analyser (Figure 4). The CT SB2 is connected to all taps of a multi-ratio CT as well as to the CT Analyser (Figure 3).

Thus, every ratio combination can be tested automatically with the CT Analyser without the need for rewiring. An integrated connection check function tests the secondary connection to the CT and indicates wiring mistakes before the measurement cycle begins.

Software Supported Testing and Assessment

The CT Analyser software (Figure 5) supports users through every single step of the testing process. During test preparation, all necessary test and asset-related entries can be undertaken in the structured software form. Before test execution, wiring diagrams help check the correct wiring of the measuring setup. Immediately after the tests, CT Analyser gives an overview of the test results and an automated assessment of the CT condition.

Thereby, the CT assessment is not only conducted in compliance with international standards (IEC, IEE) but CT Analyser also offers the flexibility to define and use local national standards (for example, Canadian or British

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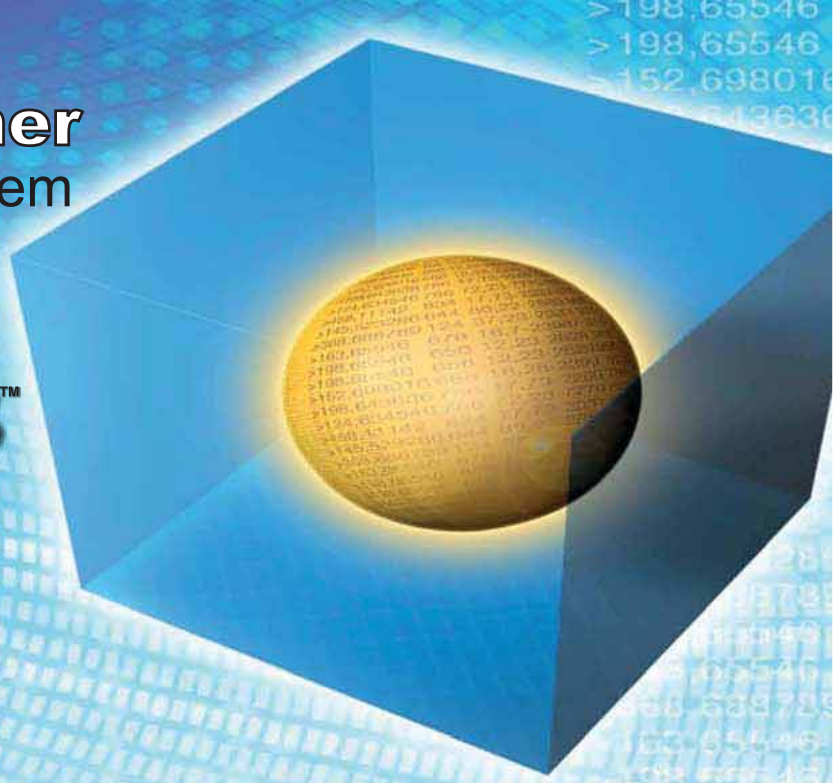

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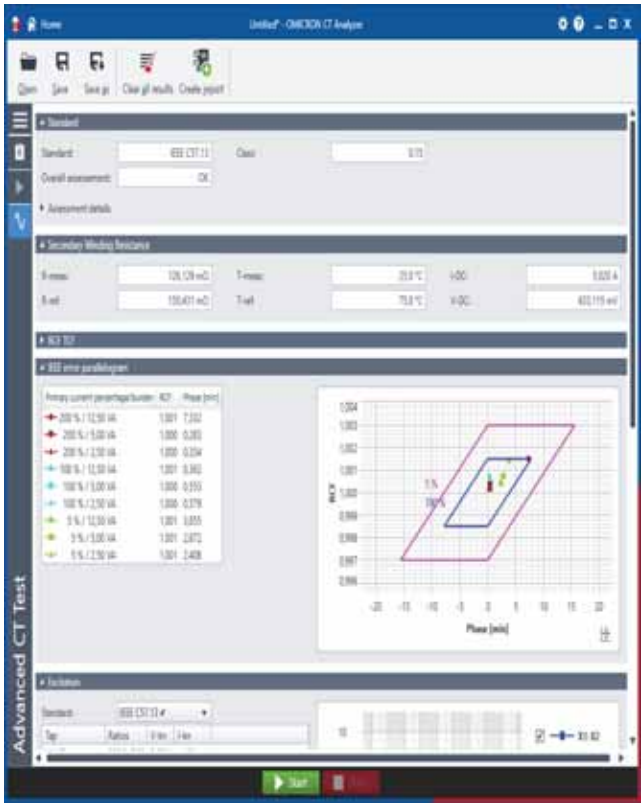


Figure 5: CT Analyser software

Figure 6: Multi-functional transport case

Standards) as well as self-defined corporate standards or assessment rules for all important CT parameters.

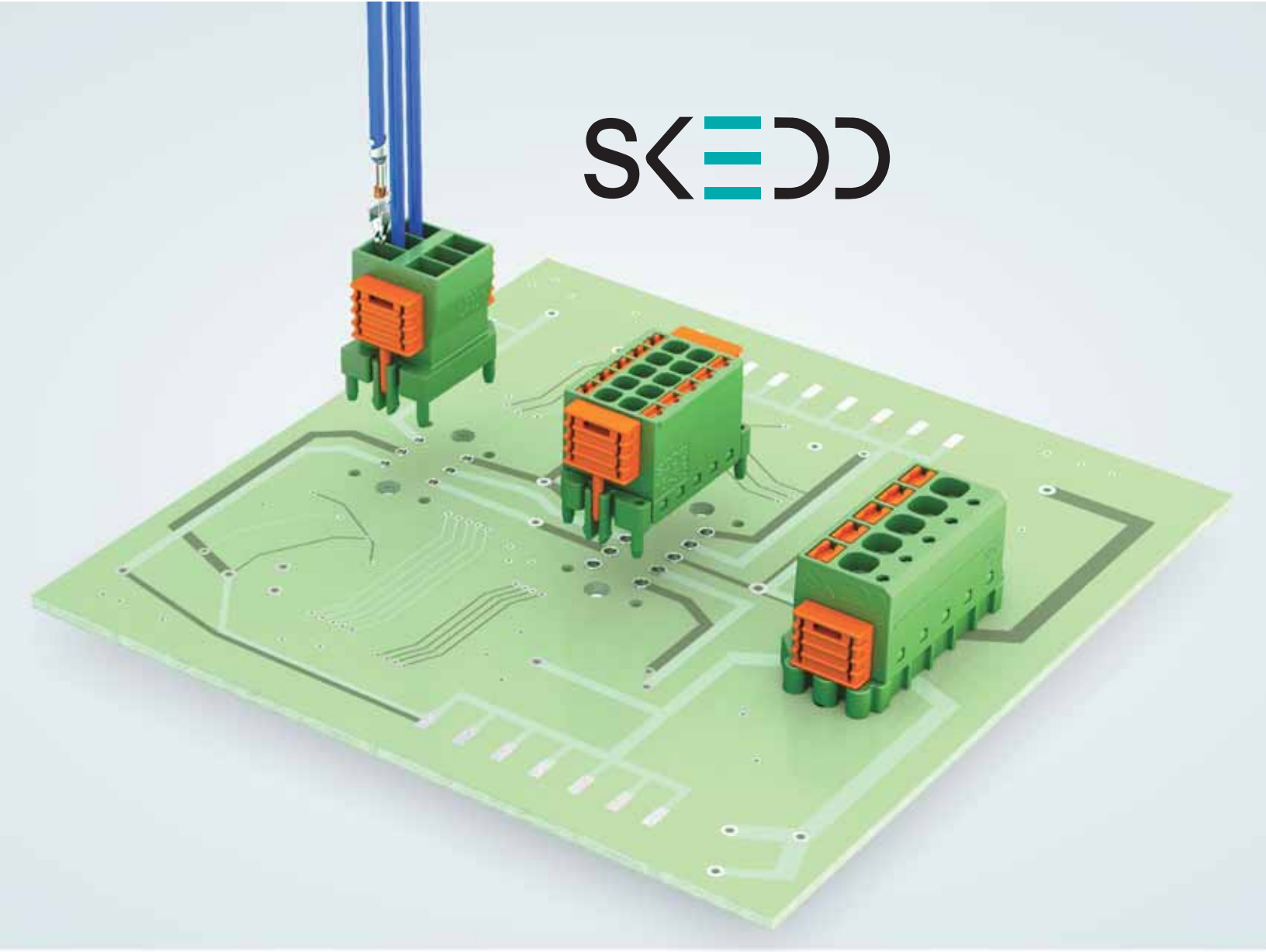
In order to make CT testing even more practical, CT Analyser offers various transport accessories.

The multi-functional transport case (Figure 6) is a heavy-duty option with wheels and serves as a "sturdy outer housing". All control elements of the CT Analyser are on the front, allowing the device to be left in the case while testing. The lid is designed to be raised for use as a bench for a laptop while the CT Analyser stays in the case. Attachable end plates can be used for mouse control or technical documents and offer further space for accessories.

Conclusion

The lightweight and portable CT Analyser offers the possibility to conduct all of the above-mentioned tests in an accurate, fast and cost-effective manner. Its wide functionality range and high accuracy make it the ideal solution for testing single and multi-tap CTs for protection and metering purposes.

Courtesy: OMICRON Energy Solutions



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Benefits of HVDS for Agriculture

Implementation of high voltage distribution system (HVDS) for agriculture consumers will result in reduction in losses, increase in energy saving and improve voltage profile.

Picture Courtesy: https://pxhere.com/en/

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.

In case of LT lines, efficiency of the electric gadgets is also affecting and breakdown is also very high. Also there is a tendency of unauthorised connections to hook to the LT lines which results in over loading of the transformers and failure of transformer.

The loads for agriculture are predominantly pump sets used for

irrigation purposes. Normally, in the present distribution network, the 11kV HT line goes to the DTC (Distribution Transformer Centre) and from there lengthy LT lines are drawn to give supply to different installations of irrigation pump set. In case of HVDS, the HT lines are run up to the installation premises and there it is stepped down through a suitable capacity transformer before arranging supply through service main. In high voltage distribution system (HVDS), the electricity is distributed to the consumers at higher voltage level (11kV) instead of low voltage (415V).

Adoption of HVDS by converting existing low voltage distribution system (LVDS) to HVDS reduces the technical losses appreciably.

In recent decades, different schemes have been proposed to reduce the losses in the distribution system and hence, to increase the efficiency of electric devices and power distribution networks.

Distribution System

Distribution system with low voltage employs four wires and long low tension lines and multiple loads fed from a bulk power transformer resulting in the increase in system losses affecting voltage profile and performance of distribution system. In existing distribution system, the voltage at buses reduces when moved away from the substation, also the losses are high. The reason for high losses is the use of low voltage for distribution as the current is high in the low voltage system. In the existing system, pilferage is very easy because of lengthy bare LT conductor and thus, many unauthorised connections are tapped from the bare LT conductor which results in over loading of the transformers and failure of the transformers. The prevailing low voltage in the LT line is also affecting the efficiency of the irrigation pump set and breakdown is also very high. Thus, by using high voltage for distribution, we can reduce the losses as current in high voltage distribution system (HVDS) is low. The HVDS employs large three phase 11kV main distribution feeders with three phase lines and three phase distribution transformers transforming 11kV into 415V.

