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ISSN 0972-3277

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## Publisher's letter

The Indian power sector has been rapidly evolving and has witnessed significant transformations in recent times. Today, almost each and every village in the country is claimed to be electrified thanks to the government's Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) that was envisaged to connect 18,452 villages to the electricity grid. Further, power to all rural households and poor urban households is envisaged under the Saubhagya scheme. The Ujwal DISCOM Assurance Yojana (UDAY) that was launched to safeguard the distribution companies (DISCOMs) has been a turnaround scheme for many utilities. Also, the government has focused on expansion of the country's transmission and distribution network with significantly higher investments than previous Five-Year Plans. Most importantly, the government's commitment towards generating 175 GW of renewable energy by 2022 has put India's energy sector in growth orbit.

All these "ambitious but deliverable" targets are adding new challenges for distribution network. Experts believe that these challenges can only be overcome with the amalgamation of electrical equipment and digital network technology. DistribuELEC 2019, the mega event on the power distribution sector, will exhibit the power of this collaboration. Electrical India, being the media partner, will be present at this event. We look forward to see you there.

Till then, happy reading.

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Single Issue: ₹ 100 / Annual Subscription: ₹ 1000

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Printed, Published and owned by Mahadevan Iyer from 906, The Corporate Park, Plot 14 & 15, Sector 18, Vashi, Navi Mumbai 400703 and Printed at Print Tech., C-18, Royal Indl Estate, Naigaum Cross Road, Wadala, Mumbai - 400 031. **Editor: Mahadevan Iyer**





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## A power packed Union Budget?

**T**he interim budget 2019 announced on 1st February by the interim Finance Minister Piyush Goyal appears to have failed to give India's power sector a reason to smile. Apart from sharing the government's achievements towards expansion of LED distribution programme and reforming of the oil and gas bidding regime, the 2019-20 budget lacked any major new announcement for the energy sector.

Renewable energy sector in India, especially solar, has faced turbulence in the year 2018 thanks to ambiguities related to GST rates and imposition of safeguard duty. Apart from cancellation of many auctions by state agencies, the rate of adding new solar capacity has also declined during the third quarter of 2018. Industry experts were expecting some breather from the interim budget 2019 that could have revitalised the sector.

However, the government's commitment towards bringing an electric vehicle revolution to India by 2030, where renewable energy will be used to power EVs, is being considered as a great initiative which is expected to boost the clean energy market. "This India will drive on electric vehicles with renewables becoming a major source of energy supply," Piyush Goyal, interim finance minister, said while presenting the interim budget for 2019-20.

Anil Chaudhry, Managing Director, Schneider Electric India, said, "The budget announcement that India will drive on electric vehicles with renewables, backed by energy storage devices, becoming a major source of power supply shows that this is expected to be a key focus area for future governments."

Announcements of tax rebates on the import of EV technology, including batteries and motors ranging from 10 to 25 per cent, and incentives for local battery manufacturing will speed up the EV revolution, claims Rahul Walawalkar, President, India Energy Storage Alliance (IESA) whereas Anmol Singh Jaggi, Director, Gensol Engineering, said, "The implementation of the electric mobility approach will not only reduce India's energy demand by 64 per cent but will also curb carbon emissions by 37 per cent. It will encourage zero emission mobility solutions to make urban transportation better and environment friendly."



*Subhajit Roy*  
Group Editor



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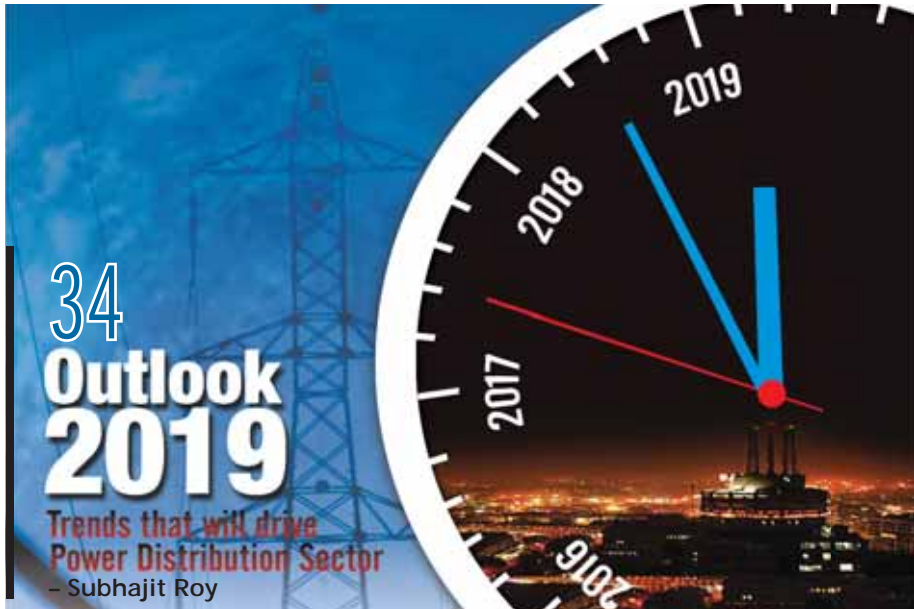
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## 100% Household Electrification Achieved in 25 States



India has achieved yet another milestone in the power sector with completion of hundred per cent household electrification in 25 states. Now, only about 10.48 lakh households are left to be electrified in four states viz Assam, Rajasthan, Meghalaya and Chhattisgarh. These states are also taking all concerted efforts to achieve, at the earliest, saturation of household electrification in their respective states.

Power Minister R K Singh congratulated all these states for achieving this herculean task. Since the launch of Saubhagya in Uttar Pradesh 74.4 lakh households have been electrified and state government has declared saturation of all 75 districts. Government of Uttar Pradesh has launched a special campaign in all parts of the state to identify any left out un-electrified households and to provide electricity connections to such households. Under the campaign, a special vehicle 'Saubhagya Rath', is moving around in villages or towns and any left-out households may approach them to avail electricity connection under the scheme. Also, any left-out household requiring electricity connection may dial 1912 to avail the facility.



## L&T's T&D Business Wins Orders Worth ` 2,084 cr

The Power Transmission and Distribution Business of L&T Construction has secured EPC orders worth Rs 2,084 crore. On the international front,



the business has won a major order in the Kingdom of Saudi Arabia for the construction of 115kV Substations with associated transmission lines and cable circuits. Another order for 132kV cable works for a Substation has also been awarded in Dubai, UAE.

EHV Substation orders have been received from reputed customers in Oman and Qatar. An order for a 275kV Substation order

has been secured in the Sarawak state of Malaysia. On the domestic front, the business has secured EPC orders from reputed developers to build 235 MW of

Solar Photovoltaic power projects in Tamil Nadu and Rajasthan.

A one of its kind Solar photovoltaic plan, floating on a reservoir, will be implemented in Chittoor district of Andhra Pradesh, as a part of Tirupati Smart City mission.

Another order for a Rural Electricity Infrastructure Development project under the DDUGJY scheme has been awarded in West Bengal.



## India's First Solar Ferry Boat Saves 58,000 Litres of Diesel

India's first solar boat Aditya has completed its two years (730 days) effective activity in Vaikom, Kerala, thus saving 58,000 litres of diesel. Solar-powered transport ferry is manufactured under Make in India initiative by NavAlt Solar and Electric Boats that expects to make water transport progressively effective. Aditya was introduced in January 2017 by the Chief Minister of Kerala Pinarayi Vijayam and the former Power Minister Piyush Goyal. The solar boat was launched for transportation purpose with a capacity of 75 passengers in Kerala backwaters. NavAlt stated that it has helped to save Rs 40 lakh on cost of diesel, which is equivalent to 58,000 litres in a span of two years.



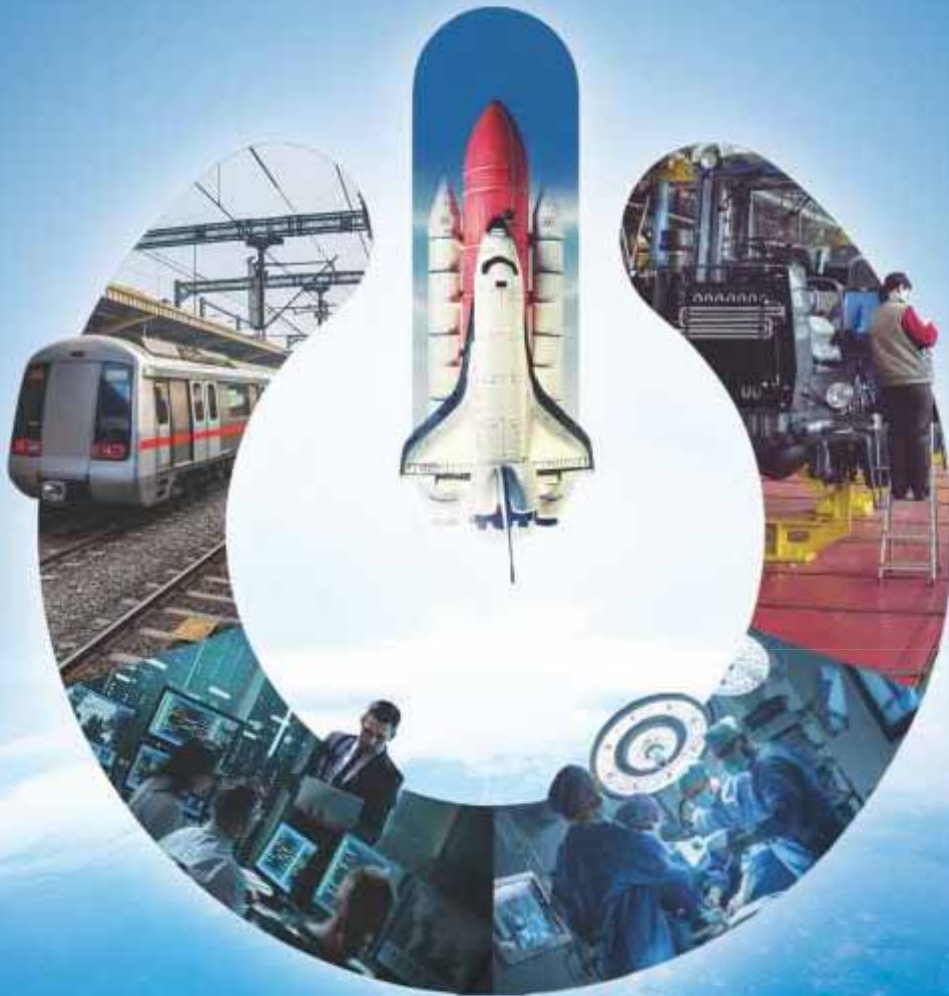
The quantity of daily commuters which Aditya drove in a range of two years (730 days) is a total of 6, 40,000 and has voyaged 38,500 kms. Sandith Thandasherry, Founder and CEO, Navalt Solar and Electric Boats stated, "It is an exceptionally glad moment for us that our flagship product 'Aditya' successfully completed its two years (730 days).. It wouldn't have been conceivable without the support of our technical team, partners and government."





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## CERTIFICATIONS



## STPI, IESA & IIIT-Bhubaneswar Join Hands to Establish Second ESDM Incubator

India Electronics and Semiconductor Association (IESA), the industry body representing the Indian electronic system design and manufacturing (ESDM) space, signed a memorandum of understanding (MoU) with STPI and IIIT-Bhubaneswar to establish the second ESDM Incubator in Bhubaneswar. Building on the success of the Electropreneur Park Delhi, this incubator will be housed at STPI Bhubaneswar to nurture start-ups and help them scale up by providing access to funds, market and mentors.

Dr Omkar Rai, Director General, STPI, said, "In collaborating to establish the Electropreneur Park at Delhi with IESA & Delhi University, we have been able to develop a good model for supporting the electronics industry. Our vision is to create more such facilities across the country to support growth of the electronics industry, in a way similar to the IT industry."

"We are delighted to associate with MEITY, STPI and IESA in setting up the Electropreneur Park. Initiatives such as these are gradual steps towards development of the ESDM ecosystem in the country," said Gopal Krishna Nayak, Director, International Institute of Information Technology, Bhubaneswar (IIIT – Bhubaneswar).

## Sterlite Power Initiates Tree Translocation in Power Transmission Sector

Sterlite Power launched an initiative to promote greener ecosystem while constructing power transmission projects. The company launched a tree translocation project by which bigger and mature living trees will be translocated within 500 meters. The project will effectively reduce approximately 40 per cent of felling of trees. The pilot of the initiative is being initiated in Indore as part of its Khargone Transmission project (KTL). The 189 km KTL project will connect Indore to 1320 MW of thermal power from Khandwa. This project will benefit domestic, commercial, agricultural and industrial segments.

Ved Mani Tiwari, CEO Global Infra Business, Sterlite Power, said, "Sterlite



Power has worked to deliver a social impact by implementing its projects in the most environment friendly manner. The tree translocation project is our way of contributing to promote green habitat. I am sure this initiative will become a norm for the power transmission industry." Tree transplantation facilitates construction of large-scale projects without cutting of trees. As the mature living trees provide wide range of benefits to human being it is prudent to ensure their survivability.

## BEE, CPWD MoU to Promote Energy Efficiency



The Bureau of Energy Efficiency (BEE) and the Central Public Works Department (CPWD) signed a memorandum of understanding (MoU), kickstarting cooperation in building energy efficiency. According to the MoU, BEE and CPWD will cooperate on promoting designs and construction of Energy Conservation Building Code (ECBC) compliant new buildings, star rating of CPWD managed buildings across

the country with no registration or renewal fee, awareness on energy efficiency in building sector and support for capacity building of CPWD officials in ECBC.

The MoU will remain in force for five years unless rescinded by either party. This association of BEE, a statutory body under the Ministry of Power which is mandated to implement policy and programs in energy efficiency and conservation with CPWD, The MoU was signed by Abhay Bakre, Director General, BEE and Prabhakar Singh, Director General, CPWD in the presence of Ajay Kumar Bhalla, Secretary of the Ministry of Power, and other senior officials of the Ministry of Power, BEE and CPWD.



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## Hind Rectifiers Bags Orders of Rs 88.05 Cr

Hind Rectifiers, has bagged orders of Rs 88.05 crore in December 2018. This includes substantial orders from Diesel Locomotive Works worth Rs 61 crore. With these order wins, the company has a strong all time high pending order book of Rs 292.92 crore. Commenting on the order, Suramya Nevatia, CEO, Hind Rectifiers, said, "The orders booked are for a new product which was launched in 2018. Through backward integration, the company is able to substantially reduce import cost for the product, thereby, helping the product margin to be upwards of 10 per cent. The company is highly focused on R&D and the future of Hirect is power packed with innovation and diversification."

