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Publisher's letter

In the recent past, India has made great strides in expanding access to electricity. Now, according to the government estimate, with around 3,64,960 MW of installed generation capacity the country is adequately equipped to meet its electricity demand. This brings loads of opportunities for the electrical equipment industry. On this note, this time we talk about the product/ technology innovations and market developments across power generation, transformers, switchgears, T&M equipment, power cables segments etc.

Further, it gives me immense pleasure to let you know that ELECTRICAL INDIA is all set to enter into its glorious 60th year of publication. To mark this occasion, in January 2020, we are coming up with an exclusive issue that will feature some of India's most reputed electrical and power companies. Based on the theme '60 POWER PLAYERS', the January 2020 issue of ELECTRICAL INDIA will feature 60 electrical and power companies who have made remarkable, impactful contribution in their respective fields of business over the years. We invite all relevant key and emerging players to be a part of the coveted '60 POWER PLAYERS' list and narrate their success stories to the world.

The year 2020 will mark the completion of 30 years of ELECRAMA. ELECTRICAL INDIA January 2020 issue will also give you an exclusive sneak peek into everything you can look forward to at this year's event.

We are sure that participation in this issue will pave the way for you to be a part of the global electrical and power industry ecosystem in a grand way. For more details on this, please write to me at miyer@charypublications.in.

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BEYOND 100 GW

In 2015, India had set the target of having 175 GW of installed clean energy capacity by March 2022 of which 100 GW was to be in solar energy, 60 GW in wind projects and the rest in small hydel and biomass plants. Since then, the country has made significant progress in this direction especially in the solar power sector.

According to the government estimate, as on 31st October, a total grid connected solar power generation capacity of 31,696 MW has been set up in the country. Further, projects of 17,998 MW capacity are at various stages of installations and tenders for 36,278 MW capacity projects have been issued. "With new tenders of around 15,000 MW planned in the remaining period of 2019-20 and 2020-21, we are on course for achieving the target," informed New & Renewable Energy Minister R.K. Singh.

Of late, there is a looming uncertainty among the industry leaders over the target of achieving 100 GW solar by 2022. A recent report by the rating agency CRISIL observed that India can only have 59 GW of solar plants by 2022 primarily due to 'unstable policy environment'. "Despite the increase in tendering volume, not only has allocation of projects slowed down, but both under-subscriptions and cancellations of awarded tenders have also increased," the CRISIL report said.

However, on 24th September, while speaking at the United Nations Climate Action Summit in New York, Prime Minister Narendra Modi expressed his government's commitment to set up 450 GW of non-fossil fuel energy by 2022. He said, "We are going to increase our renewable energy capacity to 175 GW by 2022, and are committed to further increasing it to 450 GW."

Thus, despite numerous breakdowns, the government is not only quite optimistic about achieving the target, but also confident of exceeding it. It is believed that if the government is able to address the issues related to tariff caps, land acquisition and liquidity crunch, the dream of achieving solar power target will not be 'unrealistic'. ■

Subhajit Roy
Group Editor

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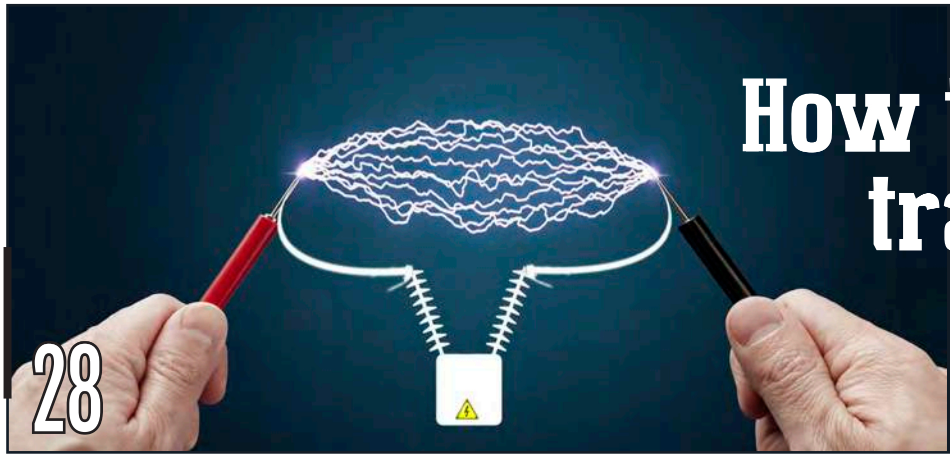

U GRO Capital, Sunvest Capital launch rooftop solar co-lending programme

U GRO Capital, a BSE listed, technology enabled small business lending platform has entered into a co-lending programme with Sunvest Capital, India's first dedicated rooftop solar financing NBFC, which will catalyse rooftop solar ecosystem and accelerate the efforts towards achieving the ambitious clean energy targets by the government.

Leveraging the expertise and market intelligence of Sunvest and the tech-driven knowledge of U GRO in SME lending, the co-lending programme with a corpus of Rs 20 crore will power the clean energy initiatives with an aim to help the MSMEs save the electricity cost hugely by offering them solar panel finance. The collaboration assumes significance as the government has set a renewable energy target of 175 GW by 2022 and solar rooftop energy is expected to contribute 40 GW to the overall target. "The co-lending programme will combine our knowledge-driven approach (sectoral focus) backed by technology with in-depth solar panel market insights of Sunvest Capital. We look forward to a long-term mutually beneficial relationship with Sunvest Capital to fill this market gap and join the nation-building through carbon mitigation and clean energy promotion," said Shachindra Nath, Executive Chairman, U GRO Capital. EI

Experts call for building energy efficient ecosystem at INSPIRE 2019

The International Symposium to promote innovation & research in energy efficiency (INSPIRE 2019) concluded in Mumbai and featured some of the most prominent leaders and experts discussing ways to harness technology to make the next generation of urban and rural spaces resilient, inclusive, and energy efficient. The symposium was organised by Energy Efficiency Services Limited (EESL) in association with The World Bank (WB), Asian Development Bank (ADB), United States Agency for International Development (USAID) and World Resources Institute, India (WRI India), the edition of INSPIRE witnessed participation from over 350 experts and delegates from India, US, UK, Israel, Maldives, Thailand and Saudi Arabia.

INSPIRE 2019 honoured five path breaking innovations in clean energy and energy efficiency as part of the second edition of InnovateToINSPIRE challenge, a first-of-its-kind energy innovation challenge. The five winners were felicitated by Sanjiv Nandan Sahai, Secretary, Ministry of Power, Government of India. Winners were awarded a cheque of Rs 5 lakh, each and mentorship to bring their solutions to market. The winners were DARWYN (E-mobility), Reckongreen (Energy Efficient Technology), Sunvest (Financial Instruments), REConnect Energy (Grid Management) and Vyoda Pvt Ltd (Clean Energy).

At INSPIRE 2019, EESL entered into an agreement with Axis Bank under the Building Energy Efficiency Programme (BEEP) and will implement Energy Efficiency Measures in around 1300 branches across the country initially, on deemed energy savings based ESCO model with 100 per cent financing by EESL and then scale it up further. EI

BHEL commissions 14 pumping units of Kaleshwaram Lift Irrigation Scheme

Bharat Heavy Electricals Limited (BHEL) has commissioned two more pumping units each at Package-6 (7x116 MW) and Package-8 (7x139 MW) of Kaleshwaram Lift Irrigation Scheme (LIS). BHEL has commissioned all 14 pumping units of these packages within a record period of six months and well within the scheduled time. These are very large size pump sets with each pump designed to lift 89 cumecs of water against a head of 100 to 125 metres.

Kaleshwaram is a greenfield irrigation project and is being developed by the Irrigation & CAD (I&CAD) department of Telangana. While, Package 6 is located in Peddapalli district, Package 8 is located in Karimnagar district of Telangana. In LIS Package 6, water shall be lifted from Sripada Yellampalli reservoir to Medaram reservoir and in Package 8, water shall be lifted from discharge of Package 7 to Mid Manair reservoir. BHEL's scope comprises Electrical & Mechanical works, including design, manufacture, supply and supervision of erection and commissioning of these Vertical Pump Motor. EI

DISCOVER THE SECRET BEHIND THE ELECTRICAL SYSTEM OF SOME OF THE LARGEST FACTORIES
The Economic Times
Bb
BEST BRANDS 2019
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Blue Star has offered MEP solutions for over a decade, with expert electrical solutions provided across a wide range of projects. The TCS office in Hyderabad, Tata Power grid in Delhi, Apollo Hospitals in major cities across India and Dr Oetker in Rajasthan are just a few of the 250 projects we have executed in India. So whether it's electrical or the complete range of MEP solutions, talk to us and get superior project delivery every single time.
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India increases its green energy share in total power generation

The Ministry of Power has clarified reports which has recently appeared in a section of media alleging that there has been fall in demand for power in the country. Following is the detailed clarification issued by the Ministry in this regard which brings out that the reports are factually inaccurate and have drawn wrong conclusions:

The monthly growth in electrical energy availability in the country has been in the range of 6.5 per cent to 8.5 per cent from April, 2019 to July, 2019. The growth during the 1st quarter of the current year was around 7.5 per cent, and in July it was 6.7 per cent. Only in the month of October, there was a decline because the rainfall was 35 per cent above normal in October, 2019 resulting in reduction in demand in agriculture sector and the reduction in cooling requirement in the domestic and commercial sectors. Indian was blessed with the prolonged rainy season and good rainfall the current year 2019-20 (up to October 2019). Due to this there has been 16 per cent growth in generation from hydro. There has been 27 per cent growth in generation from nuclear power plants and 24 per cent growth in generation from solar. Thus, the share of green power i.e. generation from non-fossil fuel has been around 27.3 per cent a substantial increase wrt 19.6 per cent during the 2015-16.

NTPC second quarter profit after tax up by 16.97%

India's largest power generator NTPC with a group installed capacity of 57106 MW, declared the financial results for the second quarter and half-year ended 30 September 2019. For H1 FY20, NTPC generated 130.14 billion units with its coal stations achieving a plant load factor of 69.04 per cent as against national average of 57.87 per cent.

For H1 FY20, the total income was Rs 48,177.04 crore as against Rs 45,325.94 crore in H1 FY19, registering an increase of 6.29 per cent. For Q2 FY20, total income was Rs 23,658.23 crore as against Rs 22,485.96 crore in Q2 FY19, registering an increase of 5.21 per cent.

Profit before tax was Rs 6,660.11 crore in H1 FY20 as against Rs 5,645.81 crore in H1 FY19 registering an increase of 17.97 per cent. For Q2 FY20, PBT was Rs 3,497.72 crore as against Rs 2,634.68 crore in the corresponding quarter of previous year, registering an increase of 32.76 per cent.

Profit after tax was Rs 5,865.23 crore in H1 FY20 as against Rs 5,014.16 crore in H1 FY19, registering an increase of 16.97 per cent. For Q2 FY20, PAT was Rs 3,262.44 crore, as against Rs 2,426.02 crore in the corresponding quarter of previous year, registering an increase of 34.48 per cent.

EESL signs MoU with BSNL to install 100 public charging stations in Punjab

Energy Efficiency Services Limited (EESL) has signed a Memorandum of Understanding (MoU) with BSNL (Punjab Telecom Circle) to install 100 public charging stations to boost e-mobility in Punjab. Both EESL and BSNL have entered this 10-year MoU with the objective of building electric vehicle infrastructure in BSNL, Punjab Telecom Circle area and explore synergy for further promoting EVs.

Under the MoU, EESL will make the entire upfront investment on services pertaining to the MoU, along with the operation and maintenance of the public charging infrastructure by using qualified personnel. BSNL would be responsible for providing the requisite space and power connections for installing the charging infrastructure.

Venkatesh Dwivedi, Director (Projects), EESL stated, "Developing a strong supporting EV infrastructure is the key to cultivating consumer confidence in electric vehicles and would significantly enhance consumer convenience as well. EESL is leading initiatives to promote EV adoption in India under its national e-mobility program."

Several states in India have released policies for promoting local adoption of EVs. Installation of public charging stations would help in gaining considerable strides towards creating a sustainable EV ecosystem in the states. With installation of public charging stations, the range anxiety among residents will reduce considerably, which would spur the proliferation of e-mobility. This would help meet the state level targets of increasing EV adoption as well and will help bring down emission levels.


ELECRAMA

Fuji Electric announces India 2.0 plan

Fuji Electric, a 915 billion Yen, energy and power electronics global major headquartered in Tokyo, Japan; announced its India 2.0 plan to expand its business operations in India. The FE India 2.0 plan envisages the revenues from the Indian market to reach Rs 1,500 crore by 2023 supporting the global objective of Fuji Electric's Reiwa Prosperity 2023 plan to grow global revenues to 1 trillion Yen when FE celebrates its Centennial Anniversary.

Fuji Electric is globally developing its core business of power electronics systems and India has been identified as one of the key markets as part of FE's global growth plan. FE will expand its power electronics systems business in India, targeting mainly the manufacturing industries, core heavy industries, buildings, infrastructure and data centre market. With the recent acquisition of Consul Neowatt Power Solutions, Fuji Electric has a strong presence across India with almost 1,000 employees, four manufacturing plants and a pan-India sales network operating out of 25 offices with ability to provide support services in over 80 locations through 400 factory trained service engineers.

Kenzo Sugai, Executive Vice President and Elected Corporate Director, Fuji Electric, said, "The FE India 2.0 Plan involves integration of the FE business in India including Consul Neowatt, Fuji Electric India and Fuji Gemco to ensure all Fuji Electric customers in India have the same and consistent pre-sales and post sales experience." EI

Tata Power to develop 50 MW at Dholera Solar Park in Gujarat

Tata Power announced that Tata Power Renewable Energy Limited (TPREL), has received a Letter of Award from Gujarat Urja Vikas Nigam Limited (GUVNL) on 7th November to develop a 50 MW solar project in Dholera Solar Park in Gujarat. This LOA is in addition to the 250MW Solar Project being set up by the company at Dholera Solar Park.

The energy will be supplied to GUVNL under a Power Purchase Agreements (PPA), valid for a period of 25 years from scheduled commercial operation date. The company has won this capacity in a bid announced by GUVNL in June 2019. The project has to be commissioned within 15 months from the date of execution of the PPA.

Praveer Sinha, CEO & MD, Tata Power, said, "With this award the cumulative capacity under development in Gujarat would be 400 MW. We are delighted to contribute towards the realisation of our country's commitment towards clean and green energy through solar power generation."

Ashish Khanna, President-Renewables, Tata Power said, "This is an important milestone in our endeavour to generate 35-40 per cent of Tata Power's total generation capacity from clean energy sources. We hope to continue to build on our capabilities, deliver over expectations and create high benchmarks all around." EI

KEC International wins new orders of Rs 2,255 crore

KEC International, an RPG Group Company, has secured new orders of Rs 2,255 crore across its various businesses:

Transmission & Distribution: The business has secured orders of Rs 885 crore for T&D projects in India.

- 400 kV transmission line and substation orders from a Power Grid Corporation of India (PGCIL) entity under Tariff Based Competitive Bidding (TBCB) route.
- 765 kV Transmission line project from Tamil Nadu Transmission Corporation Limited (TANTRANSCO).
- 220 kV GIS Substation project along with associated overhead lines and cable works from Karnataka Power Transmission Corporation Limited (KPTCL)

Vimal Kejriwal, MD & CEO, KEC International, commented, "We are delighted with the prestigious order win from DMRC. This order along with the orders announced earlier, widens our presence in the urban transport sector. The order wins from PGCIL and the state power utilities, further strengthens our position in the domestic T&D market." EI

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	> 24mA	- OL -
0-20mA	< 0mA	0000
	0 ~ 24mA	Measured Value
	> 24mA	- OL -
0-10V	< 0V	0000
	0 ~ 12V	Measured Value
	> 12V	- OL -

* Default SLL is 3.9mA (SLL : Set Low Limit)

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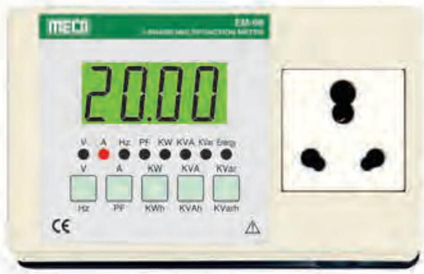

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MG Motor India and Fortum to install first public fast charging station

Underlining its commitment towards catalysing an EV revolution, MG (Morris Garages) Motor India and Fortum Charge & Drive India unveiled the first 50 kW DC charging station at MG's flagship showroom at Gurugram. The charging station has been installed by Finland-based clean energy major Fortum and was operationalised for public use, ahead of the launch of MG Motor's first pure electric car – the MG ZS EV in December 2019. Fortum has installed four public 50 kW fast charging stations in South Delhi, West Delhi, Noida & Gurugram. Besides, six more public 50 KW DC fast chargers have been installed at MG's Dealer locations in Mumbai, Bengaluru, Hyderabad and Ahmedabad. The smart chargers can be accessed by an EV user owning vehicles compatible with CCS/CHAdeMO charging standards and by registering with Fortum Charge and Drive India through its Mobile App.

"Our endeavour is to create a robust ecosystem for EVs, right from charging to end-of-life for electric vehicles in India and the installation of the first public fast charger is the first major step in this direction," said Rajeev Chaba, President & Managing Director, MG Motor India.

Sanjay Aggarwal, Managing Director, Fortum India, said, "We have already witnessed an uptake in adoption of electric vehicles in the last one year through our existing charging network of 15/20 KW DC001 Chargers." EI

Finolex Cables launches electrical accessories range

Finolex Cables, a manufacturer of electrical and communication cables, has introduced a fast-moving range of electrical wire accessories like door bell, extension box, spike guard, angle holders, batten holders, etc to satisfy the growing demand for quality electrical products.

Striving to provide their valued customers nothing but the best and to further expand its offering with contemporary design cues and best-in-class quality, these stylish new products will enhance the aesthetics of today's contemporary homes and offices by blending in beautifully with the decor. The company plans to amplify the scale and the strength of its business to address growing customer aspirations.

Deepak K Chhabria, Executive Chairman, Finolex Cables, said, "The launch is the result of significant investments that we have made in product design after identifying a gap for stylishly designed quality accessories in the market." He further added, "With our product portfolio and its diverse applications, we continue to meet the requirements of a wide range of customers."

Amit Mathur, Senior Vice President, Sales & Marketing, Finolex Cables, said, "We expect to increase our reach in the retail segment, as they are expected to receive good demand from end-users. We have already appointed more than 200 distributors all over India." EI

Magenta join hands with Lodha Group on zero emission mission

Magenta Power, a company in establishing the EV Ecosystem in India ties up with Lodha Group, listed amongst the coveted real estate developer, encouraging green building solutions, with complete end to end electric mobility charging solutions in their upcoming projects in Mumbai.

Under the partnership, ChargeGrid will install its Electric Vehicle Charging Solution - ChargeGrid Pro Chargers delivering installation to charging support, round the clock service, maintenance support and remote vehicle charging monitoring and e-payments through the ChargeGrid Mobile application based on iOS & Android platforms. The chargers shall be designed and installed for all kinds of two-wheelers and three-wheeler that comply with the global charging standard.

"We are pleased to join hands with Lodha Group, on our Zero Emission Mission. This is in line with our goal to provide accessible EV solutions to Indian customers and create a complete EV ecosystem, that further bolsters the EV adoption. With this step, address the major roadblock to EV update in India," said Maxson Lewis, Managing Director, Magenta – ChargeGrid. EI

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Siemens Gamesa dictates wind flow at offshore wind locations

Siemens Gamesa Renewable Energy (SGRE) announced the launch of Wake Adapt feature at the the WindEurope Offshore 2019 Conference & Exhibition in Copenhagen. It allows SGRE to actively adjust the heading of individual offshore wind turbines, directing the wind which flows off the individual machine in a different direction than what normally occurs. This resulting shift in direction of the wind turbine wake away from downstream wind turbines allows an increase in overall wind park performance of upto 1 per cent in annual energy production.

"The Wake Adapt feature is about proactive problem-solving. Instead of letting the wind and wake fully dictate how much energy we can capture, we safely direct the wake - and its unfavourable effects - away from our machines across the entire power plant. Through digitalisation, we can produce more energy from the same turbines, benefitting our customers, ratepayers, and society overall," said Morten Pilgaard Rasmussen, Head of Offshore Technology at Siemens Gamesa.

On a technical level, SGRE's Wake Adapt applies wake steering techniques to reduce wake-induced production losses on offshore wind power plants by up to 10 per cent.

ABB uses AI to revolutionise energy management

ABB is deploying Artificial Intelligence (AI) to help commercial and industrial buildings revolutionise their energy management and tackle rising electricity peak tariffs. The company has added two new AI-powered applications to the ABB Ability Electrical Distribution Control System (EDCS): Energy Forecasting and Intelligent Alerts.

ABB has developed the AI functions in partnership with Silicon Valley AI specialist Verdigris Technologies as part of the company's Open Innovation program. The Energy Forecasting app will enable users to reduce their electricity bills by reducing peak demand charges. The Intelligent Alerts app uses machine learning algorithms to help customers better manage their assets, identifying underlying issues before they become problems.

Andrea Temporiti, Digital Leader for ABB's Electrification business, said, "Our use of AI to help customers make better energy management decisions demonstrates ABB's commitment to innovation in our products and quality in our services. With the new Energy Forecasting and Smart Alerts apps, AI drills down into the facility's power data to pinpoint actionable opportunities for productivity improvements and energy cost savings."

ABB Ability Energy Forecasting uses AI to give facility managers accurate power consumption predictions.

Best Power Equipment expands to Philippines

Best Power Equipment (India) Private Limited (BPE), an end-to-end strategic power solutions company has entered the Philippines market and launched its range of UPS. The range of UPS includes LI series BPI Series 650VA-2200VA, Online UPS 1 Ph Output, MSI Series 1-10KVA, Online UPS 3 Ph Output & GTMI Series 60-120KVA, and entire Modular range 6K to 1000KVA, and smart rack, modularised data centres.

In the Philippines market, BPE has tied up with Machine Mart, a young technology distributor company handling the distribution of UPS in the market. Using cutting edge technology, the UPS product range launched in the Philippines is targeted at SOHO as well as industries such as pharmaceuticals, manufacturing, banking and others data centres. Philippines has lot of call centres, and BPE Indian approval e.g., TCS, McDonalds, KFC, Dominos will help Machine Mart, to expand local business.

Amitansu Satpathy, MD, BPE, said, "The Philippines has great potential due to the technological development of the country. We have constantly directed our efforts towards providing technologically superior international quality products for our consumers." He added, "We would like to invite partners, retailers to work and grow together with BPE thus, making each of our association profitable."

IRENA urges leaders to build climate response around renewables

Public and private sector leaders are being urged to double annual investments in renewable energy to keep the world well below 2C of warming, says a new report by the International Renewable Energy Agency (IRENA). With just 11 years left for action to limit the effects of climate change, annual investments of USD 4.3 trillion in the energy sector until 2030 is the world's most practical and readily available climate solution.

Annual renewable energy investments for the next decade need to double from around USD 330 billion to nearly USD 750 billion per year until 2030. The findings form part of a new climate investment report by IRENA that highlights how cumulative global energy investments must pivot overwhelmingly towards low-carbon technologies. More than USD 18.6 trillion of planned fossil-fuel investments by 2050 need to be redirected to hold the line called for by the Paris Agreement and reaffirmed by the recent special report of the Intergovernmental Panel on Climate Change (IPCC).

According to the report, together, renewable energy and energy efficiency, along with deeper electrification, can deliver 90 per cent of the energy-related emission cuts needed under the Paris Agreement. EI

GE Renewable Energy announces 350 MW order for Foard City Wind Project in Texas

GE Renewable Energy announced that it was selected by Innergex Renewable Energy to supply 139 2.X-127 onshore wind turbines on 89-meter towers for Innergex's approximately 350 MW Foard City Wind project located in Foard County, Texas. The order also includes a 20-year full-service agreement. The Foard City wind farm reached commercial operation on September 27. The deal is another sign of the success of GE Renewable Energy's best-selling 2 MW product platform, which will have a total installed capacity of more than 15 GW by the end of 2019. GE's 2 MW fleet operates at an industry-leading average of more than 98 per cent availability.

Vikas Anand, GE Renewable Energy's CEO for Onshore Wind, Americas, said, "We appreciate the opportunity to work with Innergex on this project. GE is focused on delivering technology and long-term services that enable customers like Innergex to succeed in bringing clean, affordable renewable energy to the grid, both now and well into the future."

The US wind market remains strong. According to the American Wind Energy Association, the second quarter of 2019 saw a record wind capacity of nearly 42 GW under construction or in advanced development, a 10 per cent increase over the level of activity this time last year. GE Renewable Energy was recognised by AWEA as the top manufacturer of wind turbines in the US in 2018, supplying over 3 GW of capacity, 40 percent of the total onshore wind installed nationwide. EI

Clean energy investment in developing nations slumps

New investments in wind, solar, and other clean energy projects in developing nations dropped sharply in 2018, largely due to a slowdown in China. While the number of new clean power-generating plants completed stayed flat year-to-year, the volume of power derived from coal surged to a new high, according to Climatescope, an annual survey of 104 emerging markets conducted by research firm BloombergNEF (BNEF).

The findings suggest that developing nations are moving toward cleaner power but not nearly fast enough to limit global CO_2 emissions or the consequences of climate change. The majority of new power-generating capacity added in developing nations in 2018 came from wind and solar, for instance. But the majority of power to be produced from the overall fleet of power plants added in 2018 will come from fossil sources and emit CO_2. This is due to wind and solar projects generating only when natural resources are available while oil, coal, and gas plants can potentially produce around the clock.Across the 104 emerging markets surveyed in Climatescope, coal accounted for 47 per cent of all generation. EI


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Perkins Engines Company announces leadership changes

Perkins Engines Company Limited, a subsidiary of Caterpillar Inc, is pleased to announce David Nicoll has joined the Industrial Large Engine department as product manager. Beginning November 1, 2019, he will lead global strategy, product introductions, and lifecycle management for Industrial 9.3 to 18 litre engines at the Mossville facility in Illinois, US.