Losses in Distribution Network

Generally, in the process of supplying electricity to the consumers, energy losses occur due to technical and commercial losses. The main reason for high losses is considered to be the use of low voltage for the distribution of power leading to the high current and thus, more resulting in losses.

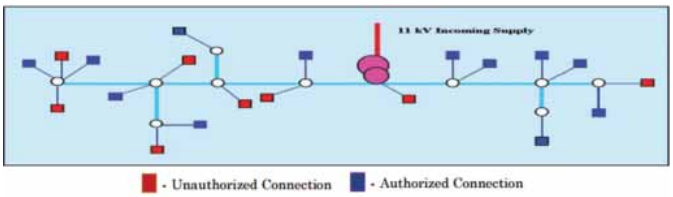

Figure 1: Single line diagram showing authorised and unauthorised connections in the existing LT system (before HVDS)

Technical losses include the losses due to the heat dissipation resulting from current passing through conductors, magnetic losses in transformers, resistive losses in windings and the core losses, resistive losses in service line and losses in energy meter. These losses cannot be eliminated but can be reduced. The commercial (non-technical) losses are the losses which include, power theft by hooking the lines, unauthorised connections from the power line, errors in the meter reading or defective meters and in the estimation of unmetered energy supply, loss at the loose connection ends etc. These losses can be eliminated by taking some precautions. And thus, it is necessary to focus on technical losses as well as on commercial losses and it can be achieved by using HVDS method for distribution. The various reasons for higher losses in the existing system are:

a. Over rated distribution transformers and hence their under utilisation
b. Lengthy distribution lines
c. Inadequate size of conductors
d. Low voltage (less than declared voltage) appearing at transformers and consumers terminals
e. Distribution transformer not located at load center on the secondary distribution system
f. Low power factor
g. Poor quality of equipment
h. Too many stages of transformations
i. Transformer losses
j. Bad workmanship
k. Direct tapping by the non-customers
l. Pilferage by the existing customers
m. Defective metering, billing and collection functions.

To reduce the distribution losses, many techniques are developed and some of the loss reduction approaches are listed below:

a) Network reconfiguration and phase load balance

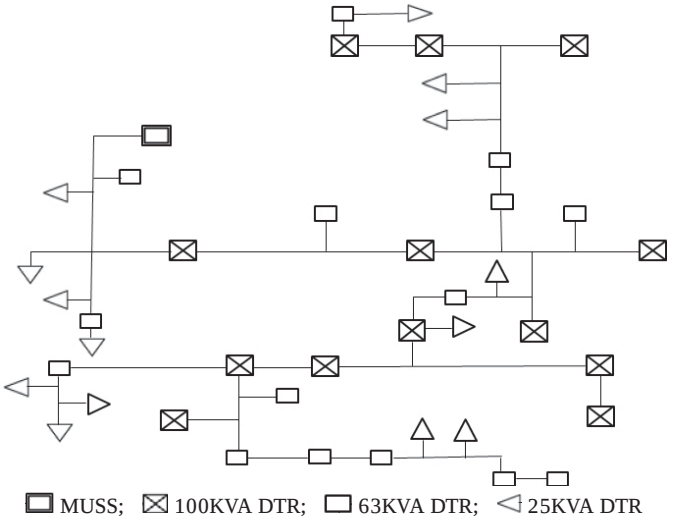

Figure 2: Single line diagram of Feeder-1 of the existing LT system (before HVDS).

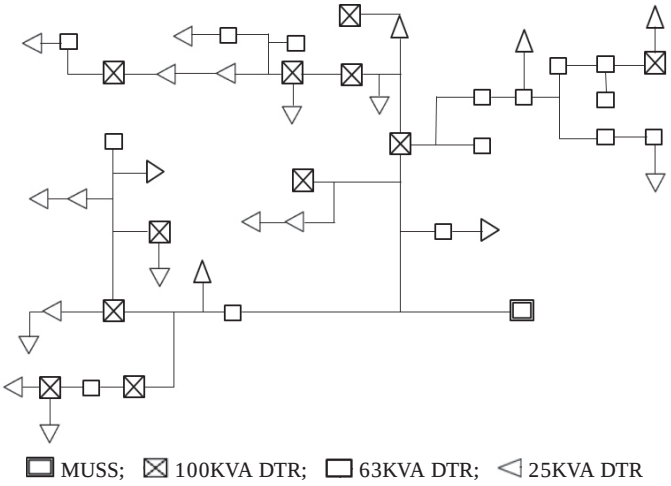

Figure 3: Single line diagram of Feeder-2 of the existing LT system (before HVDS).

b) Automatic voltage booster
c) Network re-conductoring
d) Distribution Transformers - Locating and Sizing
e) High efficient Transformer
f) Reactive power compensation
g) Aerial Bunched Cables (ABC)
h) HVDS

High Voltage Distribution System (HVDS)

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. 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. By converting LT lines to HVDS, the current flowing through the lines shall reduce and will bring down the technical losses in the LT line drastically. The main purpose of using high voltage for distribution is to reduce the theft of energy and decrease in unauthorised connection as the LT lines are virtually eliminated and even short LT lines required will be with insulated aerial bunched cables (ABC). This makes direct tapping very difficult and thus, increases the authorised connection and further faults are totally eliminated which improves the reliability. HVDS is to reconfigure the existing low voltage (LT) network as high voltage distribution system. Each 11kV feeder which emanates from the 33kV substation branches further into several subsidiary 11kV feeders to carry power close to the load points (irrigation pump sets). At these load points, a transformer of suitable capacity further reduces the voltage from 11kV to 415V to provide Low Tension (LT) line to individual customers, either at 240V as single-phase supply or at 415V as three- phase supply.

In irrigation, HVDS provides availability of good quality of motors improving pump set efficiency and providing high yield of water. On each distribution transformer, only two or three pump sets are connected and the problem of frequent failure of power due to failure of distribution transformer will be reduced considerably.

Figure 1 illustrates that only 12 consumers (blue colour) are authorised; remaining 8 consumers (red colour) have unauthorised connections leading to the theft of the power and are making all the consumers to suffer from low voltages and transformer overloading.

Effective implementation of HVDS scheme will have the following benefits:

- Reduction in line losses since HV line is taken almost upto consumer load point and on LV side AB cable is used.
- Failure of agriculture DTRs are minimised as LT overhead line is avoided and also load per DTR is restricted. Hence, there is no failure on account of

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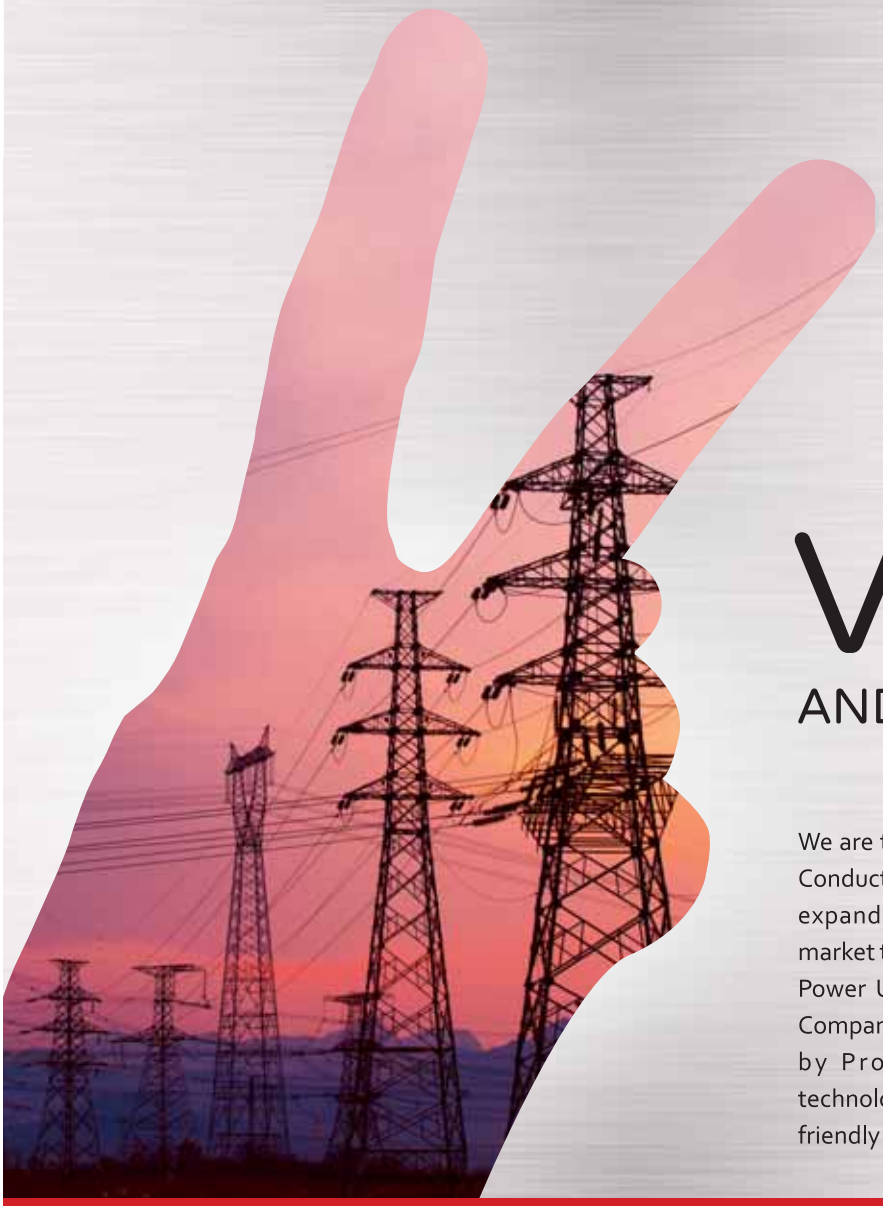

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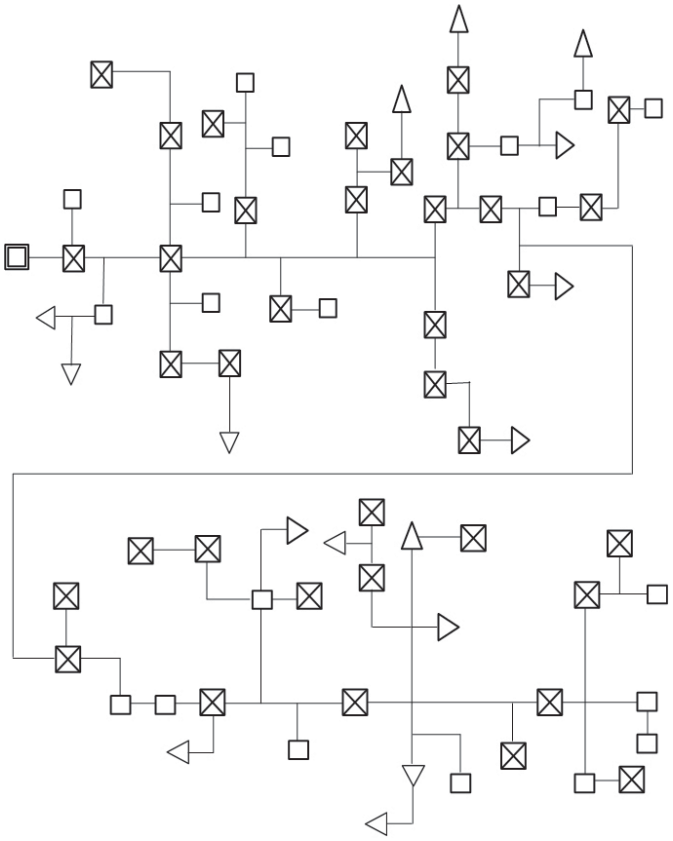


Figure 4: Single line diagram of Feeder-3 of the existing LT system (before HVDS).

over load and LT faults.