With India being at the crux of infrastructural and transportation growth, there are possibilities, and Hirect will be capitalising on all the right ones, informs the release from the company.

The company manufactures highly technical and strenuously engineered products using dynamic tools, leading-edge technology and non-parallel design. Hirect is gradually transforming from being just a cost-effective manufacturing company to an indigenous technology company. 

## JSW Energy plans `6,500 Cr investment in EV manufacturing


JSW Energy is planning to invest around Rs 6,500 crore in manufacture of electric passenger cars, informs the company's Joint MD and CEO Prashant Jain while announcing the result for third quarter.

He further informs: "We are already in discussion with leading global OEMs and engineering service providers on product and technology partnerships for electric vehicles. There will be a significant development in this space in the fourth quarter."

The company posted a profit of Rs 146 crore in the quarter through December, compared with Rs 47 crore a year earlier due to better realisations from both merchant and PPA customers. Consolidated revenue rose 20 per cent to Rs 2,492 crore.

JSW Energy's Vijayanagar plant achieved an average PLF of 57 per cent as compared to 51.2 per cent in the corresponding quarter of previous year primarily led by healthy merchant power offtake.

Ratnagiri plant operated at an average deemed PLF of 83.7 per cent as against an average deemed PLF of 77.8 per cent in the corresponding quarter of previous year due to healthy offtake from both short term and long-term customers.

Barmer plant achieved an average deemed PLF of 79.5 per cent as against an average deemed PLF of 82.4 per cent whereas Himachal Pradesh plant achieved an average PLF of 24.2 per cent for the quarter vis-à-vis 24.5 per cent in the corresponding quarter of previous year. 


## Vikram Solar Commissions 20 MW Projects

Vikram Solar commissioned two 10 MW solar projects for West Bengal State Electricity Distribution Company (WBSEDCL). The plants are located at Patni, near Kharagpur and at Lalgargh, near Midnapore, West Bengal.

The Solar PV Power Plant at Patni deployed Vikram Solar's high efficiency Eldora 4 BB series 60 cell modules, while Solar PV Power Plant at Lalgargh was consisted of Eldora 5 BB series 60 cell modules, ranging from 265 Wp to 270 Wp. Both plants are expected to generate 1.55 MU/ MW energy annually.

Kuldeep Kumar Jain, COO- EPC, Vikram Solar, shared on the occasion, "We are happy to commission two prestigious solar EPC projects



for WBSEDCL. Having extensive experience in installing solar plants at various topographies, we were able to offer good results to WBSEDCL. The successful commissioning of these projects reaffirms our superior performance and quality standards in the execution of solar power development. We congratulate WBSEDCL for their success in taking another step towards green energy transition and we hope to be with them along the way in future endeavours as well. 



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## Inox Wind, AMSC Pact to Launch 3MW Wind Turbines in India

Inox Wind has signed an exclusive agreement with AMSC, a solutions provider serving the wind and power grid industry, to launch the 3 MW wind turbine which is especially suitable for low wind regimes in India. The 3 MW wind turbine platform is a globally operating and proven platform. This agreement comes on back of the existing licence for the 2 MW range of wind turbines currently being offered by Inox Wind.

The 3 MW wind turbine extends the existing WTG product offering from Inox Wind and reinforces the company's position. The 3 MW wind turbine is going to be a revolutionary product in India which would improve energy yields, reduce levelised cost of energy (LCoE) and offer superior performance. This product would also support the competitive tariff environment currently present under the auction regime in India.

Devansh Jain, Executive Director of Inox Wind Limited said, "The launch of the 3MW wind turbine is a momentous occasion in the company's journey to become the leading wind energy solutions provider in the country. This product reinforces our firm commitment to provide our clients with energy efficient, superior output products and ensures that Inox Wind continues to play a pioneering role in the wind turbine industry in India."

## BHEL to Set up 129 MW SPV Plants



Bharat Heavy Electricals Limited (BHEL) has won an order for setting up 129 MW Solar Photovoltaic (SPV) power plants in Telangana from Singareni Collieries Company Limited.. Valued at Rs 565 crore, this is the largest SPV power plant order won by BHEL till date.

The plants are to be set up at four locations in Telangana - Ramagundam (50 MW), Yellandu (39 MW), Manuguru (30 MW) and Pegadapally (10 MW) on EPC basis. BHEL's solar portfolio has risen to

more than 710 MW. with this order.

BHEL has more than three decades of expertise in solar photovoltaic products and services backed by a dedicated R&D setup. BHEL is one of the very few companies in India, having established capability in major segments of the PV value chain viz., solar cells, PV modules and power conditioning units and systems.

BHEL has significantly contributed to the 'Make in India' initiative of the Government of India and various initiatives for developing and promoting renewable energy-based products and services on a sustained basis. The company has also enhanced its state-of-the-art manufacturing lines of solar cells and solar modules.

## V-Guard to Get Japanese Certification

V-Guard has received the QCFI-JUSE Certification for its 5S Workplace Management and becomes the first among the wire and cable manufacturers in India to achieve this distinctive status. The company's wires and cables plant at Coimbatore received this certification in a ceremony held at IITM-Gwalior recently.

Prior to this, V-Guard had received QCFI Certification for 5S Workplace Management in February 2018, which entitled the company to apply for the JUSE certification. JUSE commonly known as Union of Japanese Scientists and Engineers is an internationally acclaimed institution under Ministry of Science and Technology of the Japanese Government. It is also the custodian



of the renowned Deming Prize.

V-Guard's strong focus on manufacturing excellence has led the wires and cables division team to install the best 5S workplace management practices to gain higher levels of productivity and quality for enhanced level of customer satisfaction. This recognition also adds to the glory of V-Guard's manufacturing efficiency which is the result of inculcating core operating principles to deliver best quality products with excellent service to the consumers, making them the topmost priority.



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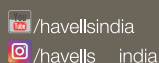
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\*Conditions apply.

## Toshiba ESS to Contribute to Maldives's Clean Power Supply

Toshiba Energy Systems and Solutions (ESS) Corporation has won an order to supply the Micro Grid Energy Management System ( $\mu$ EMS) to preparing outer islands for sustainable energy development (poised) project in the Republic of Maldives from Nishizawa Limited, a Japanese general trading company. The system will start operation in Hithadhoo Island of Addu Atoll in 2020.

Almost all of the Maldives's current power generation capacity is from diesel generators. The government of the country, which faces a crisis of rising sea levels due to global warming, is promoting the introduction of solar power systems to realise a low carbon society. As one of the promotions, the government has already installed solar power systems in the Hithadhoo Island in 2017.

The system comprised of an energy management system and battery energy storage system (BESS), offers the ability to predict the amount of power demand and supply using weather forecasts and helps realise an optimal operation plan for diesel generators. In addition, by optimally controlling the output fluctuation of the solar power systems with BESS, it contributes to the reduction of CO<sub>2</sub> emissions by reducing the fuel consumption of diesel generators. E1

## Lidar Lights Up Wind Opportunities for Tilt in Australia

Tilt Renewables, a developer, owner and manager of renewable energy generation assets in Australia and New Zealand, has confirmed the use of wind Lidar technology from ZX Lidars to remotely measure wind conditions above ground without the need for a traditional met mast. Initial deployment has been to a remote site in complex terrain for the purpose of confirming the quality of the wind resource.

With more than 1.6 GW of approved wind projects in Australia and New Zealand Tilt Renewables required a flexible solution to wind resource assessment that could also be used to bolster existing anemometry and with an eye on operational sites emerging. New Zealand-based wind engineering consultancy Energy3 provided



expert advice and support on how to achieve this.

"A key advantage of Lidar is that it can be easily mobilised and rotated to a number of sites within the Tilt Renewables' portfolio and can be used so flexibly for a range of purposes including feasibility assessments at potential new sites and improving the coverage of site measurements at existing sites," commented Sherrin Yeo, Engineering Manager at Tilt Renewables. E1

## GE to Digitise Tata Power's Thermal and Renewable fleet in India

GE has implemented the first Predix Asset Performance Management (APM) solution in India for Tata Power's thermal business. This is one of two deals that GE won in India to optimise approximately 8 GW of Tata Power's thermal and renewable energy power portfolio using digital solutions. GE is implementing the Reliability Centered Maintenance (RCM) solutions for Tata Power's thermal assets across nine sites for a period of seven years. The renewable deal is still under execution.

Praveer Sinha, CEO & MD, Tata Power said, "Our aim is to continue to be the leading power company in India and globally by constantly upgrading our

assets with state-of-the-art technology. GE has provided a noteworthy contribution to fulfill our vision of digitizing our thermal and renewable assets." Ashok Sethi, COO and Executive Director,

Tata Power said, "This company wide program aims to improve assets reliability, embed best in class O&M processes while optimising cost. We're glad to partner with GE and their APM solution to bring to life our vision." Andrew DeLeone, Managing Director, GE Power India said, "Given the enormous potential of digitisation and IIoT to drive operational performance, this technology will help improve asset reliability and availability while reducing O&M costs. GE remains committed to improve India's thermal assets." E1





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## BP Restructures US Wind Energy Business

BP has divested three wind energy operations in Texas as part of a broader restructuring designed to optimise its US wind portfolio for long-term growth. The three wholly-owned BP wind facilities –Silver Star (60 MW generating capacity), Sherbino Mesa 2 (145 MW) and Trinity Hills (225 MW) -- were purchased by funds managed by affiliates of Ares Management Corporation with Bank of America Merrill Lynch serving as financial advisor to BP in the transaction. BP Wind Energy will use the proceeds from the deal to fund technology upgrades elsewhere within its substantial remaining US wind portfolio.

“This deal allows us to focus on optimising and upgrading our other sites, helping us create a wind energy business that is sustainable for the long term,” said Laura Folse, CEO of BP Wind Energy. Following the deal, BP will continue to own interests in 11 wind farms in eight states, 10 of which it operates, with a net ownership of more than 1000 megawatts of wind power. “BP’s commitment to a low-carbon energy future remains as strong as ever as we seek to reduce emissions and create new low-carbon businesses,” said Dev Sanyal, CEO, BP Alternative Energy. “We remain one of the largest operators of renewables amongst our peers and continue to grow as we see more opportunities.”

## ABB, Audi & IONITY Transport Delegates in Sustainable Limos



Participants at World Economic Forum annual meeting in Davos, Switzerland had the experience of travelling by road between Zurich International Airport and Davos in an environmentally sustainable way. Fifty Audi e-tron sedans were charged in a matter of minutes at a total of 31 fast-charging stations provided by the global market leader ABB in Kempththal, Heidiland, Küblis and Davos.

The charging infrastructure is operated by IONITY, a joint venture

between automotive manufacturers. The three partners are using the project to underscore the crucial importance of e-mobility for the advancement of sustainable transport.

ABB has installed with over 8,500 fast charging stations in 70 countries around the world. “The company offers the most powerful charging station available today. It can supply enough energy to achieve a range of 100 km in just four minutes,” a statement issued by ABB said.

## RE the Most Competitive Source of New Power Generation in GCC: Report

Renewable energy is the most competitive form of power generation in Gulf Cooperation Council (GCC) countries, according to a new report published by the International Renewable Energy Agency (IRENA). Abundant resources, together with strong enabling frameworks have led to solar PV prices of below 3 cents per kilowatt hour and dispatchable concentrated solar power (CSP) of 7.3 cents per kilowatt hour, which is less than some utilities in the region pay for natural gas.

IRENA’s new ‘Renewable Energy Market Analysis: GCC 2019’ launched during Abu Dhabi Sustainability Week, says achieving stated 2030 targets can bring

significant economic benefits to the region including the creation of more than 220,000 new jobs whilst saving over 354 million barrels of oil equivalent (MBOE) in regional power sectors. “The GCC is among the most attractive regions in the world to develop large-scale solar and wind energy projects as a result of resource abundance and a favourable policy environment, a fact that is backed up by record low prices,” said IRENA Director-General Adnan Z. Amin.

“The UAE’s commitment to diversifying the energy mix is central to sustainable development objectives,” said H E Suhail Al Mazrouei, UAE Minister of Energy.



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## DERC Appoints Vashishta as Electricity Ombudsman



Suresh Chand Vashishta

The Delhi Electricity Regulatory Commission has appointed Suresh Chand Vashishta as the Electricity Ombudsman

with effect from 7th of January. Vashishta was administered the oath of office by Justice S S Chauhan, Chairperson, Delhi Electricity Regulatory Commission and assumed the charge of Electricity Ombudsman. Prior to his appointment as the Electricity Ombudsman, he has previously held a number of prestigious appointments in the power sector in Haryana and retired as the Director Technical of Haryana Power Generation Corporation Limited in 2013.

Thereafter, Vashishta was appointed as the Electricity Ombudsman in the Joint Electricity Regulatory Commission for the states of Goa and UTs with effect from January 2018 till his appointment as Electricity Ombudsman for the National Capital Territory of Delhi. <sup>ET</sup>

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## Thyssenkrupp Names Vivek Bhatia as MD & CEO



Vivek Bhatia

Thyssenkrupp has appointed Vivek Bhatia as Managing Director and Chief Executive Officer of thyssenkrupp Industries India effective from 1 January 2019. Vivek was earlier CEO - Asia Pacific at thyssenkrupp AG, driving group activities for all thyssenkrupp companies in the region. Prior to that, he led strategy, markets and development for the Asia Pacific region for the group and was based in Singapore.

Vivek has extensive business experience across mining, metals and mineral processing, cement, power and engineered or capital goods. Vivek Bhatia added, "I am truly excited and grateful for the trust placed in me by our global leadership in assigning me to this position. thyssenkrupp Industries India is a global center of competence and we have a rich 70 plus year history. I look forward to working with our dynamic and experienced team." Vivek holds an MBA (from IIM Calcutta), MTech. (Gold Medalist from IIT Delhi) and BE (with honours from University of Delhi). <sup>ET</sup>

## Francesco La Camera Appointed as New IRENA Director-General



Francesco La Camera

The International Renewable Energy Agency (IRENA) Assembly selected Francesco La Camera to be the next Director-General of IRENA. The appointment took place during the Ninth Assembly of IRENA, the ultimate decision making body of the Agency. La Camera will take office on 4th April, succeeding Adnan Z Amin, who has been IRENA Director-General since 2011.

Francesco La Camera currently serves as the Director General for Sustainable Development, Energy and Climate at the Italian Ministry of Environment, Land and Sea. La Camera led the EU and Italian negotiation teams at the climate COP 20 in Lima and was the head of the Italian delegation to the three previous COPs. He has represented Italy in many international forums including at the EU, UNECE, UNCSD, UN Environment, and the OECD. From 2003 to 2010, he was also Professor of Environmental and Land Economics at the Faculty of Engineering of the Rome Tre University. La Camera has a degree in political science from the University of Messina. La Camera is elected for a term of four years. After assuming office as Director-General, he will lead the IRENA Secretariat and the implementation of the Agency's work programme and budget.