In David's decades-long tenure at Caterpillar, which acquired Perkins in 1998, he has gained experience across a wide variety of roles in distribution, machine and engine businesses.

"It's clear David's passion lies in seeing our customers thrive," said Perkins Vice President of global sales, marketing, service and parts Jaz Gill. "His customer-focused approach is key to his—and our company's—success. I'm looking forward to seeing the impact that his distinctive outlook will bring to the large engine division and Perkins as a whole."

Before beginning his career at Caterpillar, David earned his bachelor's degree in business from Bradley University, and went on to earn his MBA from the University of Cambridge Judge Business school. He also serves as a leader with several professional organisations such as the Association of Equipment Manufacturers Components Committee. Succeeding David will be Jason Kern, fulfilling the role of marketing and channel development director, also effective November 1, 2019. In this role, Jason will be responsible for execution of global marketing and rental strategies and leading the Perkins Distributor Excellence programme.

Tony Berland takes reins at Legrand India with Global experience of over 20 countries


Tony Berland

Legrand announced the appointment of Tony Berland as the CEO and Managing Director for Legrand Group in India. Berland takes over reins from Thuard, will be responsible for strengthening India as a strong base for business operations making Legrand the industry leader in the domain of electrical and digital infrastructure.

Berland has thirty years of experience working in the international electrical industry. He is associated with Legrand Group for over a period of 28 years. He was responsible for leading Legrand operations across markets like Europe, South East Asia, New Zealand and Australia. Tony has driven strategy-oriented growth across different geographies.

Jean-Luc Cartet, Executive VP Asia-Pacific Middle East Africa South America, said, "Tony is a strong, strategic and dynamic leader, given his strong command of our business and proven ability to drive results in international markets. With his breadth of experience across diverse business verticals, we are confident that he will drive Legrand India into the next phase of growth."

Tony Berland said, "India is important market for Legrand as it presents tremendous growth potential and development. From last few years, we have grown from strength to strength and have introduced new products in the market. Our focus will continue to remain on keeping the momentum alive."

Atlas Copco India appoints Tony Van Herbruggen as General Manager of Power Technique


Tony Van Herbruggen

Atlas Copco India has appointed Tony Van Herbruggen as the General Manager of its Power Technique Customer Center, effective July 2019. He is now leading the core areas of the business - portable air, power and flow divisions in India.

Giovanni Valent, Managing Director, Atlas Copco India, said, "The collective knowledge, analytical input and expertise that Tony brings to the team will push the brand further as the front runner. His years of experience with the brand brings a natural edge to power technique, making him an excellent choice for the role." Tony has been associated with Atlas Copco since 1981. Starting out in a technical role, he rose through the ranks in marketing and sales to take on senior leadership global positions. Tony has a rich experience as Country Manager in Oman and Regional General Manager in Algeria before taking on the role as General Manager of the Power Technique Customer Centre in India.

Tony said "I look forward to this new role with Atlas Copco India and I am excited to work with the new team with a new strategic approach. The aim is to keep striving towards our vision of being the industry innovators, and the best solution providers for sustainable productivity in the market."

NTPC wins 'Golden Peacock Award for Sustainability' 2019

National Thermal Power Corporation (NTPC) has been bestowed with the 'Golden Peacock Award for Sustainability' 2019, during the 19th International Conference on Corporate Governance & Sustainability held in London (UK).

The award was conferred by the Institute of Directors (IOD), India. Justice (Dr) Arijit Pasayat, former judge, Supreme Court was the Chairman of the Jury for the awards. The award was received by Biswarup Basu, CGM (SSEA) and Vikash Kumar, DM (SD) on behalf of NTPC.

Sustainability Award has been given to NTPC for its efforts to provide cleaner and green energy, to minimise environmental impact. NTPC Ltd has adopted high efficient sustainable technologies such as FGD for SOx emission control and de-nitrogen oxide (NOx) systems at all its power stations.

NTPC is steadily increasing its renewable energy portfolio by power generation from solar, hydro, wind. NTPC has showed its commitment by adopting proactive approach in making Zero liquid discharge (ZLD) and taking Water Conservation measures (Reduce, Recycle & Reuse) during its power generation. EI

L&T CEO & MD S N Subrahmanyan gets prestigious IIM-JRD Tata Award

S N Subrahmanyan, CEO and MD of Larsen & Toubro, has been conferred with the prestigious IIM-JRD Tata Award for Excellence in Corporate Leadership in metallurgical industries.

With this, Subrahmanyan joins the league of eminent awardees like Ratan Tata, E Sreedharan, Sajjan Jindal, who have received the coveted IIM-JRD Tata Award in the past.

Union Minister of Steel (MoS), Dharmendra Pradhan, handed over the award to the L&T CEO and MD at the 57th National Metallurgists' Day held at Kovalam in Kerala recently.

Thanking the award committee, the L&T CEO and MD said, "I am honoured to have received this prestigious award, which also comes as a recognition of L&T's contributions to the Indian industry. We will continue in our endeavours to excel and set new benchmarks."

Subrahmanyan was selected in recognition of his outstanding contributions to the metallurgical industry in the sphere of leadership and development that have had an impact on both the national and international landscape.

The IIM-JRD Tata Award is instituted by the Indian Institute of Metals (IIM) in 2007. The award is conferred annually at the National Metallurgists Day instituted by the Ministry of Steel & Mines.

Binoy Kumar, Secretary, and Ruchika Chaudhry Govil, Joint Secretary in MoS, IIM President Dr U Kamachi Mudali and Secretary-General Kushal Saha were among the dignitaries present. EI

EV component market to generate revenue worth USD 157.4 bn by 2025

The growing adoption of electric vehicles across the world is contributing in the growth of the electric vehicle component market.

The global electric vehicle component market generated revenue of USD 22.2 billion in 2018, and it is expected be valued at USD 157.4 billion by 2025, exhibiting a CAGR of 29.4 per cent between 2019 and 2025. Based on component, the battery pack contributed the highest revenue in 2018.

The battery pack is the most important component in an electric vehicle and is responsible for the largest contribution among all the components to the vehicle cost. As a result of this, battery packs are responsible for generating the highest revenue in the electric vehicle component market.

Shift toward lithium–nickel–manganese–cobalt (NMC) oxide batteries from lithium–iron phosphate (LFP) batteries is a major trend in the market. A major trend being witnessed in the electric vehicle component market is the shift of electric vehicle manufacturers from lithium–iron phosphate (LFP) batteries toward lithium–nickel–manganese–cobalt (NMC) oxide batteries. In the past, most of the manufacturers, especially, the Chinese players, used LFP batteries in their electric vehicles. For instance, BYD Co. Ltd., a major electric vehicle manufacturer, still uses LFP batteries in its vehicles. LFP batteries come with higher safety features and a longer life cycle, which made them a favourable option. However, in the recent years, the usage of NMC batteries in electric vehicles has witnessed a drastic climb. The shift toward NMC batteries from LFP batteries is mostly because the former batteries offer a greater energy density, which enables a longer vehicle range. Moreover, these batteries are much lighter than LFP batteries as well as consume lesser space in the vehicle. Thus, with the growing demand for longer-range and lighter electric vehicles, manufacturers are shifting from LFP batteries to NMC batteries.

The growing adoption of electric vehicles across the world is contributing in the growth of the electric vehicle component market. In 2018, the total electric car fleet across the world surpassed 5.1 million, increasing by over 2 million from the previous year, and it is expected that by 2030, the total fleet size will exceed 130 million. Thus, with such massive growth expected for electric vehicle production and sales, the demand for their components is also forecast to increase. The battery pack generated the highest revenue in the electric vehicle component market in 2018 among all components. The battery pack is further comprised of a battery cell, battery management system (BMS), battery thermal management system, and other components, out of which the battery cell alone is responsible for generating around 70 per cent of the revenue for the battery pack.

OEMs were the highest revenue generator in 2018 in the electric vehicle component market. In the forecast period, the demand for components is expected to witness faster growth in the aftermarket, due to the increasing requirement for replacement. APAC is the largest electric vehicle component market. The government of different countries in the region are actively taking initiatives to propel the adoption of electric vehicles, which is further contributing to the growth of the components' market. Also, in 2017, Government of India outlined a vision that aims to have an electric vehicle fleet by 2030. Further, the National Electric Mobility Mission Plan 2020 was launched in 2013 to promote electric and hybrid vehicles in India.

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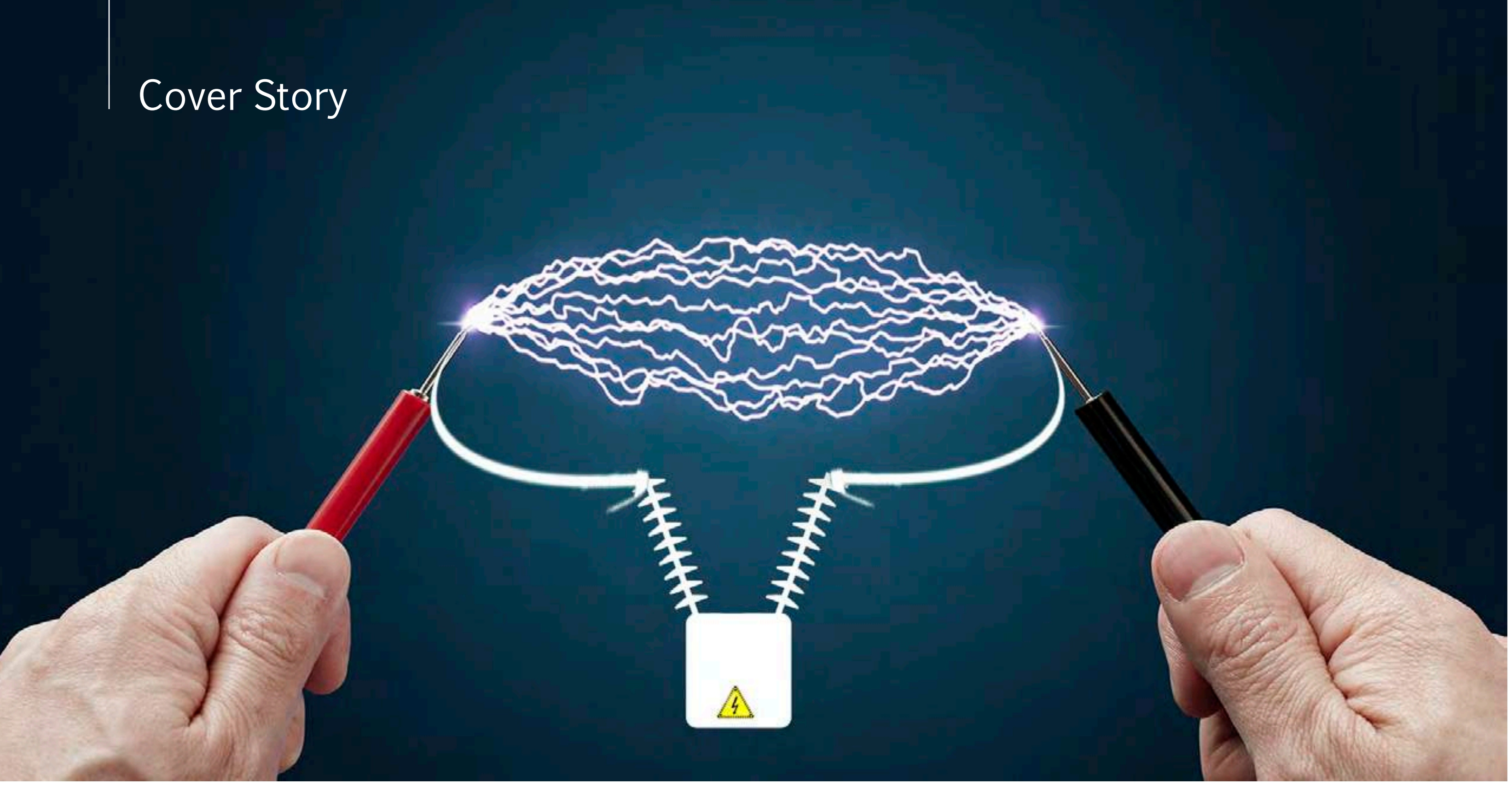


How to enhance transformer efficiency

As the transformer acts as a mediator for the smooth passage of electricity, a small efficiency improvement in the transformer results in significant electricity savings.

- Supriya A Oundhakar, Associate Editor

The power and distribution transformer sector has been witnessing an upstick due to renewed infusion of investments in transmission and distribution (T&D) sector as a positive impact of the government's UDAY scheme for strengthening of T&D infrastructure. International Energy Agency (IEA) report predicts that the power demand in India will triple between 2018 and 2040. Moreover, the government's schemes such as the Deendayal Upadhyay Gram Jyoti Yojana (DDUGJY), the Integrated Power Development Scheme (IPDS) and the recently launched Sahaj Bijli Har Ghar Yojana (Saubhagya) have generated a surge in the demand for transformers.

The Ministry of New and Renewable Energy under Green Energy Corridor (GEC) scheme has planned to invest Rs 430 billion for enhancing transmission network under which projects of about Rs 11,500 crore have been awarded so far both through bidding and regulatory tariff-based route, for the expected commissioning over the next two-year period. This paradigm shift towards alternative energy resources like nuclear and solar energy for power generation is expected to further boost the transformer deployments in the country in near future. Thus, demand for distribution transformers is projected to grow at a CAGR of over 10 per cent till 2020.

Need for efficiency

Transformers are considered as efficient machines that help in maintaining the safety and efficacy of a power system by controlling the rise and fall of voltage levels as and when needed. As the transformer acts as a mediator for the smooth passage of electricity, a small efficiency improvement in the transformer can result in significant electricity savings. With an increase in residential and industrial applications, transformer plays an important role in the distribution and regulation of power across long distances.

Efficiency is a key element in the performance of a transformer. In theory, a transformer is designed never to suffer from load losses. However, in reality, transformers used in real-world applications suffer from load as well as no load losses.

Enhancing efficiency

Transformers have undergone technology transformation from the first transformer built in 1885 based on Faraday's Law of electromagnetic induction. The efficiency of transformer has improved significantly and total mass has reduced considerably. With the growth in demand for electricity, the unit capacity of transformer has increased along with transmission voltage which has now reached 1200 kV.

According to M Vijayakumar, Senior Transformer Expert, Primemeiden, the transformer efficiency is the ratio of output/input. The reduction in output is due to generation losses, which are categorised as no-load loss and load loss.

"The efficiency of a transformer solely depends upon the inherent loss of the transformer. An ideal transformer would have no losses, and would, therefore, be 100 per cent efficient. But in reality, transformer suffers from losses. Losses can be classified into two types firstly load losses and secondly no-load losses. Load losses result from resistance in the copper or aluminium windings while no load losses result from resistance in the transformer's laminated steel core. The relative values of these losses decide the load at which maximum efficiency should occur. However, one cannot do much about changing

The efficiency of a transformer solely depends upon the inherent loss of the transformer. An ideal transformer would have no losses, and would, therefore, be 100 per cent efficient.

ATUL AGRAWAL, MANAGING DIRECTOR, UTTAM (BHARAT) ELECTRICALS PVT LTD.

this ratio since these figures are mostly decided or rather specified by the purchaser of the utility," states Atul Agrawal, Managing Director, Uttam (Bharat) Electricals Pvt Ltd.

He further informs that the magnitude of power loss determines the efficiency of a transformer. Large power transformers attain efficiency as high as 99.75 per cent whereas small transformer's efficiency can be measured around 97.5 per cent. The ideal efficiency limit for an electrical transformer should be anywhere between 98 and 99.5 per cent. With the shift towards environment friendly designs in building, maximising transformer efficiencies is essential as the owners are striving for more high-performance building. Nowadays, consumers are also more concerned about rising electricity bills. So, they look for efficient transformer which can save their power consumption. The more efficient transformers require less cooling, which in turn saves more energy.

According to M Vijayakumaran, no load loss and load loss are analysed separately below. He also suggests solutions to reduce these losses, leading to enhanced efficiency of transformers.

No load loss

No load loss is also known as core loss. Power transformer core is made up of Cold Rolled Grain Oriented (CRGO) steel laminations. CRGO steel is available 0.18 to 0.5 mm thick and 1,000 mm wide. Modern CRGO has a silicon content of about 3 per cent that gives rather a high resistivity.

The main constituent of core loss is hysteresis loss and eddy current loss. Hysteresis loss depends on permeability and eddy current loss inversely depend on thickness. Therefore, to minimise core loss, we use high permeability and thinner CRGO. Specific loss of CRGO varies between 0.65w/kg ~1.5 w/kg. at 1.7 T. Therefore, for minimising core loss, it will be better to use high permeability thin core lamination. High permeability thinner core material will be costlier and availability can be difficult at times.

Building factor

The specific core loss guaranteed by the supplier at operating flux density multiplied by total core weight gives a value which is lower than value that measured in assembled core. This discrepancy is due to the fact that stacked core requires joints which change the induction direction and create a gap between different laminations. There are other factors such as cutting, burrs, type of joints, handling etc. affecting the losses. Building factors are generally in the range of 1.2~1.4 but will depend on

CRGO grade and make, operating flux density, step lap, number of limbs etc.

Interlaminar losses

The core laminations are coated with very thin inorganic coating (few microns) to keep the space factor high. The coating is not a perfect insulator. Thus, Eddy current driven by the bulk flux in the core can flow across the stacked laminations, the coating must be good enough insulator to keep these low.

Load losses

The constituents of load losses are: I^2R loss, stray losses, Eddy current losses in the coil, tie plate losses, tie plate and core loss due to unbalanced cross flux, tank and clamp losses, tank losses due to nearby bus bar, tank losses in bushing turret, and winding losses.

I^2R loss

I2R loss is the major component of load loss. They are normally computed value of resistivity. This value varies depending on current density used. The reference temperature for loss measurement is 75C.

Stray loss

These are losses generated by leakage flux. The stray flux depends on the winding sizes and spacing, the tank size, the clamp position etc. The losses generated by this flux depend on whether shunt or shield is present. Also, the geometric and material parameters can have impact on loss reduction. In addition to the coil flux, there is flux produced by the leads.

Eddy current losses

In order to study the effect of stray fluxes in the coils, the individual strand which could be part of transposed cable, the strand is assumed to have rectangular cross section. The magnetic field of the strand segment will point in a certain direction relative to the strand's orientation. Losses associated with each component of magnetic field are analysed separately and added for the results. It may be noted that continuously transposed cable (CTC which comprises several small strands) is used instead of bigger rectangular conductor to minimise eddy current losses.

Tie plate losses

The tie plate is located just outside the core in the space between the core and innermost coil. It is a structural plate which connect the upper and lower yoke clamps. Tension in the plate provides the clamping force necessary to hold the transformer together should a short circuit occur.

Tank and clamp losses

Tank and clamp losses are very difficult to calculate accurately. Here, we are referring to the tank and clamp losses produced by the leakage flux from the coils. The eddy current losses can be obtained from the finite element calculations. For reducing the losses in tank and clamps, shunts are used.

The transformer efficiency is the ratio of output/input. The reduction in output is due to generation losses, which are mainly no-load loss and load loss.

M.VIJAYAKUMARAN, SENIOR TRANSFORMER EXPERT, PRIMEMEIDEN

Winding losses

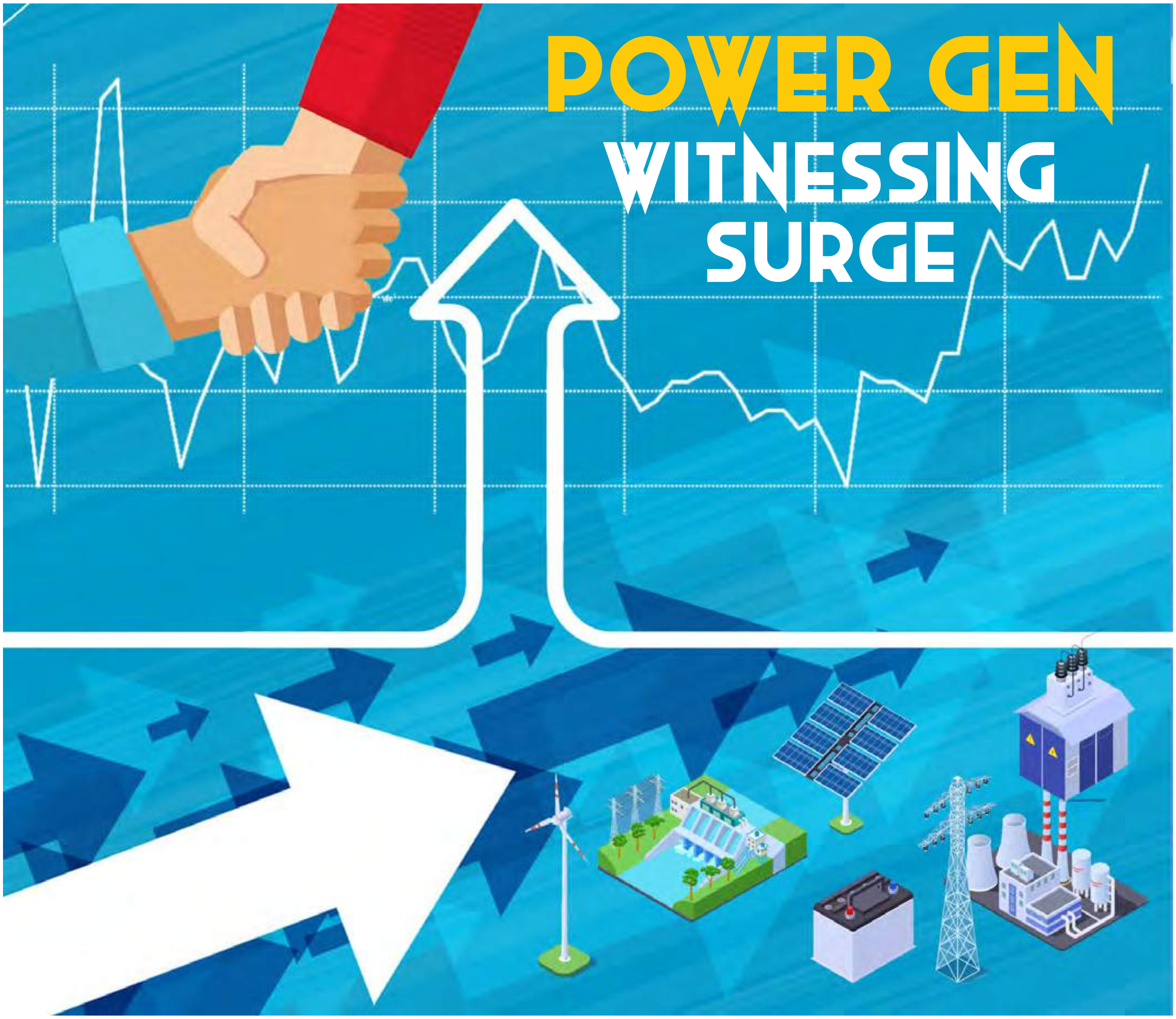
When two or more wires are in parallel and used to make a coil, it is necessary to interchange their positions at suitable points along the winding in order to cancel the induced voltages produced by the stray flux. Otherwise, any net induced voltage can drive currents around the loop established when parallel turns are joined at either end of the winding and these circulating currents can cause extra losses.

IEC/BIS standards

BIS has introduced STAR ratings for distribution transformers up to 2500 kVA, 33kV wherein losses are standardised. IEC has issued standard IEC 60076-20 for transformer energy Efficiency where efficiency is standardised for all ratings of transformers. IS will also adopt IEC in the near future so that the minimum efficiency required for all range of transformers will be standardised. Consequently, losses for all transformers will be standardised.

Conclusion

Indian government is working towards controlling the losses in the transformers. "With the introduction of star ratings by Bureau of Energy Efficiency is one such step towards improving energy efficiency. Due to this, the losses in the transformer have been reduced considerably which were never experienced or achieved in the past. The element of compulsion for the companies, acted a driving force for in the whole process. This has resulted in the increase or enhancement in the efficiency figures of the transformer," informs Agrawal, from Uttam (Bharat) Electricals.

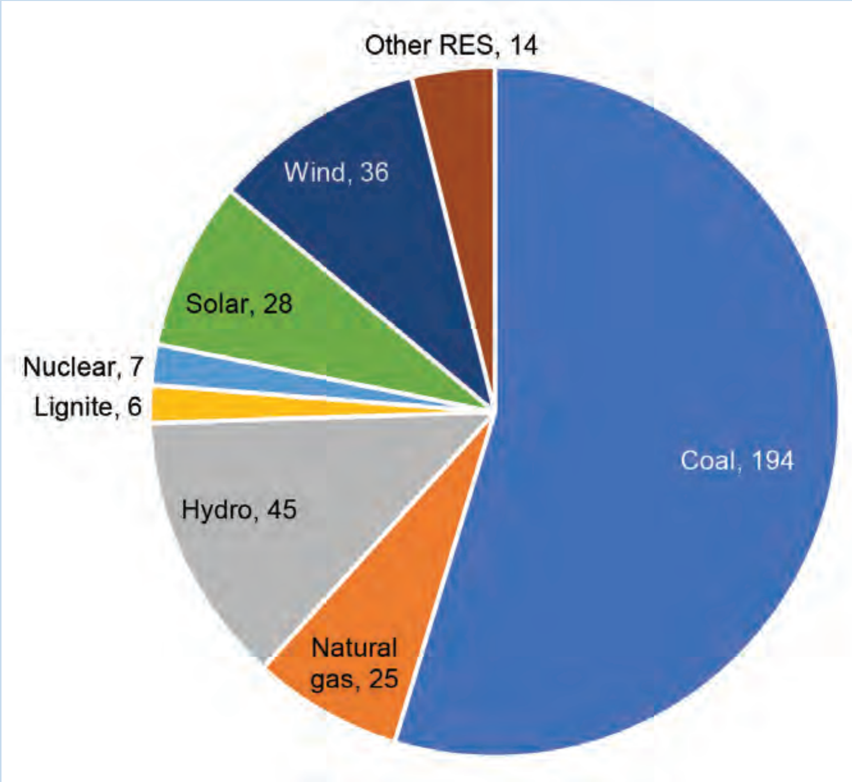


Generation segment witnessed robust growth led by rising private sector participation.