- Reduction of unauthorised agriculture connections, as one small capacity (25KVA) DTR is erected for two or three agriculture consumers. The agriculture consumers will have a feeling of ownership of transformer due to limited connections on it.
- As 11kV line is taken almost to the load point, improvement in voltage regulation near agriculture pump sets, resulting in good performance of motor.
- Pilferage of electricity is completely avoided as LT AB cable is used from DTR LV upto consumer pump set.

In high voltage distribution system, the authorised consumers do not allow unauthorised tapping by another as their transformer gets overloaded or may get damaged, resulting in outage of power supply for longer durations. The use of HVDS results in reduction in losses and hence, improves quality of supply.

Case Study

Case study of three feeders proposed for conversion from existing LT distribution to HVDS is taken up for the study. The feeders are supplying load for agricultural consumers in which, the 11kV is stepped down to 415V by using distribution transformers. The existing LT distribution system consists of three phase DTR of 100kVA, 63kVA & 25kVA installed at various points and the connections to each load is extended through long LT lines. The long LT lines and many number of load connections with high capacity distribution transformer resulting in the increase in power losses, unauthorised connections, electricity theft losses, overloading and failure of distribution transformers. The existing LT distribution system also affects voltage profile and performance of the distribution system. By converting LT lines to HVDS, the current flowing through the lines will be reduced and bring down the technical losses in the LT line drastically.

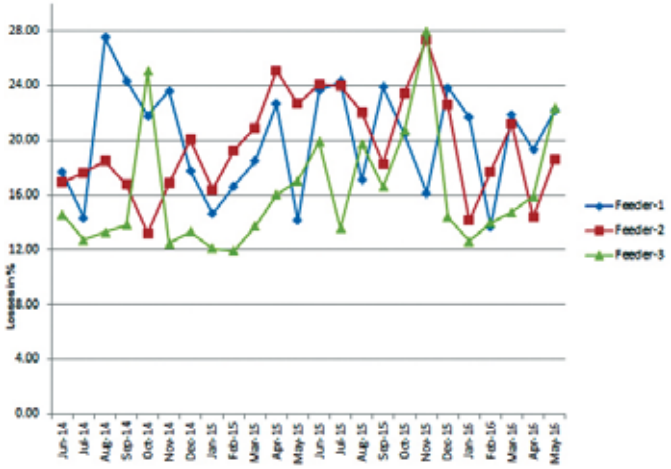
The schematic diagrams of the existing LT system (before HVDS) for three feeders supplying load to agriculture consumers are shown in figures.

It is found that, in the above feeder, total no of irrigation pump sets (authorised & unauthorised) connected is 282. The total length of existing 11kV line is about 94 km approx. and total length of existing LT line is about 8 km approx.

It is found that, in the above feeder, total no. of irrigation pump sets (authorized & unauthorized) connected is 281. The total length of existing 11kV line is about 85 km approx. and total length of existing LT line is about 10 km approximately.

It is found that, in the above feeder, total no of irrigation pump sets (authorised & unauthorised)

Graph 1: Technical & commercial losses of existing LT system for three feeders for 24 months period



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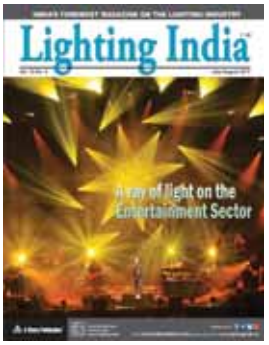

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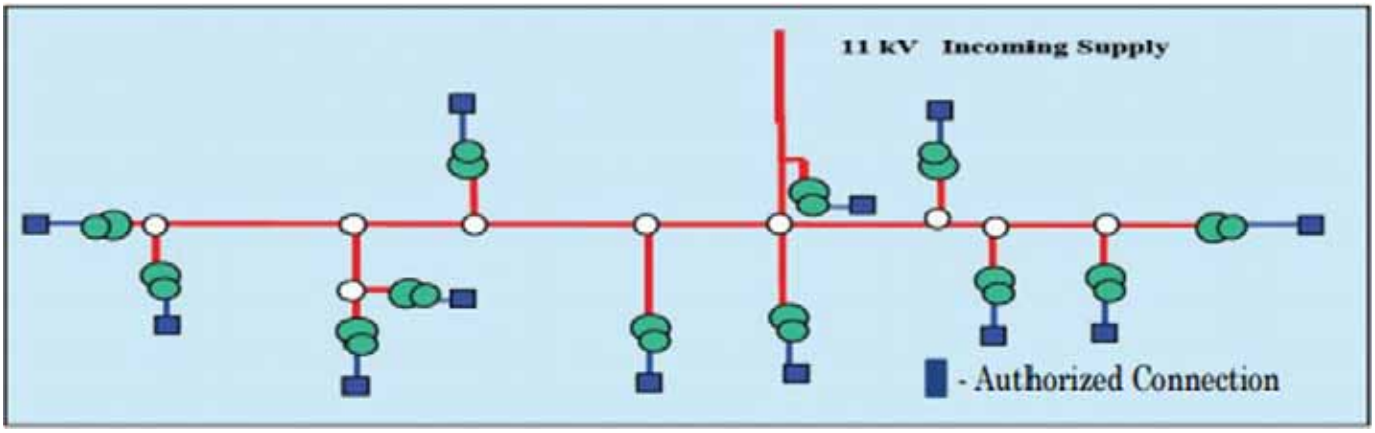

Figure 5: Single line diagram of HVDS scheme

connected is 663. The total length of existing 11kV line is about 185 km approximately and total length of existing LT line is about 14 km approximately. The investigation is carried out to determine the losses in the existing low voltage (LT) distribution system. The technical and commercial losses of the existing LT system for above three feeders for 24 months period are represented in graph 1.

It is found from the above graph, the percentage of losses in feeder-1 varies from 13.70% to 27.51%; in feeder-2 varies from 13.21% to 27.36% and feeder-3 varies from 11.92% to 27.95%.

Implementation of HVDS for the above feeders can result in reduction of technical and commercial losses and also unauthorized connections. The HVDS scheme consists of converting the existing 3 phase 4 wire lines to 11 kV systems using the existing supports and providing intermediate poles wherever necessary and individual transformers of suitable capacity (25kVA) are provided to supply 2 or 3 agriculture consumers. The LT line from the transformer is drawn very close to the agriculture load and hence, the requirement of LT lines is less compared to LT system. The LT lines used is insulated overhead cables like ABC (Aerial Bunched Cables). The authorized consumers do not allow unauthorized tapping by another as their transformer gets overloaded or may get damaged, resulting in outage of power supply for longer durations. As 11kV is extended up to load ends & AB cables are used for transmission from DTR to loads, theft, fault on LT lines and line losses are reduced & voltage profiles are maintained. The typical single line diagram of the HVDS scheme is shown in Figure 5.

The investment on conversion of existing LT distribution system to high voltage distribution system (HVDS) can be easily recovered by the way of loss reduction and annual savings.

Conclusion

Implementation of high voltage distribution system (HVDS) for agriculture consumers will result in reduction in losses, increase in energy saving and improve voltage profile. The adoption of HVDS makes the system more reliable and thus, reduces the number of outages. The chances of unauthorised connections and theft of energy are reduced.

The restructuring of existing low voltage distribution system (LVDS) as HVDS in agricultural sector presents one of the best technically feasible and financially viable method for providing reliable and quality supply to agriculture consumers.

The case study of three feeders implementing HVDS is highlighted. Adoption of HVDS in these feeders reduces both technical as well as commercial losses and improves the commercial and technical performance of the distribution system. HVDS also provides better reliability and results in the increase in annual energy saving to the utility.

V Suresh

Engineering Officer
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Penchant for Quality Products

WAGO started its India operations in the year 1997 as a joint venture between WAGO Kontakttechnik Germany and C&S Electric Ltd. Currently known WAGO Pvt Ltd became a 100 per cent subsidiary of WAGO Kontakttechnik, Germany in 2011 having its manufacturing facility in Noida along with 9 sales offices across India. With the current positive momentum and future growth prospects, the company is expecting a double-digit growth year-on-year, informs **Alok Kishore, CEO, WAGO Pvt Ltd** during an interaction with **Electrical India**.

What are the products and services offered by WAGO?

We classify our range of more than 25,000 stock keeping units (SKUs) in three product lines – electrical interconnections, automation technology and interface electronics. Our electronic interconnection product line ranges from Rail-Mount Terminal Block systems, installation and field-wiring terminal blocks, through pluggable connectors and feedthrough components, up to PCB connections and marking solutions.

Versatile and future-ready automation technology from WAGO includes I/O systems for decentralised automation, controllers, switches, sensor or actuator boxes, displays and panels.

WAGO interface electronics range offers interface modules, signal conditioners, relay and optocoupler modules, voltage converters and power supplies and system wiring.

What is the USP of your products?

We are the inventor of CAGE CLAMP and world-leader in gas tight spring pressure connection technology. This technology eliminates time-consuming screw tightening and requires no maintenance as well as any speciality tool to make a safe wiring connection. Rigorous mechanical, electrical and environmental tests, as well as additional industry-specific tests for connection strength, safety and reliability, ensure that no interruption of the electrical connection occur even in the harshest of operating conditions as against screw-type connection.

What are the growth drivers of your business?

As I described earlier, WAGO products are best-suited to harsh operating environments such as vibration, heat or moisture. Industries that operate in these environments are the growth drivers such as railways, metros, elevators, escalators, marine and machine automation among others.

Since our products are proven for easy, safe and reliable connections in variety of applications, it opens up a wide market for us to serve. To cater to this large set of industries and growing demand for our products, we have our market fulfilment plans ready. Upcoming WAGO production facility in Vadodara and ever growing partner network are a few steps towards the goal.

How would you differentiate the German market from Indian market in context to your business?