With a membership approaching near-universality, IRENA serves as the principal platform for international cooperation on renewable energy, providing a centre of excellence for knowledge and innovation <sup>ET</sup>

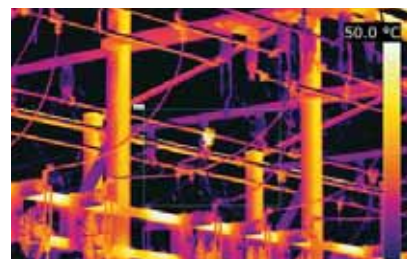
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Transformer Thermal Image



Substation Thermal Image

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## Padma Vibhushan for A.M. Naik

Industry veteran A.M. Naik of L&T group has been awarded the second highest civilian honour Padma Vibhushan



on the 70th Republic Day. He thus becomes one of the very few professionals from the field of industry to win this award.

“This honour is a deserving acknowledgement of Naik’s extraordinary record in serving industry while simultaneously fulfilling the twin objectives of building the nation and creating value for all stakeholders. In our company’s long history, he is the first L&T-ite to climb this pinnacle. He has been awarded the Padma Bhushan in 2009,” a statement issued by the company said.

Responding to the announcement, Naik said: “I am deeply honoured to be conferred with the Padma Vibhushan. I belong to a family of teachers who hail from a tiny village in rural Gujarat. To receive this high national recognition for my role in the industry is an affirmation of my belief that total commitment to a cause, with passion and utmost dedication is destined to win the highest recognition. For me the Padma Vibhushan is also an acknowledgement of the contribution made to industry, nation and society by Larsen & Toubro – the 80-year old company that I am proud to have served for over 50 years and led for nearly two decades.”

ET

## ISRO Wins Award for Energy Storage for Space Application



Indian Space Research Organisation (ISRO) wins the Innovative Company of the Year award in Energy Storage for Space Application at India Energy Storage Alliance Industry Excellence Awards 2019 in New Delhi.

ISRO’s Vikram Sarabhai Space Centre (VSSC) has developed and qualified lithium-ion cells of capacities ranging from 1.5 Ah to 100 Ah for use in satellites and launch vehicles. VSSC has received tremendous response from more than 141 companies across the globe for its lithium-ion cell technology, said ISRO in a statement.

ET

## Exicom Wins EV Infrastructure Company of the Year Award



Exicom wins ‘EV Infrastructure Company of the Year’ award at India Energy Storage Alliance (IESA) Industry Excellence Awards 2019 held at 6th Energy Storage India Conference & Expo.

Receiving the Award, Anant Nahata, Managing Director, Exicom said, “I would like to thank IESA for honouring our efforts in developing innovative EV charging solutions for all types of charging needs. We continuously work towards introducing new technologies in the area of energy storage applications to address the ever-growing energy demands.”

ET

## Tata Power Gets Recognition at CBIP Awards 2019

Tata Power was honoured with two awards at the recently held Central Board of Irrigation and Power (CBIP) Awards 2019 in Delhi. While the company won the ‘Company Category



Award’ for Best Performing Utility having integrated operation in Generation, Transmission and Distribution, Ashok Sethi was felicitated with the ‘Individual Category Award’ for Excellent Contribution in Power Sector Development by R K Singh, Minister of Power, New and Renewable Energy.

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# Growth Prospects of Transformer Oil

**A**ccording to Global Market Insights release, the transformer oil market has been gradually emerging as one of the most profitable niche verticals of the global energy industry owing to the massive grid infrastructure modernisation initiatives being undertaken by various nations in the recent times. Power grid networks in the developed and emerging nations alike have been struggling with an asset base nearing the end of its lifetime.

Moreover, decades of underinvestment, stringent regulatory compliance, and burgeoning electricity demand have strained the efficiency of these networks which necessitates revamp of components like transformers. Needless to mention, the major companies partaking in transformer oil industry have a vital role to play in strengthening the energy transmission networks across the world.

One of the major trends to have impacted the growth trajectory of transformer oil market is the rising global preference toward renewable energy sources. European nations are making swift progress in upgrading their power grid networks to accommodate the switch to an energy system based on renewables. Germany has intensified its efforts to construct new cross-country high-voltage direct current (HVDC) power lines to ensure smooth energy transition. The nation has recently proposed a new Power Grid Action Plan to accelerate the power grid expansion by fixing technical glitches, incorporating cutting-edge technology, and enhance the flexibility of grid network. Apparently, the action plan

would update transmission grids to run more power through them to bridge the gap until new HVDC lines are up and running by 2025. Needless to mention, an increased investment in deploying power transformers would benefit the Germany transformer oil industry. As per estimates, power transformers held more than 57 per cent of the total transformer oil market share in the year 2017 and the segment is expected to grow in the immediate future as well.

Developing countries such as China and India are deemed to be the major terrains to lead the Asia transformer oil market. China for instance, has laid out ambitious plans in its 13th Five Year Plan to reboot the electricity sector by strengthening the power transmission infrastructure and lifting price controls in specific segments of the sector to encourage competition. Considering this plan, the firms operating in the transformer oil industry are set to observe an increased product demand in the future.

Apart from China, India has been proactive in diversifying and expanding its electricity distribution network over the recent years. For instance, the Power Grid Corporation of India Ltd has announced in 2016 to spend ` 1 trillion over a period of four years to connect and expand its network across areas affected by left-wing extremism. Moreover, this massive investment would enable utilities to enhance price realisation and ensure reliable power supply to customers. The state-owned power transmission company would further reshape the electricity sector by revamping the power grid infrastructure – a factor that would propel the transformer oil market share in the nation. As various countries speed up modernisation of power grids and transmission networks to achieve the aforementioned goal, the transformer oil industry players are bound to witness enormous business opportunities in the upcoming years. In fact, as per a research study collated by Global Market Insights, Inc., the remuneration scale of the transformer oil market is estimated to surpass USD 3 billion by 2024. 

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– Subhajit Roy, Group Editor

A sneak peek of the mega event on power distribution sector.

In an emerging economy like India, availability of quality and reliable power, is essential for the flawless functioning and increased productivity of all its sectors. Though the Indian power distribution utilities have come a long way toward achieving this objective since the enactment of the Electricity Act 2003, distribution remains the weakest link.

Further, the growth in load and distributed generation brings new challenges for distribution network and these challenges can be overcome with the amalgamation of electrical equipment and digital network technology. DistribuELEC 2019, the mega event on power distribution sector, will exhibit the power of this collaboration. Companies from across the globe will bring in innovative, state-of-the-art technologies that are designed to improve quality and reliability of supply and also reduce losses.

The third edition of DistribuELEC organised by the Indian Electrical and

Electronics Manufacturers' Association (IEEMA) in Mumbai, will bring utility, consumer, electrical operational technology (OT) and Information Technology (IT) on same platform to empower all stakeholders. India's only exposition on power distribution, scheduled to be held between 4th and 6th February, will showcase products, technologies and services from 220V till 33kV in traditional electrical equipment like transformers, cables, capacitors, switchgears, insulators, conductors and new age technologies in distribution automation and control systems, energy efficiency, demand response, advanced metering, communications technologies, cyber security, electrical fire safety etc.

The concurrent exhibition BuildElec 2019 will exhibit smart electrical technologies and equipment to make buildings as intelligent structures.

Here we present to you a sneak peek of the advanced solutions to be showcased at DistribuELEC 2019.

# Key highlights

## ERDA to present a host of testing solutions

Electrical Research and Development Association (ERDA) is a professionally managed not-for-profit organisation serving the industries and utilities since 1974 in the areas of test, evaluation, certification, consultancy and R&D related to electrical products and systems.

ERDA has established testing facilities to cater to all the requirements of all aspects of the distribution sector. The organisation is also keeping pace with the new emerging fields in this sector and is upgrading its laboratories. In the upcoming DistribuELEC 2019 exhibition at Mumbai, ERDA is planning to exhibit its services with the theme of “ERDA’s contribution in Power for All” incorporating three verticals namely Testing & Evaluation, Field Services, and R&D and Expert Services.

ERDA is going to exhibit its facilities like solar



Power Quality Measurement in Power Evacuation Substation (Photo - ERDA)



Rural household electrification under SAYBHAGYA scheme pump testing system, solar lighting system, smart meter testing, power system studies (focusing on integration of renewable energy into grid) and T&D equipment testing (e.g. transformers, cables, conductors, piercing connectors), informs Hitesh Karandikar, Director, ERDA.

KUSAM-MECO introduced and pioneered the used Digital Multimeters and Clamp Meters in Indian industry. The company is participating in DistribuELEC 2019 and will display the latest range of Digital Multimeters and Clamp Meters suitable for the solar industry.

KUSAM-MECO will display Battery Quality Analyser for battery manufacturers who supply batteries detectors etc.



KM 907  
(KUSAM-MECO)

for inverters and UPS systems. Besides, according to Chandmal Goliya, Director, KUSAM-MECO, the company will also display a diverse range of other products such as gas detectors, environmental instruments, process calibrators, high-voltage non-contact

## Digital Multimeters and Clamp Meters from KUSAM-MECO

## HPL to target right audience

HPL is an established electric equipment manufacturing company in India, offering a diverse portfolio of electric equipment including metering solutions, switchgears, lighting equipment and wires and cables. At DistribuELEC 2019, HPL Electric's product focus would be again on all categories i.e. meters, switchgears, LED lighting, wire and cables, modular switches, and solar. "Our target groups would be utility, power sector, builder association, consultants, contractors, architecture, and dealers," said Gautam Seth, Joint Managing Director, HPL Electric & Power Ltd.

The event provides an enormous opportunity for the manufacturers of electrical equipment and technology providers to showcase the solutions which can help in outage management, demand management, metering, microgrid, storage, sub-station and feeder automation etc.

"DistribuELEC 2019 provides an outstanding platform to showcase latest product offerings and provides hands-on experience of products and technology in electrical equipment and manufacturing space to relevant audience," avers Gautam Seth.



Home lighting solution



HPL's Metering Solutions



Solar inverter



Solar Cables



Osafe



Switchgear

## Next Gen brings Swiss expertise to India

Vadodara-based Next Gen Equipments Pvt Ltd announced the launch of state-of-the-art 12 kV Tan Delta unit from Raytech AG, Switzerland.

CAPO 12 is a fully-automatic 12kV AC capacitance and insulation  $\tan \delta$  or power factor measuring instrument at variable frequency developed by Raytech Engineers which is perfect for use in the field, facility or manufacturing plant.

### Key features of CAPO 12

- Touch screen operation



- Test voltage up to 12kV
- Built-in standard capacitor
- Test frequency 10Hz to 400Hz
- Capacitance measurement up to 53nF
- Test current of 200mA continuous at 12 KV
- $\tan \delta$  accuracy ( $\pm$ ) 10-4
- Internal thermal printer
- Internal storage for over 10,000 test results
- Portable, rugged & easy to transport.

CAPO 12 is specially designed for fast and easy measurements with the high precision and quality of all Raytech instruments.

Raytech products are readily available in India and have efficient after-sales support set up too.



## Elmex to showcase wire termination technology

Elmex is one of the pioneers in the field of electrical wire termination technology in India. The company believes that today's ever-expanding markets and globalisation has made exhibitions as an inevitable part of marketing and promotions. "Exhibitions offer a splendid showcase and opportunities unavailable to other marketing

media," opines Vipul Ray, Managing Director, Elmex Controls Pvt Ltd.

He adds, "DistribuELEC 2019 will serve as an influential platform to showcase our termination technology products as it is India's only exposition on power distribution, showcasing products and new age technologies in power distribution sector."

Testo India aims to feature a wide range of products that has revolutionary German technology and has major share in power sector applications. The company has introduced many SMART instruments in emission parameters monitoring, power systems condition monitoring and in internal air quality measurement.

Testo products like flue gas analysers are being widely used to precisely monitor the emissions from the coal-based and gas-based power plants. This instrument is also used as a proof checking on the inline or in-site instruments. This enables the power plants to fine tune their processes to minimise the emissions to the permissible levels and improve combustion efficiency.

At DistribuELEC 2019, Testo will showcase its new electrical



instruments that are very distinct and unique in their features. They are excellent instruments to inspect the electrical components and circuit failure threats during power transmission and distribution. "Our latest solution to the industry is new thermal imagers with smartphone integration designed to deliver networked thermography mostly used for predictive and preventive maintenance in electric and power sector," said Parag Yelegaonkar, Manager – Business Development, Testo India Pvt Ltd.



Testo thermal imager - electrical application



Testo Voltage tester application

## Testo brings advanced T&M solutions



## WAGO to showcase its power engineering solutions

At the forthcoming DistribuELEC 2019, WAGO plans to showcase its range of solutions for power engineering including digitisation, renewable energy generation, integrating decentralised suppliers, energy grids, energy storage systems. Vineet Jain, AGM - Telecontrol, WAGO Private Limited believes, Power Grid must be modernised for electricity to be transmitted freely and distributed safely to even the smallest branch. WAGO has numerous solutions for feed-in management according to EEG



and control, regulation of medium-voltage systems, telemetric solutions for providing control energy and cybersecurity among others.

### Advantages of WAGO Smart Grid solutions

- Reliable energy grid measurement, control and regulation
  - Process automation, load management
  - Secure and economical access to remote systems
  - Broad product portfolio
  - Proven, rugged products
- All relevant worldwide approvals
- Maximum signal level and bus

protocol flexibility

- Easy configuration
- Cybersecurity: PFC100/PFC200 controllers comply with current IT security regulations for grid operators and can be hardened as described in the BDEW white paper.
- Cloud connectivity: Connection to the cloud thanks to an MQTT software upgrade.

Visitors can experience live application for transformer monitoring, sub-station automation and energy monitoring at the WAGO booth.


### Conclusion

DistribuELEC 2019 is an exhibition on high-tech power distribution which will cover not only advanced electricity distribution technologies but also conventional electrical equipment.

Intelect 2019, a concurrent conference in its 3rd edition with the theme of "Towards Smart, Reliable, Efficient and Safe Electricity" will also

be organised where manufacturers, system solution providers etc. will share their experiences of deployment of advanced technologies in power sector. A host of prepayment meters, smart meters and distribution automation equipment will also be showcased. These equipment play an important role in loss reduction and reliability improvement. BuildELEC will showcase products covering

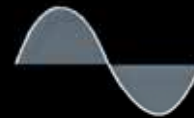
electrical safety, building management systems etc. Altogether, the forthcoming edition of DistribuELEC is going to be a must-visit one!

"We are participating in DistribuELEC regularly. DistribuElec provides a focussed platform to reach the customers in distribution arena," concludes R. Prakash, Country Head - Mktg & Service, Easun - MR, Chennai. 