The total installed power generation capacity in the country as on March 2019 was 356 GW, of which approximately 111 GW of capacity was added over fiscals 2014-2019 on the back of demand growth of 5 per cent over the last five years.

Coal-based installed power generation capacity has maintained its dominant position over the years and accounts for 56 per cent as on March 2019. On the other hand, gas-based power generation has remained low over the years due to lack of domestic gas leading large gas-based capacity being stranded. Hydro and nuclear power generation accounted for ~11 per cent and 3 per cent respectively in fiscal 2019. However, renewable energy installations have more than doubled to ~78 GW capacity, compared to 32 GW as on fiscal 2014, constituting ~22 per cent of total installed generation capacity as of date. In

Installed Capacity in India (by fuel type) (in GW)



Note: Other RES > Other Renewable Sources include small hydro, waste to energy, bio power

particular, this growth has been led by solar power, which grew at a break-neck speed to ~28 GW from ~3 GW over the same period.

The Electricity Act, 2003 coupled with competitive bidding for power procurement, implemented in 2006, encouraged the participation of private players who had announced large capacity additions The share of the private sector in power generation increased rapidly to ~31 per cent in fiscal 2019 from 24 per cent in fiscal 2014 largely driven by significant capacity additions by private sector over the same period.

Solar Capacity additions of ~1.2 GW in Q1 FY'20; ~26.5 GW added between fiscals 2014 and 2019

Capacity additions in Q1 FY'20 have remained tepid at 1,229 MW, lower by 10 per cent y-o-y as 1,371 MW was added over the same period in the last fiscal. This slowdown continues from last fiscal where several policy issues had caused capacity additions to slow down.

In 2018-19, ~7.1 GW of solar power projects were commissioned, which was lower by ~24 per cent over FY 18 which had seen an increase of 69 per cent y-o-y. This was mainly due to additional taxation in the form of imposition of a safeguard duty, higher GST rate and other policy issues such as cancellations or renegotiation affecting developer sentiment. Further, implementation risks like lower tariff ceilings, in firm module prices have put elevated pressures on solar capital costs.

Wind Capacity additions reach ~14.5 GW between fiscals 2014 and 2019; slowdown in additions continue, down 11% y-o-y in FY'19, but Q1 of fiscal 2020 sees pickup

While, there are continued delays in terms of execution of allocated capacities, fiscal 2020 YTD (till July) saw a pickup in additions at ~1,060 MW compared to the 257 MW added over the same period last fiscal. Even though, there is a pickup, it can largely be attributed to the commissioning of delayed projects under SECI Tranche I and II as well as Tamil Nadu's 500 MW wind tender auctioned previously.

Capacity additions has fallen 11 per cent y-o-y in fiscal 2019, with additions at 1.6 GW added compared to 1.8 GW in the previous fiscal. The sector continues to adjust to the significantly lower tariffs under competitive bidding as well as land availability and grid connectivity concerns, where developers are facing issues from delayed/congested infrastructure.

Capacity additions had also plummeted by 68 per cent in fiscal 2018 on account of multiple factors including unplanned phasing out of feed in tariff regime by government, delay in the issuance of bidding guidelines and tenders by the states and cancellations of allotted capacities (LOAs) to developers for setting up project capacities under the Feed-in-Tariff mode. Moreover, halving of accelerated depreciation benefit (from 80 per cent in fiscal 2017 to 40 per cent in fiscal 2018) and elimination of generation-based incentives (GBI) of Rs. 0.5/unit also reduced investments in the sector from non-IPPs players.

Conventional Capacity: 41 GW of conventional capacities to be added over next five years led by central and state sectors

CRISIL Research expects 41 GW of conventional capacities to be added between fiscals 2020 to 2024 due to oversupply situation leading to lack of fresh power purchase agreements, stretched financials of private players and delays in commissioning of large hydro and nuclear projects.

Power demand is expected to rise at CAGR of ~5.2 per cent over the next five years (fiscal 2020 to 2024). Despite gradual pick-up in GDP growth and infrastructure development (Smart Cities, Make in India, Dedicated Freight Corridors, and metro expansion), demand constraints emanating from energy efficiency measures, reduction in AT&C losses, higher off-grid generation will stagger cumulative power sales of ~750-800 billion units over the next five years.

Central sector to account for highest share (~54%) of the capacity additions on account of assured power purchase agreements. No new capacity announcements are expected as large quantum of under construction capacity is already under stress.

Stretched financials, delay in clearances and lack of PPAs to hamper capacity additions

While there is ~65 giga watt (GW) of thermal power generation capacities under construction as of March 2019, CRISIL Research expects only ~36 GW to commission between fiscals 2020 and 2024. In addition, ~4 GW of hydro and ~1.4 GW of nuclear capacities are expected to be added. Beyond fiscal 2019, yearly conventional capacity additions are expected to slow down gradually as against 23-24 GW witnessed between fiscals 2015 and 2016. The above view is driven by declining power deficit, completion of large announced projects, as well as delays in a few projects due to fund constraints. Moreover, bankers are also adopting a cautious approach given their high-power sector exposure.

NTPC will dominate the capacity additions backed by a strong execution track record, sound financial strength as well as assured power off-take by PPA holder discoms which insulates it from any downward risk for upcoming capacities.

On the other hand, capacity additions by private sector players are expected to taper owing to completion of their announced projects and acquisitions and lack of fresh PPAs. With high gearing and low coverage ratio, the private sector is expected to slow down their capacity addition from that planned earlier. The trend has already been visible over the last three years when the private sector capacity additions declined to 5 GW in fiscal 2017, 4 GW in fiscal 2018 further down to ~1 GW in fiscal 2019 compared with average 12 GW being added annually in the preceding five years.

While ~23 GW of under-construction projects by private players are stalled due to lack of adequate fuel supply arrangements, absence of PPAs and stressed financials of promoters. Thus, private players would account for only ~1 GW (~3 per cent of capacity additions) between fiscals 2020 and 2024 compared with 49% share over the past five years.

Capacity additions by the state sector are expected to pick up over the next five years owing to large number of under-construction projects by major state gencos (~17-18 GW). In particular, states such as Uttar Pradesh, Telangana, Tamil Nadu, Jharkhand and Odisha would drive capacity additions.

Further, weak financials of state discoms (average AT&C losses for fiscal 2019 ~18.3 per cent, average ACS-ARR gap of Rs. 0.27/kWh) coupled with operational inefficiencies often lead to backing down of power despite underlying demand.

Coal-based capacities to account for 87 per cent of total additions

CRISIL Research expects ~36 GW of new coal-based capacities to commission between fiscals 2020 and 2024, led by large number of planned projects and the fact that coal continues to remain the most widely available and cheapest source of fuel. Moreover, the government's policy for flexibility in utilisation of domestic coal, new linkage policy (SHAKTI) and increased domestic coal production would lead to significant improvement in coal availability over the next three-five years for power plants.

No further gas-based capacity additions expected until fiscal 2024 on account of limited availability of domestic gas

With declining domestic gas production and power not being a priority sector any more for domestic gas, the generation from gas plants has become costlier owing to high prices of re-gasified liquid natural

Continued on page 36

Continued from page 34

gas (RLNG). Close to 6.6 GW of private gas-based capacities continue to be stranded due to non-supplies on RLNG and unfavourable economics. Even after the government's initiative to support RLNG-based power generation until March 2017, the average PLFs for gas-based plants remained low at about 22.5% over the last three years, with the private sector plants operating at even lower PLF of 14% in fiscal 2019.

Delayed commissioning of hydro projects owing to geographical and socio-economic challenges at project sites

CRISIL Research expects ~4 GW of hydro power capacities to commission (out of ~12 GW presently under construction) between fiscals 2020 and 2024 as against 4.8 GW added during fiscals 2015-2019. Geopolitical issues such as inter-state water sharing, difficult terrains, adverse weather conditions, frequent labour strikes, rehabilitation and resettlement and unrest over land acquisition would hamper execution of hydro projects. The Supreme Court had in 2013 stopped work on more than 24 hydroelectric power projects in Uttarakhand shortly after flash floods devastated portions of the state.

CRISIL Research further believes that central sector (NHPC, NEEPCO and NTPC) will lead capacity additions in hydro power followed by a few states such as Himachal Pradesh, Punjab, Telangana, Andhra Pradesh and Kerala. Several private projects that are in initial stages of construction are expected to get delayed due to lack of power off-take arrangements and funding constraints.

51-53 GW solar capacity to be added over next five years (fiscal 2020- 2024)

CRISIL Research expects solar power capacity additions of 51-53 GW over the next five years (FY 2020-24) as compared to ~26 GW over the last five years (FY 2015-19). However, the share of solar power in total units generated (MUs) is likely to remain between 6 - 7 per cent by 2024 as thermal based power would continue to be the dominant source of power. ~ 6 - 7 GW of solar PV projects are expected to be commissioned under the solar rooftop segment over the next five years (2020-2024), mainly led by capacities tendered by SECI capacities allocated by the state governments, commissioning by government institutions such as metro, railways and airports; and additions by industrial and commercial consumers under net/gross metering schemes. To fulfil their renewable purchase obligation (RPO) targets, as per respective trajectories, there has been increased tendering by states. Capacity additions of ~9.5 GW of solar projects are under construction from different state policies and ~4.2 GW is in tendering. However, uncertainties owing to offtake risk, counterparty risk will continue to impact the sector, albeit, the effects are expected to be more benign.

Wind: ~12-14 GW of capacities expected to be added over next five years (fiscal 2020- 2024)

With the FiT regime ceasing to exist, discovered prices for wind energy fell as low as Rs. 2.43/unit (in 500 MW wind energy auctions for GUVNL).

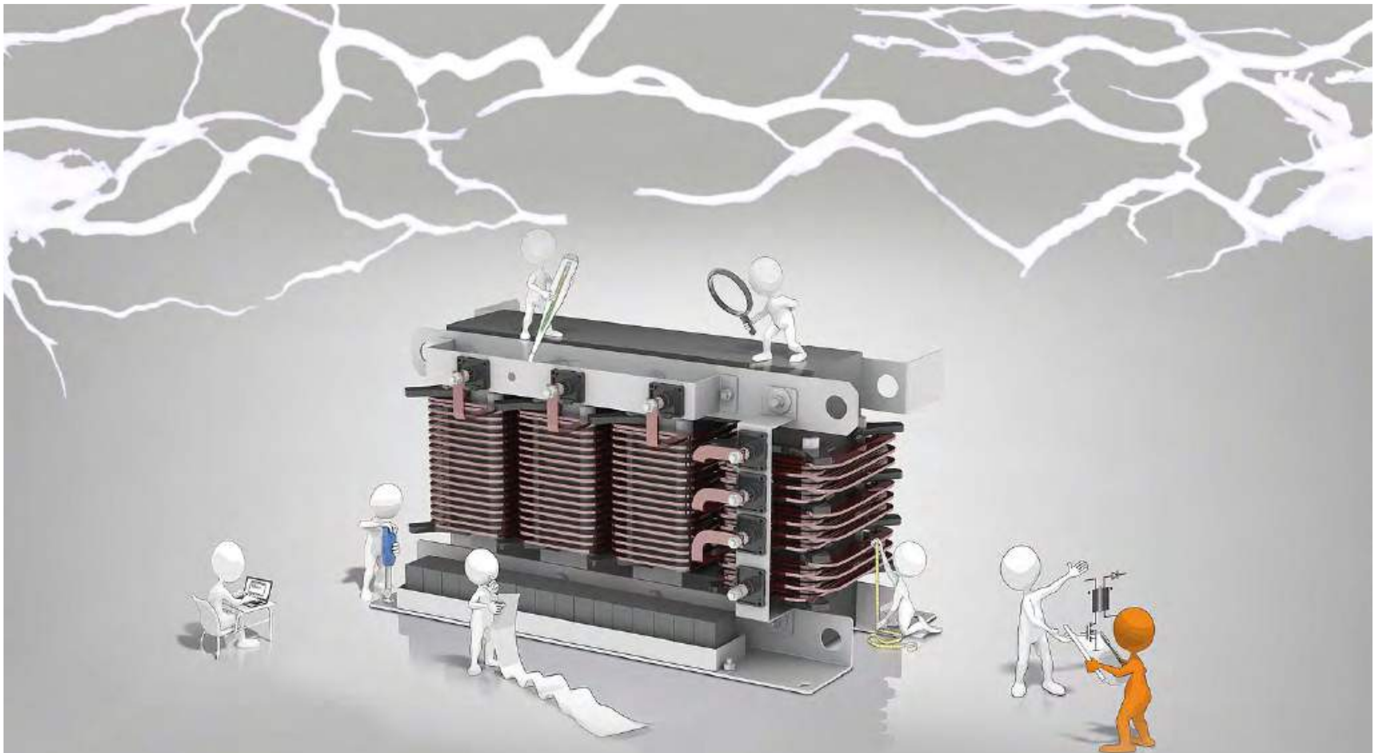
This has caused realisations to fall across the value chain with both developers and OEMs reeling under the increased pressure to execute projects at such tariffs. This is due to the fact that firstly, capital costs have seen a correction post a fall in FY'18 (which was due to an inventory build-up with OEMs). Secondly, developers are facing increasing difficulties in tying up adequate quality wind-sites with connectivity prior to bidding. CRISIL Research estimates that developers currently require tariffs near Rs 3 per unit as and PLFs in the range of 32-35 per cent for projects to be viable at current capital costs of Rs 68-70 million per MW. This should be in conjunction with developers tying up adequate land, with prior wind resource assessment, to ensure rationality while bidding.

Additionally, transmission constraints have hit the sector far more than solar, which has caused bid response to be lower for certain auctions (SECI and NTPC 2 GW). Adequate grid infrastructure remains a key monitorable for wind power.

However, on the plus side, SECI has already allocated 8.5 GW of ISTS connected wind capacities over past 2 years. With commissioning timelines of 18-24 months, capacities are now lined up for commissioning FY'20 onwards. Further, the Centre also has an ambitious tendering roadmap which will also support additions to an extent.

Based on project level analysis and industry outlook, CRISIL Research expects wind power capacity additions of ~12-14 GW over the next five years (FY'2020-24) similar to the run rate of ~15 GW over the last five years (fiscal 2015-19).

(Courtesy: CRISIL Research)



EVALUATION & ESTIMATION OF LOAD LOSS FOR THREE-PHASE TRANSFORMERS

This article discusses the use of capacitors and its effects on the individual phase windings for the current drawal and active power measurement. The data as obtained from pattern of the transformers have analysed by comparing the values from each pattern.

Short circuit impedance and short circuit loss measurement for three-phase transformers during the testing is done by confirming the specimen under short circuiting condition to one side of the winding and application of the required voltage on the other side. This pattern of circuit condition indicates of developing the equivalent circuit of the transformer of being loaded to the extreme condition (zero-ohm load impedance). Because of this the requirement of the test supply voltage needs to be suitable for driving the load current to the winding for measurement. Due to inductive nature of coil winding, the current drawl from the supply demands higher magnitude of voltage application which becomes impractical and difficult to obtain. So, to compensation of reactive power, capacitors are used in the supply circuit. Now, use of these capacitors and effects on the individual phase windings for the current drawal and active power measurement has been discussed in this paper.

Moreover, the data as obtained from pattern of the transformers have also been analysed by comparing the values from each pattern. The mechanical design, disposition of the windings with core, clearances etc.. are the factors, which have been considered for this study. The review of the test circuit connections, parameters used for the testing are being considered also on the basis on its importance for the evaluation of the data from the testing. These factors have been mentioned below.

- Earthing of the star connected system in the circuit like (Capacitor bank, Supply Voltage source, Analyser CT/PT Circuit and the Y connected test specimen if any)
- Temperature during the time of testing
- Application of voltage/ current
- Use and calculation of capacitors for the test
- Tap position of test specimen
- Use of MF (Multifying Factor) for evaluation of loss
- Review of the formulae for equivalent calculation
- Use of connecting lead and reviews of the electrical parameters.
- Other factors like use of CT/CTR, PT/PTR for obtaining the accurate zone of measurement.

The detail study being supported by analysis, test results, data review are the main focus of this article, which may create awareness to test engineers and the utility engineers regarding the confirmation of the load loss of the specimen.

Transformer is the static electromagnetic device, works on the principle of mutual induction and transforms input electrical energy into output. First the input electrical energy is converted into magnetic energy and then re-converted to output electrical energy. During this conversion of energy, the active materials particularly electrical (Winding) and magnetic (Core) play the vital role for successful transformation of this energy without causing any storage in the device. It has two circuits, an electric circuit (that carries the current in the winding) and a magnetic circuit (that carries the magnetic flux in the core). Current in the winding and flux in the magnetic core decides the performance of parameters of the transformers. This electrical apparatus is the most efficient equipment in the electrical system, which indicates that the losses are very small as compared to the capacity of the unit. The loss is categorised of two types (No-Load Loss and Load Loss). In this article the measurement practice of load loss, its estimation and evaluation of the test results have been discussed.

Transformer load loss is developed at the condition when the active windings carry current due to loading of the transformer and this includes I2R losses, eddy losses due to leakage fluxes in the windings, stray losses caused by stray flux in the core clamps, magnetic shields, tank wall, etc., and losses due to circulating current in parallel windings and parallel conductors within windings. So, this loss primarily is resulted for different effects that developed in the transformer for the flow of load current in the system. Even the flux linked losses are included under the load loss as discussed. For three-phase power transformer the load losses are commonly measured by three watt-meter method. It is generally observed that the three readings become different during measurement of these losses in the system. But the total load losses calculation or measurement do not get affected and sum of these readings can be concluded as the total load losses of the transformer and accordingly the allowable value could be confirmed from this reading.

Measuring Circuitry for three-phase Transformer

Every three-phase system requires the involvement of common path for the measurement of electrical parameters. Say for the star connected system, the common star terminal if so considered for the measurement circuit, then the measurement of parameters would be easier and accurate for either of the conditions i.e balanced or unbalanced. Considering this concept generally for three-phase transformer, three watt-meter method is used for measurement of load losses during testing of the transformer without the use of capacitor banks on the input side (Refer Fig-1). But in practice due to higher inductive nature of transformer coil the circuit demands higher magnitude of supply voltage, which becomes impractical to attend. So, for compensation of reactive power, capacitors are used in the supply circuit (Refer Fig-2). The star connected common terminal is taken as the reference point for per phase connection for the individual phase circuit. Load losses are normally measured with following circuit conditions.

- One of the winding is shorted preferably Low Voltage winding is selected for shorting.
- Voltage as per the calculation of the impedance value is impressed on the other winding, preferably on high voltage winding. The calculation value does not become practical and feasible for application to the testing job due to inductive nature of coil winding. So, to maintain the required full load current drawl from the supply the reactive voltage due to inductance

need to be compensated and accordingly capacitor of suitable values are used in the circuit.

- The rated supply frequency of sinusoidal nature shall be applied to the system.
- The measurements may be made at any current between 50 and 100 per cent, but preferably not less than 50 per cent, of the rated current (principal tapping).
- The difference in temperature between the top oil and the bottom oil shall be maintained small enough to enable the average temperature. If required oil pump could be used for this purpose.
- Derived value can be calculated by considering the temperature of the circuit, both at available and reference temperature.
- Earthing used for the circuitry shall be connected to each other and maintained at equipotential point.
- On three-winding transformers the impedance voltage/short-circuit impedances (principal tapping) and the load losses shall be measured between windings taken in pairs as shown below
  a. Between winding 1 and winding 2
  b. Between winding 2 and winding 3
  c. Between winding 3 and winding 1

Note:- While measurement is taken for two windings, the third winding is to be taken open.

- The other factor say % impedance can also be obtained from this test.
- Calculation of load loss: - According to IEEE standards, load losses should be measured at a load current equal to the rated current for the corresponding tapping position. However, if it is not exactly equal to the rated current, the measured load-loss value will need to be corrected by the square of the ratio of the rated current to the test current (average of the measured phase current in three-phase transformers)

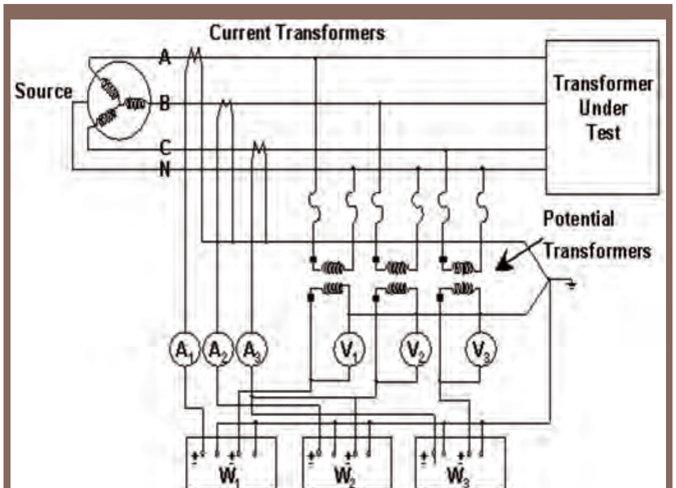


Fig. 1: Ideal Circuit without use of Capacitor Bank

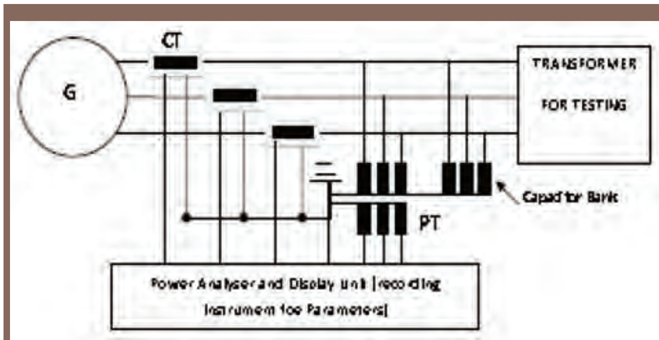


Fig. 2: Circuit with Capacitor Bank

Design Calculation of Load Loss

Load loss = I2R Loss+ Eddy Loss+ Stray Loss

While the design value is obtained, the dimension and design parameters are considered in the formula. This value under testing is compared and confirmed for the performance of the transformer. The use of correct measuring instruments with proper measuring set during the testing of load losses are highly important to achieve the value as near as the design value with allowable tolerance.

% Eddy Loss Calculation:

This loss in the transformer is developed due to the flow of eddy current in the lamination during loading condition of transformer and calculated from the dimension by the formulae as described below.

% Eddy Loss= e4 x (n2 - 0.2) x 100 / 9

Where, e= factor = (Hcu / Hel)1/2 x0.9621 x t

(Hcu / Hel) = Ratio of copper height to electrical height of winding, t= thickness of conductor

n= no. of conductors in radial direction

Stray Losses:

This loss consists of the losses due to stray magnetic flux in the windings, core, core clamps, magnetic shields, enclosure and tank wall. During loading condition, the load current in the winding develops the flux in the core and subsequent leakage flux in the iron part of the transformer. This nature of losses in the core clamps, leads etc is constituted as the stray loss and become the part of the load loss of the transformer.

Stray Loss=(%Z X Bm X CA / (a X 10000))1.7 X (2000 / hw)1/2 X ((MVA / 100)X a)1/4 X k

Where %Z= percentage Impedance

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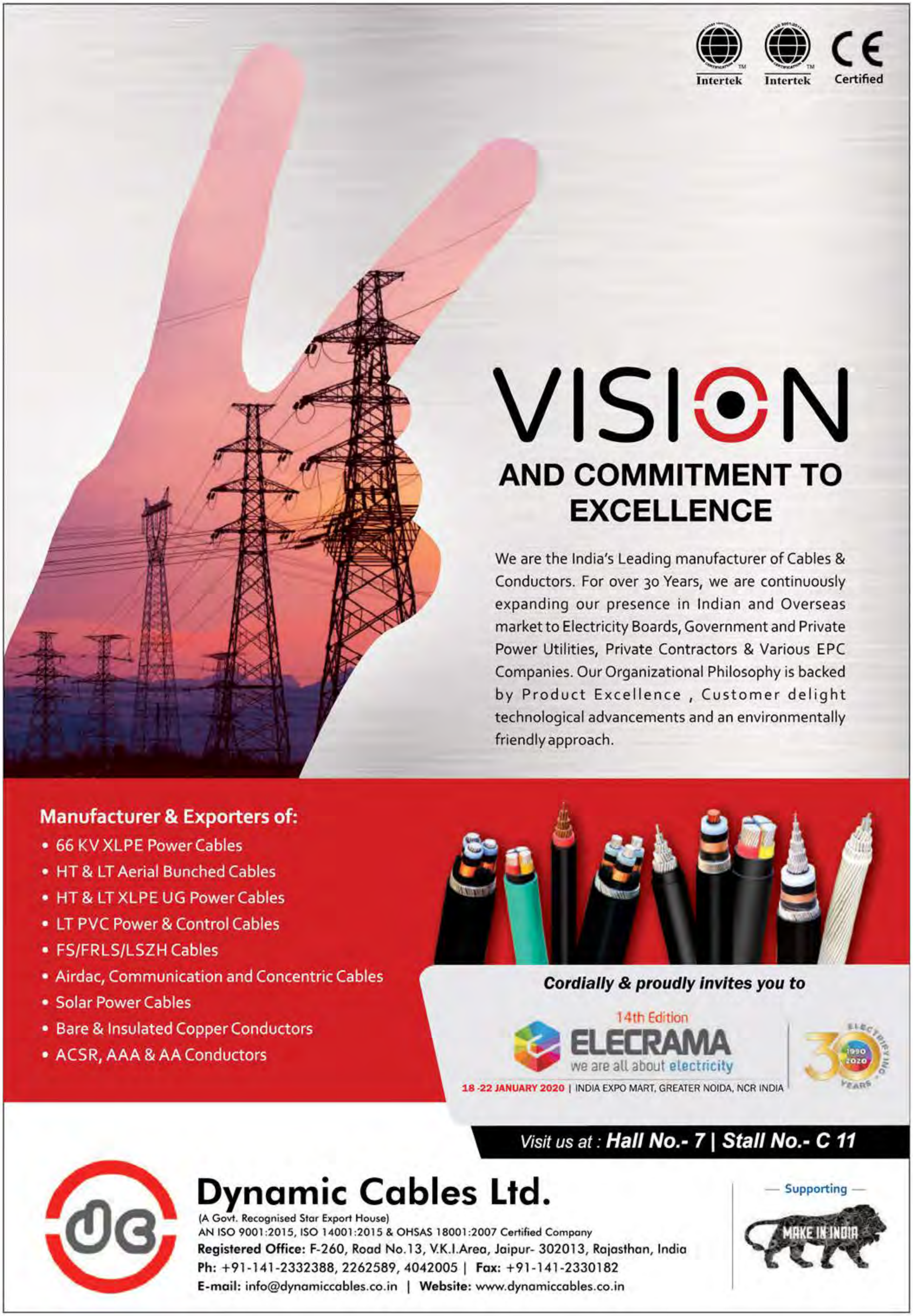
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Rating of Transformer	Current			Load Losses			Total Losses
	I1	I2	I3	W1	W2	W3	
63 MVA, 132/33 KV Star/Star	275.23	277.47	274.12	64.78	48.27	59.85	172.9
75MVA, 220/11KV, Star/Delta	193.63	199.74	196.63	52.33	47.08	25.1	124.51
160 MVA, 220/132/33 Star/auto/ Delta	419.84	419.14	420.52	54.3	71.7	63.3	189.3
160 MVA, 220/132/33 Star/auto/ Delta	408.15	422.5	431	32.282	50.749	110.19	193.22
150 MVA, 220/66/11 Star/Star/Delta	397.19	399.33	388.63	13.67	74.57	221.61	309.91

Bm= Max. Flux Density

CA = Net Core Area

a= Auto Factor (1= Non Auto Transformer) and less for auto transformer.

hw= Average height of winding.