While the requirements of the applications are same yet there is a difference between how buyers approach fulfilling these requirements. While in European market quality of the product supersedes all other

evaluation criteria, whereas in India it's a tough battleground when it comes to top quality at a premium price. We have seen scenarios in India where the need of connection safety and reliability gets compromised due to budget constraints and availability of below par quality products at cheaper rates, even in critical applications. However it will be wrong to say that the customer orientation towards quality consideration is not changing. With growing incidents of accidents and huge associated costs of shutdowns due to improper wiring connections, more and more buyers are now becoming conscious about products' reliability aspects and are now willing to pay premium for quality. Slowly and steadily market dynamics are slated to change.

We understand that WAGO started with an innovation in connection technology. How is WAGO continuing its legacy of innovation?

It is relatively easy to innovate for the first time than spotting newer challenges and replicate the practice of innovation to overcome these. WAGO launches about 30 new products every year globally and gets four to five patents. With a sizeable investment in Research and Development, we are currently working on over 170 patents. That shows the organisation's commitment to empower its customers with the best available technology.

How do you maintain the quality aspect while manufacturing in India?

Good you asked. It is a widely accepted belief that German quality is the best one can get when it comes to machine technology. It is not very difficult for us to maintain that quality levels in India as the practices and standards of quality are well documented and enforceable by our Germany headquarter. We have replicated the material, processes and equipment set-up to match that standard including rigorous German Quality Assurance practices. Moreover, major components of raw material are imported from Germany so that we have same product quality across the global manufacturing facilities.

Another component of quality is the manpower that runs these equipment, system and processes. Since we are a manpower centric facility, a lot of attention is given to hiring and retaining skilled workers and continuously developing their functional knowledge and skill to keep pace with the new products' requirement.

Condenser Bushings

The article focuses on basic design changes and materials being addressed to bushing apparatus used on power transformers in high voltage substations.

Condenser bushings are devices which allow high voltage conductor to pass through grounded walls of power transformer. Condenser bushings should meet the electrical, thermal and mechanical requirements of the application which is taken into consideration. Insulation against internal breakdown and external flashover must be provided and bushings should operate even if exposed to periodic over voltages and contaminated conditions to

Figure 1: Catastrophic Failure of Bushing

avoid severe catastrophic failure of substation as shown in figure 1.

The basic construction of condenser bushings has remained the same from 15 kV to 800 kV. Majority of bushings installed on power transformer have oil impregnated condenser core with porcelain serving as external insulator.

In condenser bushings, there are three main insulation systems used around the world which are as follows:

- Resin Bonded Paper (RBP) Bushings
- Oil Impregnated Paper (OIP) Bushings
- Resin Impregnated Paper (RIP) Bushings

Previously, dry insulation without oil and resin bonded bushings were used. Now, oil impregnated bushings are used throughout the world with resin impregnated bushings being the

Figure 2: Moisture Contamination in Oil End Part of Bushing

future market needs. These are described briefly in following sections.

Resin Bonded Paper Bushings

These bushings were started in 1940s from 15 kV till 72.5 kV. Resin coated kraft paper was used as insulation paper; hence called resin bonded bushings. The winding machine would itself provide the heat to activate the bond for the resin while the insulation paper was wound with aluminium foil inserts on the aluminium conductor. These inserts served as voltage grading layers for the condenser bushings. After the machining process, bushings were lathe, oven cured and then dipped into varnish. The lower side did not have a porcelain insulator. It was only provided for the upper air end portion of condenser bushings.

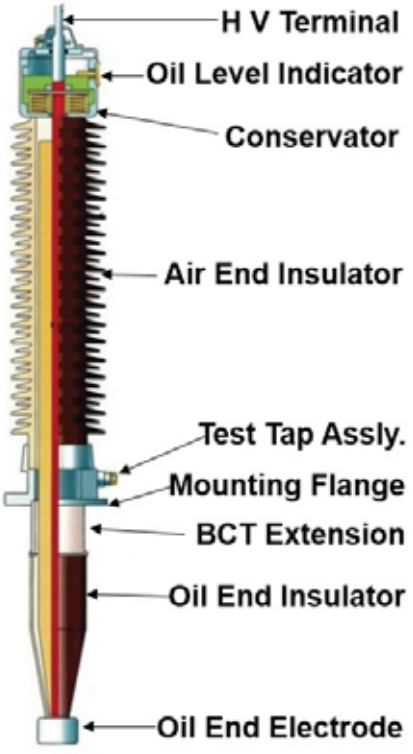

Figure 3: Schematic Construction of OIP Condenser Bushings

These bushings had several concerns and hence they were only manufactured till 1980s. If these bushings were not properly stored then moisture contamination would take place in the lower part which was not covered with external insulator as shown in the figure 2. Over the years, the varnish layer would delaminate and the transformer oil would seep into the insulation paper. Uneven redistribution of electrical stresses would take place and as all the layers were not affected by the same; this would ultimately lead to change in the capacitance of bushing.

Inspite of these concerns in the bushing, these still found a ready market due to competitive price. These bushings were only used for lower voltages as the risk of thermal instability and the dielectric losses of insulation paper would lead to thermal runway.

Oil Impregnated Paper Bushings

This type of insulation philosophy has become a common technology in the substation transformer bushings. At least three out of every four bushings installed around the world have an oil impregnated paper design and the percentage would increase in the countries like China and USA. Figure 3 shows us the schematic diagram of OIP condenser bushings used over the years.

Keeping current advancement in power system components, this long existing technology is fact of no small achievement. Due to the variety of small refinements by the manufacturers, there has always been a strong preference for OIP

Figure 4: RIP Bushings

design by different power utilities. Hence, it has always been an attractive propaganda with ever changing market needs and demand.

The manufacturers always wanted to standardise the high creepage distance in the OIP design. Their goal was to achieve the same bushing design to be used across variety of bushings installed which in turn will reduce the different styles end users hold. There has been continuous effort by the suppliers over a decade or so which has in fact streamlined their further orders and inventorying of porcelain which ultimately leads to reduction in cost and production lead time.

Particulars	OIP with porcelain insulator	RIP with composite insulator
Insulator	Porcelain	Glass fiber reinforced epoxy resin tube with silicone sheds
Condenser core	OIP	RIP
Secondary insulation	Oil	SF6 or foam
Oil end part	Epoxy resin	Not necessary

Table 1: Comparison to OIP and RIP Bushings

Manufacturers over the years have also carried out design changes to make slimmer profiles by the reducing the diameters of porcelain housings which will also make them lighter. These changes have led to easy handling of bushings during installation and maintenance practices. Reduction in weight due to smaller dimensions is directly proportional to the reduction in purchase price. There will also be reduction in volume of oil which will progressively reduce the risk of oil leaks and fires among the end user's assets.

Some manufacturers have made additional improvements like better sealing against the leaks; designs suitable for vertical as well as horizontal mounting; ease of visual monitoring of the oil

level of condenser bushings; ease for interchangeability between power transformer bushings and other switchgear applications like circuit breakers; better contact between the top terminal and the incoming conductor even if the contact thread out over a period of time. Refinements have also been developed which gives these bushings to change quickly without hampering the operation of the affected device.

One question is still unanswered in the interest of thousands of condenser bushings installed all around the world - How intelligent our bushing designs should be? Especially, in internal monitoring of oil levels and other such crucial parameters. The bushing industry feels that there should be further development in the areas of monitoring systems of bushings where there has been a growing interest in recent years.

Given the fact of such continue fine-tuning in the OIP bushing technology, one wonders whether there is anything left to enhance the functionality or performance of the asset. We can say that this style of bushing today has reached the stage of maturity with very little room for any development. So, finally, one can fairly say that OIP bushings 'Once built like battleships', everything possible has been done to make them neater and as small as possible.

Resin Impregnated Paper Bushings

Compared to the previous RBP bushings, significant changes have taken place to introduce a new and successful technology where insulation paper will be impregnated with epoxy resin which will give us dry and void-free bushings. Same like the OIP bushing manufacturers, the suppliers of RIP bushings have also carried out some refinements to seek the heavy cost that utilities will be paying to them. Most important development is the use of silicone rubber as external insulator in the condenser bushings which can be seen in figure 4. Some say that it is the ultimate design evolution one has seen in the bushing history to increase performance levels.

There will be no doubt that in the future; market acceptance of silicone rubber insulators with RIP cores will be greater mainly due to safety and environment concerns. European countries like Germany, Austria and Switzerland have already started to incorporate RIP bushings in their fleet. The motivation behind such transition has factors such as reduced risk to human life, better performance which is invulnerable to pollution, faster lead time in production process, reduction in weight and easier handling. There are many examples of porcelain housing catching flashover under wetting which will not be happening in the case of silicone rubber. However, overpowering the OIP bushings in terms of cost will always remain the biggest challenge for the RIP bushing especially, below the 245 kV level where the business volume is focused. A comparison between the OIP bushings and the RIP bushings is shown in Table 1.

Higher the voltage level, higher will be the volume of material; which will ultimately lead to internal stresses and formation of cracks. Great care has to be taken further in the curing cycle of RIP bushings especially as we rise to higher and higher voltages in the future. Among the more noteworthy developments has been the molding of fibre-reinforced plastic tube directly on to the epoxy core. The direct molding eliminates the use of dielectric materials which fills in the area between the epoxy tube and RIP core. The main advantage of doing so is the potential savings assured up to 5 percent of total cost of the bushing due to direct mold instead of stand-alone cores.

With these large in-house processes which requires a large investments, there are other technical challenges too at higher voltage levels related to it. Problems related to interfacing occur if the chemical bond between the core and silicone is improper. Initially, these bushings might have high dissipation factor as silicone material is directly molded on to the RIP core. Experts say that vapor must have been absorbed by the resin body before the energisation.

Whatever will be the improvements in the future of RIP bushings, engineers will be always striving for better grading of conductive layers with smaller diameters. To increase the robustness of production processes, there will be a need of greater process control which will give us more consistent product which can be controlled and repeated easily every time.

Finally, in the end, the customer selection cannot only be decided by just comparing OIP and RIP

bushings. Given the known fact that huge efforts will go in commercial considerations in the future, suppliers of condenser bushings who provide the most features irrespective of the advance technology will be in great success. Features such as interchangeability between related applications, seismic and high altitude capabilities, higher creepage distance and more cantilever strength are more likely to be added in near future.

Conclusion

If not in the first glance but bushing technology has come a far way which looks quite impressive. They look very much like the old designs from the past but upon closer examination, one can say that there have been fine improvements and subtle refinements considering the scale, cost, performance and functionality of the power asset. The ongoing efforts to reduce the cost, lead time of production processes and standardize the bushing to reduce the need of end user to stock up many different styles will always be serving as driving forces in the bushing industry. As commercial considerations will be playing a huge impact on the purchase decisions in the future, the bushing suppliers who offer the most features irrespective of the price will be in great success. Moreover, the engineers have to seek more design optimizations wherever possible due to the internal competition in OIP and RIP styles. Finally, we conclude that, RIP bushings which are a 21st century product might also last the 22nd century in future.