Attracting Tomorrow



# Active Harmonic Filters – PQSine™ for Ideal Power Quality.



## Product highlights

- Ultra-fast-best-in-class reaction time of 21  $\mu$ s
- Compensation up to the 50<sup>th</sup> harmonic & load balancing
- State-of-the-art three-level NPC topology with 12 IGBTs and 32 bit DSP ensures best performance and lowest losses
- Modular systems from 60 to 600 amps with independent redundant module operation

## Customer benefits

- Power quality improvement increases equipment operating life and reduces downtime leading to higher production output and lower maintenance cost

## Areas of use

- Applications with variable frequency drives, inverters, welding equipment or UPS, in nearly all industries, such as automotive, paper, steel, textile, oil and gas, pharmaceutical or plastics
- Data centers, water treatment facilities, airports
- Solar farms and wind turbines

[www.tdk-electronics.tdk.com](http://www.tdk-electronics.tdk.com)





# Outlook 2019

## Trends that will drive power distribution sector

– *Subhajt Roy, Group Editor*

Access to reliable and affordable energy supply is an important factor affecting the quality of life and economic development in any country. Hence, the Indian government has announced its commitment to ensure 24x7 power supply for all by 31st March. Towards this goal many important milestones have been achieved and the year 2018 had been historic for electricity reached every village on 28th April 2018 under Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) scheme. Now focus is on electrifying every household under Saubhagya scheme. With 9 states already reaching 100 per cent household electrification, this target is also expected to be achieved within its deadline.

On the other hand, amendment of Indian Electricity Act is on the anvil. A lot of talk is going on to segregate “carriage and content” in the distribution sector.

Consumers will be able to choose between their power suppliers in line with the telecom services. Customers are demanding affordability, reliability and availability of power instead of earlier requirement of only a supplier of power, observes Hitesh Karandikar, Director, ERDA.

The Ujjwal DISCOM Assurance Yojana (UDAY), launched by Government of India in November 2015, reduced average national AT&C losses from 21 per cent to 18.8 per cent. However, Karandikar said, there is still lot of scope of improvement in this regard – particularly the billing efficiency of distribution companies (DISCOMs) needs to be improved.

The central government has taken an initiative to install smart meters in all the states. With smart metering DISCOMs will be in a position to engage with customers, meet peak demand, manage PPC and increase billing efficiency. Greater transparency and accountability will

come into the system. DISCOMs are looking forward to adopting smart metering solutions to reduce AT&C losses.

### **Need strong and reliable distribution network**

Indian government has an ambitious plan to increase the power generation capacities both in public and private sectors. Also, there is great emphasis on power generation by renewable energies like wind and solar energies. The government also has an ambitious plan to provide electricity to every household in India. To be able to achieve the target of providing electricity to every household in India, there has to be a very strong and reliable distribution network which will provide uninterrupted power everywhere, opines Chandmal Goliya, Director, KUSAM-MECO.

### **Focus on quality**

Electrical distribution sector is becoming more quality conscious and committed to energy conservation. According to Karandikar of ERDA, quality control order has ensured that only BIS certified good quality and safe distribution transformers, energy meters, wires, switches and plugs and sockets are used in the electrical distribution system. Use of such quality products will ensure safety of people and equipment and reduction of AT&C losses, he adds.

Echoing Karandikar's comments, Vipul Ray, Managing Director, Elmex Controls Pvt Ltd said, "The opportunity lies in improving the power quality, metering and last mile connectivity. With India's generation turning gradually towards renewable energy source efforts have been made to ease the long-standing problems like power shortages,

rural electrifications, distribution infrastructure and financial health of poor DISCOMs through various policy interventions."

R. Prakash, Country Head - Marketing & Service, Easun - MR, Chennai also observed: The gladdening area is more and more focus is being thrust upon ensuring not only 24x 7 supplies, but also quality power to consumer.

Several grid expansion programmes such as the GEC and cross-border links are underway to expand the physical grid infrastructure. Further, transmission utilities, at the central and state level, are expected to invest significantly in new technologies to make grids more reliable, resilient, secure and smart, informs Gautam Seth, Joint Managing Director, HPL Electric & Power Ltd.

### **Mix bag of opportunities and challenges**

Ray of Elmex Controls Pvt Ltd believes that the distribution segment is in a state of mix bag of opportunities and challenges. He said, "The sector has been plagued by high distribution losses coupled with theft of electricity, low metering levels and poor financial health of utilities with low cost recovery. Due

to this, the DISCOMs have not been able to undertake corresponding investments in infrastructure augmentation."

To tackle this situation government schemes, such as Accelerated Power Development and Reform Program (APDRP) for urban areas and Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) for rural areas, were initiated with aim to bring in investment and creating an efficient distribution infrastructure throughout the country. Further the scheme of Ujjwal DISCOM Assurance Yojana (UDAY), is turning out to be a saviour for most of the DISCOMs signed under it, with early signs of financial recovery being noticed, Ray opines.

### **The key lies in increasing efficiency**

India accounts for around 3.4 per cent of global electricity consumption having 5th largest power generation capacity. The power distribution sector is going through a rapid transformation phase. Increasing pressure of expanding reach, reducing operational cost, minimise downtime and improve productivity is forcing distribution sector to explore new ways of keeping pace with the demand of reliable power



- Hitesh Karandikar, Director, ERDA

“ The AC power evacuation will drive market of medium voltage equipment in near future



- Vineet Jain, AGM - Telecontrol, WAGO Pvt Ltd

“It becomes necessary for states to encourage private participation for exponential network build-up and better utilisation of resources.

supply. Amidst high rate of power transmission and distribution (T&D) loss combined with pricing pressure, drastic efficiency boost in distribution networks seems to be the only way out for utilities to remain commercially floating, said Vineet Jain, AGM - Telecontrol, WAGO Pvt Ltd.

Recently the government has taken initiatives to increase private participation in electricity distribution through distribution franchise model and sub-contracting of non-core operations.

Regulatory reforms for this sector including UDAY and SAMAST schemes have shown early signs of T&D companies' recovery. There are important steps taken towards strengthening of sub-transmission and distribution networks and metering of distribution transformers and feeders.

In addition to these measures, according to Jain, one of the important inclusions is IT enablement of distribution sector to improve the strategic, tactical and operational efficiency. Instead of merely distributing energy, the interplay between decentralised producers and consumers must be intelligently coordinated. This requires sophisticated digitalisation

strategies and business models. Smart grid technology will surely enhance grid reliability and efficiency by automatically responding to system disturbances in real-time, Jain claims.

### Long way to real reforms

Power distribution sector is still struggling for lot of inefficiencies in the distribution due to T&D losses. Also, this sector is still far from 24x7 availability front in non-metro cities, semi-urban and suffering heavily in rural areas. T&D losses correspond to electricity produced but not paid for. T&D losses are caused by a variety of problems, including energy sold at low voltage, sparsely distributed loads over large areas, inadequate investments in the distribution system, improper billing and theft.

Highlighting the challenges in Indian power distribution sector, Parag Yelegaonkar, Manager - Business Development, Testo India Pvt Ltd, said, “The modernisation plans in distribution of power are still not implemented to the desired level. Smart grid concept is also far from achieving good pace in this sector. Monitoring and control, though vital, still not modernised across the sector and leads incurring heavy costs and time-consuming process to fixup the issues because of this. In a nutshell, there is huge scope in business potential in this segment.”

Another important and highly discussed cause of the problems being faced in the power sector is the irrational and unremunerative tariff structure, opines Yelegaonkar.

All the above issues highlight the importance of initiating power sector reforms at the earliest and the need for tariff rationalisation. But, Yelegaonkar sounds quite optimistic as he said: It is definite that these issues will improve as we have already seen in the field of rural electrification and pump-set energisation, country has made a tremendous progress. About 85 per cent of the villages have been



- Parag Yelegaonkar, Manager - Business Development, Testo India

“Tariff rationalisation and control and monitoring systems to minimise the T&D losses will be of prime importance in 2019 and years ahead.



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- R. Prakash, Country Head – Marketing & Service, Easun - MR, Chennai

“With right usage of tap changing and automation voltage technologies, the utilities can derive a double benefit of good cost saving and smooth voltage for their consumers.”

electrified except far-flung areas in North Eastern states, where it is difficult to extend the grid supply, he added.

## What will drive the power distribution sector in 2019

India is making a steady growth on the transmission front and the sector has witnessed commendable growth over the last few years with substantial capacity additions. An estimated Rs 22,60,000 crore investment is required in the transmission sector to meet future peak load, which is expected to reach 234 GW by 2021-22.

Gautam Seth of HPL Electric & Power, “The sector has started receiving greater attention and investment with the restructuring of the state electricity boards (SEBs). Several new initiatives have been introduced to reduce aggregate technical and commercial (AT&C) losses along with a definitive regulatory framework. Electricity Act 2003, National Electricity Policy 2005 and National Tariff Policy 2006 are important regulations governing the sector today with an aim to bring competition in the sector and improve the services to the end consumers.”

Participation of private players

into the distribution sector has also been encouraged through various models such as public-private participation as in case of Delhi and Odisha and more recently through input-based distribution franchisee models in Maharashtra, Madhya Pradesh and Uttar Pradesh.

If we look at government’s ambitious project of smart city development, to get continuous supply of power to the smart city, it is essential to have strong and smart transmission and distribution (T&D) systems. But today’s T&D systems seem to be inadequate to meet the increasing power demand of smart cities.

With rise in demand of clean and affordable electricity, the government has announced an impressive goal to add 40 GW of rooftop solar (and 60

GW of medium- and large-scale grid-connected solar projects) by 2022. It will turn out to be a progressive step to provide affordable energy source and combat climate change.

Rural electrification, integration of renewal generation and grid stability will throw both challenges and opportunities for the sector, said Vipul Ray of Elmex Controls.

Let’s take a look at what will drive the power distribution sector in 2019.

## Technology

DISCOMs are losing money on account of improper voltage regulation. With right usage of tap changing and automation voltage technologies, the utilities can derive a double benefit of good cost saving and smooth voltage for their consumers, observes R. Prakash of Easun - MR, Chennai. He adds, “To offer quality power, ensuring constant desired voltage at consumer side plays an important role.”

Moving forward, technology, approach and actions towards elimination of inefficiencies will drive the power distribution sector, said Parag Yelegaonkar of Testo India. He adds, “Tariff rationalisation and control and monitoring systems to minimise the T&D losses will be of



- Chandmal Goliya, Director, KUSAM-MECO

“The sectors manufacturing the products for harmonics filters and UPS system and inverter will get a big boost in their demands.”



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- Gautam Seth, Joint Managing Director, HPL Electric & Power Ltd.

“The sector has started receiving greater attention and investment with the restructuring of the state electricity boards (SEBs).

prime importance in 2019 and years ahead.”

### Distribution sector to attract huge investment

In the coming year, increase in providing power connection for both the industrial and residential sector will see huge investment in the distribution sector, said Chandmal Goliya of KUSAM-MECO. He adds, “New technologies will be required to cope with the increase demand for efficient and clean power. The sectors manufacturing the products for harmonics filters and UPS system and inverter will get a big boost in their demands.”

Hitesh Karandikar of ERDA also anticipates that electricity consumption is expected to grow exponentially in coming years due to success of Saubhagya scheme, owing to availability of power and changes in lifestyle e.g. increase in use of appliances such as air-conditioners and refrigerators. Therefore, utilities have to gear up to meet this demand.

But AT&C losses of average 18.8 per cent is still very high according to global standards. The next target of DISCOMs should be to reduce the AT&C losses to a level of 7 to 8 per cent. This will require better and smart metering and huge investment in the infrastructure. According to

Karandikar, this requirement will drive the power distribution sector in future.

### Data driven efficiency

In order to meet the demand, it is imperative to develop incremental power distribution infrastructure and this would require substantial long-term capital expenditure from public and private companies. This will also fuel growth of ancillary sectors including substation equipment, automation components, information technology, towers etc. Manufacturers of these products will have to timely strategise and deliver their maximum potential value to the distribution sector. “Unprecedented use of modern automation technology integrated into decentralised suppliers, intelligent distribution substations

and virtual power plants optimising control of the distribution grid will drive the power distribution sector. This will enable integration of IT and OT to shorten data collection, analysis, review and reaction time for better efficiency,” comments Vineet Jain of WAGO Pvt Ltd.

### Renewable push

With increasing focus on renewable energy, states and companies will have to transform the ways of T&D planning as against conventional power plants including generation forecast, optimum reserve, and real time monitoring. According to Jain, “It becomes necessary for states to encourage private participation for exponential network build-up and better utilisation of resources. States can then prioritise their thrust on reforms and connectivity.”

### AC power evacuation will drive market

India is also committed to add 175 GW renewable energy into the grid, out of which 100 GW is from solar generation. This wide spread solar generation will require DC distribution and DC switchgear equipment. Also, the AC power evacuation will drive market of medium voltage equipment in near future, predicts Karandikar .



- Vipul Ray, Managing Director, Elmex Controls Pvt Ltd

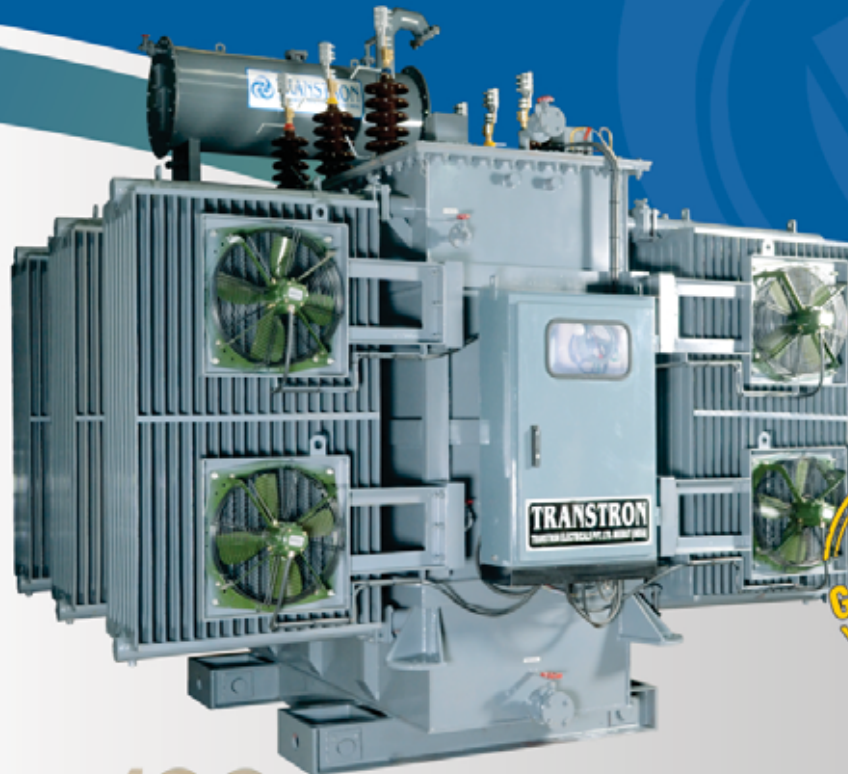
“Rural electrification, integration of renewal generation and grid stability will throw both challenges and opportunities for the sector.