MVA= MVA rating of transformer

I2R Loss:

This loss is developed in the winding of the transformer due to the flow of load current and resistance of the winding. So calculation is simple as the multiplication of square of the load current and resistance of the winding reference to the standard temperature.

Typical Test Results of Load Loss:

In this stanza the value of different transformers from test results have been mentioned for reference of the discussion.

Observations:

- The individual wattmeter reading as observed from the table is not same, but the total readings are close to the value as per the mentioned data in the GTP.
- The current drawl is also different but as not like power reading and approximately same for each phase.
- The power factor though not mentioned in this table are found of very low value in the range of (p.f 0.01 to 0.003, angles are in minutes)
- The value of loss measurement is proportional to the rating of the of the transformer.

Analysis of the Test Results

The test results under load loss measurement are very important to be analysed and interpretation for coming to the final value by the application of correction factor are also to be incorporated properly to avoid the confusion between the clients/customer and manufacturer. The reason of indifferent readings should also be reviewed before drawing any conclusion for acceptance/rejection of the test values. In this stanza the analysis of test results has been narrated for developing the awareness among all the engineers involved in this test.

- The reasons of power and current asymmetry during this test are mainly due to the following points.
  a. Load loss is the constituent of Loading Stray loss, eddy current loss and I2R loss. But the value of stray and eddy loss under loading condition is flux dependent, particularly the leakage flux linkage to the supporting structures like tank, frame and other metallic parts of the transformer.
  b. For the three-phase three limb transformer, the leakage flux distribution on the tank is more for the middle limb than that of the side limbs, because of the asymmetrical limb structure.
  c. The other factors like the compactness of the core assembly, clamping design etc also decides the magnitude of leakage flux.
  d. The asymmetrical magnetic couplings, the reason of asymmetrical mutual impedance along with effective AC resistance of the winding are also the factor of asymmetrical reading value of individual phases.
- The value of current flow from the source is mainly dependent on the electrical parameters of the winding and these values do not change much. The variation of winding resistance and reactance is quality supply dependent. Resistance value changes due to availability of DC and AC component factor and reactance is frequency factor of the supply source.
- The reason and effect of Low Power factor for the load loss measurement of the transformer can be summated as follows.

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a. The load loss measurement is done by short circuiting one side of the winding with application of voltage on other side of the transformer. The electrical circuit of this shorting is represented as a low resistive load on the system. This way equivalent circuit of both sides get reflected to the supply end and the short circuit impedance is measured by the calculation of voltage applied and the current drawn from it.

b. During this test the inductive reactance of the transformer compared to resistance is more and the equivalent circuit to the supply system becomes inductive in nature with larger phase angle and lower power factor.

c. Effects:- As the power factor is very small, the phase angle is nearer to 900. Load loss at low power factor is very sensitive to its calculation. Because any small error in comparison to the actual low power factor is considerable and results with serious error in the load loss value. Phase-angle error of 1 minute in the voltage or current will result in approximately 3% error in loss measurement for a transformer with a load-loss power factor of 0.01. So Phase-angle uncertainty is one of the many uncertainties associated with measurement of the transformer load losses at low power factor (Refer Fig-3 and 4)

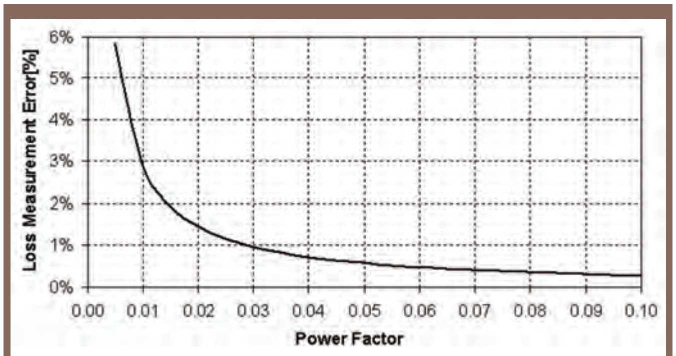

Fig. 3: % error for different power factor(IEEE) factor

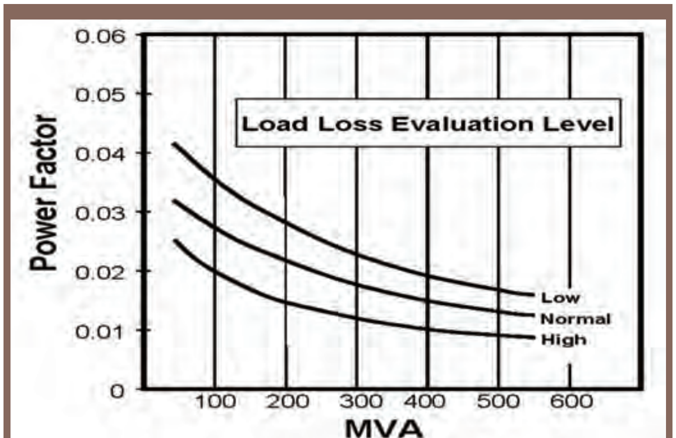

Fig. 4: Typical value of Load loss for large Transformer (source IEEE)

Use of Correction Factor

As discussed above in the measuring circuitry of the load loss, the role of measuring instruments are very sensitive for the calculation and evaluation of load loss. We use CT for correct transformation, PT for voltage transformation and power analyser for correct recording of the value. Every parameter replica into the display recording is important and its effect on the measuring set up is now discussed.

- Use of CT and current element:- For Current transformer, secondary rating of higher range say 5 A than to 1 A may contribute comparative more error with of same accuracy class. Because the current being the RMS is recorded in the logarithm cramped scale for higher range. So any error becomes significant for the measurement. Moreover the CTR should also be of proportionate with minimum error. If any correction factor is mentioned should be used during calculation of the load loss for the composite error (combination of phase angle and ratio error). Measurement of losses at lower range of supply current could cause error more. So it is recommended to use at least 50 % of the rated current and correction can be done by the multiplication of square of the ratio of rated current to the applied current under testing.
- Use of PT and Voltage element:- Similarly the voltage transformer should be of electromagnetic type with allowable limit of ratio and phase angle error for all the range of voltage recording condition. This effect does not carry that much of impact on the measurement of the load loss as compared to the current factor due to the application of a particular range of voltage supply for testing of load loss. If any correction factor is mentioned should also be used during calculation for both ratio and phase angle error.

Note:- The use of Instrument transformer below 70 % of the rated operation value contributes considerable higher error for measurement. So it preferable to apply the value more than 70 %. (Refer fig- 5, 6).

- Correction due to use of connection leads:- The wire/ lead used for the connection of the equipment also plays role to affect the measurement of load loss. The wires used from the secondary side of the instrument transformers (CT, PT) should be of suitable size to avoid considerable loss of measurement parameters.

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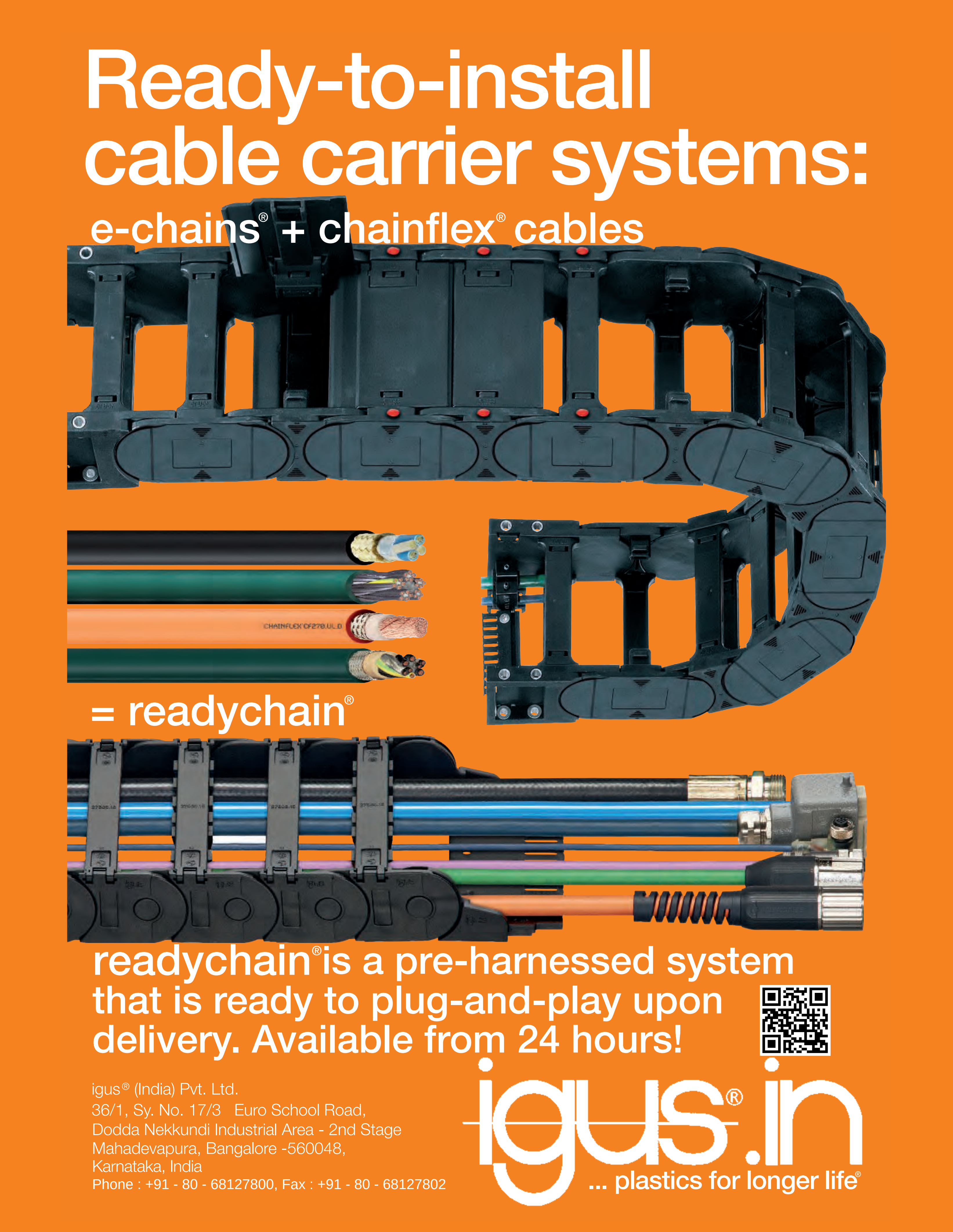
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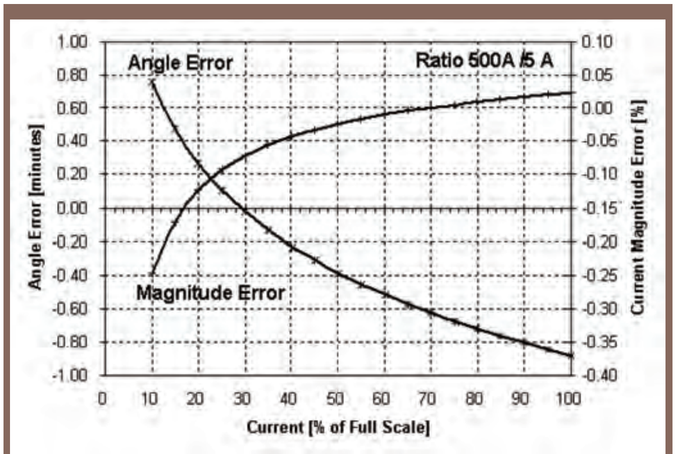

Fig. 5: Typical % error for CT at different current value

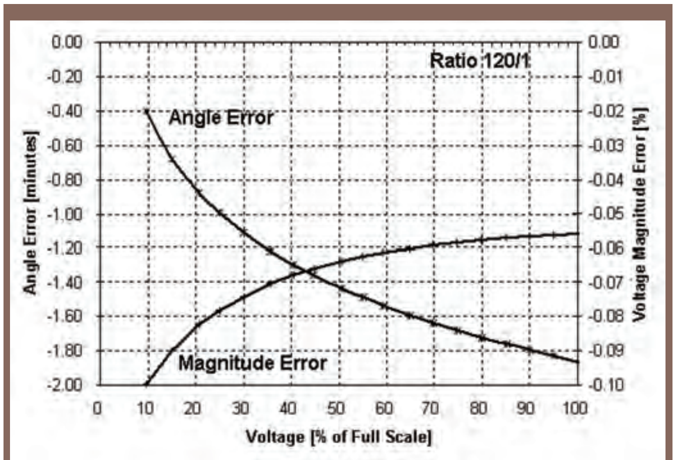

Fig. 6: Typical % Error for PT at different value (Source IEEE)

Particularly for the PT, the secondary lead connection should be of minimum of 4 Sq.mm size with distance of testing control room being less than 20 meters. The primary connecting leads for shorting the winding becomes the part of the winding and its connection to the bushings should have proper contact with minimum contact resistance. It is advised that if the shorting connection losses exceed 5% of the total load losses, the shorting connection should be replaced by one that of a larger cross section and that the joints be made tighter to minimise contact resistance at the joints. The circuit including the shorting connection could be introduced with special instrument connection to auto deduct the loss due to this shorting. The connection for the single phase circuit is shown in fig-5. Similarly for three-phases winding the corresponding circuit can be taken. However this type of the use of circuit is generally not used. Rather suitable size of the shorting

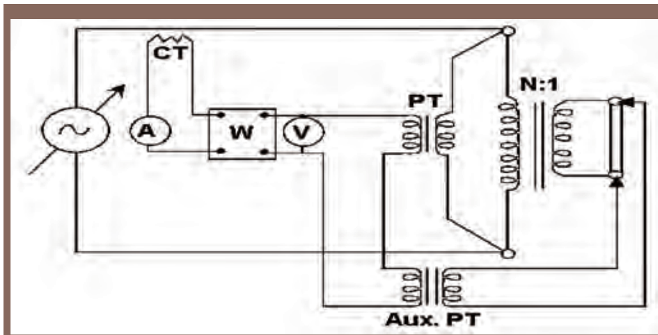

Fig. 7: Circuit for auto-correction due to short circuit (Source IEEE)

connection is taken in the circuit.

- Correction factor for temperature and total time period of measurement: - Temperature during measurement is one of the most important factors for correction of the load loss. Because the winding resistance changes of its value due to change of temperature and affects the recording of the losses. Moreover, the testing time should also be minimum as possible to avoid considerable rise of winding temperature.
- Use of display meters (Power analyser):- The digital scale used in the power analyser should be at least of 4- ½ digit for better accuracy for all used range of measurement and should be of better quality with optimum range operating range at minimum allowable error. The use of multiplication factor should be avoided and the reading directly obtained should be reported in the form final value of the load loss.

Conclusion

The load loss measurement during the routine test of the transformer is considered as one of the important techno-commercial test upon which the performance of the transformer depends upon. The client and manufacturer insist for the correctness of the test practice and its methodology for measurement of the load loss. This test and obtained value is also referred for financial calculation for the case of any deviation from the declared value in the GTP/ specification. So, the described concepts can develop the awareness among the testing engineers to be cautious for the measurement of Load Loss in the transformer. EI

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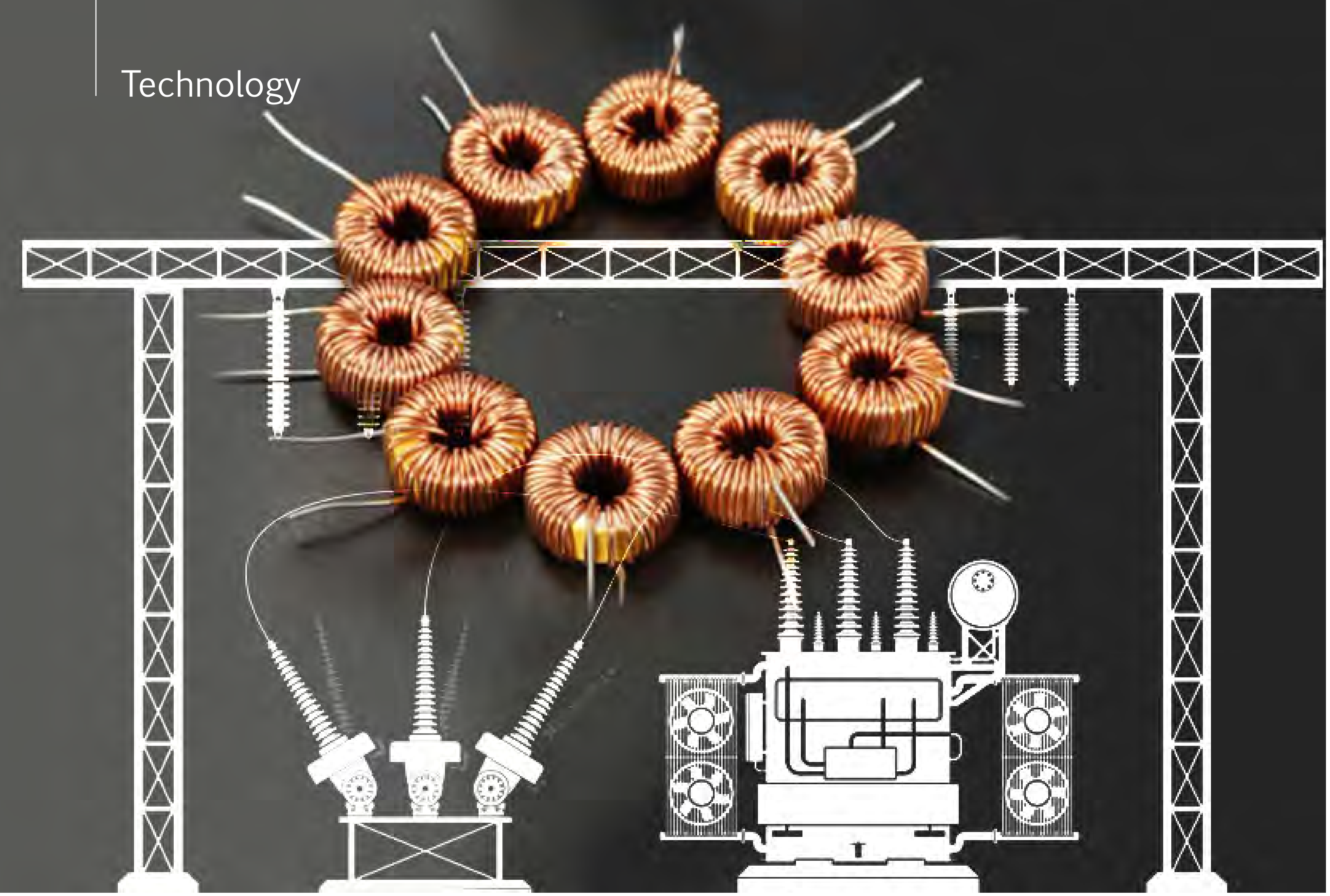

VA BURDEN OF CT

Current Transformer (CT) is an instrument transformer that simply steps down the high current and provides it in 5A / 1A range for measurement. CT consists of a toroidal core with primary winding as a conductor passing through the core center. Depending on the required secondary current, number of turns are wound on the core as the secondary winding. The As per IEEE

$$\frac{I1}{I2} = \frac{N2}{N1} = \frac{V2}{V1} = K$$

............Transformation ratio

Just like other transformers, there will be load on CT secondary and that load is called Burden.

Why Load on CT is called Burden?

The reason why we called load on CT as a burden is that, like a normal Transformer, CT secondary can't be kept open. As high current is stepped down to lower value, open CT secondary will cause 0A current in secondary, which will ultimately lead to a high voltage which may burn the CT secondary winding and can damage the system. So it is necessary to load the CT secondary continuously and ultimately it acts a burden on CT, and that's why the load on CT is named as a burden.

In Fig 2. circuit, CT secondary is short- circuited when a no-load condition occurs. Due to this 5A current, flows through the loop but the voltage is zero because of the shorting of CT terminals.

In Fig 3. Circuit CT secondary is kept open with no load condition, causing the Voltage to rise up to 1000V and making CT secondary current zero due to open circuit condition. This high voltage will lead to insulation failure or permanently damage the insulation causing inaccurate

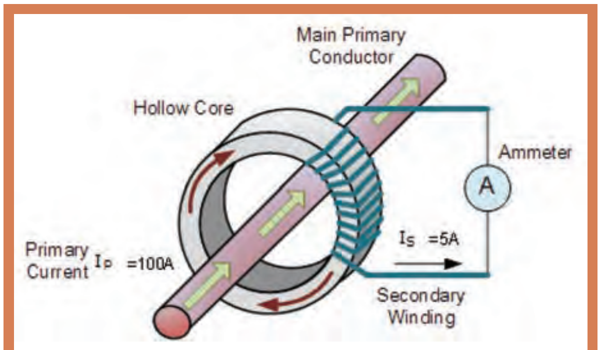

Fig: 1 CT (1)

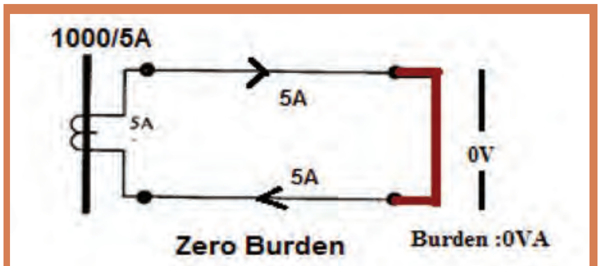

Fig 2: CT secondary Closed Circuit

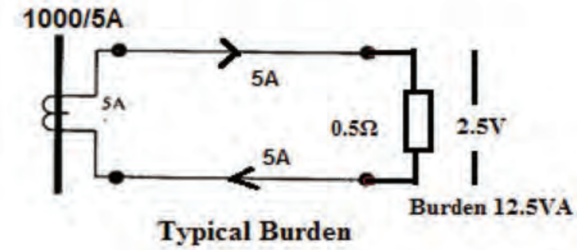

Fig 3: CT secondary Open Circuit

reading after connecting to the instrument and in the worst case, it can lead to burning of the CT coil.

The load connected to CT secondary is mentioned in VA (normally), as in a Transformer, the connected load is of Resistive, capacitive or inductive type.

Burden of CT can be specified as Volt-Ampere absorbed at certain Power Factor i.e the VA that can be consumed by the load. The burden can also be expressed as total Impedance in terms of ohms connected on secondary of CT i.e. pilot conductor and instrument burden (I2 x R=VA).

To simplify the above point, let us take an example: for a 100/5A CT with a Burden of 0.4ohm impedance, the burden can be expressed as 10VA at 5A secondary current " I2 x R = 52 x .4 = 10VA ". In industries, VA is more commonly used unit for CT burden

Burdens on CT

There are 2 types of CT.

Metering Type and 2. Protection Type.

Burden for **Metering type CT** = Total Burden of Meters (Digital/Analog Ammeter, Voltmeter, Power Meter, MFM, Transducer) which are in series with CT + The total VA of the Cables connecting CT and the Meters.

Burden of Cable can be calculated as "Current Square x Resistance of cable per length x 2 times the length of cable" i.e

Cable VA = (2L x R x I^2).

Example: If a 250/5A CT is connected to a load of 0.02 ohm resistance through a cable 2-meters long, then the VA burden of Cable will be

Cable VA= 5^2 x 0.02 x 2 x 2=2VA .

The cable burden will be as per its cross-section area and length. Resistance of Cable depends on the Gauge & Length of cable. Burden of different meters are mentioned in their respective datasheet and catalog provided by the manufactures.

For better understanding burden of various meters is mentioned in table 1.

So if you are using an analog meter with 2 m cable then the total burden on CT will be 1VA+ 2VA= 3VA.

Meters	Burden
Analog Meters	1VA
Digital Meters	0.5VA
Current Coil of Watt Meter /VAR Meter	1.5VA
Current coil of energy Meter	2VA
Current coil of PF Meter	2.5VA
Current coil of Tri- Vector Meter	5VA

Table 1

Burden for Protection class CT will be similar to Metering type only instead of meters the burden will be of individual relays. Burden of Protection class CT = "Total VA burden of cables connecting CT to relay + Total VA of Individual Relays".

Burden of various Relays or protective system is mentioned in table 2

Protective System	I_2	VA	Class
Per-current for phase & Earth Fault Relay	1A	2.5	10P20/5P20
	5A	7.5	10P20/5P20
Unrestricted Earth Fault Relay	1A	2.5	10P20/5P20
	5A	7.5	10P20/5P20
Motor Protection Relay	1A/5A	5	5P10
IDMT Earth Fault Relay	1A/5A	15	10P10

Table 2

Effect Of Burden on CT Accuracy and ISF

For any CT, Instrument Security Factor(ISF) is nothing but the ratio of Maximum limited Primary current to rated Primary Current.

$$ISF = \frac{\text{Limited Primary Current}}{\text{Primary rated Current}}$$

Basically, the ISF is used to protect the load connected in the secondary side of the metering CT i.e meters etc. The core of CT will get saturated at higher current i.e 5 to 10 times(depends on ISF) higher than the rated primary current.