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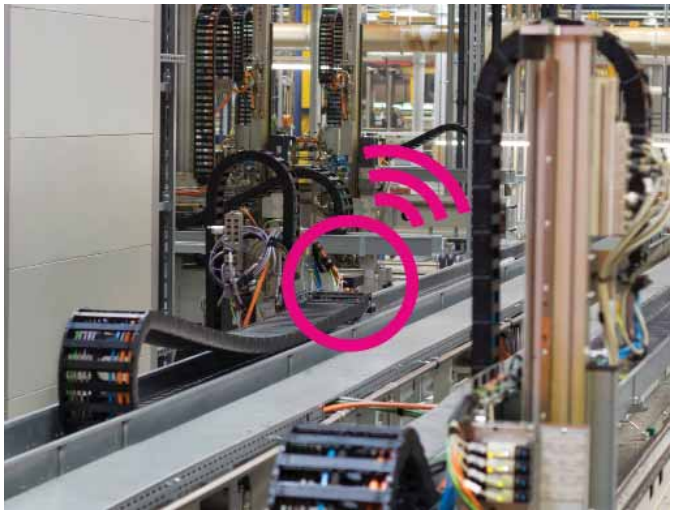
Increase plant safety, reduce maintenance costs with smart plastics from igus

New intelligent plastic solutions offer many options for predictive maintenance



The smart plastics increase plant reliability by the accurate prediction of their service life. This is especially useful, for example, when a large number of e-chains are used in production.

Machine Learning, Big Data and Industry 4.0 - the real potential customer benefits from digitisation are often hidden behind these buzzwords. Intelligent products such as igus smart plastics, for example, enable companies to increase the reliability of their systems, plan maintenance tasks accurately and thus save costs. The way this works was demonstrated by igus with new ideas at the Hannover Messe 2018.

igus has been developing a family of products since 2016 under the heading 'isense', where various sensors and monitoring modules add intelligence to plastic solutions such as energy chains, cables, linear guides and slewing ring bearings. They measure among other things the wear during the operation and alert the user early enough to plan repair or replacement. By networking using the igus communication module (icom), the online status and alert display, for example via a PC, tablet or smartphone, is just as possible as a direct integration into the customer's infrastructure. These smart plastics are already predicting the service life of numerous customer applications, such as in the automotive industry. They are continuously developed in close cooperation with customers. These novelties were presented by igus at the Hannover Messe.

Individual integration of smart plastics

The improved isense modules, which use sensors to collect data from the energy chain, cable, linear guide or slewing ring bearing, are equipped with a serial interface and can be easily integrated into a control cabinet. A data logger allows the storing of values on an SD card. The data measured by the different isense systems are then sent wirelessly to the icom module, summarised and processed. The customer has the choice of various concepts for integration into their own infrastructure. In this way there is an option for the icom to send the data from the sensors to a PC or integrate the data via the computer into the existing software environment and intranet solution. In addition, a connection to the igus Data Center is possible. In this case, the maintenance recommendations via Machine Learning and AI algorithms are constantly compared and defined with the experiences of many existing applications, for example in the large igus test laboratory spread over a floor area of 2,750 square metres.

For more details, visit www.igus.in

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DEIF ensures reliable power for hospital

Power outages force hospitals to look for alternate power sources, where diesel genset are the most favoured option for in-house power generation.

AGC4

Indian healthcare sector

According to the department of commerce, Govt. of India, the Indian healthcare sector is one of the fastest growing industries and was sixth largest market globally in terms of size in 2015. Healthcare revenue in India is set to reach $ 280 billion by 2020. Govt. of India has allowed 100 per cent FDI in healthcare sector – a major growth driver for this sector. Medical tourism in India is on the rise because of state-of-the-art private hospitals and diagnostic facilities available at low cost. Treatment for major surgeries in India costs approximately 20 per cent of that in developed countries. Patients from developing countries are also attracted due to lack of advanced medical facilities in their own countries. For healthcare sector to grow further by attracting foreign patients, availability of reliable power is the critical need.

Why is it so critical for hospitals?

Designing electrical systems for healthcare facilities, especially hospitals, is more demanding than for conventional buildings due to complexity of the system and its size. It involves many different systems consisting of alternate sources of power, switching equipment, controls and distribution equipment. The stakes are so high that even a slightest interruption of power can result in to a tragic event. Seriously ill and injured people's lives could be at risk. On the other hand, there is increased patient awareness while insurance companies play a crucial role through regulations. Hospitals come under the Clinical Establishment Act and Consumer Protection Act and any shortfall in patient care and safety will invite medico-legal consequences. Major accreditation bodies such as JCI (Joint Commission International), NABH (National Accreditation Board for Hospitals and Healthcare Providers), and ISO (International Organisation for Standardisation) have stringent norms for electrical power availability.

Modern healthcare facilities depend on reliable availability of medical equipment. Without power backup, high-tech healthcare equipment are vulnerable to software or hardware damage. It would result in loss of respiratory devices and other critical equipment for patients in intensive care, neonatal or cardiac units. ECG monitors, ventilators, incubators, laparoscopy system, electrocautery, suction apparatus, defibrillator, ultrasound, biochemistry analysers, and other equipment can stop working. It would also result in loss of lighting, HVAC, refrigeration and water pressure, inability to sterilise instruments, transportation of patients and supplies between floors due to non-operational elevators. Disturbances of the power translate into failed processes, lost electronic patient medical records, decreased efficiency, unhappy patients and lost revenue.

A primary challenge for many healthcare facilities is to provide a high-quality source of electrical power

that is backed up with highly reliable emergency and standby power systems to ensure uninterrupted flow of electricity to the entire facility, particularly during crisis and natural disasters. Power outages force hospitals to look for alternate power sources, where diesel genset are the most favoured option for in-house power generation. Control system that would support future expansion for at least over a decade without major modifications is preferred. Availability of local service and support during sudden breakdown is most sought for.

DEIF suffices your requirements

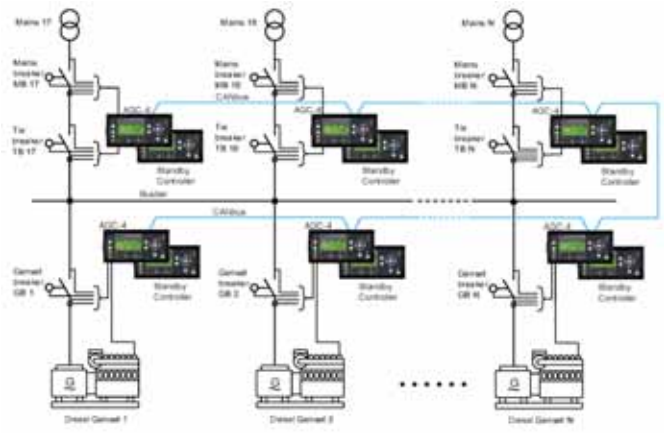
DEIF has a strong track record in developing emergency, standby and backup power solutions for hospital and healthcare facilities. DEIF's Automatic Genset Controller, AGC-4 features proven technology for a wide range of generation systems in critical power applications.

Increased reliability and flexibility

In DEIF's redundant control system, two controllers operate in Hot Standby mode, with one as active controller while the other acts as a standby controller. The standby controller is connected to the active controller through CAN bus and remains updated with the latest events and information at all times. In case of any unexpected fault in the active controller, the standby controller assumes control without any load or speed jumps during transition, thus ensuring continuous flow of power.

Fast energy backup

AGC-4 controllers are capable of synchronous starting of multiple genset using Close Before Excitation and can deliver record start-up from an impressive less than 10 seconds for multiple genset in parallel, redundant control systems, or even an entire redundant power plant.



Application Drawing Hot standby - AGC-4

AGI-407

Fuel optimisation

DEIF's controllers are designed to run optimum combination of genset thus reducing fuel consumption, cutting emissions and operating cost, and increasing efficiency of a backup genset power making it greener with fast ROI.

Remote monitoring

DEIF's Advanced Graphical Interface - AGI 400 series, allows the user to view the entire system on a single screen thus facilitating convenient and effective monitoring and control of all systems or any other third-party systems and critical parameters simultaneously; over one centralised IP based network from a remote location at the touch of the graphical user interface.

Scalability

DEIF's controller system is fully scalable multi-master system of up to 992 gensets with plant management option in one application without making major modifications in the existing project to meet future growth and expansion plans.

Quick service

DEIF India has offices in Mumbai, Delhi, Bangalore, Ahmedabad, Chennai and a repair centre for fault identification and rectification in Mumbai. This enables reliable and fast on-site service and support.

For more details, Contact at - india@deif.com

How to determine ideal type of solar paneling for each installation?

Researchers at MIT find out a formula that can determine when and where advanced photovoltaics would be economic to install.

A team of researchers at MIT and elsewhere has come up with a way to figure out the best type of solar panel for a given location and type of installation. Image: MIT

As the solar power industry has taken a center stage, there are varied range of solar panels available in the market, complicating the decision-making process for installation. Also, though the costs of solar cells continue to plunge, the costs of installation and the associated equipment remain relatively constant. So, figuring out the tradeoffs involved in planning a new installation has become more complicated. The new study by MIT researchers provides a clear way to estimate the best technology for a given project.

The team of researchers includes MIT graduate student Sarah Sofia, associate professor of mechanical engineering Tonio Buonassisi, research scientist I. Marius Peters, and three others at MIT and at First Solar and Siva Power, solar companies in California. They have come up with a way to figure out the best option for a given location and type of installation. The bottom line is that for household-scale rooftop systems in relatively dry locations, the more efficient but more costly panels would be better, but for grid-scale installations or for those in wetter climates, the established, less efficient but cheaper panels are better.

The study compared two basic varieties of solar cells: standard designs that use a single type of photovoltaic material, and advanced designs that combine two different types (called tandem cells) in order to capture more of the energy in sunlight. For the tandem cells, the researchers also compared different varieties: those in which each of the two cells are connected together in series, called two-junction tandem cells, and those where each cell is separately wired, called four-junction tandem cells.

Instead of just looking at the amount of power each kind can deliver, the team analysed all the associated installation and operational costs over time, to produce a measurement called the levelised cost of electricity (LCOE), a measure that incorporates all the costs and revenues over the lifetime of the system.

“Standard single-junction cells have a maximum efficiency limit of about 30 per cent,” grad student Sarah Sofia told MIT News. “Tandem cells, using two materials, can have much higher efficiency, above 40 per cent.”

For their analysis, the team looked at three types of environment — arid (Arizona), temperate (South Dakota), and humid (Florida) — because the amount of water vapor in the air can affect how much sunlight reaches the solar cell. In each of these locations, they compared the standard two kinds of single-junction

solar cells (cadmium telluride, or CdTe, and copper-indium-gallium-selenide, or CIGS) with two different types of tandem cells, two-junction or four-junction. Thus, a total of four different technologies were studied in each environment. In addition, they studied how the overall LCOE of the installations would be affected depending on whether overall energy prices remain constant or decline over time, as many analysts expect.

The results were somewhat surprising. "For residential systems, we showed that the four-terminal tandem system was the best option, regardless of location," Sofia says. But for utility-scale installations, the cell with the lowest production costs is the best deal, the researchers found.

The new findings could be significant for those planning new solar installations. Sofia says, "For me, showing that a four-terminal tandem cell had a clear opportunity to succeed was not obvious. It really shows the importance of having a high energy yield in a residential system."