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## 'Power for All will enhance quality of lives'

**Kirit Sitapara, Managing Director, Ascent Electrification Engineers Pvt Ltd** sheds light on products & services of the company, projects, the government's initiatives like Power for All, Make in India etc. in an interaction with **Electrical India**.

### What are the products and services offered by the company catering to power sector?

Ascent Electrification Engineers Pvt Ltd has been providing services in the entire gamut of power sector since the past 22 years. We have been offering our services of erection, testing, commissioning and maintenance in generation, grid transmission, distribution substations, and power plants up to 400 kV to multinational companies. We have clients like Adani Group, Reliance Group, Tata Group, Essar Group, L&T Group Suzlon, Powerica, Vestas, Enercon, Gujarat Energy Transmission Corporation Limited, Gujarat State Fertilizer & Chemicals, JSW Group, Indian Oil Corporation Refinery, ONGC Refinery, Cairn India, GAIL India, Pipavav Port etc. Further, we are manufacturing all types of control panels, APFC panels, relay panels, instrument panels, low tension panels, MCC panels, PLC panel, power control panel, power distribution panels, switchboards, switchgear panels, synchronisation panels etc with world-class technology.

### What are the projects executed by the company for the power sector? What kind of challenges do you face during execution of projects?

We have executed many turnkey projects for substations up to 220 kV and erection of power lines, providing quality work. The company has also worked on setting up of solar power projects. We have accomplished various electrification projects in refineries, malls, buildings, public sector, and government sector etc. We face a lot of challenges

during project work. Despite the challenges, our team has successfully completed projects in different environments and remote area where access to transportation and accommodation is poor. We have completed the projects despite the pressure from contracting companies for the completion of the work within short span of time.

### What potential do you envisage with the government's initiatives of 'Power for All' by 2022, rural electrification?

Power for All is incredible scheme of the Government of India. Through this program, the government has the plan of giving access to power to every house in the country by March 2019. This will enhance the quality of lives of those people having no access to power.

We are working on solar rooftop projects and Sky Agriculture project, thus, contributing to the government's rural electrification program.

### What opportunity do you foresee with the government's initiative of 'Make in India'?

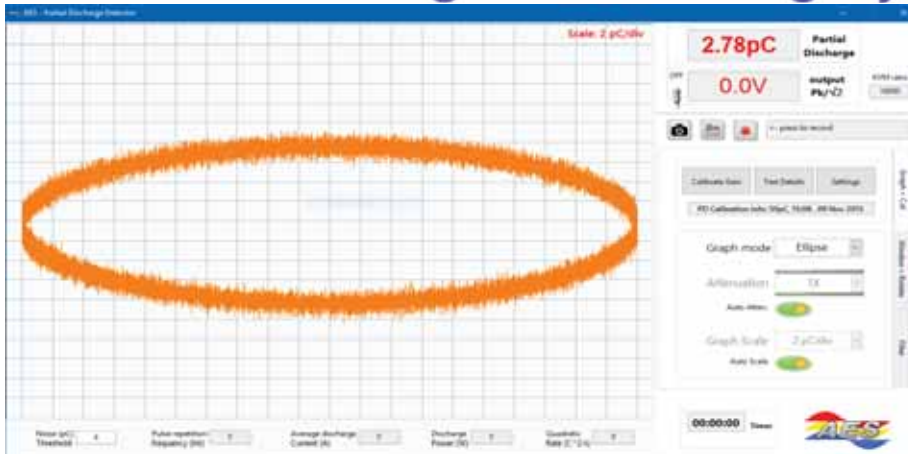
The government of India has launched 'Make in India' initiative to make the country a manufacturing hub. We manufacture our products in India with the requisite equipment and skills. So, Electrification Engineers support the 'Make in India' initiative.

### What is outlook for the sector?

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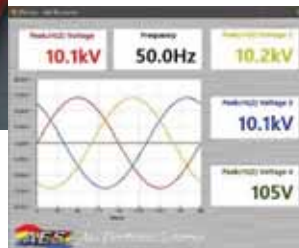


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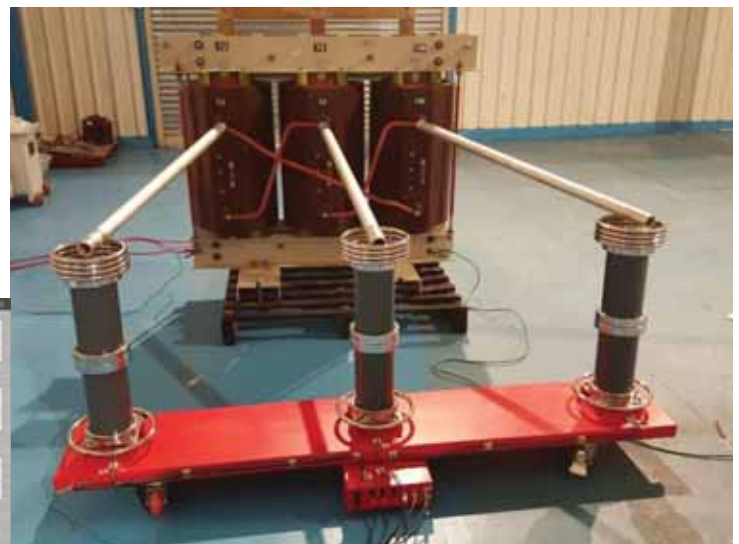
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This article provides an overview on various decision dilemmas with respect to procurement in utilities and the critical success factors which the utilities can leverage for their benefit ensuring the quality and efficiency in execution.

The electricity utility sector in India is witnessing a transformational change with progressive policy level changes and effective implementation of directives. The operating environment continuously poses challenges in the form of variable demands, an unpredictable economy, regulatory uncertainty, environmental mandates, investment needs and paradigm shift in technology. These forces translate into increased pressure and challenges for utility companies to operate strategically and minimise risk. In this context, the

procurement function is becoming a critical lever for power utilities to achieve superior performance as they seek cost savings and process effectiveness at every level.

### Modes of Contracting

One of the key decisions that utilities' procurement function essentially take is the choice between modes of contracting – the turnkey and the non-turnkey mode. In the turnkey mode, all the materials and services are in the scope of the vendor. It places the purchaser in an advantageous position where the complete risk of ownership is with the vendor,



reduced supervision needs by the purchaser and has lower contract management costs. This is because the purchaser needs to interact and transact with a single supplier only for the design, development, supply, and execution of the project. The non-turnkey mode is one where the major material is provided by the utility and only the services and associated consumables are in scope of the vendor.

Hence, utilities adopt the turnkey mode of contracting to address those areas where they lack in-depth expertise of concerned material or services. Moreover, it also takes into consideration substantially variable performance based on the equipment or materials used and the way it has been implemented or commissioned. The technology related procurements generally fall in this category because, historically, the utilities have been focusing more on building the operational

capacities and skill sets, where the technology related know-how is a relatively weak proposition for them.

Hence, it becomes easier for the utility in such cases to define and monitor the end deliverables along with assurance on post-implementation support, AMC etc., thereby leaving the finer details of product and implementation to the vendor. Presence of certain players operating in the market also provides such services to the customers aiding them in defining the scope, SLA or key performance measures in an elaborate and explicit manner. The vendor is thus bound to supply suitable products and implement the entire solution in such a manner so that they can meet the end deliverables as defined in the contract. This also ensures that the choice of product and its implementation quality is robust enough so that the subsequent maintenance costs for the vendor are

as low as possible. All other sundry wastages in terms of material or resources is owned by the vendor in turnkey mode of contracting, which makes it all the more important for the execution contractor to execute with quality and finesse, thereby reducing re-work and wastages, especially when the stakes are high – the usual case in such contracts.

### Thinking-through the Costs

It is pertinent to mention that convenience comes at a cost. For all the risk that the turnkey contractor assumes, he understandably loads all that cost on to the purchaser. The companies who execute the jobs on a turnkey or composite basis usually build the costs towards the risk, wastages and working capital etc., which may increase the overall costs by approximately 25 per cent - 35 per cent. Though this may discourage a few, it is, however, still a better choice of paying a



little higher initially than to incur increased costs in the longer run, owing to delays, lack of ownership on the performance of the complete solution.

On the contrary, experienced utilities have been working on such projects regularly and intend to carry them in the future as well. For such kind of projects, a utility may follow the non-turnkey mode of contracting to optimise the costs without any risk on project performance, as sufficient expertise to ensure quality in execution and obtain a desirable performance are already available within the utility itself. Since the onus of project performance lies with the utility in such cases, utilities are inclined to source the major material or equipment from reputed suppliers available in the market. This gives the utility comfort in terms of robust product quality, price advantages owing to larger volumes and reduction in the supply chain length from source to destination. The utilities thus chose such vendors who can execute the projects in the field with major material supply owned by the utility and the vendors' purview is to address the petty consumables. This reduces the cost of execution drastically but increases the pressure on the utility to ensure timely availability of materials or equipment in its scope and availability of sufficient vendors to execute the services in the field.

Therefore, to address the need for a continuous supply of materials or equipment and availability of services in the field, the utilities, in general, opt for a mode of contracting known as Rate Contracts. The Rate Contract is an agreement on unit rate of material or services between the

purchaser and seller; and has certain validity. The rate contract places the purchaser in a better position to source the material as needed, thereby reducing the inventory carrying costs and eliminating the need to conduct a fresh market search on every requirement through tenders or otherwise. Tendering is a tedious process for the utilities considering the stringent regulatory and statutory controls; hence entering into such long-term rate contracts makes business sense for the utilities – longer the term, better for the utility. The provisioning of materials or services through Rate Contracts is equally beneficial for the suppliers because it gives them an assurance of business over the contract period (which is a blessing in today's business context) and consequent savings in administrative and marketing overheads. It is to be noted though, that due to lack of commitment from the utility on the actual volume of purchase, the procurement through rate contract may look to be marginally costlier but such costs must be seen in conjunction with the processing cost of the procurement.

### Market Factors

Another aspect which is worthwhile pondering upon is the fact that the market factors may change during the contract period, making the contract non-sustainable either from the utility or from the supplier point of view. Hence, even though the utility as a purchaser would like to know its costs commitment beforehand in order to enter into firm price contracts, it may prove to be a double-edged sword for the utility as the utility risks the chance

of either the suppliers shying away from entering such Rate Contracts or building the costs of risk into the cost of product or service. In either case, the utility is at a disadvantage.

Hence, it is always better to have appropriate Price Variation Clauses built into the contracting provisions which provide due alterations to the contract price – upward or downward, based on the market forces like variations in raw material, labour components et al. But it is equally challenging to define the Price Variation formula which suitably covers the cost components of a product or service. The finer details on cost are both available in more depth with the supplier than the utility, and may vary from supplier to supplier; thus making it difficult to devise a Price Variation formula which is a true representation of costs for all the bidders. In scenarios where the market factors are comparatively less dynamic or where there is greater accuracy in projecting the future trends, the utilities may opt for firm price contracts with variability in rates allowed on a definite frequency for each phase of the contract (say on yearly basis). An alternate could be shortening the contract validity suitably so that firm price contracting does not act as a disadvantage to either party.

### Approaches Differ

It is imperative to mention that the key to success for a power utility lies in the quality of services that a utility provides to its customers and compliance with regulatory provisions. One of the key aspects to ensure uninterrupted customer services is the creation of a robust

*Continued on page 48*

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— Supporting —



# Utility Management

*Continued from page 46*

infrastructure and faster restoration of the equipment, thus minimising the downtime. It is important to understand that a utilities' business differs from the manufacturing industry in the sense that the former needs to procure the finished products or equipment on a repetitive basis to augment its network or infrastructure and to service its customers. A manufacturing setup, on the other hand, procures primarily the raw material as its routine purchase, whereby the finished products are generally an output of the manufacturing industry rather than the input.

Therefore, a utility needs to create suitable arrangements with the Original Equipment Manufacturers (OEM) for maintenance and upkeep of equipment throughout their life cycle. Provisioning of spares is an integral aspect of such operational strategies wherein a utility keeps certain spares within its inventory to ensure immediate replenishment in case of a failure. Because these spares generally come from the OEM; hence utilities often need to resort to procurement on a proprietary basis from the OEMs, which in turn may charge high costs for the spares due to monopolistic market conditions. With the ever-increasing cost pressures, utilities are on the lookout to minimise the costs towards these spares.

## Spare some parts

One of the sourcing strategies that utilities adopt to reduce the cost of spares is to procure a set of spares along with the main equipment itself. At the time of procurement of main equipment,

there is competition amongst the equipment manufacturers, hence it gives significant price benefits to the purchaser utility and the market data suggests that in such cases the costs for spares can be reduced by as much as 90 per cent.

A utility should be adept in managing these spares and should not worry too much about their sourcing. The area where the utilities have often struggled is to have a technology-driven system in place to track and monitor the spares available within their infrastructure. There are solutions available in the market which gives the utilities complete visibility on the spares purchased, their utilisation, and availability in inventories along with their quantity, type, part numbers among many other things. Based on these data inputs, the utilities can also decide which all spares to procure with the main equipment along with their quantities, thus

optimising on the overall equipment maintenance and inventory cost.

To summarise, a utility business is different and so are its challenges. The approaches which are successful in a manufacturing utility might not be relevant for a utility and vice-versa. The procurement function is a cog in the wheel for the utility to function efficiently, and hence needs to continuously evolve itself to ensure that the overall business objectives are met with a carefully chosen mix of strategy, technology, mode of contracting and contracting terms, thus ensuring a win-win for all stakeholders – the customers, the suppliers or vendors and the business itself. ■



**Yogendra Singh Butola**

Head – Contracts & Stores,  
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## ELECRAMA 2020 to present future of energy

The focus will be to present the future of energy to India, and showcase India's strength to engage more deeply with the rest of the world, informs **Anil Saboo, Chairman of ELECRAMA 2020 and Chairman-cum-Managing Director of Elektrolites (Power) Pvt Ltd** in an interaction with **Electrical India**.

### What is your opinion about ELECRAMA 2020 exhibition?

ELECRAMA has now turned into a movement, just beyond an exhibition. The 14th edition of ELECRAMA in 2020 will be flagship showcase of the Indian electrical industry ecosystem and the world's largest confluence of the power transmission and distribution community. We are excited to launch it at this key juncture to boost the Indian economy.