If ISF of a 100/5 CT is 5 then at 500A CT will provide equivalent 25A in the secondary side but once the current cross beyond that i.e 600A or 1000A the core will get saturated and the meter will get protected.

If CT Burden is chosen much higher than required, then the CT accuracy deceases for less than 100% load and increases for more than 120% of load or we can say the accuracy of CT get out of phase and also the ISF of CT gets an increase (refer to table 3&4). Designing CT for higher burden increases the saturation characteristic of core causing the risk for the load connected in CT

Error Measurement			
Rated I_1	Ratio Error	Phase Error	Accuracy Class
120%	-0.07	+ 21 min	0.5
100%	-0.05	+ 19 min	0.5
20%	-1.47	+ 65 min	1.0
5%	-3	+ 134 min	1.0

Table 3

100/5A CT 10V Class 1 tested at Burden of 2.5VA Error Measurement:-			
Rated I_1	Ratio Error	Phase Error	Accuracy Class
120%	2.77	+ 37 min	OUT
100%	2.75	+ 43 min	OUT
20%	2.59	+ 69 min	OUT
5%	2.4	+ 102 min	1.0

Table 4

secondary and also lead to CT failure. If a CT with 10 VA design against the required Burden 2.5VA will lead to increase ISF by 4 times i.e if ISF for 10VA is claimed as 5 that means saturation Voltage will be 10Volts (i.e " $V_{sat} = \frac{VA}{I_2} \times ISF$ ")but if operated at 2.5VA then Saturation voltage will be 2.5Volts against 10Volts which leads the increase in ISF up to 20. So if high current flows then CT will provide 20 times secondary output current leading a meter or circuit connected on secondary to fail or get damaged it. Let's check the accuracy of 100/5A CT 10VA class 1 tested at full rated burden 10VA and tested at rated burden of 2.5VA.

From the above Test it is clear that the CT design with a higher burden if used at a lower burden then that will leads to higher error in measurement even if CT is at 100% of rated Primary Current and also that CT accuracy gets even better when operated at nearly rated Burden even at 50% of rated primary current.

It is often seen that load on CT is majorly only Meters and Cable (max. It can be 10VA for metering CT), so we suggest that the rated Burden for the metering CT shall be a standard value and as close to the connected Burden as possible.

The Core thickness of CT depends on the VA. Therefore for higher VA and for smaller rating CT,core thickness will increase, which leads to difficulties in mounting of CT in respective applications. EI

- Rahul Pansare, Product Manager Analog, Rishabh Instruments Pvt. Ltd

SMART GRID VISION FOR INDIA

The article discusses that smart grid development is one of the most important technology revolutions currently taking place as electricity grids are the world's large blocks of infrastructure still need to be digitised.

Smart Grid Vision for India is -Transform the Indian power sector into a secure, adaptive, sustainable and digitally enabled ecosystem that provides reliable and quality energy for all with active participation of stakeholders.

Few nodes of power generation and billions for power consumption, Indian electricity sector has witnessed an enormous growth in its energy demand, generation capacity, transmission and distribution networks. Indian power system is the second largest synchronous grid in the world. With an installed capacity of 362.12 GW as on 30th September 2019, India is also the third largest producer and fourth largest consumer of electricity in the world. India's thermal (coal, lignite, gas and diesel) dependency for meeting the world's second largest population energy demand is approximately 63 per cent and only coal dependency is about 54 – 55 per cent which constitutes roughly 86 per cent of thermal dependency, i.e. country's much of the energy demand is served by traditional grids, focused on burning of fossil fuels. In spite of large generation of the energy, due to small number of generation nodes and high amount of transmission losses varying from 6 per cent to 50 per cent, India has low per capita consumption.

Renewable energy is looked upon as an alternative to fossil fuels but total dependency on renewable cannot be achieved with present technology and huge reforms is required in the field of renewable energy sources. Power flow in traditional power system is unidirectional and traces the fact of not considering variation in demand and serving when it is required rather supplies energy as it is generated. In this context, smart grid has proven the capability of load consideration and transmitting energy from multiples sources meeting the demand, minimising the transmission losses and managing the peak loads.

Smart Grid development has become a key priority for the Government of India (GoI) – not only to curb power transmission and distribution losses but also to improve reliability and quality of power supply, and ensure power to all. SGs development is one of the most important technology revolutions currently taking place as electricity grids are the world's large blocks of infrastructure still need to be digitised. A smart grid is an electrical grid with automation, communication and IT systems that can monitor power flows from points of generation to points of consumption (even down to the appliances level) and control the power flow to match generation in real time. The increased visibility, predictability, and even control of generation and demand bring flexibility to both generation and consumption and enable the utility to better integrate intermittent renewable generation, making it cost effective and responsive. Smart grids are engineered for reliability and self-healing operations.

In August 2013, with the input and consultation from India Smart Grid Forum (ISGF) and various other stakeholders, a roadmap – Smart Grid Vision And Roadmap in India – was drafted in alignment with ongoing projects - Restructured Accelerated Power Development and Reforms Programme (R-APDRP) and Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) with an objective of 'Access, Availability, and Affordability of power for all' and was issued by the Ministry of Power (MoP).

The objectives of the roadmap as laid out in 2013 was as follows:

- Access and availability of quality power to all
- Electrification of all households by 2017
- Reduction of power cuts with minimum of eight hours of electricity supply
- Reducing AT&C losses in distribution losses to below 15 per cent
- Advanced metering infrastructure for all by 2027 in three phases
- Deployment of Wide Areas Monitoring Systems (WAMS)
- Development of micro grids
- Generation of 30 GW energy using renewable energy sources
- Energy efficient programs for lighting and HVAC in metros and state capitals
- Initiating Dynamic (smart) Energy Efficiency Programs, to be spread nation-wide
- Charging stations for electric vehicles
- Promoting energy storage systems
- Indigenous smart meter by 2014
- Training of at least 10 per cent of utility technical personnel in smart grid technologies

India Smart Grid Forum

ISGF is a Public Private Partnership initiative of MoP, Government of India for accelerated development of smart grid technologies in the Indian power sector. Mandate of ISGF is to advise government on policies of SGs in India and is also focused on eight working groups on different aspects of smart grid such as WG1: Grid Modernisation and Smart Cities; WG2: IoT, Smart Metering, AI & Analytics; WG3: Digital Architecture and Cyber Security; WG4: Policy, Regulations and Business Models; WG5: Renewables & Microgrids; WG6: Flexibility & Electric Mobility; WG7: Smart Gas; WG8: Smart Water.

- ISGF worked with stakeholders in finalisation of Smart Meters Standards as a part of the committee under Bureau of Indian Standards (BIS) which is now under printing
- Worked with BIS and MNRE in creation of BIS ETD46 Committee for Large Scale RE-Integration to the Grid
- ISGF work closely with international standards development agencies such as IEC, IEEE, Smart Grid Interoperability Panel (SGIP), OpenADR Forum, Wi-SUN Alliance, Open Smart Grid Protocol Alliance (OSGP)etc
- ISGF closely work with Telecom Standards Development Society, India (TSDSI) for formulation of standards in the M2M/IoT domain.

According to ISGF Annual Report 2017-18:

- ISGF published a white paper 'Leveraging Smart Grid Assets for

Building Smart Cities at Marginal cost'. The key concept proposed is to consider smart grid as the anchor infrastructure and can be extended to domains such as water distribution, gas distribution, traffic and security etc.; and further extending the service of billing and collection and customer care systems at marginal cost and operate efficiently.

- ISGF in association with India Energy Storage Alliance (IESA) is developing energy storage roadmap for India from the period 2018-2032 supported by MacArthur Foundation.
- New Energy and Industrial Technology Development Organisation (NEDO), Japan has come forward to fund one of the Smart Grid Pilot projects in India. Accordingly, MoP and Government of Haryana have allotted Panipat Smart Grid Project to NEDO for demonstration of Japanese Smart Grid Technologies.
- IoT is an emerging disruptive technology that transforms the way physical object or assets operate and adds value in automation of any industry. ISGF in association with PWC and Shakti Sustainable Energy Foundation has conducted the study Diagnostic Study of Energy Efficiency of IoT to stimulate policy dialogue among key stakeholders for guiding the evolution of IoT industry to adopt low power communication technologies, minimise the risk of excess energy footprint and also sense the readiness of the industry for embracing standby power standards.
- ISGF is preparing Smart Grid Roadmap for Bangalore Electricity Supply Company (BESCOM) in alignment with on-going programs such as – R-APDRP, IPDS and DDUGVY which will outline activities BESCOM can undertake over a specified timeframe to achieve stated goals and its expected outcomes.
- ISGF prepared an Implementation Plan for public transportation in Kolkata, India with support from Shakti Sustainable Energy Foundation in October 2017. This study assessed the potential for electrification of public transportation in Kolkata and proposes an integrated transportation, electrification, and charging infrastructure, and a prioritized roadmap for buses, 3-wheelers, and ferries.

National Smart Grid Mission

After drafting of roadmap, during the implementation of Smart Grid Pilot projects in state utilities, it was felt necessary to create an institutional arrangement capable of taking necessary actions needed to take it forward and thus, National Smart Grid Mission (NSGM), housed under MoP was established by the Government of India vide MoP Office Memorandum dated 27.03.2015 to plan and monitor the implementation of policies and to accelerate smart grid deployment in India. Under Phase – I (2014 - 2017), NSGM recommended following interventions in Smart Grids for 12th Plan (ending March 2017), costing Rs 980 crore:

- Deployment of Smart Meters and AMI
- Substation renovation and Modernisation with deployment of GIS wherever economically feasible
- Development of medium sized Micro grids
- Development of Distributed Generation in form of Rooftop PVs
- Real-time monitoring and control of distribution transformers
- Provision of Harmonic Filters and other power quality improvement measures
- Creation of EV charging infrastructure for supporting proliferation of EVs.

Whereas, under Phase – II (2017-2020), NSGM has following objectives for development in smart grid till 14th Finance Commission period (ending in March 2020), costing ₹ 990 crore:

- Enable access and availability of quality power to all
- Loss reduction
- Smart Grid roll outs including automation, microgrids and other improvements - AMI roll out, prosumer enablement, demand response (DR) or demand side management (DSM)
- Policies and tariffs – dynamic tariff implementation, DR programs, tariff mechanisms for solar PVs
- Green power and energy efficiency – renewable integration
- Electric vehicles and energy storage – electric vehicle (EV) charging stations & energy storage systems. There are 5 SG projects sanctioned under NSGM – CED-Chandigarh (Sub Division 5), CED-Chandigarh (Complete City excluding Sub division 5), KSEB-Thiruvananthapuram (Kochi), JBVNL-Jharkhand (Ranchi), OPTCL-Odisha (Rourkela).

UDAY and NTP

Last few years, witnessed a series of interventions by Central

Government to reallocate the resources with special focus on electrification and 24x7 power to all, which triggered a new flagship program – Ujwal DISCOM Assurance Yojana (UDAY) was announced in November 2015 by MoP for state-owned DISCOMS and main objectives of this scheme include compulsory feeder metering by 2016 and distribution transformer metering 2017, consumer indexing and GIS mapping by 2018, smart metering of all consumers consuming more than 200 units per month by Dec 2019, demand side management like LED lighting, energy efficient appliances by March 2019 and also setting up a mechanism on judging the efficiency of DISCOMs on the basis of their reduction in AT&C. After UDAY, amendments to National Tariff Policy (NTP) was published in January 2016. NTP seeks to spread smart metering to enable Time of Day tariff and allowing net metering to encourage rooftop solar generation.

Integrated Power Development Scheme

The scope of R-APDRP has been extended under the newly launched program called Integrated Power Development Scheme (IPDS), and 11 SG projects were sanctioned under this program – AVVNL (Ajmer), APDCL (Assam), CESC (Mysore), HPSEB (Himachal Pradesh), PED (Puducherry), TSECL (Tripura), TSSPDCL (Telangana), UHBVN (Haryana), UGVCL (Gujarat), WBSEDCL (West Bengal), IIT Kanpur and SGKC (Manesar).

Smart Grid Drivers

Unlike conventional energy sources, renewable generations are highly unpredictable, intermittent, variable type and thus, requires special control and balancing architecture to deal with the uncertainty and variability to maintain grid stability and security. Key factors driving smart grid in developed countries include Demand Side Management (TOU tariff, automated demand response, etc.) and environmental concerns for renewable integration. But, along with every global factors, India has additional smart grid drivers which includes – Reduction of T&D losses in all utilities as well as improved collection efficiency, peak load management – multiple options from direct load control to consumer pricing incentives, reduction in power purchase cost, increased grid visibility, improved reliability of supply to all customers, improve quality of supply, financially sound utilities and last but not the least reduction in emission intensity.

Research and Development

Government Ministries or departments supporting the smart grid research includes – Department of Science and Technology, Government of India, Science and Engineering research board (SERB), Ministry of New and Renewable Energy, Ministry of Power, Central Power Research Institute (CPRI), The Energy and Resources Institute (TERI) and Centre for Development of Advanced Computing (C-DAC), Bengaluru. Various institutes or universities working on smart grid are – IIT Roorkee (Smart Grid-DC grids), IIT Delhi (Prevention of blackouts, control of micro-grids), IIT-Kanpur (Smart grid- micro-grids), IIT-Kharagpur (Protection and Renewable Energy integration to grid), IIT-Bombay

(Power electronic interfaces for non-conventional energy sources).

Challenges and issues

Power industry is witnessing higher versions of technology like SGs and with support from stakeholders, SG success is possible but like any other technology, this technology also needs to overcome few challenges (or barriers) such as – technical, social and economic. Technical challenges are basically related with integration of several devices or resources with grid network and includes – Inadequacies in grid infrastructure, cyber security, energy storage concerns, data management, communication issues, stability concerns, energy management and electrical vehicles while social acceptance and economy are the key factors and plays a vital role for development of any technology. The socio-economic challenges include – high capital investment, stakeholder's engagement, system operation aspects, lack of awareness, and fear of obsolescence, new tariffs, RF signal interference and health issues. Other than these, few miscellaneous challenges demand attention which includes – regulation and policies, power theft, expertise of work force and coordination among enterprise of power, information and communication industries, policymakers, system operators, regulators, government, utilities, manufacturers, business market, economists as well as consumers.

Suggestion and Conclusion

For any system to be effective and efficient, it should be intrinsically viable with minimal or no dependency on any of the external support system such as – subsidies. Some of vital recommendations from various studies for efficient deployment of smart grid include – loss reduction with accurate and timely meter reading, real time granular level energy audit, precise interventions for power theft detection and load curtailment, making 24x7 power accessible by load limiters for rationing power supply, TOU tariff by introducing dynamic pricing, rooftop solar generating green energy at user end and net metering using smart meters, value-added services for smart city such as - DISCOMS to provide anchor infrastructure for smart cities and sharing data backbone with governance stakeholders, value-added services for smart home such as - consumers willing to pay for additional services will get the option to avail special ICT-enabled facilities, electric vehicle rollout will lead to EV charging infrastructure and Vehicle to Grid (V2G) services, metering, data and communication technology standards need to be formulated and advertised such as - smart metering rollout framework for the country, new tariffs, etc. Policy and regulation interventions on emerging subject areas must include - energy storage systems, rural mini-grids, anti-theft provisions, model regulations for time of use tariff, model regulations for demand response, policy considerations for electric vehicle infrastructure and integrating DRE micro-grids etc.

With continuous monitoring of the system, it requires an immense database, maintaining lots of servers and processing immense data which are prone to cyber-attack. To overcome this, researchers suggested for integrating power sector with Blockchain Technology. A blockchain is a shared, encrypted ledger that is maintained by a network of computers, i.e. no single authority. These computers verify transactions and each user can access the ledger, and is able to track, coordinate and carry out transactions or processing and store information from a large number of devices making it as a decentralised encrypted network.

When a unit of electricity is generated today, a meter send data that gets logged in a spreadsheet which is then sent to a registry provider, where the data gets entered into a new system and a certificate is generated. A second set of brokers deals with the buyers and sellers of these certificates.

Such a byzantine system racks up transaction costs, while leaving plenty of room for accounting errors that can range from honest mistakes to outright fraud. The lack of transparency also scares many people off entirely. The technology pieces that need to fit together from the perspective of smart grid marrying digital need to be focused on: Analytics for Demand Forecasting, Analytics for Energy Auditing, Analytics for fraud detection and loss reduction, Analytics for forecasting renewable generation, Mobility Solutions for field workforce, mobility solutions for customers, remote monitoring, control and operation. EI

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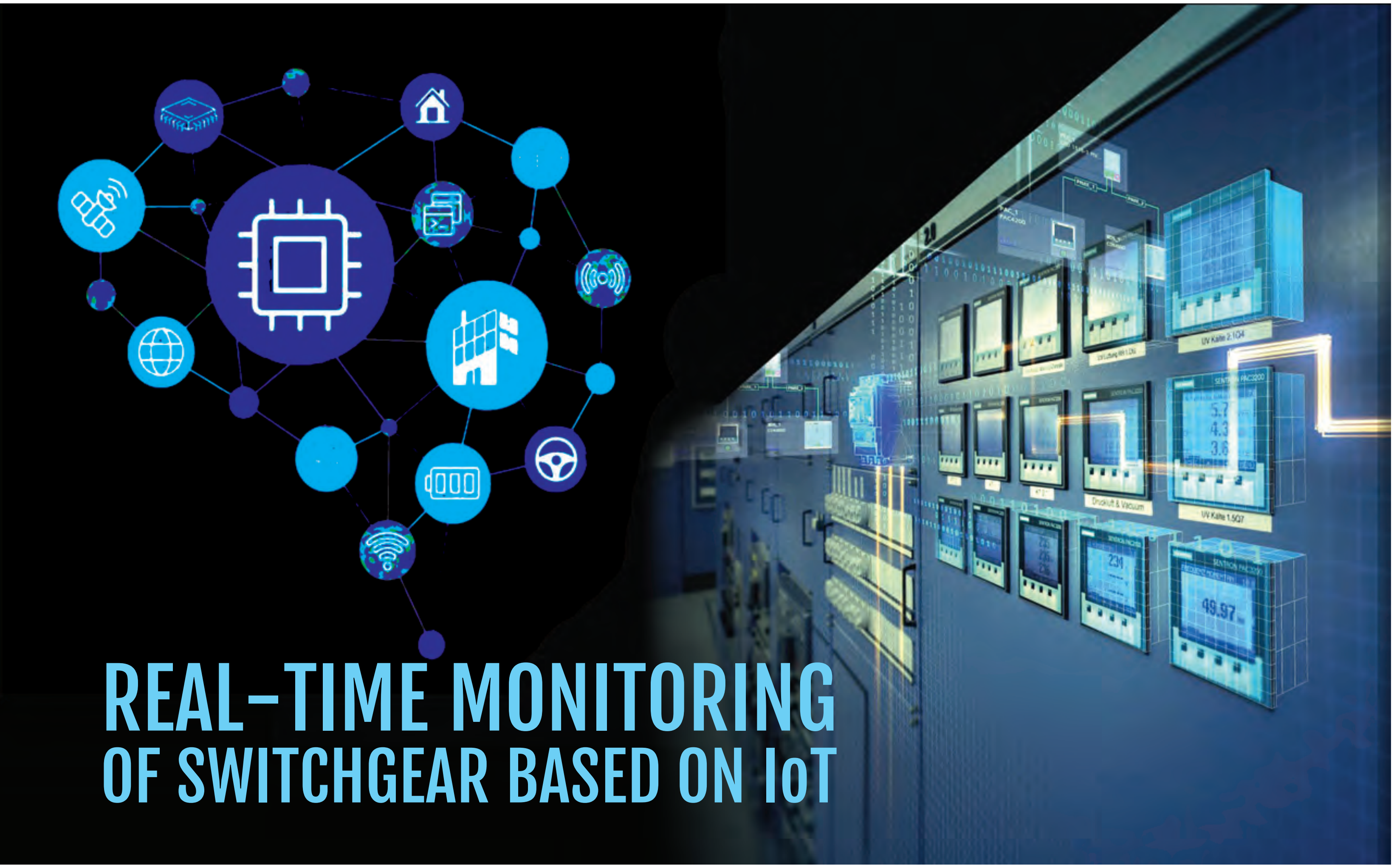


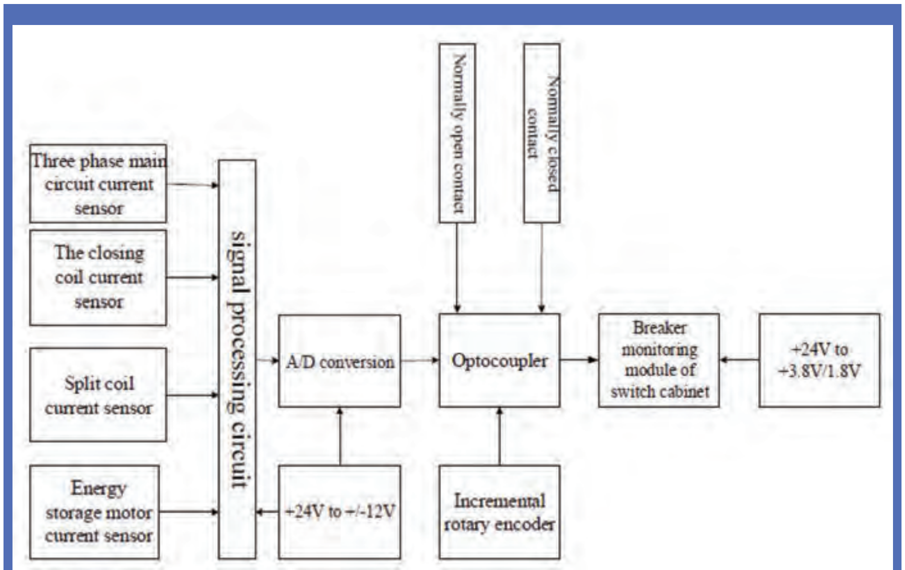
REAL-TIME MONITORING OF SWITCHGEAR BASED ON IoT

The article talks about an on-line monitoring device based on IoT (Internet of Things) that enables safeguard the normal operation of a switchgear and enhance longevity of power systems and degree of automation operation.

Switchgear is an important apparatus in power transmission and distribution system, the switchgear encounters a vital role in the power transmission line and the monitoring data. The safety and reliability of power equipment is usually an important link to ensure the security of distribution and transmission and power grid. In this article, it reflects a switchgear on-line monitoring device based on IoT (Internet of Things), to safeguard the normal operation of the switchgear and enhance the longevity of power systems and degree of automation operation. Thus, it has a very important connotation.

Structure and Principles of the Integrated Monitoring Device

The IoT based monitoring of switchgear consists of four parts, which are monitoring units, identification unit, control unit and switchgear IED (intelligent electronic equipment). Amongst, monitoring unit comprises mechanical attribute of monitoring unit, a bus or contact temperature unit of monitoring; the recognition unit primarily includes all kinds of electronics tag information installed in an equipment. The control unit incorporates control cabinet subunit 'Five Anti' lockout control sub-unit;



Mechanical attribute of monitoring sub-unit of circuit breaker.

switchgear IED through CAN, to communicate with other units. Zig-Bee transmission is there, hence make the appropriate processing and algorithm. The overall structure of the schematic diagram is shown in below figure.

Monitoring Unit

The mechanical attribute of monitoring unit can gather the running state parameter of the circuit breaker in real time, depend upon the sensor signal precisely or through processing data to obtain the required status of circuit breaker, and analysed the circuit breaker condition. In addition, there are two types of digital inputs in monitoring units: normally open contact and normally closed contact, through these circuit breakers were permitted normally open and normally closed and switch state was decided by the auxiliary contacts.

Bus and contact temperature monitoring sub unit

The contact temperature monitoring sub unit was installed in the bus, contact arm, mainly monitor bus/ contact temperature was connected through the ZigBee wireless communication method to transfer monitor data to switchgear IED.

Control Unit

Cabinet gymnastics control unit

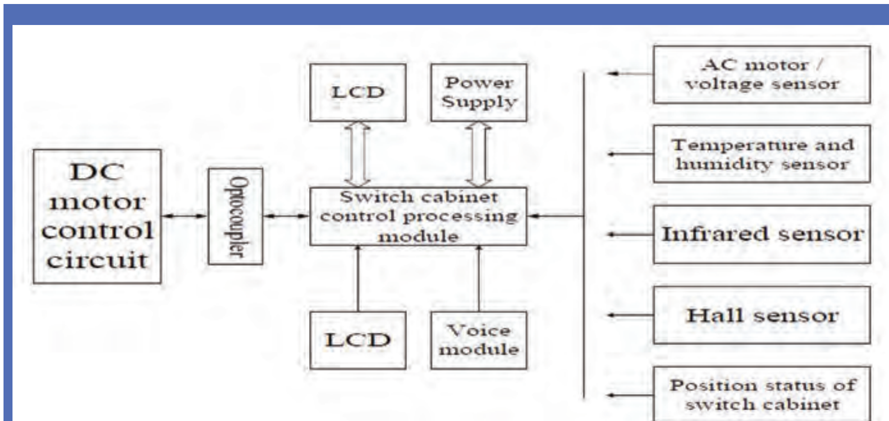
The gymnastics control unit in monitoring of switchgear consists of three parts: the first part used to be monitoring of switch in cabinet and the switch status was displayed from the signal taken of the auxiliary contact of the first element in the switchgear; the second part is control switchgear by means of electric operation; the third part is the signal from the temperature and humidity inside the switchgear.