But because utility-scale systems can spread the costs of the installation and the control systems over many more panels, and because space tends to be less constrained in such installations, "we never saw an opportunity" for the more costly, efficient cells in such settings. In large arrays, "because the installation costs are so cheap, they just want the cheapest cells (per watt of power)," she says.

Researchers say that their study could help to guide research priorities in solar technology. The methodology the team developed for making the comparisons should be applicable to many other comparisons of solar technologies, not just the specific types chose for this study, Sofia says. "For thin-film technologies, this is generalisable," she adds.

Because the materials they studied for the four-terminal case are already commercialised, Sofia says, "if there was a company that had an interest," practical, affordable four-junction tandem systems for residential applications could potentially be brought to market quite quickly.

Offline Solar PV Panel Data Transmission using QR Code

The paper discusses the transmission of solar panel data using QR code for a small recording duration only but this novel technique can be implemented to integrate over other components of solar photovoltaic system with continuous recording.

Solar energy is one of the rising areas in the field of renewable energy due to its several advantages such as available in plenty, clean source of energy, safe for environment. Sun is the source of solar energy. The radiations emitted by sun are absorbed by solar cells and solar energy is produced through the process of photoelectric effect. These solar cells are the smallest component in solar photovoltaic system. These solar cells are connected in a well-arranged manner of series and parallel combination called as solar module. Many solar modules are connected to form a solar panel. A solar photovoltaic system consists of solar panels, solar

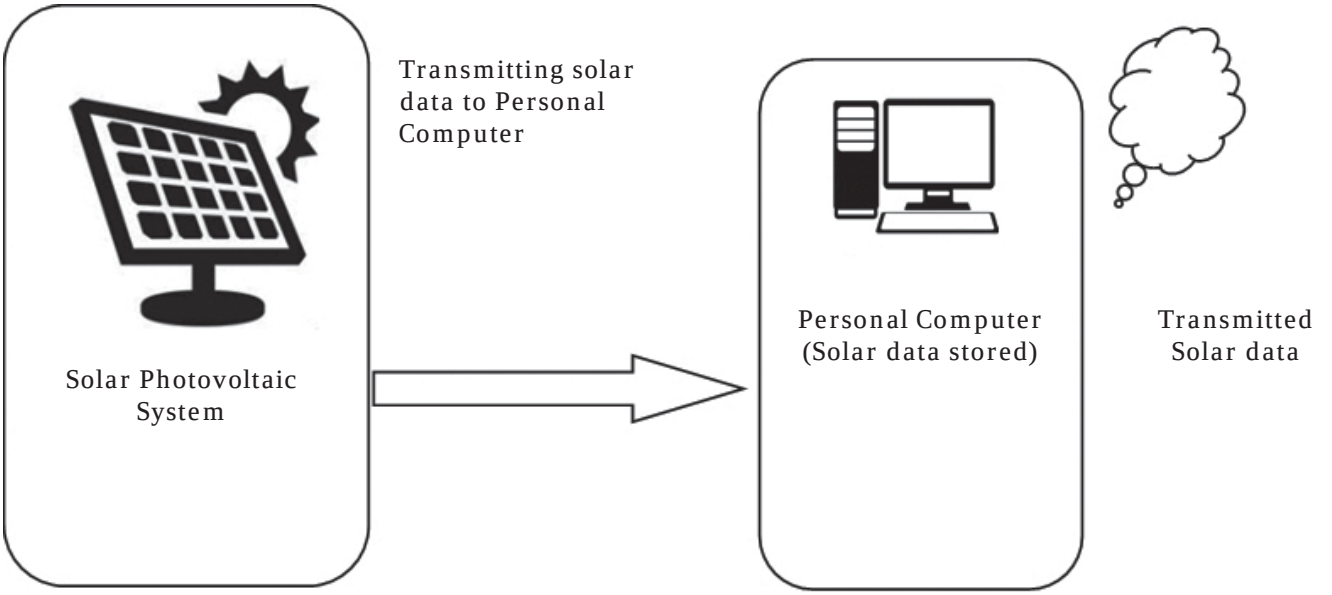


Figure 1: Representing complete mechanism of monitoring and transmission of data generated by solar photovoltaic system

charge controller, solar battery and solar inverter. The input is the solar radiations and output is the solar energy obtained in electrical form.

As solar panels are installed in open atmosphere the possibility of fault becomes dominant. The fault can occur in any component of solar photovoltaic system but the solar panels are more sensitive because they are exposed to direct contact of environment. When such type of faults occurs in any of the photovoltaic component, the performance of complete system decreases. Some of the common reasons are change in operating temperature, shade of tree, building or tower on solar panels, degradations and ageing effect in solar photovoltaic components, deposition of sulphur on terminals of solar batteries. All these effects decrease the efficiency and performance of complete solar photovoltaic system. Therefore, to monitor the changes occurred due to atmospheric conditions the remote condition monitoring is implemented now-a-days.

The remote condition monitoring provides direct online monitoring of the parameter values for different components of solar photovoltaic system. The change in output current, output voltage and output power along with variations in ambient temperature, component operating temperature, solar irradiance for solar panels can be monitored online. In case of solar battery, the state of charging and discharging, operating temperature, voltage and current profile can be monitored easily. The condition monitoring shows the graphs of different parameter values on the screen of monitoring system (personal computer).

This solar data i.e., current, voltage, power and

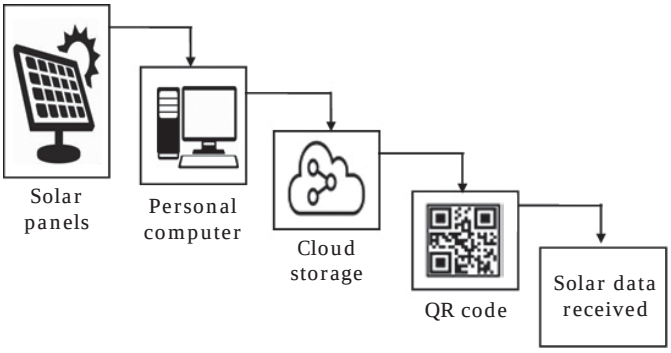


Figure 2: Shows block diagram of the algorithm used to transfer solar data using QR code

temperature etc shown on the screen of monitoring system is stored in MS excel file format (.csv) in the monitoring system (personal computer). Storage of monitoring data provides as an additional advantage to view the graphs and values of stored solar data offline.

The transmission techniques allow to transfer the stored data from stored personal computer to the receiving point through several means but wireless transmission is more common. Some of commonly used wireless transmission techniques are zigbee, gsm due to their own advantages and applications

Table 1: Name Plate Rating Details Of Solar Panels Used In Solar Photovoltaic System

S. No.	Name		Value	
1.	Company		BP SOLAR	
2.	Module No.		L20220	
3.	$P_{maximum}$		165 WP	
	Warranted $P_{maximum}$		160 WP	
	$V_{maximum\ power}$		35.2 V	
	$I_{maximum\ power}$		4.7 A	
4.	$V_{open\ circuit}$		44.2 V	
5.	$I_{short\ circuit}$		5.1 A	
6.	Maximum system voltage		600 V	
7.	Min. bypass diode rating		8 A	
8.	Maximum series fuse current protection		15 A	
9.	Fire rating class		C	
10.	A.	STC (Standard test conditions):	INSOLATION	1000 W/m^2
	B.		AM	1.5 spectrum
	C.		Cell Temp.	25 °C

Figure 3: Solar panels installed on roof of EE lab, Faculty of Engineering, DEI

and ability to work but has some limitations of time delay and data loss in the transmission of recorded data in video form. The QR codes being frequently used in transmission and sharing of video data improves the complexity of data transmission.

Monitoring, Transmission and Storing of Data Generated by Solar Photovoltaic System

Basically, there are two broad categories of solar photovoltaic generated system, they are off-grid (standalone) solar photovoltaic generated system and grid connected (online) solar photovoltaic generated system. The main components of a standalone solar photovoltaic generated system include:

- Solar panels
- Solar charge controller
- Solar battery
- Solar inverter

In case of online or grid connected solar photovoltaic generated system, the solar batteries are absent. To monitor the condition of solar components,

Figure 4: Data logger recording and displaying solar panel data as numeric values

Figure 5: Data logger displaying graph of solar panel data

wireless technique provides better results because of remote accessing through data loggers. The online variations in current, voltage, power, temperature and other atmospheric parameters like solar irradiance, humidity etc can be view on the screen of personal computer through remote condition monitoring. Zigbee and gsm are becoming more popular among other transmission due to their advantages. The solar data generated in personal computer is stored in MS excel (.csv format) from which graphs can be plotted offline means.

The block diagram shown in figure 1 represents the complete mechanism of monitoring and transmission of data generated by solar photovoltaic system.

Solar Photovoltaic Transmission with QR Codes

Now-a-days QR are becoming more popular as a method of communication, because of its several advantages and applications. Some the advantages of QR code are listed as:

- Fast scanning
- Smaller in size
- More capacity to store data
- It can support to many languages (numeric, alpha-numeric, kanji etc)
- Accessible through 360°

The maximum storage limit of a QR code for characters is 7089, for alphanumeric characters is 4296, for binary bytes is 2953 and for Kanji characters is 1817. Moreover, a QR code can store texts, contacts, url, shareable link, email etc so used in educational institutions, business, medical and security. QR code

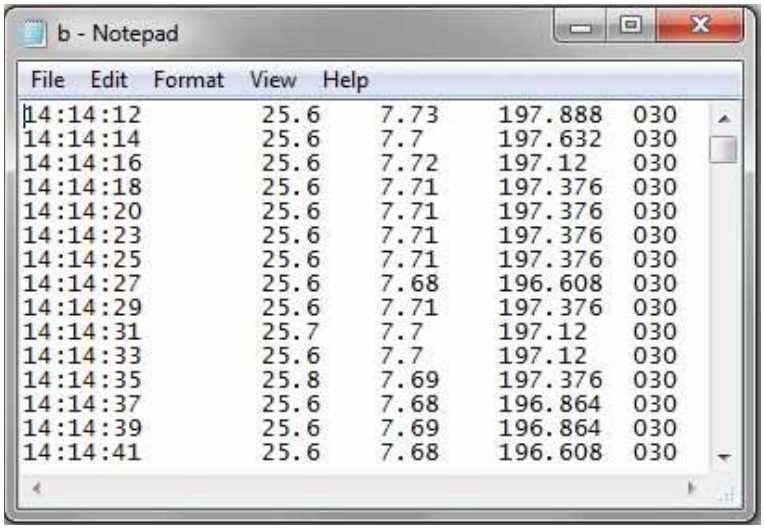


Figure 6: Data logger recording numeric values of solar panels in .csv format

Figure 7: QR code generated for recorded solar panel data

is a two-dimensional barcode having more storage capacity than one dimensional barcode because in QR code the data can be stored in both direction (horizontal and vertical). The basic construction of a QR code has two regions namely function pattern region and encoding region. The function pattern region contains finder, separator, timing patterns, alignment patterns while the information is stored in encoding section of a QR code. This stored information can be shared by providing a shareable link to QR code. The generated QR codes can be easily scanned through a QR code scanner installed in mobile phones to obtain the data contained within it.