ELECRAMA 2020 will focus on innovation and new technology apart from creating platform for partnership with other countries.

### ELECRAMA 2020 will be held during a very crucial economic situation in India. What are your observations?

India is firmly set on a path of economic growth that is estimated to usher in prosperity like never

before. This economic prosperity will need to be built on the back of significant transformations across several facilitating elements, the primary ones being infrastructure development, research and development, energy availability, and sustainability.

Government's 'Make in India' program has placed India on the world map as a manufacturing hub and has given global recognition to the Indian economy. India is expected to become the fifth largest manufacturing country in the world by the end of 2020.

The government has set an ambitious target of increasing the contribution of manufacturing output to 25 per cent of Gross Domestic Product (GDP) by 2025, from 16 per cent currently. India's manufacturing sector has the potential to touch USD 1 trillion by 2025. There is potential for the sector to account for 25-30 per



cent of the country's GDP and create up to 90 million domestic jobs by 2025.

### **What will be the focus points for the electrical and electronics industry in ELECRAMA 2020?**

The key theme for ELECRAMA 2020 will be innovation – building new technologies. The focus will be to present the future of energy to India, and showcase India's strength to engage more deeply with the rest of the world. We will work towards increasing our exports and bring in the best-in-class equipment to be used in the country's power sector. ELECRAMA promotes thrust on research and development. This time, we shall add many new segments. Traditionally, it was only about transmission and distribution, sometimes generation. Now, we have expanded the focus of ELECRAMA to new segments like e-transportation, railways, solar, and Nasscom.

We will be focusing on connecting the equipment manufacturers, suppliers, and service providers to the key decision makers and end customers like utilities, EPCs, private power producers and adding our MSME units to global value chains.

### **What are the milestones of expanding business network through ELECRAMA?**

ELECRAMA, organised by IEEMA, brings together the entire electrical industry ecosystem. Being the largest gathering of electrical industry, the show has been widely praised for its all-encompassing approach to include everything that is significant in the industry and matters for its growth. The exhibition provides a strong forum and international platform for knowledge sharing in the form of innovation, technical conclaves and industry summits.

The exhibition offers insights on key factors like latest technology, international network, export, energy storage revolution in business technical collaboration and building partnership through global value chains to the participants.

### **How you foresee the growth of electrical and energy markets?**

The energy and electrical market will continue to grow quite significantly because of new trends and technology in all sectors. The innovations are also taking place in energy transition and the demand will go up for new technology products for replacement of old one.

The expected growth of energy market for developing countries like India, Vietnam, and Indonesia will be more than 12 per cent per year and in developed countries it may vary from 3-5 per cent per annum.

### **What are the main challenges affecting this market?**

For Indian electrical industry, the golden era of growth has begun due to their competitive new prices and young workforce. The main challenge for Indian industries is in getting technological knowledge and upgradation of products to the world-class level. The ELECRAMA is a platform where we are bringing the people from more than 100 countries and providing a platform to Indian electrical Industry to collaborate themselves for new technology and making world class products.


### **What is your opinion about field of trading and contracting in the electrical world during ELECRAMA 2020?**

ELECRAMA 2020 will focus on renewable energy, energy storage, energy solution and digitisation. The Indian economy has reached a GDP of Rs. 167 lac crore in 2017-18, translating to USD 2.3 trillion. A key component of the USD 5 trillion ambitions is the target of USD 1 trillion from manufacturing, requiring the sector to grow 2.5 times in the next 7 years, implying a 12.5 per cent CAGR. The country needs to build further momentum and target at maximising local value add, creating scale, capturing global market share and fulfilling India's job creation needs. To generate the revenue, we need to adopt new digital technologies for sustainable power solutions and building partnerships for our MSMEs with global network.

### **R&D activity is a major part of business expansion.**

#### **How ELECRAMA 2020 will promote this?**

True. R&D activity is a major part of business expansion if we invest in R&D and international peer accepts trials that would provide the opportunity for large exports in the field of electrical equipment. I would strongly recommend every industrialist to invest at least 30 per cent of revenue in R&D.

India is poised to become the third largest economy worldwide in the next 15 years. The electrical, industrial electronics and allied equipment industry must invest in research and development of storage systems so that electricity can reach all households. 



# Transformer industry expects consolidation: IEEMA

With thinner margins there will be lesser investment in R&D and consolidation of industry is likely over the next 3 years.

**Sunil Misra,**  
Director General, IEEMA



power transformer industry badly. With thinner margins there will be lesser investment in R&D and consolidation of industry is likely over the next 3 years.

Last 5 years also saw more stress or control put by major customers on quality of material used, quality of processes and overall quality of transformers with sub-vendor approval process which has helped to elevate product quality in the industry. Short-circuit testing has become a common type test with most of utilities and success rate of successful short-circuit testing has increased considerably raising confidence on manufacturers.

Further, new power transformer technologies and applications have made inroads in market and also has and will boost growth for special power transformers. Statcom transformers which are specially designed for system conditions involving harmonics. Total 13 statcom projects were announced and 4 are under implementation. Ester filled transformers are gaining momentum in the country upto 20 MVA but soon will cover transformers upto 160 MVA and 220 kV voltage class. It is green solution with fire safety. These liquids are having higher temperature withstand capability

**I**ndian Electrical & Electronics Manufacturers' Association (IEEMA), the apex industry association of manufacturers of electrical, industrial electronics and allied equipment, observes that there is excess manufacturing capacity coupled with buying process of reverse auction has hit margins of power transformer industry badly. The industry body anticipates consolidation over the next 3 years. Edited excerpts from interview with IEEMA DG Sunil Misra:

**How do you assess the performance of power transformer industry in India?**

With "Make in India" mission, manufacturing industry of power transformer has also gone through changes in terms of additional capacities in the ranges up to 765 kV and also in terms of ownership with multinational companies investing moderately. In the country presently, there is excess manufacturing capacity coupled with buying process of reverse auction has hit margins of



and enables longer insulation paper life. Globally transformers upto 400 kV are believed to be installed.

Lastly, investment in railway electrification has introduced new products in power transformers namely Scott-connected and V-connected transformers which will boost demand in next 5 years

**Aggregate Technical & Commercial (AT&C) losses in India remains a major roadblock. What are the remedial steps to be taken by various agencies?**

At an all-India level, the total losses came down from 26.63 per cent in 2011-12 to 21.81 per cent in 2015-16. It is clear that the fruits of increased power generation cannot be reaped unless there is serious effort towards reducing losses. Even in 2015-16, there were 17 states/UTs with aggregate losses exceeding 25 per cent. In other words, out of the 100 units of energy supplied, the government is able to account for less than 75 units in these places. South of India is the only region in the

country where every State/UT has an aggregate loss of less than 20 per cent. In all other regions, there are places with losses exceeding 30 per cent as well. In Jammu & Kashmir, Bihar & Arunachal Pradesh, the aggregate losses are close to 50 per cent.

**What are the challenges T&D segment faces?**

The T&D Industry is engulfed with myriad challenges. The most critical ones pertain to obtaining forest clearances and Right of Way (RoW) mainly related to compensation payments and unit rate finalisations. Further, there are issues related to bidding like the time gap between bidding and award of order as well as, contractual issues.

**How to overcome such challenges?**

The IEEMA T&D projects division is very active and voices the concerns of its members across relevant platforms. We recommend some remedies for expediting the progress of Indian transmission line industry. We feel more policy focus is required to expedite and remove the execution and procedural bottlenecks. Forming of empowered panel for spot decisions or advance approvals etc. are some of the ways which will boost the progress of this sector.

The industry needs more support in terms of funding for developmental and R&D initiatives, manpower planning and skill up-gradation for the T&D Industry.

Implementation of mechanisation and related funding has also to be proposed and provided for in the contracts.

In conclusion, a holistic view and action plan by all stakeholders will pave the way for rapid development of this sector. **ET**

# Transformer Industry Poised for Growth

The government's plans of generation of renewable energy and 24\*7 Power for All will generate a positive growth opportunity for transformers.

– *Supriya A Oundhakar, Associate Editor*

Being the key link for delivery of power between the point of generation and the end-user, transformers have been witnessing buoyant growth on account of various reforms in the Indian power sector. Power transformers are deployed in transmission networks at high voltages, while the distribution networks install distribution transformers (DTs) at low voltages. Apart from the Ujwal Discoms Assurance Yojana (UDAY) for operational and financial turnaround

of state-owned Power Distribution Companies (DISCOMs), 100 per cent village electrification under Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), the government's roadmap for achievement of 175 GW capacity in renewable energy by 2022, and the focus on attaining 'Power for All' are stimulating the generation capacity of the power sector. In turn, the enhanced capacity additions will escalate the demand for transformers.

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power and distribution transformers projects a growth at CAGR of 10.5 per cent during 2015-20. Under the 12th Five-Year Plan, the government has focused on expansion of the country's Transmission and Distribution (T&D) network with significantly higher investments than previous Five-Year Plans, which is expected to result in robust growth of the power and distribution transformers industry over this period.

Further, the government projects like Green Energy Corridor for power generation from renewable sources would give a boost to the overall power and distribution transformer installations in the country. India has also entered into a technological collaboration with Germany under which Germany would extend its technical assistance for upgrading India's existing power grid and facilitate flow of renewable energy through the grid.

According to Indian Electrical and Electronics Manufacturers' Association (IEEMA), growth in power transformers is attributed to demand for High Voltage (HV) and Extra High Voltage (EHV) transformers with support from growth in exports also; whereas in distribution transformers, growth is led by domestic demand especially rural electrification program.

## Stumbling Blocks

Indian transformers industry has been facing the various challenges of availability of adequate quantity of raw material, testing facilities and skilled manpower. Issues like high input cost due to exchange rate, crude price, and working capital management for MSME sector continue to be the hurdles in the sector.

According to International Copper Association India (ICAI), the distribution transformer business has had its own set of challenges in the past few years, mainly emerging out of reasons below:

- Mandatory certification of BIS as per IS1180 and MEPS through BEE's Star labelling program that initially was not in harmony with national standard by BIS and observed by utilities. The process also failed to recognise customised requirements, generally of limited quantity, placed by industrial users.
- Dual certification by two government authorities created hurdles in carrying out smooth business. The transformer manufacturing cycle was also ignored considering ongoing orders under execution take 4 to 12 months or more to complete.
- Initial absence of clarifications on confusion created



Emergence of requirement of charging stations for electric vehicles at national level the transformer requirement will see further growth.

**U C Misra**, President, Indian Transformers Manufacturers Association (ITMA)

by above orders and amendment on cards caused discord. It also caused economic burden to those who followed rules and standards and left others unintentionally unlawful.

- Unfair competition, due to abnormally low pricing pattern of some manufacturers, who, in absence of proper enforcement and monitoring mechanism, were able to supply the actual product deviating from specification. Others are left with options either to adopt unfair practice or with reduced margins or even loss of business.

"After much needed effort from various quarters the situation looks like light at end of tunnel supported by electrification schemes of the central government. Even now, this is changing at a slow pace, and it is suspected that utility transformer business may be affected, as many projects like DDUGVY, IPDS, Saubhagya etc are scheduled to be completed in 2019," states Manas Kundu, Director (Energy Solutions), ICAI.

Further, the misuse of warranty or guaranty period insisted by the DISCOMs or utilities in the tender hurts the interests of the transformer manufacturers. DISCOMs or utilities are imposing warranty or guaranty period for 60 to 66 months in their tender documents against standard guidelines of Ministry of Power of 12 to 18 months. Due to the long warranty or guarantee period over five years backed by the bank guarantee, the cash flow or working capital limits of the manufacturers gets adversely affected, and day to day business transactions suffer. "Moreover, the utilities or DISCOMs do not



The type of protection used should reduce the disconnection time for faults within the transformer and minimise the risk of catastrophic breakdown to simplify eventual repair.

**Pradeep Azad**, Managing Director, UP Transformers (India) Ltd.



**Manas Kundu**, Director (Energy Solutions), ICAI

The OEMs and utilities have to see each other as not adversaries but join hands to ensure growth of the power distribution sector in creating sustainable infrastructure. Customers too must pay for what they use i.e electricity one's lifeline today.

adhere to proper maintenance schedule of the DTs resulting in premature failure of the transformer, and the manufacturer has to replace the transformer free of charge within the warranty period," states U C Misra, President, Indian Transformers Manufacturers Association (ITMA) and former Director, Power Grid Corporation of India Ltd. "The matter has already been brought to the notice of authorities at the Central Government and state power utilities. In this connection, the utilities or DISCOMs may consider to insure their assets i.e. DTs towards failure beyond the warranty period for any claims, and warranty should be restricted as per standard guidelines i.e. 12 to 18 months," he further adds.

In addition to this, delay in payments by utilities or DISCOMs has aggravated the problems of the transformer industry. It has a cascading effect on the production process and discharge of liabilities towards banks and other institutions. "Online payment on delivery of the equipment needs to be ensured as per the Prime Minister's commitment in various forums. Further, the utilities or DISCOMs are advised at national level to get themselves registered with the Receivables Exchange of India Ltd (RXIL), a joint venture between SIDBI and NSE, in order to facilitate prompt payments to the MSME industries for doing business with ease," advises Misra.

In distribution transformers, many small



**M Vijayakumaran**, Senior Transformer Expert, Primemeiden

Short circuit testing as recommended by CEA is to be made mandatory for reducing failure rate, but it is failing to achieve due to limitations in facility for performing the same and cost implication.

manufacturers are slowly switching over to manufacturing of the large capacity category transformers, thus expanding the organised participants' base. "This makes the market more competitive and sensitive to price rather than quality. If an organisation focuses on quality manufacturing of transformers, they cannot sustain the competition due to rock-bottom cut-throat rates quoted by the small players," informs M Vijayakumaran, Senior Transformer Expert, Primemeiden.

### Availability of CRGO steel

The production of transformers requires cold-rolled grain-oriented (CRGO) steel as the key raw material. Procurement of CRGO steel is one of the major bottlenecks for the transformers industry as this material is not produced in India, and the industry has to depend on imports for its requirement. The transformer industry is facing the scarcity of high-grade material CRGO. The cost of CRGO accounts for around 25 per cent of the total cost of the production of transformers.

With the enforcement of quality control orders bringing CRGO, along with distribution transformers under mandatory certification of BIS with energy efficiency levels defined, the demand for high quality CRGO steel has swollen manifold. This in turn increased pressure on suppliers, importers and manufacturing mills too.