'Five-Anti' lockout control sub-unit

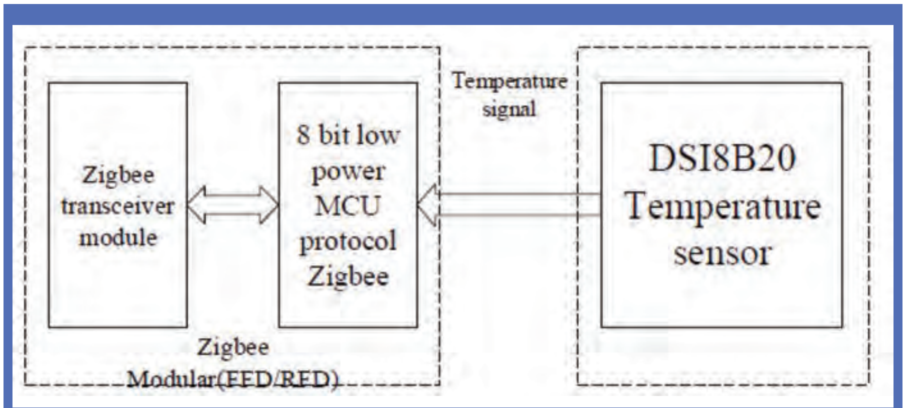
'Five Anti' means, in extension to avoid misclassification, mistakes in breaker, the alternative 'four defence' needed compulsory locking. The core of the locking device was controlled by the processor, and user need to operate and follow certain steps, the controller inspect each operation as directed to the stored program, if performed correctly, the correct audible indicator was sent and admissible operation was carried out; if wrong then it will play a voice reminder, and next operation cannot be carried out, hence, the person and apparatus safety were safeguard.

Identification unit

RFID is known for non-contact automatic identification technology. RFID technology of circuit breaker is used for in-exclusive monitoring device and recognition unit, cabinet and other apparatus report recognition. The information of apparatus was pre-buried inside it such as circuit breaker, isolating switch, grounding switch, bus, the information was sent to the monitoring host directly by RFID technology to understand the dynamic operation of the apparatus



Control monitors unit hardware structure of the cabinet



Comprehensive Monitoring Devices Software Process

and also to locate the apparatus precisely.

Switchgear IED

These are units primarily accustomed to receive every observance units knowledge from realising remote observance operate. It will be endorsing a numerous reasonably completely different observance units within the switch cupboard that uses a great deal of communication ways to harmonise the switchgear. It conjointly endorses the cable transmission and wireless transmission mode to analyse the info communication and management between every observance unit and also the switchgear IED so it can't be tormented by the robust electrical fields within the switchgear, high voltage, high current, robust no particulate radiation, high-frequency noise harmonious wave interference issues. The hardware assumption diagram is shown within the below figure.

This system uses modular, structured design ideas for software design, in order to promote the future of the program and the expansion and transplantation of different functional modules. The software program progresses the chart of the monitoring device is shown in figure below. The overall process is an infinite loop, each cycle will continue interrogate the state of the switchgear, press and other assorted input.

Conclusion

The proposed based on networking technology integrated switchgear cabinet detection means a collection of various of monitoring units, the use of wired communication and wireless communication way will set up a variety of information of the switchgear, analysing the monitoring and control of the switchgear effectively. The monitoring device of high integration, reliable data transmission, realise the intelligent switchgear, boost the level of online monitoring, reduce the maintenance workload, enhance the reliability of power supply. EI

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Fluke Corp. launches compact 417D laser distance meter

Fluke Corporation, one of the global leaders in compact, professional electronic test tools and software for measuring and condition monitoring, has recently launched its most compact laser distance meter yet, the 417D. This speeds up layouts with instant, one-button measurements up to 131 feet (40 metres) and an accuracy of 0.08 inches (± 2 mm). This ultra-portable meter increases measurement efficiency while maximising the reliability of measurements by reducing estimation errors, saving time and money.

It is designed for indoor and outdoor applications. The palm-sized device features a bright laser for clearly tracking targets, even at long distances or in hard-to-reach spots. The 417D can survive a one-metre drop and is rated IP54 for dust and water resistance, making it ideal for even the harshest work sites.

Tracy Montanez, Product Manager, Fluke Corporation, said, "Our customers who have seen the 417D laser distance meter, love it. It has the necessary features to get the job done right, the first time. When your tool belt is already loaded with essential tools, the 417D takes up minimal space and can easily fit into your pocket."

The 417D features a large two-line illuminated LCD screen for easy viewing of measurements and can deliver continuous measurements as well as quick calculations of area (square footage). Due to the automatic shut-off feature, the meter lasts up to 3,000 measurements. EI

For more information, visit: www.fluke.com/india

Prysmian cable laying vessel

All cables are not the same!

Benoit Lecuyer, CEO, Prysmian India outlines some of the great innovations in the field of cables.

Jawaharlal Port; near Mumbai

Pushkar monitors the cables' system in real time. Port cranes' cables are exposed to harsh and heavy-duty conditions due to challenging environmental factors, and failures could lead to severe operation losses. Thanks to the Protolon IQ technology cables, the fibre optic embedded in the cables centre measures real time strain, excessive torsion, elongation on the cables, that require preventive maintenance

The Protolon iQ cables have a tension sensor (TESE), a special sensor fibre located in the centre of the cable that measures real-time strain along the entire cable length caused by stress. A torsion sensor (TOSE), an embedded RFID in the sheath of the cable provides information about the twist of the cable compared to its initial position. The Prysmian technology identifies faults and provides immediate first-hand information about the cable's condition, as well as providing information as to when the cable needs to be changed, thus allowing action to be taken before there is a major breakdown, reducing costly machine downtime.

Delhi

Ramesh comes back home after a day at work. He parks his electric car in his garage, but, while his mind is still focused on the afternoon meeting, he forgets to insert the plug in the recharge station. Will he be late for his important client presentation tomorrow morning? Not to worry! Thanks to a Bluetooth connection, the cable installed beneath the car automatically uncoils and joins the charging base thanks to a magnetic base. When Ramesh will start his car the next morning, the cable will automatically rewind back to its receptacle beneath the car base.

These are two examples of cable innovations that help assets protection, work optimisation, and daily life.

Cable systems provider for energy and telecom sectors Prysmian Group has developed an eco-friendly cable, manufactured using thermoplastic materials. Explaining the unique features of this innovative cable system, Benoit Lecuyer, CEO, Prysmian India, said, "P-Laser is an astute and eco-friendly insulated EHV cable, with a higher performance than

Automotive

Automotive

prysmian iq protolon

XLPE (cross linked polyethylene), using HPTE (high performance thermoplastic elastomer polypropylene based insulation). P-Laser insulated cables withstand increased operating temperatures by over 20 per cent, abiding to fluctuating demands in harsh environments. P-Laser cables production process utilises zero gas technology, reducing CO_2 emissions by 1-tonne per km. Furthermore, degassing is no more required."

He further informs, with a turnover of €11 billion and a workforce of over 30,000 people worldwide, Prysmian considers India as a core strategy of the group.

Looking closer, there are several great innovations in cables.

In the smart cities, an innovative idea consists of making use of the smart grids to allow bi-directional electric cars charging. In this situation, power can be shared between vehicles' batteries. Electricity can also be drawn through the grids through photovoltaic solar panels. This is made possible thanks to dedicated cables.

Assets condition monitoring today is a paramount topic, as a loss of energy can generate large losses for the industries.

Prycam by Prysmian standalone or on cloud devices technology measures partial discharge on cables and accessories without service interruption. It eases the assets management, helps the prevention maintenance strategies, allows savings for the utilities. It reduces maintenance costs, and matches the smart cities requirements.

In the mining industry, safety is an essential factor. Here again innovative cables are proposed. Luminescent cables thanks to energy fed base, allow the workers to have luminous guidance in all conditions, and safeguard activities.

On fibre optics, innovation is a master key. The new Prysmian Flex ribbon offers lighter cables with a significant smaller diameter, ensuring kink resistance, and enabling use of smaller ducts. It features 200 and 250-micron fibre ribbons that still provide the advantages of mass fusion splicing. It is an ideal answer to the data centres and hardware infrastructures which need to evolve rapidly, addressing issues related to power efficiency, heat and cooling, and data transmission.

P-Laser insulated cables withstand increased operating temperatures by over 20 per cent, abiding to fluctuating demands in harsh environments.

Benoit Lecuyer,
CEO, PRYSMIAN INDIA

On the overhead cables, heat dissipation can be a challenge, new technology E3X, featuring a thin, durable coating applied to the surface of any overhead conductor gives substantial results.

On submarine interconnections, higher connections are a must, involving bigger conductors in greater water depth. Using aramidic armor give tremendous results in both these areas.

According to Benoit Lecuyer, "Partnership with great universities can instil new concepts or deepen new techniques. In this field, Prysmian studies nanotechnologies in power, control and instrumentation, mechanical resistance, low weight, chemical inertness, high degree of flexibility, electrical and heat conductivity. To facilitate innovation, several cable companies incepted it in their core program."

Prysmian has initiated the "Corporate Hangar", a fly-in zone for new ideas, where innovative projects can find a fertile ground to thrive.

Ideas are fuelled into the hangar from Prysmian Group employees, whose innovative ideas are developed into actual projects, and from the team of the Hangar who scouts for innovation outside the group's perimeter, diving into the latest technology trends – such as Artificial Intelligence, machine learning, and looking for high-potential start-ups which can bring value to smart cable embedded activities. EI

Focus on ALTERNATIVE ENERGY SOURCES

For sustaining the existing standards of life, energy efficient methods must be employed. There is a need to conserve energy sources.

Energy is one of the important inputs for economic growth. Developing countries' energy needs keep increasing exponentially for the development of infrastructure, manufacturing and transportation to mention the few. Developed countries have high energy needs in sustaining the development. Though the developed countries population is only 20 per cent of total world their energy consumption is about 60 per cent against 80 per cent population and 40 per cent energy consumption of developing countries.

Energy needs of the world are being supplied by coal, oil, natural gas, nuclear fuel, electricity etc. Electricity is generated using primary fuels, predominantly from coal, oil, natural gas and nuclear fuel. In India about 70 per cent of electricity generation is from coal. Though all countries energy needs are supplied from these energy sources, their availability geographically is not even. Different countries have in different proportions of these energy sources. USA has the largest share of global coal reserves (25.4 per cent). India is fourth largest country with 8 per cent global coal reserves. Saudi Arabia had largest global oil reserves

(23%). Russian Federation has largest global gas reserves with almost 24 per cent.

The problem and its solutions

For the world to sustain the standard of living, its energy needs must be supplied. The problem is that our present primary sources are not infinite. They are not going to last forever. Coal and other fuels which took about three million years to form are going to extinct. Past 200 years mankind consumed about 60 per cent of coal reserves. Coal is expected to last over 200 years. Oil reserves are expected to last just about 45 years and gas for nearly 65 years. Alternate sources for electricity generation needs to be developed. Enough technological developments must be made to make the technology safe, efficient and economical. Generation from nuclear fuel is definitely promising but more penetration is needed. Governments and policy makers must consider this option seriously in the coming Five-Year Plan. Solar energy though being encouraged much, high investment, low capacity factor and less awareness among private investors has limited its capacity. Recent fluctuation in government policy making has brought great ambiguity in solar industry in India. For sustaining the existing standards of life, energy efficient methods must be employed. There is a need to conserve energy sources.

For energy conservation, there are methods made to reduce the consumption of energy by using less of an energy service. This can be done by using energy more efficiently and by reducing the amount of services used. Energy can be conserved by reducing wastage and losses, improving efficiency through technological upgradation and improved operation and maintenance. Energy conservation is achieved when growth of energy consumption is reduced. Energy conservation can, therefore, be the results of several processes or developments.

What is India doing about the problem?

With higher energy saving potential the Government of India has enacted the Energy Conservation Act in 2001. The act provides necessary legal framework and institutional arrangement for observing energy efficient process. According to the Act, an institute was to be set up which would look after the implementation of policy programs and coordination of implementation energy conservation strategies. Bureau of Energy Efficiency (BEE) was established on 1st March, 2002.

Important features of Energy Conservation Act

Certification of Energy Managers and Accreditation of Energy Auditing firms

Training modules and accreditation programs has to be designed by BEE in such a way that a cadre of professionally qualified energy managers and auditors can be raised. They need to expertise in implementing energy efficiency projects, analysis of policies, financing and project management. BEE conducts a national level examination for certification of energy managers and auditors.

Standards and Labeling (S&L)

S&L is a key activity in improving energy efficiency. This program objective is to bring only standard and energy efficient equipment and appliances into availability for consumers. For this, minimum energy consumption and performance standards for notified equipment and appliances must be evolved. Any equipment or an appliance which does not conform to these standards will not be allowed for manufacture, sale or import. Develop labeling system for notified equipment to enable consumers to make informed choices. The present star rating is implementation of this program.

Energy Conservation Building Codes

BEE would prepare guidelines for conserving energy in buildings referred as “Energy Conservation Building Codes” (ECBC). Buildings with connected load of 500kW or contract demand of 600kVA and above with commercial purpose intention are considered buildings and come under ECBC regulations. These buildings would be notified to suit local climate conditions and other compelling factors by the respective states. Energy audit would also be prescribed to consumers with specific designated commercial building.

Central Energy Conservation Fund

This fund would be setup at the Centre to support the creation of development and testing facilities. Give thrust to R&D and develop the delivery mechanism for large scale adoption of energy efficiency services, promote consumer awareness and demonstration to boost market penetration of efficient equipment and appliances.

Designated Consumers

Energy intensive industries and other establishments should be designated as ‘Designated Consumers’. They have to comply with standards and norms of energy consumption as prescribed by the central government. Energy Managers with prescribed qualification are required to be appointed by the designated consumers and get energy audit conducted by the accredited energy auditor. Aluminium, iron and steel, cement, paper, sugar, textile, chemicals, petrochemicals, gas crackers, naphtha crackers, petroleum refineries, fertilisers, railways, port trust, transport sector (industries and services), thermal and hydel power stations, transmission and distribution companies and commercial buildings and establishments are the designated consumers. EI

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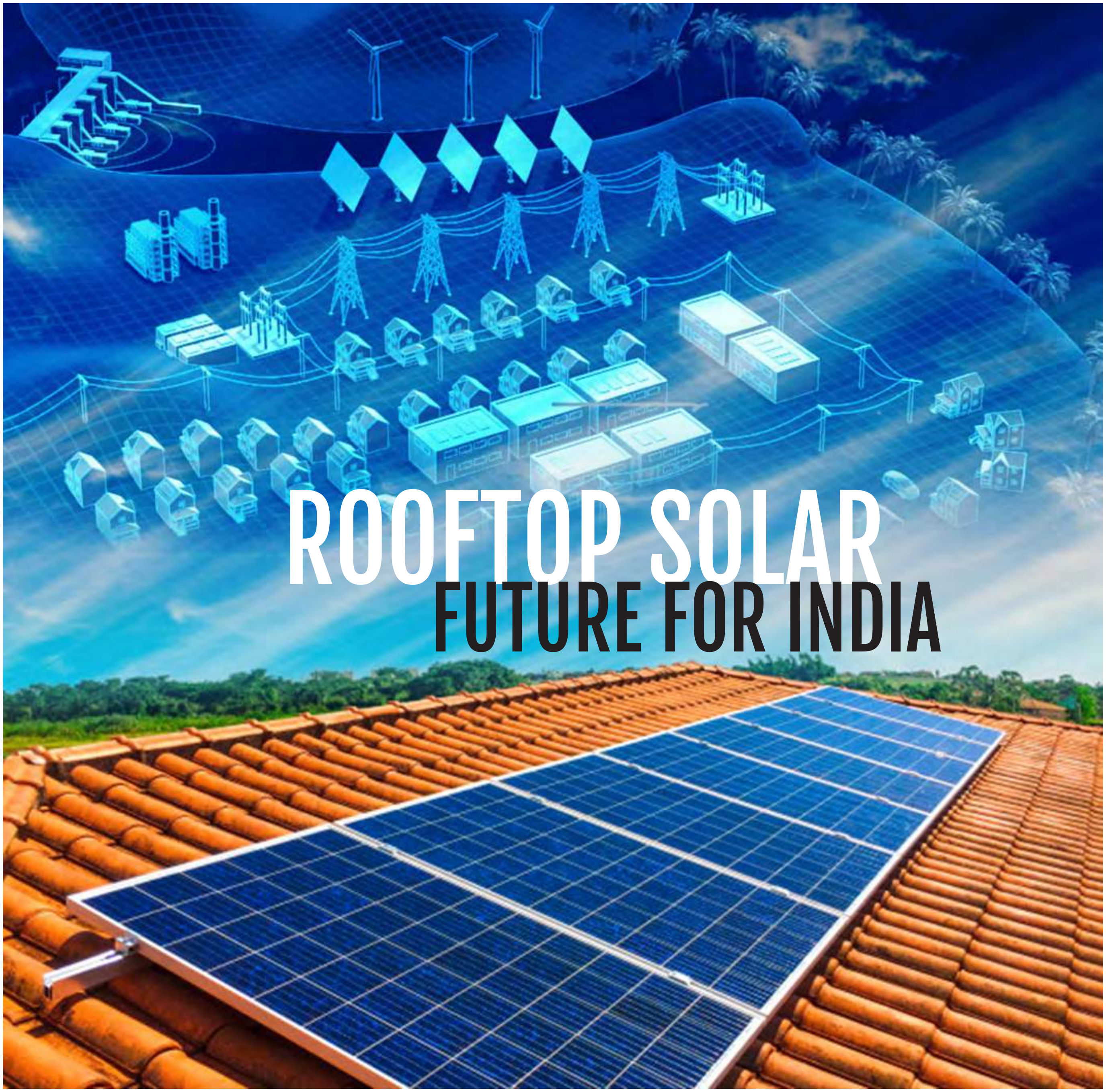


ROOFTOP SOLAR FUTURE FOR INDIA

India has committed to Paris Agreement to generate 30 per cent of its total electricity from renewable sources by 2030. Rooftop solar system will help it to some extent. It is also expected that the distributed generation (rooftop solar PV) at the consumer end will compensate to the acute power shortage in several states.

A rooftop solar power plant is a photovoltaic system that has its electricity-generating solar panels mounted on the rooftop of a residential or commercial building or structure. Solar power plants have many advantages, but one major drawback is that it requires more space. One cannot provide fertile agricultural or forest land for this purpose. Only arid lands and desert areas can be utilised for harnessing solar power. But there are large buildings, on top of which solar power plants can be installed. For rooftop solar plant, space required is about 10 square metre per kW of installed capacity.

Rooftop mounted solar systems are small compared to ground-mounted photovoltaic power stations with capacities in the megawatt range. Rooftop PV systems on residential building typically, feature a capacity of about 5 to 20 kilowatts (kW), while those mounted on commercial building often reach 100 kW or more.

Installation

The urban environment provides a large amount of empty rooftop space and hence can be used for installation of solar panels. Solar insolation in rooftops depend on time of the year, latitude of the place, weather conditions, roof slope, roof aspect and shading from adjacent buildings and vegetation.

The various components of such a system include photovoltaic modules, mounting systems, cables, inverters and other electrical accessories.

Grid-connected and Off-grid Rooftop Solar System

The rooftop solar power plant can be connected to the nearest electricity grid or it can directly feed to the consumer. In a grid connected rooftop photovoltaic power station, the generated electricity can sometimes be sold to the servicing electric utility for use elsewhere in the grid. This arrangement provides payback for the investment of the installer. Many consumers from across the world are switching to this mechanism owing to the revenue yielded. A public utility regulatory commission usually sets the rate that the utility pays for this electricity.

Advantages

With rooftop solar plant, the power bills will be massively reduced because we will need less electricity from the grid. The cost of electricity from the grid is expected to rise in the coming years, so our cost savings should also rise. With a linear power warranty of 20 to 25 years, we can expect long-term cost savings from avoiding the cost of expensive electricity from the grid.

Installers have the right to feed solar electricity into the public grid and hence, receive a reasonable premium tariff.

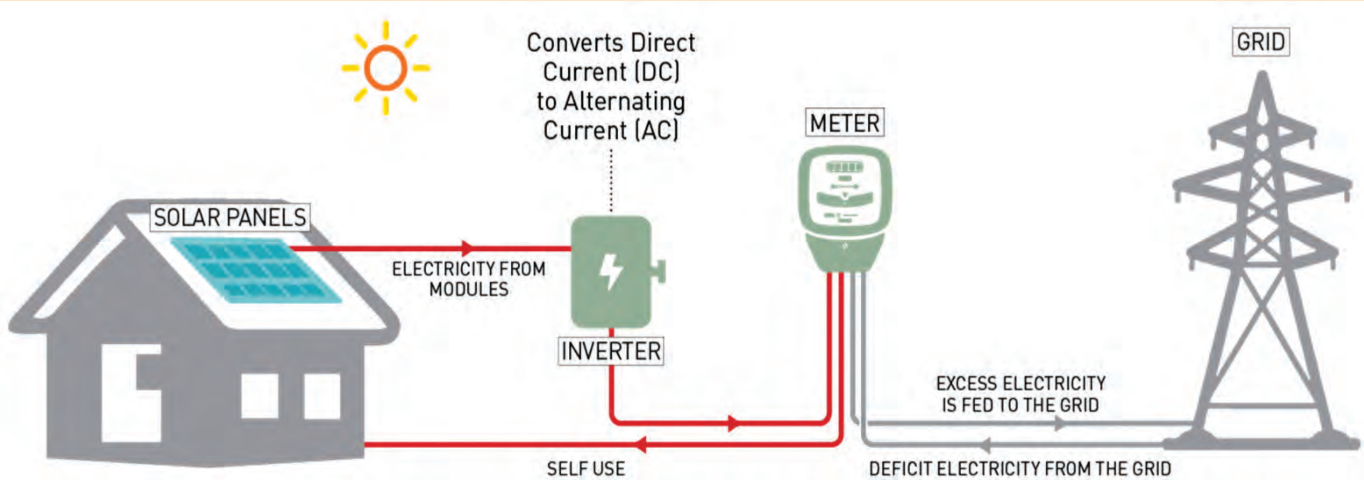
Rooftop solar system helps in reducing the generation capacity of fossil fuel power plants thereby, reducing carbon emissions to the atmosphere. It also reduces the burden of transmission and distribution system as it is being generated and utilised at the load centre. 1 kWh generated at load centre can save generation of 1.5 kWh by fossil fuel-based plants.

Disadvantages

An electrical power system containing a 10 per cent contribution from PV stations would require a 2.5 per cent increase in load frequency control (LFC) capacity over a conventional system. The capacity of the grid should be very high to tackle this problem.

Hybrid Systems

A rooftop photovoltaic power station (either on-grid or off-grid) can be used in conjunction with other power components like diesel generators, wind turbines, batteries etc. These solar hybrid systems may be capable of providing a continuous source of power.



Rooftop Solar Projects in India

The Indian solar PV market has seen significant growth rising from 40 MW to more than 26,000 MW in the last eight years. As on 13th February 2019, the installed capacity of rooftop solar power plants in India is 1443.74 MW. The estimated realistic market potential for rooftop solar PV in urban settlements of India is about 124 GW. It may be noted that the current total installed power generation capacity is 350 GW. Thus, rooftop solar PV can play an important role in providing energy security and in multiple utilisation of land, a scarce resource.

Jawaharlal Nehru National Solar Mission (JNNSM), aims to install 100 GW of solar capacity in the country by 2022, of which 40 GW is expected to be achieved through decentralised and rooftop solar projects.

World's largest single rooftop solar power plant of 11.5 MW capacity was inaugurated in Beas near Amritsar in Punjab in May 2016. It is spread at a single rooftop stretch of 42 acres at Dera Baba Jaimal. In addition to single largest rooftop solar power plant, seven rooftop solar power plants of 8 MW capacity were also inaugurated in Beas Dera campus making this place the highest single campus generating solar power of 19.5 MW at multiple rooftops in the country.

State-owned gas utility GAIL has commissioned India's second largest rooftop solar power plant in Uttar Pradesh. It is 5.76 MW solar plant installed at GAIL's petrochemical complex at Pata in UP. The plant installed on the rooftops of warehouses covers a total area of 65,000 square metre.

The installed capacity of ground mounted and rooftop solar power plants in different states of India are given in the Table - 1.

Policy for Installation of Rooftop Solar System

In India, different states have formulated policy to attract the consumers and investors for installation of rooftop solar power plants. However, major decisions are similar. For rooftop solar plants, minimum capacity is fixed at 1 kW and there is no maximum capacity limit. The condition is that the installed capacity of the rooftop solar plant will be limited to 100 per cent of the sanctioned load of the owner from the local electricity distribution company. If the electricity generated exceeds 90 per cent of the electricity consumed at the end of the settlement period, no payment shall be made by the distribution licensee for the additional amount of generation and shall not be carried over to the next settlement period.

The billing is done by net metering method. Net metering is a billing system that allows rooftop owners having solar system installed at their rooftop to sell any excess electricity generated from solar system to local electricity utility. The total bill is calculated with the units of electricity imported subtracted by the number of units exported by the consumer with the condition that the export cannot be more than 90 per cent of the import.

Another condition is that cumulative capacity of all solar systems installed in an area shall not exceed 75 per cent of distribution transformer capacity in that area.

Ownership Options

Rooftop solar power plants can be installed either by self-ownership (CAPEX model) or third-party ownership (OPEX model).

CAPEX Model

In this model, the entire investment comes from the owner of the building (power consumer). The owner generally hires a solar EPC company who provides turnkey installation of entire solar power system and hand over assets to the owner. The EPC company also does annual operation and maintenance (O&M) of the plant on mutually agreed cost per annum.

OPEX Model

In the OPEX model, an investor or project developer (sometimes called Renewable Energy Service Company – RESCO) invests the total capital amount and also does the annual operation and maintenance of the plant. The owner (consumer) pays for the energy consumed or supplied to the developer. Both owner and developer sign a long-term power purchase agreement (PPA) for an agreed tenure & tariff.