Work Done

The work for the experiment is performed on a

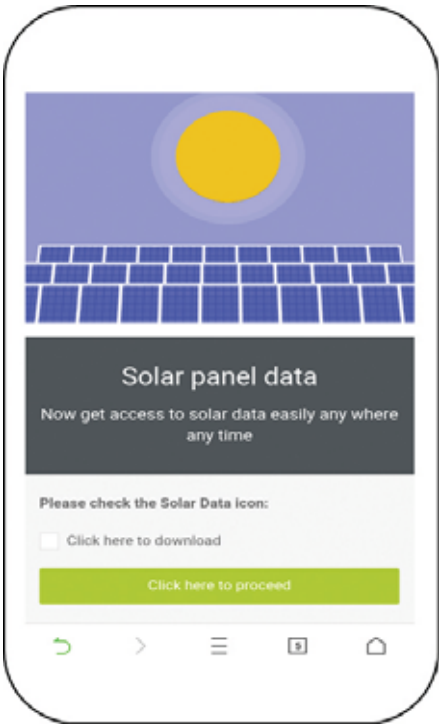


Figure 8

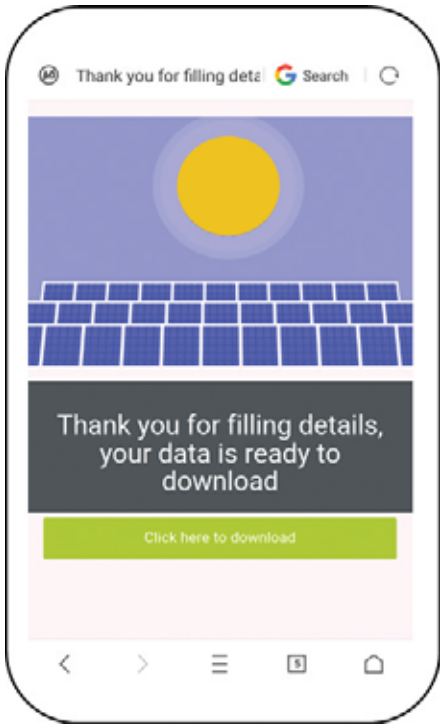


Figure 9

Figure 10

Figure 8, figure 9, figure 10 Showing snapshots of original web application obtained after scanning generated QR code for solar panel data

personal computer connected to the solar panels installed at the roof of Electrical Engineering Lab, Faculty of Engineering, Dayalbagh Educational Institute, Agra. The solar photovoltaic generating system is standalone having four solar panels, six long tubular batteries and one inverter as its components. The solar panels are installed in open atmosphere therefore the variations in output current, output voltage and output power with ambient temperature are monitored and stored in the personal computer having internet connectivity. These variations and graphs can be monitored online and stored in personal computer as MS excel sheet (.csv format). The offline data can be used to view the values of solar data stored in MS excel sheet (.csv format) and generate the graph from stored readings virtually but not really. Therefore, the concept of recording the variations of different parameter values and actual variations of graphs is introduced for better visualisation.

In this research work the online recording of solar data is performed with the help of google chrome to generate and provide a shareable link for the recorded solar data video file. This link is used to transfer the solar data when a QR code is scanned by a QR code scanning device. The figure 2 shows block diagram of the algorithm used in the experiment.

The name plate rating details of solar panels used in solar photovoltaic system is given below in table 1. The work done for transmission of solar panel photovoltaic data using QR code is divided into two sections:

A. Recording of solar photovoltaic data in PC:

The computer used to monitor the solar photovoltaic data with data logger installed on is connected with the internet and records the data using google chrome service with the help of webcam in video format (.webm). The recording is started and stopped manually by selecting the options mentioned in google chrome service. After the completing of the task the recording is automatically stored on google cloud storage with a shearable link associated with it. This link is provided for the sharing the recorded video file data using QR code.

The figure 3 to figure 6 shows snapshots of the recording of solar photovoltaic data on personal computer and shareable link ready for next phase of transmission.

B. Transmitting data using QR code:

The automatic generation of shareable link generated after completion of the video recording is attached to QR code through an android web application. The web application helps in creating and managing the accessing of solar photovoltaic panel data according to the requirements. The following figure 7 to figure 10 shows the QR code generated (QR code is watermarked for security reasons) and accessing the solar photovoltaic panel data using web application.

Proposed Strategy

The idea of transmission of solar photovoltaic panel data used in this paper can be extended to firstly store and transmit the more data with less space requirement. Secondly, the offline data transmission can also be extended to online real time if concept of variable QR codes is included in the research work. Solar data transmission through online real time with QR code has advantages of efficient storing, easy sharing, real time offline visualisation of variations in values and graphs and uniqueness in the area of solar photovoltaic.

Results & Discussions

The generated QR code is the successfully working for transmission of stored video file for the generated solar panel data. As explained earlier in the paper that the values of current, voltage and power are monitored online and stored in .csv format (comma separated value) using data logger but the new technique applied in this paper provides the real time video recording of the voltage, current and power in terms of values and graphs varying with time. The results obtained in the experiment give better visualization of the actual variations in voltage, current and power and helpful in performing detailed analysis when deep learning is required.

Conclusion

The solar photovoltaic generation system for solar panel monitors the voltage, current and power with data logger and record the values of voltage, current and power in .csv format. The new technique applied in this paper uses QR codes for storing the video recording to capture the real time variations in values and graphs for voltage, current and power. One of the biggest advantage is to store the recorded video file into QR code the tremendous reduction in size of video file from mega byte to kilo byte because the video file is stored in QR code in image form. The table 2 shows detail of recorded video file before and after conversion into QR code. The paper discusses the transmission of solar panel data using QR code for a small recording duration only but this novel technique can be implemented to integrate over other components of solar photovoltaic system with continuous recording for 24 hours a day and real time data can be transmitted easily to study better outcomes and better visualisation effects.

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Prof D K Chaturvedi

Consultant, DRDO &
Electrical Engineering Department, Dayalbagh Educational Institute, Agra,

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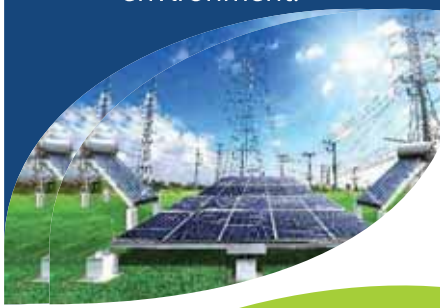

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State-wise List of Solar Cities

State-wise list of Solar Cities for which Sanctions/In-Principle approvals have been given (Sanctions accorded for Master Plans, Solar City Cells and Promotional Activities).

Sr. No	State	Cities for which in-principle approval given	Amount Sanctioned in (Rs. Lakh)	Amount Released (Rs. Lakh)
1	Andhra Pradesh	Vijaywada Mahbubnagar*	46.40 -	15.40 -
2	Assam	Guwahati	45.45	7.72
		Jorhat	49.18	24.18
3	Arunachal Pradesh	Itanagar	47.49	16.49
4	Chandigarh	Chandigarh	49.75	24.75
5	Chhattisgarh	Bilaspur	43.43	12.43
		Raipur	43.43	12.43
6	Gujarat	Rajkot	47.45	12.72
		Gandhinagar	50.00	14.00
		Surat	43.46	8.46
7	Goa	Panji City	43.30	1.65
8	Haryana	Gurgaon	47.45	3.70
		Faridabad	48.75	17.75
9	Himachal Pradesh	Shimla	42.95	11.94
		Hamirpur	42.80	11.80
10	Karnataka	Mysore	43.25	5.62
		Hubli-Dharwad	43.00	1.50
11	Maharashtra	Nagpur	48.93	4.46
		Thane	49.84	18.84
		Kalyan-Dombiwali	49.57	24.57
		Aurangabad	50.00	7.86
		Nanded	50.00	3.74
		Shirdi	43.48	1.74
12	Madhya Pradesh	Indore*	-	-
		Bhopal*	-	-
		Rewa	50.00	13.55
13	Manipur	Imphal	48.56	4.28
14	Mizoram	Aizawl	48.09	17.09
15	Nagaland	Kohima	46.98	15.97
		Dimapur	48.95	4.47
16	Delhi	New Delhi (NDMC area)	50.00	2.25
17	Orissa	Bhubaneswar	47.37	3.68
18	Punjab	Amritsar	45.00	11.50
		Ludhiana	45.00	11.50
		SAS Nagar (Mohali)	50.00	2.24
19	Rajasthan	Ajmer	50.00	1.35
		Jaipur*	-	-
		Jodhpur	43.50	1.75
20	Tamil Nadu	Coimbatore	49.00	9.00
21	Tripura	Agartala	45.49	11.75
22	Uttarakhand	Dehradun	47.40	12.70
		Haridwar & Rishikesh	45.00	2.50
		Chamoli –Gopeshwar	44.95	11.47
23	Uttar Pradesh	Agra	48.89	23.89
		Moradabad Allahabad*	50.00 -	25.00 -
24	West Bengal	Howrah Madhyamgram New Town Kolkata	50.00 50.00 50.00	4.31 4.15 11.26

*Only In-principal approval given.

(Source: MNRE)

IR270 IR Thermometer with Colour Alert

Fast response with high accuracy, the Extech IR270 is ideal for quick checks of multiple spots in a process or for catching spikes in temperature. Easy programmable High/Low Alarm with tri-colour display and audible alarm measures non-contact temperature up to 1202-degree F (650-degree C).

Features

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- Adjustable emissivity (0.10 to 1.00) increases measurement accuracy

- Record/Recall up to 20 readings
- Automatic data hold when trigger released
- MAX/MIN/AVG/DIF functions
- Bright white backlighting illuminates display for taking measurements at night or in areas with low background light levels
- Auto power off
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- Dimensions: 7.1x4.2x1.6-inch (180x107x40 mm)
- Weight: 5.3oz (150g)
- Complete with 9V battery and pouch.

For more details, visit: www.flir.in

KUSAM-MECO Dual Trace Oscilloscope

KUSAM-MECO has introduced dual trace oscilloscope that are dual-channel with maximum sensitivity of 1 mV/DIV. The time base provides a maximum sweep time of 0.2 mS/DIV. When magnified by 10, the sweep speed is 20nS/DIV. These oscilloscopes employ a 6-inch rectangular type Toshiba cathode-ray tube with red internal graticule.

According to KUSAM-MECO, the Dual Trace Oscilloscopes are sturdy, easy to operate and exhibit high operational reliability.

Features

- High luminance, internal graticule Toshiba CRT.
- Japanese electronic encoder, light handy and reliable.
- Fully sealed long live vertical mode switch.
- ALT Triggering Function. Two independent signals simultaneous observation.
- Triggering level lock function, automatic synchronise function.
- Built-in 6-digit frequency counter (available in model KM - 20 - 20).
- High intensity CRT with high acceleration voltage: The CRT is a high beam transmission, high intensity type with a high acceleration voltage of 2KV. It displays clear readable traces even at high sweep speeds.
- The Oscilloscope has a trigger level lock function which makes the triggering adjustment unnecessary.
- Alternate triggering: Even an observation of two waveforms of different frequencies, the waveform of each channel is stably triggered.
- TV sync triggering: The oscilloscope has a sync separator circuit for triggering of TV-V and TV-H signals.