Worldwide, the production, supply and price of CRGO is dominated by around 14 to 15 mills located in USA, Japan, Germany, South Korea, UK, Russia, Poland, Brazil and China. According to ITMA, the global production of CRGO stands at 35 lakh metric tons per year whereas India presently requires about four lakh metric tons. India's demand for CRGO is likely to accelerate to 7.5 lakh metric tons per year during the period 2017-2022 as power generation from nuclear, hydro, solar, wind etc will be more than approximately 400 GW. Recently TKES German Steel company at Nasik has started production of about 10 thousand metric tons of CRGO which is of no significance for the transformer industry. "The government has been endeavouring for the establishment of plant in India that will help to ease our position. The technology is not easily available. Tata Steel UK and Arcelor Mittal in Eastern Europe have technical knowledge. However, they are not coming forward to help India. The government has started R&D projects, but no serious efforts are being made to ease

*Continued on page 58*

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*Continued from page 56*

the availability of CRGO material in the right earnest,” informs Misra from ITMA.

“In order to tide over the high import price and scarcity crisis, the Government has taken a serious attempt to develop good quality CRGO in public sector steel companies with active support from renowned CRGO manufacturer POSCO,” states Vijayakumaran.

The availability issue was due to mandatory BIS certification at different mills located overseas. This issue is resolved as almost all mills have been certified now. Hence, the availability of higher grades is improved. However, the challenge for MSME sector manufacturers continues, as all of them are generally not capable of importing directly from the mills and depend on importers with core cutting lines and other suppliers, informs Rajesh Joshi, CEO, Tristar Technocrates.

## Failure Rate of Distribution Transformer

The failure of distribution transformer is one of the major concerns for the transformer industry. The failure rate officially stands at 14 per cent. According to International Copper Association and Frost & Sullivan Distribution Transformer Market Tracker, based on officially available data, the failure rate at pan-India level stands at around 13 per cent, of which, around 80 per cent of the failed distribution transformers are repaired and the remaining are replaced by a new distribution transformer unit, resulting into around Rs 2,600 crore expense every year.

The causes for failure are multifarious like:

- Non-adherence to national standards and tweaking of standards at some level
- Compromised procurement
- Improper manufacturing practices

- Inadequate Quality Control (QC) supervision
- Inadequate operation & maintenance practices
- Aged legacy assets
- Non-availability of funds.

Operating conditions like transformer overload, through faults, etc often result in transformer failure, highlighting a need for transformer protection functions, such as over excitation protection and temperature-based protection. Extended functioning of the transformer under abnormal conditions such as faults or overloads can compromise the life of the transformer. Adequate protection should be provided for quicker isolation of the transformer under such conditions. The type of protection used should reduce the disconnection time for faults within the transformer and minimise the risk of catastrophic breakdown to simplify eventual repair, suggests Pradeep Azad, Managing Director, UP Transformers (India) Ltd.

Nationwide efforts like QC order, enhanced warranty, quality input materials, and few islanded efforts in quality manufacturing practice, asset management practice etc are on to address reliability in DTs. Enormous economic burden is caused to the country due to premature DT failure causing CAPEX deployment every five years for an asset that should give minimum 20 years of life technically. This also affects public utilities tariff to rise as against the principle set out in the Act earlier.

The OEMs and utilities have to see each other as not adversaries but join hands to ensure growth of the power distribution sector in creating sustainable infrastructure. Customers too must pay for what they use i.e electricity, one's lifeline today, advises Manas Kundu.

ICAI has proved an innovative concept to give new life to old legacy transformers in improving their



reliability. This has not only resulted in life extension but also additional kVA at optimum incremental cost to the utilities while meeting energy efficiency levels contemporary with prevailing standards.

ITMA has prepared guidelines both for manufacturers and users of transformers in order to avoid this colossal loss at national level, and the same has been submitted to the Ministry of Power and Central Electricity Authority (CEA) for issue of comprehensive guidelines for the DISCOMs where there is hardly any attention on operation and maintenance of the distribution system. The maintenance staff of DISCOMs should be sensitised and trained. This will definitely make marked improvement in failure rate, informs Misra of ITMA.

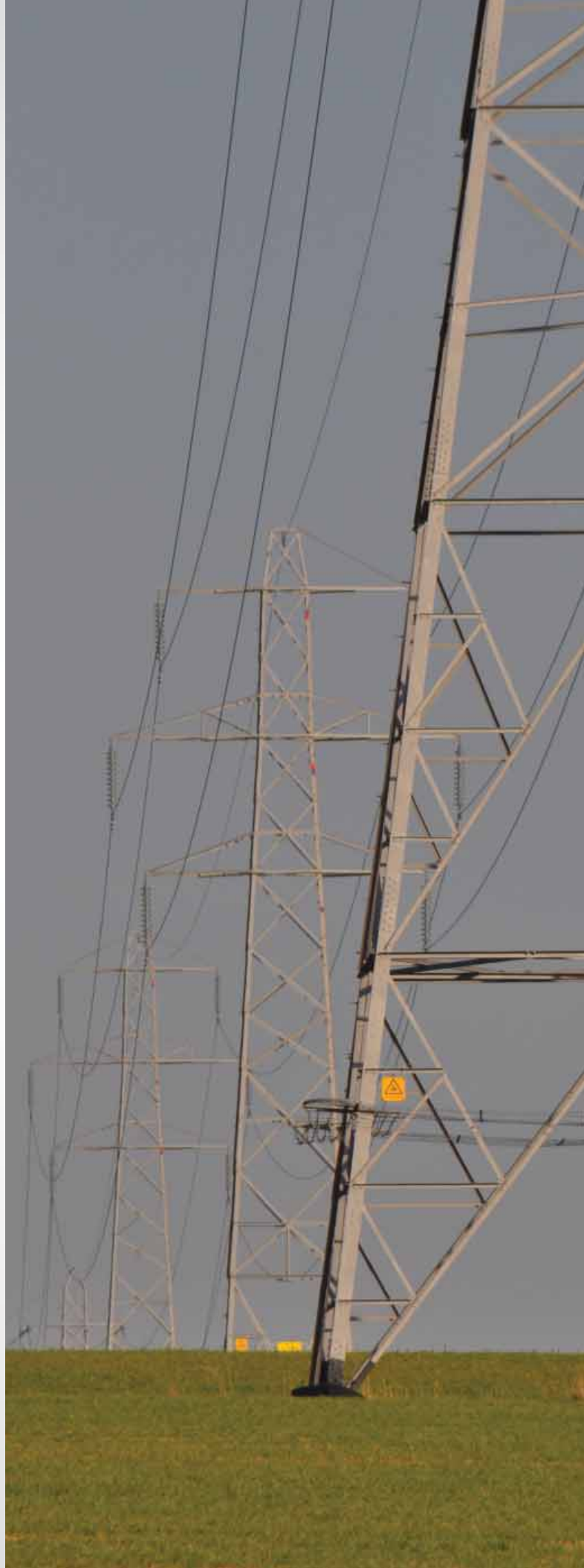
In order to improve the quality and overall reliability of DTs, short circuit testing as recommended by CEA should be made mandatory for reducing failure rate. But it is not achieved due to limitations in facility for performing the same and cost implication, states M Vijayakumaran.

## Outlook

The government's plans of generation of renewable energy and 24\*7 Power for All will generate the positive growth opportunity for transformers. It is expected that more than 85,000 ckt. km of transmission lines and 230,000 MVA of transformer capacity are expected to be added to the grid by 2021-22. Further, transformer demand other than utility business is proportional to industrial growth.

The demand of transformers will be continuously propelled due to addition of generation capacity. there is a need to increase per capita consumption to a reasonable level from 1000 KWH to international standard level say 2000 KWH, which will necessitate multiple fold growth in generation, transmission and distribution network. Now with emergence of requirement of charging stations for electric vehicles at the national level, the transformer requirement will see further growth, states Misra from ITMA.

Kundu from ICAI envisages the growth of the transformer industry at moderate rate of 6 to 7 per cent year-on-year given the central schemes reaching completion in this year added with general election knocking at the door.







# Failure of Transformer Insulation & its Maintenance

Causes of transformer failures include imperfection in design and environment. One of the main causes of failure of a transformer is the insulation failure.

Electrical transformer is one of the important equipment in the process of transmission and distribution of electricity. Transformer is the costliest equipment of power system and its proper functioning is vital to system operations. Fault is significant in all electrical devices. A fault in transformer can cause failure and result in significant property damage and serious interruption to a business.

A simple fault in distribution side can cause black-out of power in the whole area. Generally, transformer requires very less maintenance as compared to the other electrical equipment, but to track the cause of failure and the origin of a defect is not simple. Causes of failures are not just from a single factor. But these are generally combination of many factors. These factors include imperfection in design and environment.



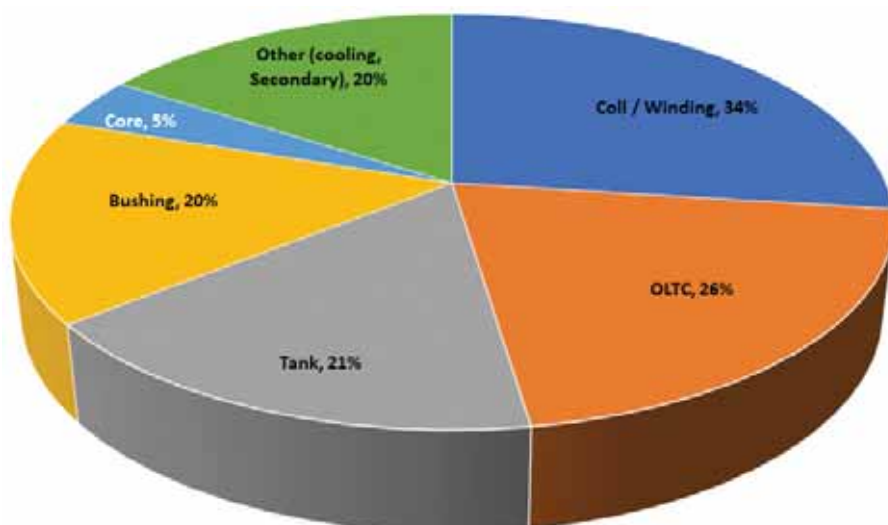


Figure 1: Different types fault occurring in transformer and its percentage.

One of the main causes of failure of a transformer is the insulation failure. The purpose of the insulation is to prevent the flow

of electric current between points of different potential in an electrical system. Failure of insulation is one of the most common failures in an

electrical equipment. The commonly used insulations in a transformer are insulating fluids, conductor insulation and solid insulator. Failure of any of these insulating medium results in catastrophic damage to transformer. The major fault and its percentage occurring in power transformer are indicated in figure 1.

## Failure and Causes

The cause of failures is classified into a) electrical b) mechanical and c) thermal and these failures can be further classified into external or internal components.

### Bushing

Bushes are insulating devices that insulate a high voltage electrical conductor to pass through an



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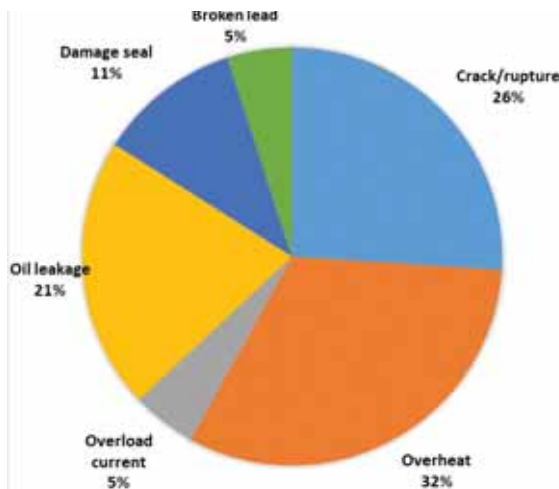


Figure 2: Percentage of Bushing failure

earth conductor. In transformer, it provides a current path through the tank wall. Inside the transformer paper, insulators are used which are surrounded by oil that provides further insulation. Bushings sometimes fail due to partial discharge. This is sometimes due to the slow and progressive degradation of the insulation over many years of energised service. However, it may also be a rapid degeneration which destroys a good bushing in few hours. Seal breaking of bushes happen due to ingress of water, aging or excessive dielectric losses. Due to this fault, core failure of the transformer occurs. Non-replacement of oil over long time or its deficiency due to

leakage causes internal over-flashing. Percentage of bushing failure is indicated in figure 2.

## Winding Failure

The causes of breaking of the windings or the burn-out will cause breakdown of transformer. There are different causes of breakdown of winding which are listed below.

- Dielectric faults occur in the winding due to turn-to-turn insulation breakdown. These are the insulation between the turns of the winding. Insulation breakdown commonly occurs due to high current and voltage which are high above the rated values. The breakdown of the insulation results in the flashover of the winding turns and cause a short circuit.
- The windings are usually of copper. Due to the copper line resistance, thermal losses occur. These thermal losses make hotspots in the winding due to poor or lack of maintenance. This over time causes wear and tear and the decrease of the physical strength up to the point of breaking of the
- Mechanical faults are the distortion, loosening or displacement of the windings. This results in the deterioration in the performance of the transformer and the tearing of the turn-to-turn ratio. The main reasons that cause this fault are the improper repair, poor maintenance, corrosion, manufacturing deficiencies, vibration and mechanical movement within the transformer.
- Deterioration of oil: Deterioration of oil may occur due to the result of prolonged overloading of the transformer. Excessive oil temperature produces the formation of sludge, water, and acids. Moisture entering the oil as a result of the breathing action greatly reduces its dielectric strength so that breakdown from coils or terminal leads to tank or core structure may take place. Narrow oil ducts are a serious menace to the operational life of a transformer.