Conclusion

India has committed to Paris Agreement to generate 30 per cent of its total electricity from renewable sources by 2030. Rooftop solar system will help it to some extent. It is also expected that the distributed generation (rooftop solar PV) at the consumer end will compensate to the acute power shortage in several states. EI

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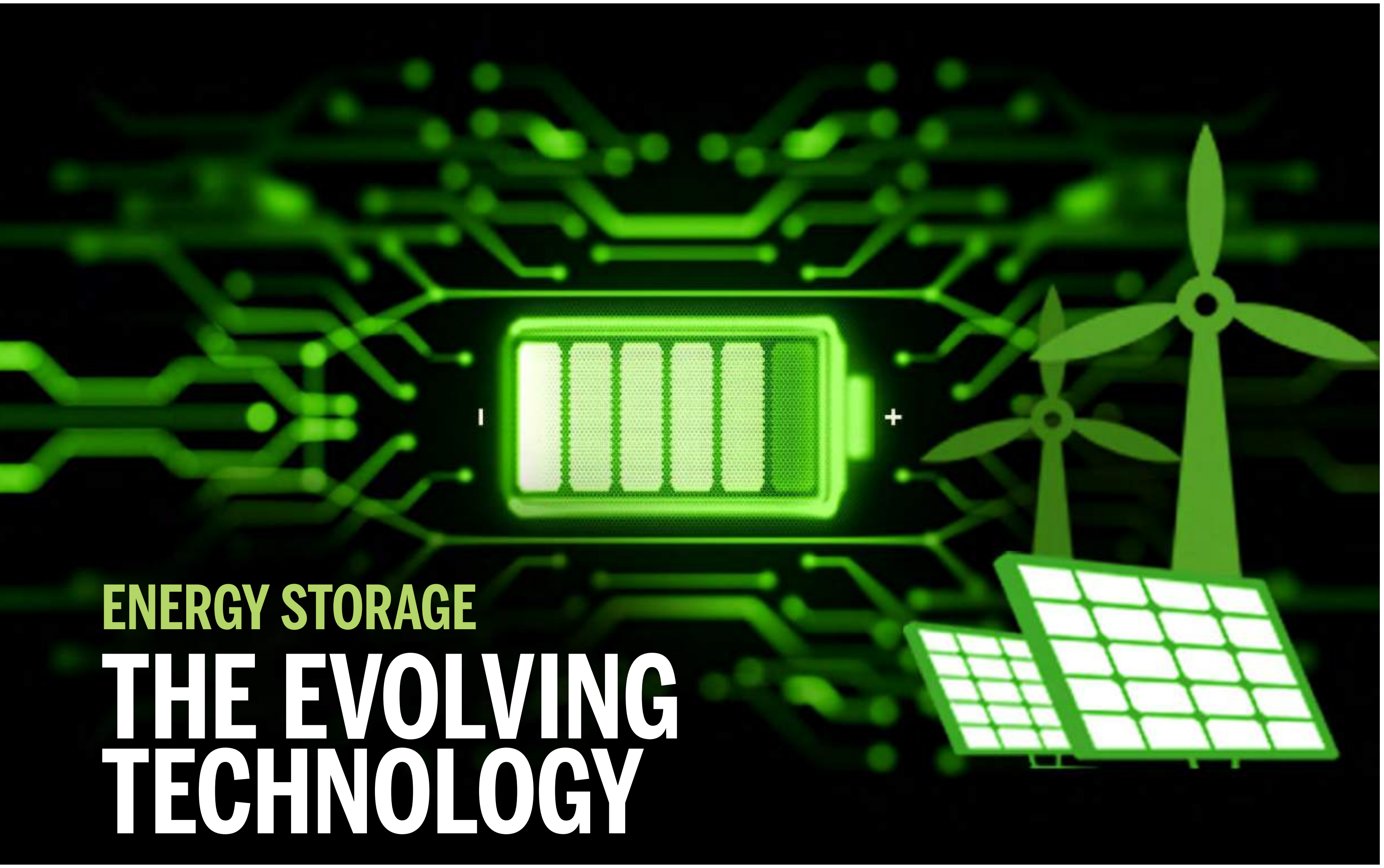
Table 1: Ground mounted and rooftop solar power plants in different states

SL. No.	STATES/ UTs	Ground Mounted (MW)	Roof Top (MW)	Total (MW)
1	Andhra Pradesh	2840.77	48.52	2889.29
2	Arunachal Pradesh	1.27	4.12	5.39
3	Assam	10.67	7.98	18.65
4	Bihar	138.93	3.52	142.45
5	Chhattisgarh	215.83	15.52	231.35
6	Goa	0.95	0.74	1.69
7	Gujarat	1836.3	166.73	2003.03
8	Haryana	130.80	88.79	219.59
9	Himachal Pradesh	0.00	4.50	4.50
10	Jammu & Kashmir	8.49	5.89	14.38
11	Jharkhand	19.05	13.36	32.41
12	Karnataka	5175.06	153.75	5328.81
13	Kerala	100.00	38.49	138.49
14	Madhya Pradesh	1619.22	30.67	1649.89
15	Maharashtra	1447.30	172.26	1619.56
16	Manipur	0.00	3.23	3.23
17	Meghalaya	0.00	0.12	0.12
18	Mizoram	0.10	0.40	0.50
19	Nagaland	0.00	1.00	1.00
20	Odisha	383.56	6.71	390.27
21	Punjab	828.1	77.52	905.62
22	Rajasthan	3045.69	96.2	3141.89
23	Sikkim	0.00	0.01	0.01
24	Tamil Nadu	2098.27	135.07	2233.34
25	Telangana	3519.27	64.34	3583.61
26	Tripura	5.00	0.09	5.09
27	Uttar Pradesh	834.00	68.33	902.33
28	Uttarakhand	239.78	64.49	304.27
29	West Bengal	50.00	19.56	69.56
30	Andaman & Nicobar	5.10	1.46	6.56
31	Chandigarh	6.34	26.06	32.40
32	Dadar & Nagar Haveli	2.49	2.97	5.46
33	Daman & Diu	10.15	4.32	14.47
34	Delhi	8.96	115.25	124.21
35	Lakshwadeep	0.75	0.00	0.75
36	Pondicherry	0.03	1.77	1.80
37	Others			
	Total (MW)	24582.23	1443.74	26025.97



ENERGY STORAGE
THE EVOLVING TECHNOLOGY

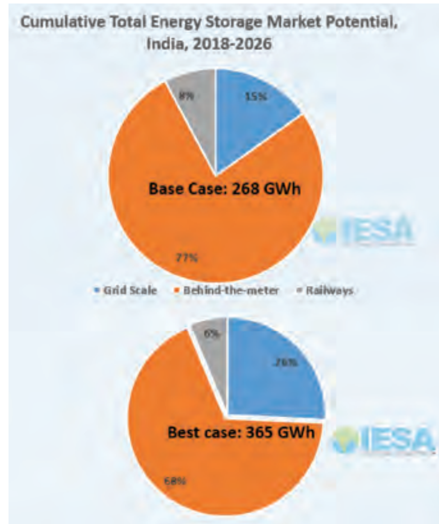
India's energy storage market is in a growing phase. According to the IESA estimates, India has the potential to integrate over 300 GWh of energy storage during 2018-25.

With a rising focus on the effective integration of renewable energy, the importance of electric vehicles and reliable energy supply, energy storage is becoming an increasingly significant means in the electricity ecosystem. Ever since the existence of an electrical grid, grid operators have been looking for ways to safely and efficiently store energy so that it can be supplied and consumed on demand. Over 170 grid scale energy storage technologies (excluding PHES) are either commercially available and or are under development across different regions worldwide. The energy storage technologies landscape is distributed across a variety of systems to ensure we meet our everyday energy needs. This includes mechanical storage like pumped hydro storage, flywheels, compressed air and electrochemical storage such as lead acid, advanced lead acid, lithium ion chemistries, sodium-based batteries, nickel-based batteries and flow batteries. Advancements in fuel cells and traditional thermal storage are also relevant to various emerging applications. It is also worth noting that energy storage is resource neutral i.e. it allows us to use electricity more efficiently, regardless of the power source. Whether the energy production is from a thermal power plant or wind power from a field of turbines, energy storage technologies can capture the energy and make it available when it is needed most. It also provides quality and reliable power to the end consumers.

World Energy Storage Day is celebrated annually on 22nd September to highlight the importance of energy storage in the energy and transportation sector, its potential and its impact on the sustainability of global energy resources. It was introduced in 2017 by Global Energy Storage Alliance to build awareness about the growing energy storage market, uses of energy storage and advancements in energy storage technologies.

The Government of India has come up with an ambitious target of installing 175 GW of renewables by 2022 and 24x7 power for all by creating an efficient, resilient and financially sustainable power sector. Likewise, in COP 21, India has committed to generate 40 per cent power from clean energy sources by 2032. This objective, along with clean energy access, has become the centre of all plans around economic development and environment. A major application of energy storage lies in the integration of intermittent renewable energy sources for applications including wind power and solar energy. In grids with a significant share of wind generation, irregularity and variability in generation output due to unpredictable changes in wind patterns can lead to imbalances between generation and load that in turn result in irregularities in grid frequency. Energy storage can provide a quick response to such imbalances and irregularities without the harmful emissions and negative environmental effects of most conventional solutions. Also, since wind power systems are often located in remote areas that are poorly connected by transmission and distribution systems, sometimes operators may be asked to curtail production, resulting in loss of energy production opportunity. Alternatively, system operators may be required to invest in expanding the transmission and distribution infrastructure. An Energy Storage system located in proximity to wind generation can allow excess energy to be stored and delivered timely upon ease of transmission. It can also be used to store the energy generated during periods of low demand (and favourable wind conditions) and deliver it during periods of high demand. With the recent focus on electric mobility, India is more dependent on battery and energy storage technologies. Battery-based energy storage provides the flexibility and agility to better integrate intermittent solar and wind energy resources into India's electric grid and ensure high-quality power for consumers.

India's energy storage market is in a growing phase. According to the IESA estimates, India has the potential to integrate over 300 GWh of energy storage during 2018-25. This includes existing applications such as backup power but also newer applications like wind and solar integration, frequency regulation, peak management, transmission and distribution deferral, diesel replacement and electric vehicles. The current size of the energy storage segment in India is estimated at over 15 GWh which is expected to grow by 12 per cent to 15 per cent year on year. In recent months various tenders by SECI, BESCOM, NTPC, NLC, CEL, GEDA and others were floated in states like Andhra Pradesh, Himachal Pradesh, Gujarat, West Bengal and Andaman & Nicobar Islands.



The Indian energy storage market is currently flooded with multiple energy storage projects in the first quarter of 2019. Presently, India already installed 14 MWh of large-scale storage for grid and renewable integration though pilot and demonstration projects at different locations. Apart from these commissioned projects, round 50 MWh of energy storage projects in India are on the verge of tender allocation or at the construction stage. Islands like Andaman & Nicobar and Lakshadweep are seeing a large number of the tender announcement on energy storage by difference agencies like SECI, REIL, NTPC, NLC and others. CEA and CERC have already recommended the inclusion of energy storage with solar and wind hybrids, so we also anticipate that in addition to the 3.6 GWh storage project, other hybrid tenders will also have an opportunity for storage technologies to be included.

India is expected to attract investment in 3 to 5 Giga factories for advanced Li-ion batteries, attracting over $3 billion investments in the next 3 years. Already, over 1 GWh of annual assembling capacity is being set up for converting imported Li-ion cells into battery modules by various Indian and global companies in India. In this regard, many Indian companies are eying to enter India's storage market while a few Indian companies are also diversifying their existing business into energy storage space. Looking at potential India has to create a 10-15 GWh capacity by 2022. And as this happens, ancillary development including module development, containers, transformers, inverters could need an equal amount of investment, taking the total potential to $6 billion.

India is also focusing on domestic manufacturing for all types of energy storage technologies including advanced lead acid, thermal storage and ultra-capacitors apart from Li-ion batteries. Ministry of Science and Technology is also keen to accelerate domestic R&D capabilities to support this growing industry through Mission Innovation. States such as Telangana, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat are showing interest in attracting investments from companies to set up units in this space. In March 2019, GoI approved setting up of National Mission on Transformative Mobility and Battery Storage to drive clean, connected, shared and sustainable mobility initiatives in the country creation of the Phased Manufacturing Programme (PMP) valid for five years till 2024 to support setting up of a few large scale, export competitive integrated batteries and cell manufacturing giga plants in India. This aims to provide a push to the entire e-mobility ecosystem that includes electric vehicle manufacturers, charging infrastructure development companies, fleet operators, service providers, etc. NITI Aayog is also working on PMP to catalyse cell manufacturing and EV component in India. Recently, India and Bolivia signed a Memorandum of Understanding (MoU) for the development and industrial use of lithium for the production of lithium-ion batteries. Bureau of Indian Standards efforts on generating energy storage standards will create the benchmark for quality and will boost the Indian energy storage and electric vehicle market.

Currently, India has 1 GWh of Li-ion assembling facility and 4-5 institutions are in discussion to put up cell manufacturing facilities in the next 2-3 years. The current cost of the Li-ion battery pack is at US$ 250-350 per KWh as compared to US$ 1,000 per kWh in 2011. Li-ion battery accounts for 40-50 per cent of the overall cost of the EV and is the most expensive component of EV. Indigenous manufacturing will bring down the cost of Li-ion batteries and to further bring down the cost of EVs. All the foremost OEMs are currently importing batteries from China, Taiwan and Korea. Various Indian companies have already entered into the cell to pack assembling. But there is a huge opportunity in India for Li-ion cell manufacturing India.

We are at a critical stage for building a manufacturing ecosystem for advanced energy storage technologies in India. Around the globe, over 200 GWh of advanced energy storage manufacturing capacity is already built and another 200 GWh of new capacity will be built within the next three to five years.

In the month of September, IESA celebrated India Energy Storage Week (IESW) on the occasion of 3rd World Energy Storage Day with a myriad of activities like India Energy Storage & EV Technology Forum, 3rd India Energy Storage & EV Policy Forum, IESA Investment Forum & start-up competition and Masterclass on energy storage manufacturing. More than 200 industry leaders gathered at IESW to celebrate 3rd World Energy storage Day in Delhi and Mumbai respectively. From 23rd September to 27th September the week-long activity saw representatives working on Technology, R&D, Policy and Investment collaborated and shared their thoughts on the future of storage. The five-day long celebration of IESW and the discussions held in the same indicates the importance of storage and the critical role the technology will play in the achievement of India's energy security. All the discussions held in the sessions stressed on indigenous manufacturing, setting up of appropriate standards, procedures and laying out of proper policies and regulatory frameworks to make storage deployment sustainable over the long run. With appropriate government support, industry participation, India will be one of the top markets for energy storage adoption and manufacturing. EI

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India Energy Storage Alliance (IESA)

Pondering over the solar and renewable sector – Intersolar 2019 Bangalore

- By Ranjana Konatt, Editor (Brand Positioning)

Intersolar India is one among India's pioneering exhibitions catering specifically to the solar sector. The Intersolar exhibition 2019 was held from November the 27th to 29th 2019 at the Bangalore International Exhibition Centre, Bangalore. As an annual exhibition, the event laid special focus on the segment of photovoltaics, PV production and solar thermal technologies. The event was hosted under the umbrella of the smarter E India – India's innovation hub for new energy. Intersolar 2019 saw approximately 10,000 attendees at the centre. The overall sentiment of industry representatives was that digitalisation and decentralisation is changing the way we view energy as a market, and with a steady rise in electricity from volatile and renewable sources, the exhibition of this scope not only aimed to be a platform to network but also to make way for new solutions for electricity generation, storage, distribution and its use in an efficient manner.

The Intersolar India Conference and the 1st Power2Drive Conference featured over 150 influential speakers who provided insight into various market dynamics and opportunities for growth during the year 2019 and beyond. The opening ceremony comprised of keynote speeches delivered by government officials and solar experts. Among the many who attended the event was - B. S. Yediyurappa, Honourable Chief Minister, Govt of Karnataka; Upendra Tripathy (IAS), Director General, International Solar Alliance; Mahendra Jain (IAS), Additional Chief Secretary to Govt, Govt of Karnataka; Ajay Misra (IAS), Spl. Chief Secretary to Govt, Govt of Telangana; Gunjan Krishna (IAS), Commissioner for Industrial Development & Director of Industries & Commerce; A.B. Basavaraju (KAS), Managing Director, Karnataka Renewable Energy Development Ltd; Praveen Saxena, Chief Operating Officer, Skill Council for Green Jobs; Ramesh Shivanna, President, Karnataka Renewable Energy Systems Manufacturers Association; Bhupinder Singh, CEO, Messe Muenchen India; Florian Wessendorf, Managing Director, Solar Promotion International GmbH, and Daniel Strowitzki, CEO, Freiburg Management & Marketing International GmbH.

The event also saw other crucial events such as Mercom India's White Paper released at the event, in addition to free expert presentations at the innovation and application stage. Another key aspect that received a considerable amount of focus during the three-day show was the know-how to financing and good business acumen when scaling within the solar and renewable sector. Speaking at one of the conferences was Chirag Vageria, Managing Partner, Agami Infra Developers LLP. Drawing attention to the Indian market, he analysed logical expansion plans for the renewable sector from a business

standpoint. While highlighting many stages for company growth and capital needs, he said: "It is key to understand customer needs, develop an initial business plan, understand the core technology and the product before you even think about scaling up." Also, he said: "It is essential to stimulate customer awareness and demand, develop the supply chain and build an operational capacity to scale."

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kVAh Based Billing Structure

kVAh billing is more effective and is preferred by utilities – Baldev Raj Narang, CEO, Clariant Power System Ltd explains.

Industrial load is mainly inductive and needs reactive power in addition to active power for its functioning. Active power is consumed by the loads to perform intended work like motion, heat or light whereas reactive power is used to provide electromagnetic field in the inductive equipment. The reactive power consumption for a resistive load is nil as no electromagnetic field is needed for its operation. Reactive power also regulates voltage, improves voltage profile and enhances system stability. Some of the grid failures occur due to insufficiency of reactive power in the system. The reactive power needs can be met either locally at consumer end by installing reactive power system or else it has to be imported from the grid. If the electricity tariff is based on active energy kWh (kilowatt hour) alone then the utility bears the burden of supplying reactive power free of cost. The measures by utilities such as power factor incentives are not very effective in curbing reactive power import from grid by consumers. Alternatively, kVAh (kilo volt ampere hour) billing is more effective and is preferred by utilities. It takes care of both active power consumption as well as reactive power consumption. The measures taken by consumers to optimise electricity bill improve the efficiency of customer installation as well that of utility network besides helping utilities in better utilisation of their installed capacity. There is reduction in heat losses. If correctly designed reactive power systems are installed by consumers there is also an improvement in quality of power. Utilities need approval of Electricity Regulatory Commissions for migrating from kWh billing to kVAh billing. The purpose of this approval is to ensure that the concerns of both consumers and utilities are taken care while changing the billing mechanism.

Scenario in case of kVAh based billing

- Utilities prefer kVAh billing wherein consumers need to maintain PF close to unity for optimum kVAh consumption. This encourages consumers to generate their own reactive power.
- Reactive power consumption charges are built in the kVAh tariff regime.
- PF incentive is built in the tariff structure thus no separate PF incentive is given.
- Utilities maintain kVAh tariff cheaper than the kWh tariff.
- The computation of kVAh is based on RMS current and thus Harmonics affect kVAh consumption. The distortion power factor increases with increase in harmonic content which reduces true power factor and increases kVAh consumption.
- Some utilities have declared migration to kVAh billing but in actual practice they continue to treat leading power factor as unity and the billing remains same as that for kWh regime if the average PF is maintained unity or any leading PF value.
- To optimise the billing consumers, need to have a relook at their reactive power installation. There has to be less reliance on fixed compensation. Automatic compensation both on LT and HT can only provide optimisation.

Scenario in case of kWh-based billing

- Utilities supply both active and reactive power. In kWh tariff active power consumption is billed whereas the reactive power supplied by the utilities remains unbilled.
- The PF incentives are normally available in this tariff regime and this encourages consumers to improve PF and reduce their reactive power consumption. In an ideal case when PF is maintained close to unity the PF incentive is highest and reactive power consumption is negligible. In such a case entire reactive power requirement of load is catered to by the consumer himself by capacitors or other means such as active compensation. The question of charging for reactive power consumption by utilities does not arise as they supply no reactive power lagging or leading to the consumer.
- If load power factor at a consumer premises is poor and is not improved by consumer the utility has to cater to the reactive power needs of load which requires utility company to strengthen its reactive power installation. The utilities in India charge PF penalty for PF values below 0.9. Wherever the PF incentives are either negligible or non-existent the consumers target for achieving somehow 0.9 PF instead of i=an ideal value of unity. This leaves a very large chunk of reactive power needs of the consumers to be taken care by utility company.
- The power factor incentive is based on average monthly value which is easier to achieve through a mix of fixed and auto compensation thus enabling consumers to get maximum incentive.
- Some utilities overlook leading PF values while computing average power factor. This tempts consumers to use capacitors indiscriminately for availing PF incentive but it does more harm than good to the installations of both utilities and of consumers.
- The low power factor penalties to consumers do not adequately compensate the utilities for unaccounted consumption of reactive energy by consumers.

Scenario in other countries

In oil rich GCC countries the power is surplus and cheap, till recently both PF penalties and PF incentives were non-existent. Thus, there was no encouragement to improve power factor. Similarly, consumers could get away without any penalties even for very low power facto values. After oil crisis a beginning has been made by specifying threshold value below which penalties have been made applicable. Similar is the case in most of the developed countries. The PF values being maintained by consumers are poor. The ROI on reactive power installations is insignificant thus discouraging investment on these systems. EI

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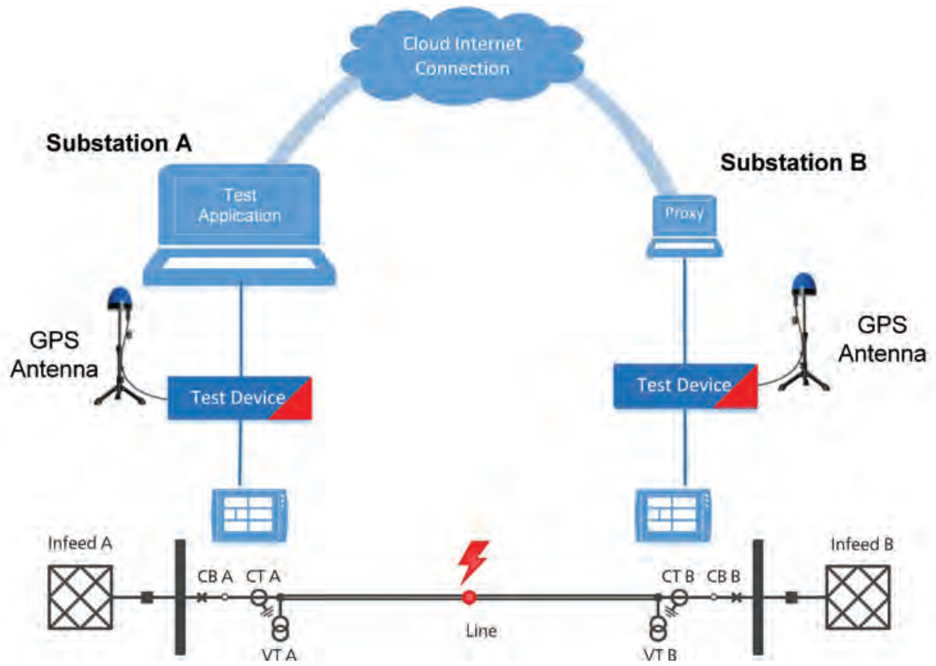

Figure 4. Test set-up with RelaySimTest for system testing

System-based testing of distance protection relays

Testing distance protection relays – safe, simple, quick

In order to guarantee an instantaneous trip on 100 per cent of the line while maintaining the same level of safety, communications-based logic is often used. A large number of variants have developed, from the permissive underreach transfer trip (PUTT) to the permissive overreaching transfer trip (POTT), all of which have their justification, depending on their use. Before commissioning distance protection with communication, it is absolutely necessary to know, understand, and test the method used in detail. Due to the brevity of this article, the relationships here are described with reference to distance protection with permissive overreach transfer tripping. POTT is, in practice, the most appropriate protection method for weak infeeds, short lines, multi-terminal or tapped lines, and strong intermediate infeeds. Checking this function on different system conditions is, therefore, of particular interest and importance.

Method of operation of permissive overreach tripping

In POTT, receipt of a release signal releases an overreaching distance zone, Z1B. In the event of a fault on a line fed from both ends, both protection relays detect the fault in the forwards direction and send each other a release.

In the case of very short lines, where the actual Zone 1 value is less than the minimum value possible for the protection relay, a release is mandatory for the trip. Otherwise the "Trip" can be sent from Zone 1 without a release (Figure 1).

Weak infeed and echo function

One particular feature of POTT is the ability to achieve 100 per cent protection instantaneously, even during weak infeed conditions. If a fault occurs near the weak infeed, the fault current can be less than the distance protection pickup. Without special logic, the protection relay at the weak infeed would not send a release and only the remote protection relay would trip in Zone 2 time. A special logic in the relevant protection relay detects a weak infeed from the undervoltage occurring due to the fault, or from the absence of a pickup from

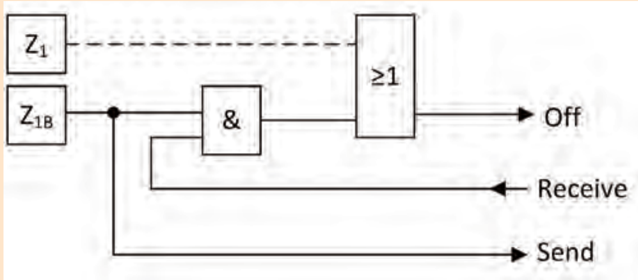

Figure 1. Distance protection with permissive overreach transfer tripping

the reverse zone while at the same time receiving a release. In this case, the local circuit breaker (CB) is tripped and the release signal from the remote end with a strong infeed is sent back like an echo.

A similar condition occurs if the protection relay receives a release while the local CB is already open. In this case the fault must be on the line. If the CB is in open state the local relay echoes back a release and the remote protection relay can respond instantaneously.

Reverse current monitoring

Due to the overreaching release logic, special precautions must be taken when using parallel lines. This becomes clear when considering the precise chronological sequence of events during a local fault in a parallel line (Figure 2 A).