For more details, contact at: kusam_meco@vsnl.net

Kyoritsu's 6201 portable appliance tester

"Kyoritsu's portable appliance testers are used widely in electrical equipment preventive maintenance programmes and enable users to verify the electrical safety of all type of appliances quickly and effectively.

– **Suneel Kapoor, Country Lead, Kyoritsu KEW India Instruments Pvt Ltd**

Kyoritsu, Japan has a frontline global presence in electrical test & measurement equipment since 1940, with specialised expertise in low voltage test & measurement.

Kyoritsu's 6201 portable appliance tester performs four functions to ensure the safety of Class 1 and Class 2 appliances along with mains voltage. Results are displayed on LCD below which four LEDs are there for 'Pass' or 'Fail' indication for threshold values dictated by AS/NZS 3760.

Key features of Kyoritsu 6201

- Auto ramp test.
- Carrying out constant measurement of voltage in standby mode at each range.
- Remote test.
- 0- and 180-degree phase angle switch permits quick tests and consistent readings.
- Dust and water proof construction.

Other features

- Trip current settings 15 mA to 500 mA.
- Self-powered by battery.
- Testing time 200 ms to 2,000 ms.
- Withstand voltage AC 3,700 V/1 min (between electrical circuit and enclosure).
- Safety standards IEC 61010-1 Pollution degree 2 CAT III300V/ CAT II400V.

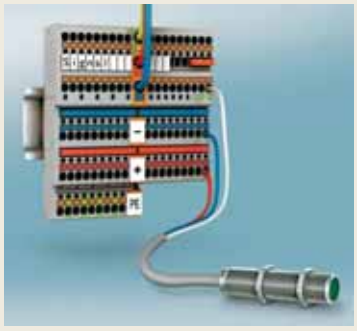
Kyoritsu products are readily available in India and have complete service and calibration support setup too.

For more details, contact at: info.ei@kew-india.co.in

Push-in connection technology by Phoenix Contact

Push-in technology is the new modular terminal block generation in the CLIPLINE complete system. The push-in technology with up to 50 per cent lower insertion forces provides user-friendly wiring with maximum contact quality never previously reached. Pullout forces are 5 times the IEC requirement direct push in of ferruled wire can be accomplished with the lower insertion force, and stripped, stranded wire is easily terminated using the orange indicator push button. Push-in-technology terminal blocks are also based on the compression spring principle, but they set new standards for ease of use and ergonomics.

With the new terminal principle, flexible cables with ferrules starting at 0.14 sq.mm. to 185 sq.mm. can be connected directly to the terminal point without tools. According to the manufacturer, the push-in technology terminal block with stripped stranded wire also offers time savings (35 per cent) over traditional spring cage, with ease of use and identification. Metal parts made of corrosion-free, high-grade copper alloys which provides good electrical conductivity, low temperature rise, surface protected by a lead-free, galvanic nickel or tin plating, leg springs made of high-strength stainless steel.



Additional benefits of push-in technology

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- Shock and corrosion resistance according to current shipbuilding registers
- Certified for process engineering for increased safety (Ex e).

For more details, contact at: adverts@phoenixcontact.co.in

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IEEMA extends focus on electrical fire safety

Organised Electrical Fire Safety Conclave in Mumbai for integrated solutions on fire protection and security

IEEMA organised its first edition of "Electrical Fire Safety Conclave" on 29th June in Mumbai. The conclave emphasised on various aspects of electrical risk management, improper maintenance and ignorance of the safety precautions during their use which leads to fire accident due to lack of awareness or knowledge.

In the Indian scenario, data shows that the majority of industrial disasters and commercial or household fires are a result of electrical short circuits. These electrical short circuits cause fires in the electrical appliances or electrical fittings, which rapidly spread through flames via the connecting electrical wires to the surrounding rooms or halls and combustible furniture, etc.

Shreegopal Kabra, President, IEEMA said, "In the last six years, there have been 29,140 fire incidents in Mumbai in which 300 people have died and 925 people have been injured. Although the regulatory and statutory framework in terms of the Electricity Act, electricity rules and the Central Electricity Authority Regulations have been framed and now even the National Building Code has devoted a portion on electrical safety of buildings, but there is felt a need to understand the concept of electrical risk management as most of the electrical accidents, which incidentally have a 40 per cent fatality rate and loss to exchequer which runs into billions of rupees, arise due to lack of awareness or knowledge. Thus, through this conclave, the experts from the industry focused on integrated solutions for fire protection and security."

Sunil Misra, Director General, IEEMA opined, "During the last one decade there was a vibrant growth in the constructions activities in India, especially in high-rise buildings. Thousands of high-rise buildings have already constructed in metros and major cities in India, and thousands are under construction. Because of its peculiar nature, fire in residential buildings in particular, high rise buildings become more complex and the salvaging operations become more difficult and sometimes even resulting in many deaths and huge property losses. Considering increasing number of incidents IEEMA came up with the idea of this conclave and in near future more conclaves are being lined up in rest of the part of country."

The conclave was organised in collaboration with Ministry of Home Affairs, Govt. of India (MHA), Bureau of Indian Standards (BIS), Central Electricity authority (CEA), National Association of Fire Officers (NAFO), and Fire and Security Association of India (FSAI).

Forthcoming Events At A Glance

National

AUTOMATION EXPO 2018

Venue: BEC - Bombay Exhibition Centre, Mumbai
Date: 29 August - 01 September 2018
Website: www.automationindiaexpo.com

Renewable Energy India 2018

Venue: India Expo Mart, Noida
Date: 20-22 September 2018
Website: www.renewableenergyindiaexpo.com

CWST-Expo 2018

Venue: BEC - Bombay Exhibition Centre, Mumbai
Date: 21-23 November 2018
Website: www.cwstexpo.com

Intersolar India 2018

Venue: BIEC, Bangalore
Date: 11-13 December 2018
Website: www.intersolar.in

International

Intersolar North America

Venue: San Francisco, USA
Date: 10-12 July 2018
Website: www.intersolar.us

East Africa Electricity

Venue: Kenyatta International Conference Centre
Date: 9-11 August 2018
Website: www.tofairs.com

Global Power & Energy Exhibition (GPEX)

Venue: Barcelona, Spain
Date: 17-20 September 2018
Website: www.gpexevent.com

Power Gen International

Venue: Orange County Convention Center, Orlando, USA
Date: 4-6 December 2018
Website: www.power-gen.com

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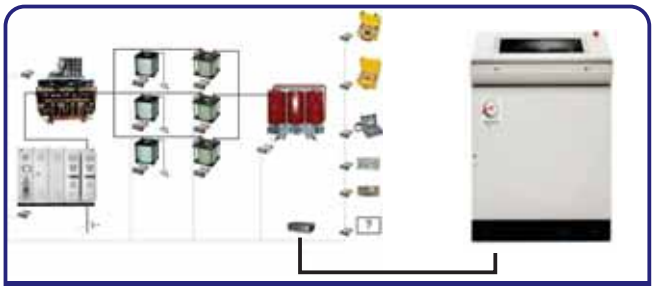
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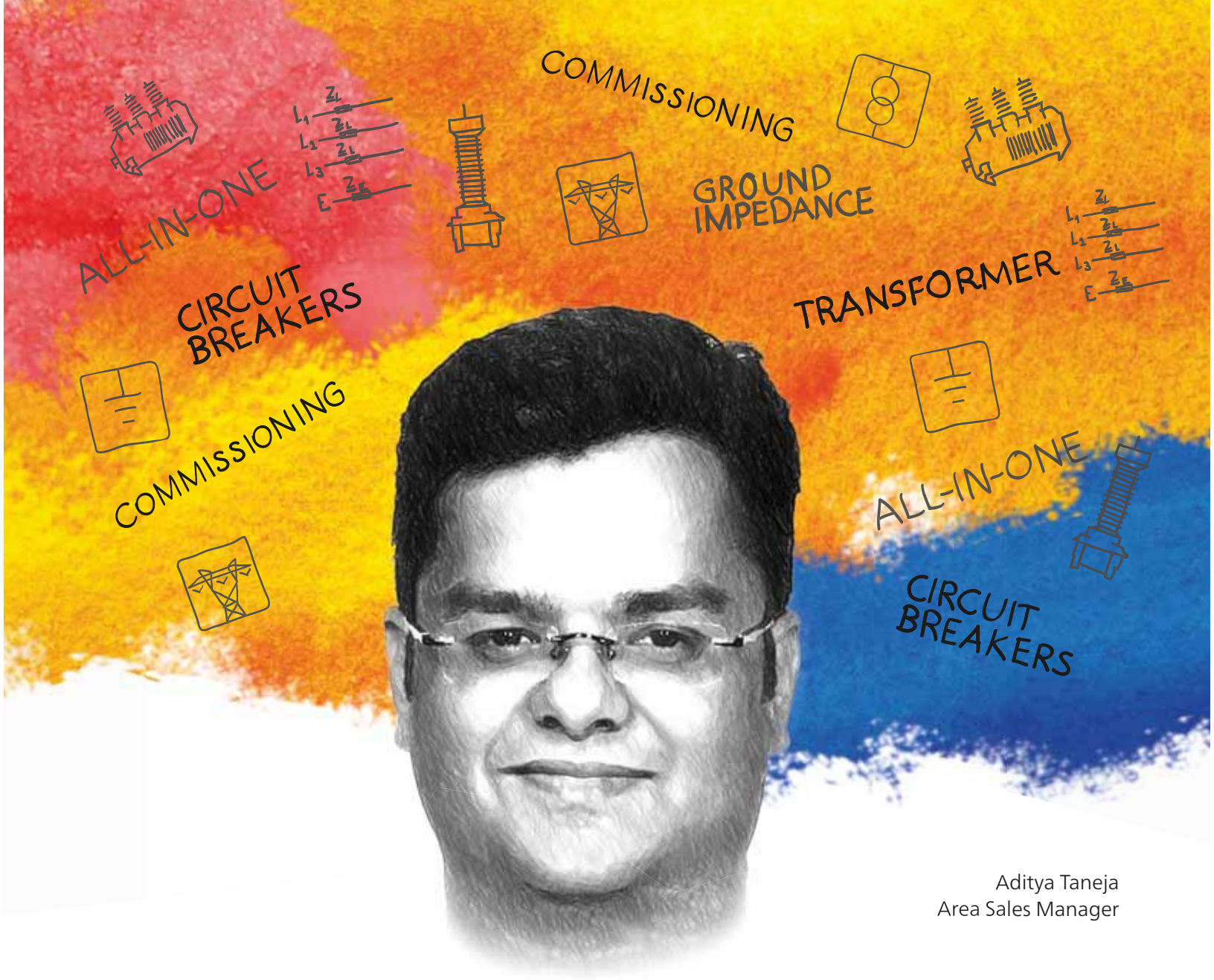

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