Relay B1 measures the fault in the extended zone and sends the release signal. Protection relay A1 measures the fault in the reverse direction which prevents an instantaneous trip. At the same time, the protection devices A2 and B2 of the faulty parallel line detect the fault and both trip instantaneously. We now assume that circuit breaker A2 opens shortly before circuit breaker B2, due to the time tolerances, which results in a current reversal for relays A1 and B1 (Figure 2 B).

Relay A1 now detects the fault in the forwards direction in its extended zone. At the same time, relay B1 detects the fault in the reverse direction and consequently revokes its release. When this happens, relay A1 detects the forwards direction earlier than the drop of the release from B1. This period is shown in red in Figure 3. According to the POTT logic, relay A1 should now trip immediately. This unselective tripping is prevented by what is known as current reversal blocking. It blocks POTT for a defined period after the detection of a current reversal.

Testing

A wide variety of test methods exist for commissioning POTT which differ in their testing depth (Table 1).

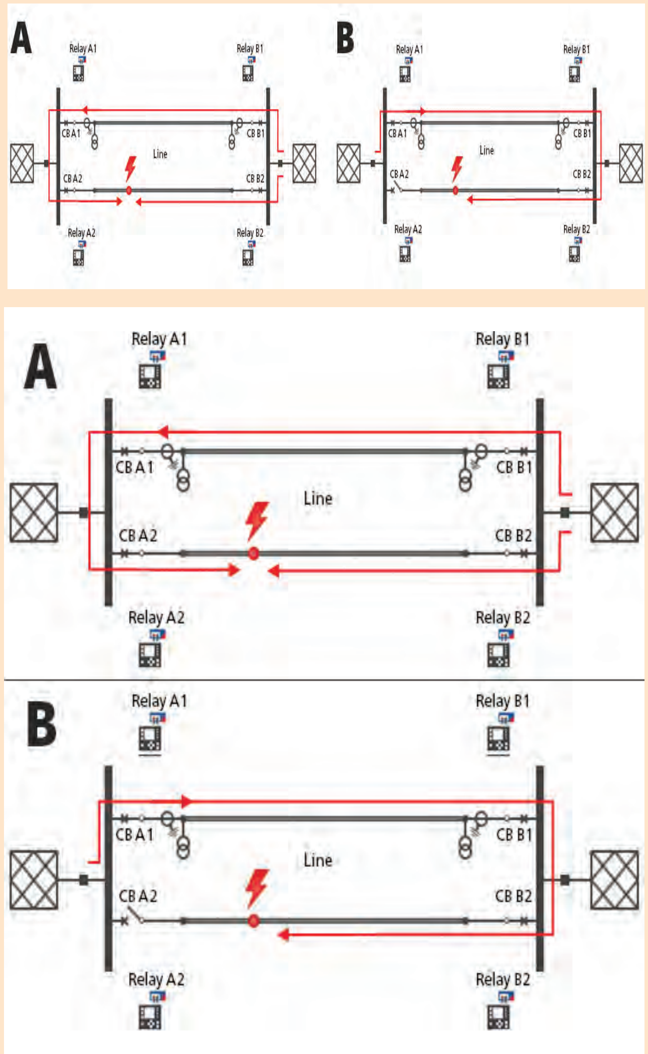

Figure 2. Current flow in the event of a fault (A) and reverse current after circuit breaker Off (B)

When setting up the test case, it is advisable to always simulate the real fault scenario as realistically as possible, regardless of the test method. This includes simulating the CB auxiliary contacts, for example. The pickups of the individual elements in the logic should be included in the log for evaluation if possible.

Single-ended testing

Since the release signal is binary information that can easily be simulated by a test unit, single-ended testing of a relay is the most frequently used method. A prefault is output for the main function, followed by a fault in Z1B while simultaneously simulating the receive signal. The instantaneous trip and the sending of the release to the remote protection relay are evaluated. Good test solutions allow the fault situation in the impedance

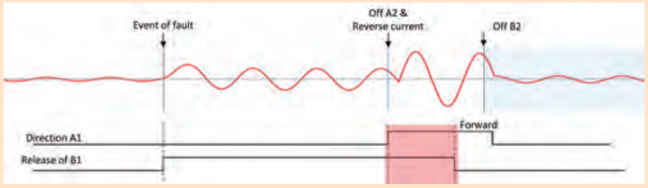

Figure 3. Signal pattern with reverse current monitoring

plane to be defined, including the representation of the distance protection polygons and tolerances. The test sequence described above can then be set up relatively easily. At the same time, this allows the reach of the extended zone and the logic circuit to be verified.

System-based testing

The following important factors influencing the subsequent operation of the protection system but which are disregarded by single-ended testing are:

- Communications delay (timing)
- Correct alignment of the relay settings to each other
- Real infeed conditions.

A system-based test is advisable in order to draw a conclusion as to whether the protection system, consisting of two or more relays; their settings; and the communication; protects the grid system. An ideal system-based test takes place at all ends (end-to-end) and is time-synchronised. The signals are calculated with the aid of a simulation of the grid section to be protected. Every fault scenario can be implemented directly using fault and CB events. In this way, a simulation of the grid allows the protection system to be tested under real infeed conditions. For example, whether or not the "weak infeed" threshold value has been correctly selected can be tested. This additional test quality feature would also be present if the protection test was single-ended with grid system simulation. However, simultaneously testing both ends also takes into account the operation of communications, the influence of delay, and the tuning of the protection relays to each other. Software solutions, which combine a transient grid simulation with simultaneous activation even of distributed test sets, already exist to carry out such a system-based test. This considerably reduces the time taken both for setting up and for executing the test. Furthermore, test solutions of this kind can include time delayed "trip" commands for the protection relays in the simulation, which not only reveals timing errors, but also checks logic functions such as the AR as well.

Summary

Commissioning a POTT method often requires more than just testing the instantaneous trip over 100 per cent of the line. Single-end tests with stationary sequences are simple and proven test methods. The complexity when designing POTT should not be denied, however. A system-based test here offers a simple but effective way of finding any faults. EI

Dipl.-Ing. (FH) Christopher Pritchard

Product Manager and in particular responsible for system-based testing solutions.

Table 1. The test methods for commissioning POTT differ in their testing depth.

Function	Fault scenario	Evaluation criteria
Overreach	Stable power flow	No pickup and trip
Communication fault	Fault in Z1 and Z2	Trip corresponding to time grading
Backup protection	Reverse and forwards fault in the subsequent line	Trip corresponding to time grading
100 per cent instantaneous	Fault along the line before and after Z1 boundary	100 per cent instantaneous trip
Reverse current monitoring	Fault in parallel line, followed by time delayed CB "trip" on the parallel line	No trip, read off blocking and pickup
Echo function	Local fault on the line with an open local CB	Release sent from the local relay and instantaneous trip of the remote relay
Weak infeed signal	Local fault at the weak infeed	Instantaneous trip despite no pickup of the extended zone at the weak end
Weak infeed overreach	Local fault in reverse direction	Trip corresponding to grading

Addressing key issues – The Cable and Wire Expo 2019

- By Ranjana Konatt, Editor (Brand Positioning)

The Cable and Wire Fair 2019 was held from November 6th to 8th 2019 at Pragati Maidan, New Delhi. This year, the event saw participation from approximately 200 exhibitors from around 25 countries. Among the many sub-sectors, the exhibitors had the following profiles: Annealers & heat-treating equipment; braiding machines; accumulators; preheaters conductors & wires; dies & die making equipment; drives, controls & process tools; extrusion lines, equipment & tooling; fibre optic cable & optical fibre manufacturing equipment; fillers, insulation, jacketing/sheathing compounds & colorants; guides, pulleys, sheaves, rollers; lubricants & process chemicals; marking and printing machines & materials; optical fibre cables; payoffs and takeups; quality control, measurement devices & testing equipment; reels, spools, baskets, cores, carriers & packaging; respoolers; rolling mills, flattening & shaping; rotating machinery - bunchers, cablers, standers, twinners.

As in its prior editions, the expo conducted this year was aimed at enabling networking while also proving to be a platform for riveting discussions. The topics proved to be critical to knowledge sharing. Among the many industry representatives participating in the conference was Dilip Dev, Chairman, SWMAI, H.D. Wires Pvt Ltd; Nirmal Saraf, Past- Chairman, SWMAI, Nirmal Wires Pvt Ltd; Siddharth Agarwal, Member, Executive Committee, SWMAI, Systematic Industries Ltd. Pointing to a key issue within the market, Dilip Dev, Chairman, SWMAI, H.D. Wires Pvt Ltd said: "Among the many challenges is the continual shift in demand for steel within the Indian market which is price-sensitive. We see a shift in demand for steel wires, and there also exists a bias within the market from the customer end. These trends are not good for the industry as a whole. Secondly, another issue is the lack of skilled-labour on the delivery end, especially for galvanised steel processes." While suggesting that the industry needs to take measures to deal with such situations, he said: "We are doing our part to deal with the lack of skilled professionals and have built a centre for training, where industry representatives can come and train to work hands-on as skilled professionals."

Another aspect addressed during the conference was the economic situation of the country as a whole which in turn has been influencing the wire and steel industry. The panellists suggested that much of the economic situation has to do with the banking system. As a consumer economy, we are to see fast growth, but the hindering problem seems to also be the liquidity crunch. Also, a few other challenges that were sighted during the extensive discussion was that the wire industry is fragmented and unorganised. Industry representatives called for a unified approach to solving industry issues while tackling them with a holistic approach. Other industry challenges sighted was the need for quality in the products being used in projects and the necessity to adhere to standards. A unified call was also made for a body or association that could cross-check the quality of the products being used in projects.

Overall, the general sentiment held by the panellists and industry representatives was positive. India is the world's second-largest crude steel producer, as its production stood at 106 metric tonnes in the year 2018. The steel and the cable and wire sector are broadly driven by domestic production of raw materials such as iron ore and cost-effective labour. This also tells us that we can hope for a competitive market. While there are challenges, the Indian steel industry is modern and it does have the potential to continually upgrade as a major producer.

Genset Controllers

A genset acts as a backup or an alternate power source. It provides power output to the loads as and when required. Genset Controller is used to control the functioning of the genset system. A genset controller provides various monitoring functions of a genset, monitoring of various electrical parameter like voltage, current, frequency, power etc. It also has capability to measure the temperature, oil level/ pressure etc.

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    The AMF controller is a kind of module used in generator control panel when you have to control a generator that is connected in standby configuration. It is about a system that is waiting for a failure of the power utility. The product is recommended for high-end offering
  - **DGC - Genset Controller (RI 302 G)**
    A Genset Controller provides an auto switch when the mains supply fails and provides back up to load as a temporary arrangement. After retaining of mains supply, the genset switches the load back on mains supply. The product is recommended for standard requirements.
  - **ATS - Automatic Transfer Switch (RI 301 ATS)**
    A transfer switch is an electrical switch that switches a load between two sources. An Automatic Transfer Switch (ATS) is often installed where a backup generator is located, so that the generator may provide temporary electrical power if the utility source fails. The product is recommended for upgradation or retrofitting solutions.
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- Gasoline engines support with automatic management of the choke valve.

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igus smart plastics make maintenance intelligent

Smart products made of tribo-polymers increase the service life of machine tools by digitally monitoring their status.

Intelligent maintenance in the era of Industry 4.0: with igus smart plastics, you can increase the reliability of machine tools, plan maintenance tasks and as a result, reduce costs.

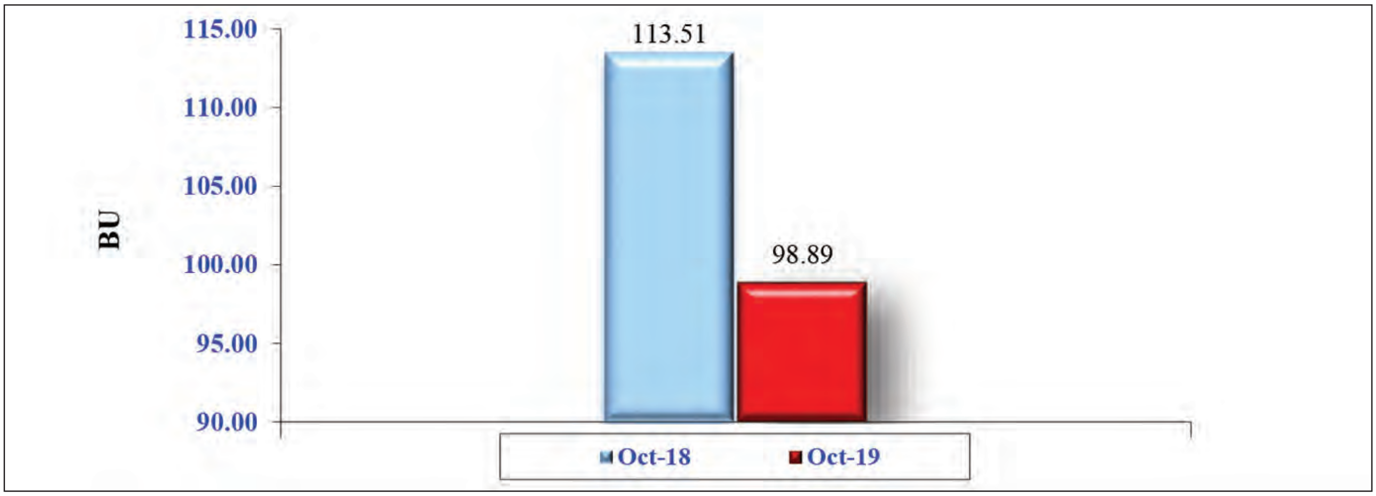
Maintenance in the era of Industry 4.0 means a clear change of paradigm. Instead of personnel carrying out maintenance at fixed intervals or merely reacting to a failure or a fault, so-called "predictive maintenance" makes it possible to continually monitor the status of the machine tool. Repair or replacement is only carried out when really necessary. Maintenance tasks can be planned precisely. At the same time, unscheduled shutdowns and therefore the costs of failure can be reduced due to condition monitoring. In order to make this possible, igus has developed sophisticated smart plastics, by using diverse sensors and monitoring modules for energy chains, plain bearings, linear bearings and slewing ring bearings. For example, sensors for the measurement of abrasion or wear of the pin/bore connections of energy chains as well as sensors for the detection of breakages and the push/pull forces being applied. Due to networking with the new igus communication module (icom.plus), the sensors are integrated into the customer's own IT infrastructure, for example into production management systems such as SCADA and MES, or online into cloud solutions throughout a company.

Flexible data integration with new icom.plus

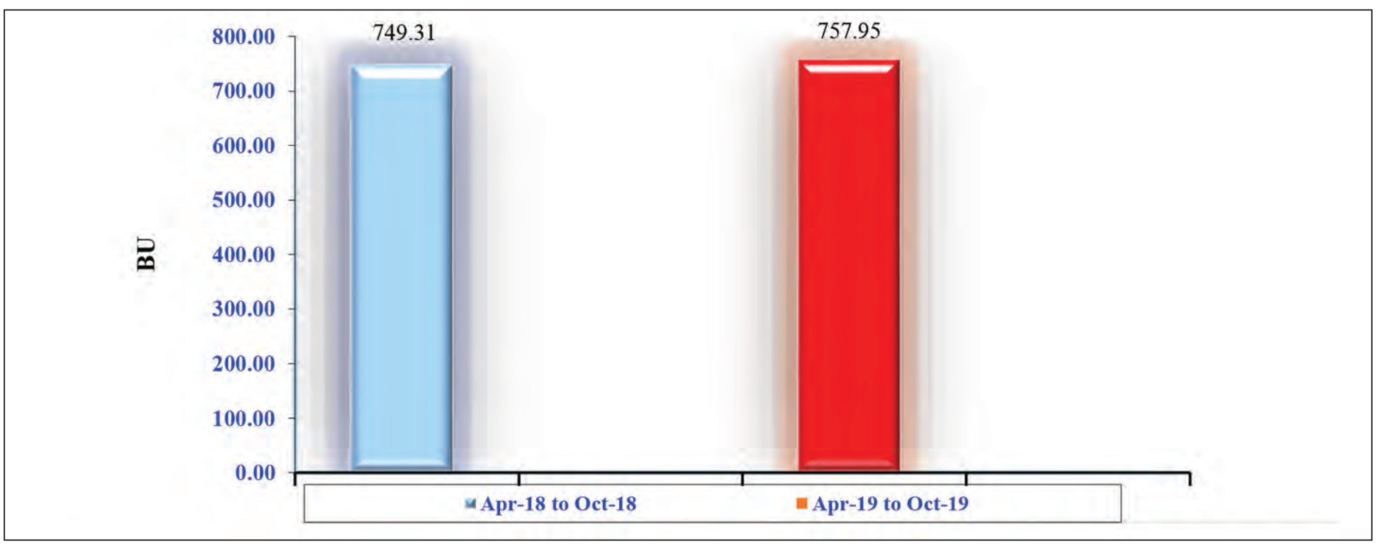
The icom.plus is programmed with initial service life algorithms on the basis of igus configuration tools and, at the customer's request, can be operated offline without an update function after online installation. The user can therefore decide how the module is connected and how the data is managed, while establishing a balance between runtime maximisation and IT security. If online connection of the icom.plus is chosen, the service life information is continuously compared with the igus cloud in order to enable maximum machine run times with a minimum risk of failure. The data in the cloud inter alia draw on the 10 billion annual test cycles of energy chains and cables performed in the company's own 3,800 square metre test laboratory. On the basis of these tests, the results of which are incorporated into the freely available service life calculator, it is possible to precisely predict how long an e-chain, for example, will work reliably in the respective machine tool application. Thanks to the isense components, the service life is continually updated, giving the customer additional reassurance. This is because each update takes into account the current ambient conditions of the application. Thanks to machine learning and continuous improvement, precise information on the durability of the individually used solutions in real applications can be obtained. This information can be viewed on the screen of the machine control system and, if online connection is chosen, an SMS or e-mail can provide the relevant details if unexpected operating states occur or maintenance is impending. At an early stage, users are informed if there is a need to procure replacement parts; a wide range of scenarios such as automatic initiation of maintenance work or the ordering of replacement parts as well as "e-chain as a service" can be implemented. EI

For more details, visit www.igus.in

Electricity Generation for Oct-2019 (BU)				
Type	Achievement	Targets	Achievement	% Change of Achievement w.r.t. Oct-2018
	Oct-18	Oct-19	Oct-19	
Thermal	97.586	99.796	78.705	-19.35
Nuclear	3.153	3.458	4.168	32.19
Hydro	12.410	11.419	15.115	21.80
Bhutan Import	0.357	0.783	0.897	151.26
All India	113.51	115.46	98.89	-12.88



Electricity Generation During Apr-18 to Oct-18 & Apr-19 to Oct-19 (BU)			
Type	Apr-18 to Oct-19	Apr-19 to Oct-19	% Change w.r.t Apr-18 to Oct-18
Thermal	627.195	613.559	-2.17
Nuclear	22.156	28.195	27.26
Hydro	95.792	111.110	15.99
Bhutan Import	4.170	5.081	21.85
All India	749.31	757.95	1.15

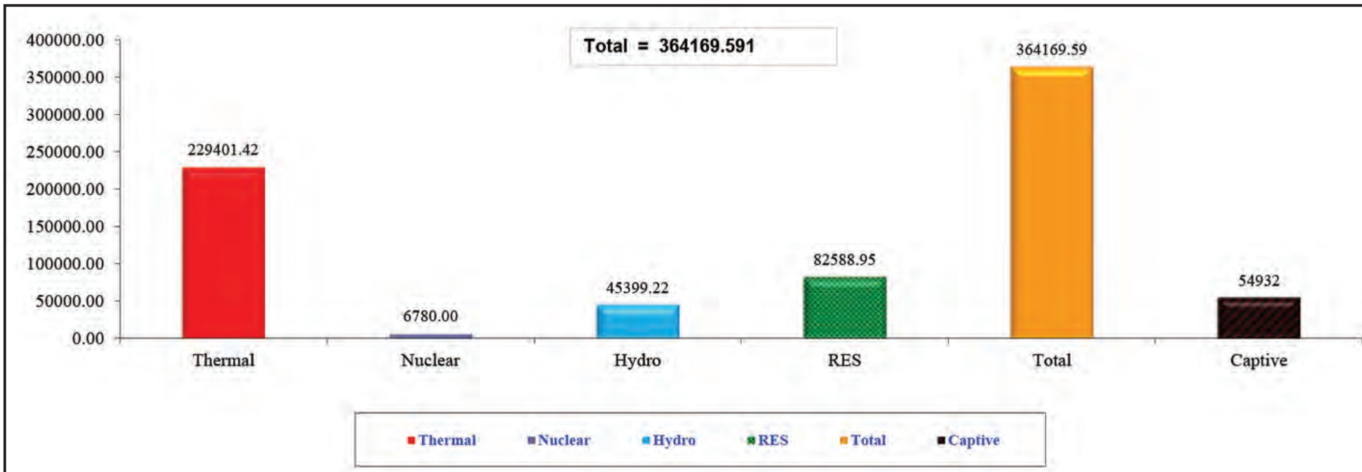


Source: CEA

Generating Capacity Addition for Oct-2019 (MW)				
Type	Achievement	Targets	Achievement	% Achivement w.r.t. Oct-2018
	Oct-18	Oct-19		
Thermal	600	500	800	133
Hydro	0	70.33	0	NA
Nuclear	0	0	0	NA
All India	600	570.33	800	133
NA -Not Applicable				

Generating Capacity Addition during Apr-18 to Oct-18 & Apr-19 to Oct-19			
Type	Apr-18 to Oct-18	Apr-19 to Oct-19	% Change w.r.t Previous Year
Thermal	669.755	4145	518.9
Hydro	140.000	0	-100.0
Nuclear	0.000	0	NA
All India	809.755	4145	411.9
NA -Not Applicable			

All India Installed Capacity (MW) Region-wise as on 30-10-19									
Region	Thermal					Nuclear	Hydro	RES**	Grand Total
	Coal	Lignite	Gas	Diesel	Total				
Northern	50811.97	1580.00	5781.26	0.00	58173.23	1620.00	19707.77	15829.74	95330.74
Western	73553.62	1540.00	10806.49	0.00	85900.11	1840.00	7547.50	24648.49	119936.10
Southern	43042.02	3140.00	6473.66	433.66	53089.34	3320.00	11774.83	40252.77	108436.94
Eastern	29516.87	0.00	100.00	0.00	29616.87	0.00	4942.12	1476.72	36035.71
North-East	770.02	0.00	1775.81	36.00	2581.83	0.00	1427.00	363.05	4371.87
Islands	0.00	0.00	0.00	40.05	40.05	0.00	0.00	18.19	58.24
All India	197694.50	6260.00	24937.22	509.71	229401.42	6780.00	45399.22	82588.95	364169.59



Note: Captive Genaration is not included in the total. *Captive Power capacity as on 31.03.2018 ** RES as on 30.09.2019.

Source: CEA

FLIR CM65: True RMS 600 a solar clamp meter

The CM65 is a rugged clamp meter designed to meet the challenges of solar installation, maintenance, and repair. This clamp meter comes with quick-connect MC4 test leads that improve the accuracy and safety of DC voltage measurements on solar panel strings and inverters. With the CM65, you can validate AC output and inverter efficiency and then store readings to the internal memory. Share data wirelessly via METERLiNK or monitor measurements live on a smartphone running the FLIR Tools mobile app. Photovoltaic (PV) installers can trust the CM65 as their go-to tool for accelerating and simplifying photovoltaic panel testing on new and existing solar panels.

Key features

- Trust AC voltage and current measurements from inverters and mains are accurate with True RMS
- Eliminate errors from residual ghost voltage using LoZ (low impedance) mode
- Get sharp (±) 1.5 per cent accuracy when taking AC and DC current readings
- Capture the smallest voltage fluctuations when calibrating equipment using the CM65's millivolt function
- Reduce the time needed for live/dead testing with included MC4 test leads
- Gain quick insights with data hold, min/max readings, and relative mode to zero the meter
- Troubleshoot string connections and components with a Continuity test mode
- Measure resistance, frequency and temperature
- Easily clamp around wires with the generous jaw (30 mm) and ergonomic design
- Take measurements, document results, and then share them on the go
- Identify trends and anomalies by data logging directly to the internal memory. EI

For more information, write at flirindia@flir.com.hk or visit www.flir.in

Safe cable guidance on robot for a small price

New retraction system from igus for energy chains ensures fail-safe operation of robots in modern factories


Cost-effective and safe: The new TR.RSEL retraction system with energy chains ensures trouble-free operation of robots.

Welding, riveting, soldering: Industrial robots must work dynamically and quickly in production. Therefore, a safe and compact guidance of cables and hoses is required. This is where the three-dimensional triflex energy chains from igus are used. If the e-chains form loops in the work area of the robot, it can damage the cables and hoses as well as lead to machine failure. For this reason, igus has now developed the new low-cost TR.RSEL retraction system. The system guides the energy chain in a line on the robot, ensuring trouble-free and fail-safe operation.

Industrial robots for assembling vehicle parts in the automotive industry, for example, work with high rotations and many fast movements. Users rely on energy chains to ensure that cables for in automated production technology, it is necessary to guide not only electrical and pneumatic cables, but also hoses for bolts, rivets and screws. Since these hoses are not compatible with tight bend radii, a retraction system is required for the energy supply of the robot. For this reason igus has now developed a new, very cost-effective retraction system triflex RSEL for its energy chains. This ensures that the e-chain is kept as compact as possible on the robot arm. The system prevents the hanging energy supply system from affecting or blocking the movements of the robot, even in highly dynamic applications. In the worst case, looping would damage the energy chain, the cables and hoses inside it, leading to machine failure. EI

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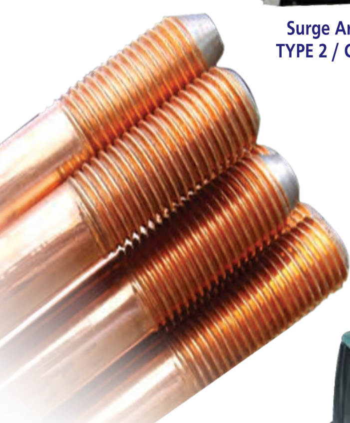

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Leader Inception Theory (LIT)

LPI uses the Leader Inception Theory (LIT) for designing lightning protection systems for HV power facilities. LIT is one of a number of design methodologies detailed in IEEE Std. 998.

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