Petroleum based mineral oils are the generally used fluids for electrical insulation and heat transfer. But they are non-biodegradable. Vegetable oils

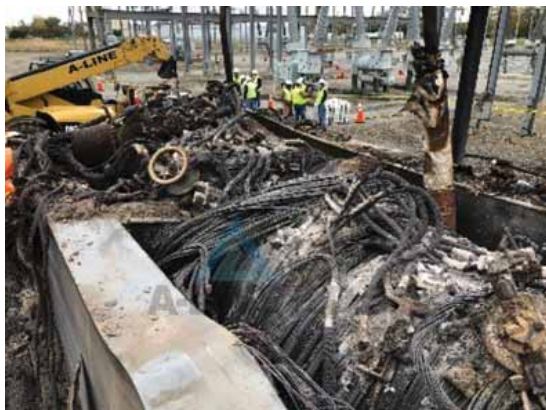


Figure 3: Transformer Winding Burnout

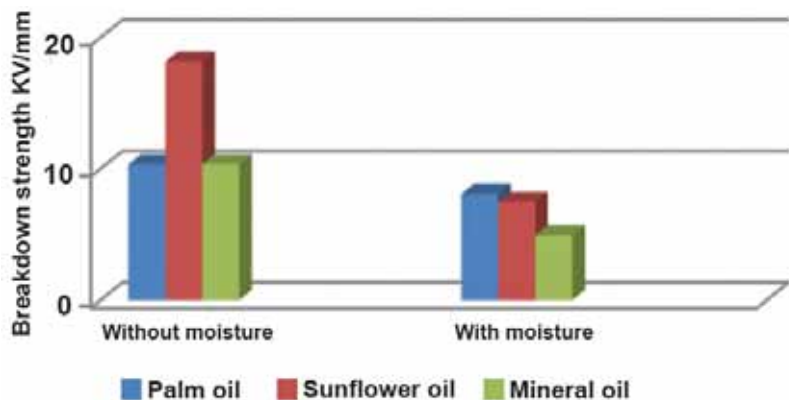


Figure 4: Breakdown strength of different oils without moisture and oils which contain moisture at d=2.5mm

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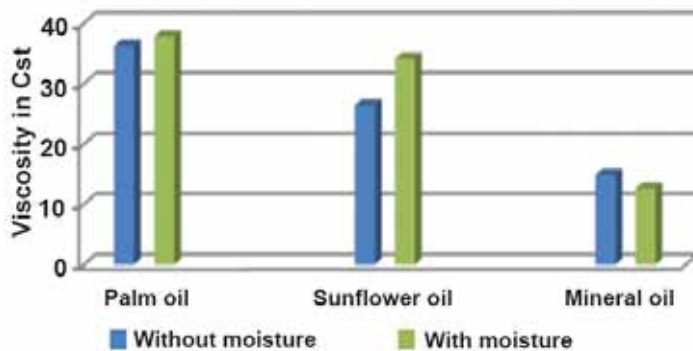


Figure 5: Viscosity of different liquids

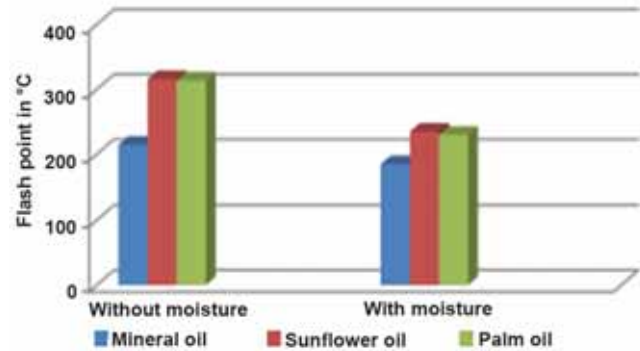


Figure 6: Comparison of flash points

obtained from seeds, flowers and vegetables are biodegradable, non-toxic, environment-friendly.

The breakdown strength of both oils without moisture and oils which contain moisture at a gap distance of 2.5mm are shown in figure 4.

The viscosity, flashpoint and also fire point of different liquids is as shown in figure 5, figure 6 & figure 7.

Liquid dielectrics used are the most expensive components in power systems like transformers and circuit breakers. It is proved that the breakdown voltages of oils increase as the gap distance between the electrodes increases. It is also proved that the oils without moisture are better insulators than those of oils with moisture. The flash point and fire point of oils without moisture are greater when compared to the oils with moisture. Hence, oils without moisture are good.

## Maintenance

For a safe and reliable operation of transformers, preventive maintenance is must. The maintenance detects problems at an early stage and can prevent further deterioration. Preventive maintenance includes oil sampling and analysis (oil quality, moist level, etc.) and electrical measurements (insulation resistance, winding resistance, etc.).

The protection system is to protect the transformer from faults by first detecting the fault and then resolving it as fast as possible. If it cannot fix the fault, it isolates it so that it may not damage the transformer. Protection systems include the Buchholz protection, pressure relief valve circuitry, surge protection and sudden pressure relays. The Buchholz is one of the main protection systems that detects

failure in insulation of transformer as it is sensitive to dielectric faults.

The Dissolved Gas Analysis (DGA), moisture analysis and other oil tests, and partial discharge are of the most important tests that are performed on transformer. Dissolved gas analysis of transformers provides an insight into thermal and electrical stresses sustained by oil-immersed power transformers. In addition, DGA is a sensitive and reliable technique for detecting incipient fault conditions in oil immersed transformers. DGA can help prevent further damage since test can detect incipient transformer faults. Partial Discharge (PD) can be measured offline using a high voltage power source, or online as the transformer is energised—under load or no-load.

As technology has advanced, online monitoring of power transformer has been introduced. A technique called Electrical Signature Analysis (ESA) had received attention by the industries for the increase in demand of predictive technology. On-line condition monitoring reduces cost related to the operation and maintenance of installed equipment and has mentioned the need of change in time-based maintenance program to condition based diagnostic procedure and online monitoring approaches.

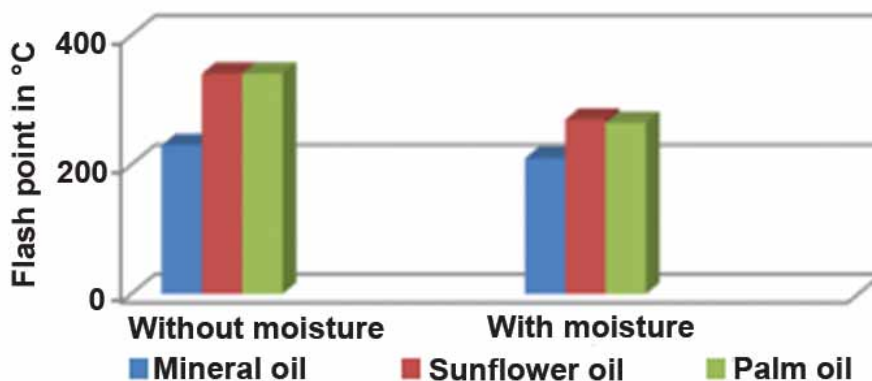


Figure 7: Comparison of fire points


Online monitoring to optimise the operational management is the key factor for future profitable generation, transmission and distribution within the power system.

## Recent Technology for Fault Analysis

In the recent years, several researchers and transformer experts have been able to achieve significant breakthrough in developing ways and means of assessing condition of the in-service power and distribution transformers that have proved a boon for detecting incipient faults in them. As a result, catastrophic failures can be easily detected and remedial actions can be taken timely to save both

human life and other capital losses in addition to preventing electric supply failures and economic losses to state electricity boards and utilities. Some of the recently developed techniques are On line Chromatography, Oil test by UV-VIS Spectroscopy, SFRA Diagnostics, Furan Analyses, Dielectric Dissipation Factor (DDF) or Tan Delta ( $\tan \delta$ ), Water in oil Analyzer, Online Transformer Temperature Monitor, Routine Inspection Monitor & Indicator device using  $\mu P$ , Thin film

Capacitor Sensor and Use of HTS Transformers.

The basic concept behind all above methods is the idea that calls for either continuous or periodic monitoring of all key performance affecting parameters of the transformer. Any departure from its normal value indicates a fault condition which needs the utmost attention to circumvent faults of all sorts and help prevent catastrophic failures. 



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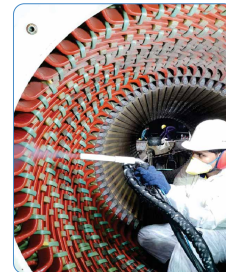
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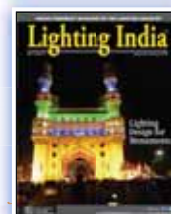
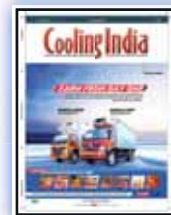


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# Applications of Flux Estimator for Motor Drives

The flux estimator finds many applications in high performance induction motor drives. These applications are reviewed and comprehensively presented in this article.



Over many years, the induction motor drives are widely used in various applications such as paper and textile mills, steel and cement mills, robotics, wind generation system etc. This is because the induction motor is reliable, simple in construction, easy in maintenance and provides high robustness. The overview of the variable speed control methods for induction motor are shown in figure 1.

In the past, induction motors were controlled using scalar control methods. In this control, only the magnitude of control variables is varied. It is simple to implement, but gives poor and sluggish dynamic response. This scheme can control the speed of the motor satisfactorily under steady state only.

With the advent of vector control schemes in the late 1970s, the control of an induction motor is transformed similar to a separately excited DC motor by creating independent channels for flux and torque control. In vector control, both the magnitude and phase alignment of vector variables are

controlled and kept valid for steady state as well as transient conditions. The vector control is of two types namely Direct Vector Control (DVC) and Indirect Vector Control (IVC). If the field angle is computed using the flux, it is termed as direct vector control. If the field angle is computed using speed and slip, it is termed as

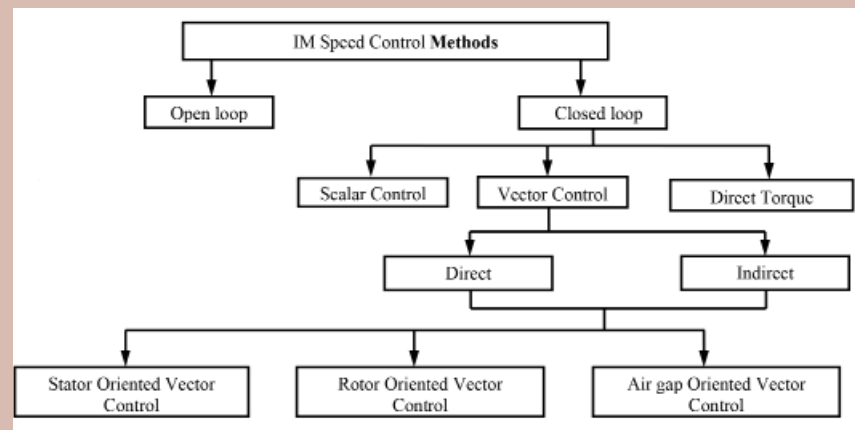


Figure 1 Overview of Induction Motor Speed Control Methods

indirect vector control.

Another control method is direct torque control. This method does not require any transformation of vectors and found to have nearly comparable performance with vector control. The vector control and direct torque control methods are better option than the scalar control to obtain the desired dynamic performance. An accurate knowledge of motor flux assumes importance to ensure proper operation and stability of high-performance IM drives. The knowledge of motor flux can be obtained through measurement using flux sensors. But the measurement of flux is difficult and expensive. Hence, the flux is generally estimated. In the literature, numerous applications of flux estimator are available for both vector and direct torque-controlled IM drives. These are dealt in the following sections.

#### FLUX ESTIMATOR APPLICATIONS

The applications of flux estimator could be broadly classified as follows.

- Speed estimation in sensorless vector or direct

torque-controlled IM drives

- Rotor resistance estimation in indirect vector-controlled IM drives
- Flux angle or field angle and resultant flux estimation in direct vector-controlled IM drives
- Electromagnetic torque, flux angle and resultant flux estimation in direct torque-controlled IM drives.

#### Application of flux estimator for speed estimation in Sensorless induction motor drives

Recently, the speed sensor-less control of IM drives whether it is a vector control or direct torque control has received great attention and is popularly used in industries. The sensorless control does not require speed sensor and hence leads to cheaper and more reliable control. The figure 2 shows the overall block diagram of the speed-sensor-less vector-controlled IM drive system of an induction motor. Generally, through a PI controller, the speed error signal is processed and the torque command is generated. Using the torque command, the corresponding reference torque producing component of



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stator current is generated. Using flux as the reference, corresponding reference flux producing component of stator current is generated. Using the PI controllers, the current error signals are processed and the corresponding two command voltages are generated. The two command voltages are combined to common reference voltages. The reference is used to produce the PWM pulses to trigger the voltage source inverter and control the voltage and frequency applied to the IM drive.

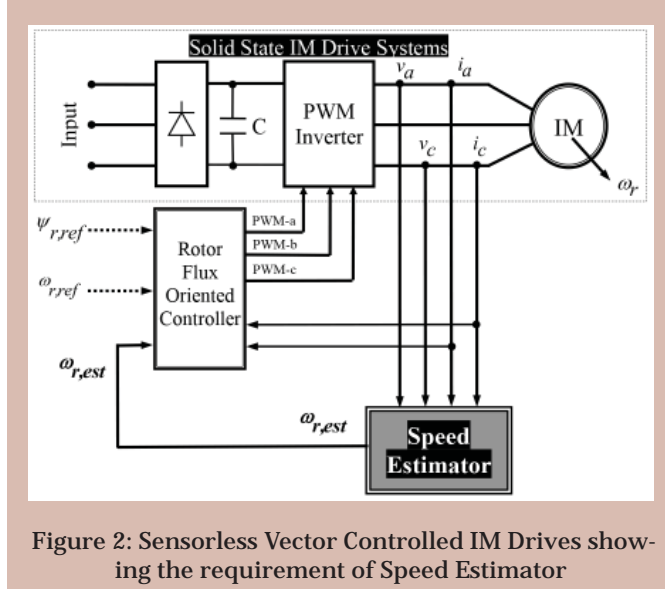


Figure 2: Sensorless Vector Controlled IM Drives showing the requirement of Speed Estimator

The performance of sensorless controlled IM drives to a large extent depends on the accuracy of speed estimation and require the knowledge of flux.

#### Application of Flux Estimator in State Synthesis equations-based Speed Estimator

The rotor speed can be estimated through state synthesis equation which is given in (1).

$$\omega_{r,est} = \frac{\left( \lambda_{dr}^s \frac{d\lambda_{qr}^s}{dt} - \lambda_{qr}^s \frac{d\lambda_{dr}^s}{dt} \right) - \frac{L_m R_r}{L_r} (\lambda_{dr}^s i_{qs}^s - \lambda_{qr}^s i_{ds}^s)}{\sqrt{(\lambda_{dr}^s)^2 + (\lambda_{qr}^s)^2}} \quad (1)$$

The state equation depends to a large extent on the accuracy of flux estimation. The voltage model and current model equations are popularly used for flux estimation. The current model equations for flux estimation are given in (2) and (3). The rotor fluxes can be calculated using the stator currents and rotor speed.

$$\frac{d\lambda_{dr}^s}{dt} = -\omega_r \lambda_{dr}^s + \frac{L_m}{T_r} i_{ds}^s - \frac{1}{T_r} \lambda_{qr}^s \quad (2)$$

$$\frac{d\lambda_{qr}^s}{dt} = \omega_r \lambda_{qr}^s + \frac{L_m}{T_r} i_{qs}^s + \frac{1}{T_r} \lambda_{dr}^s \quad (3)$$

The current model cannot be used because it requires the rotor speed as one of the inputs which is highlighted in red color. Hence voltage model can only be used for flux estimation. The schematic diagram of this scheme is shown in figure 3. The voltage model equations for flux estimation are given in (4) and (5). These equations are independent of rotor speed. The rotor fluxes can be computed using stator voltages and currents. It is noted that the flux estimator assumes importance for the good performance of this speed estimator.

$$\lambda_{dr}^s = \frac{L_r}{L_m} \left( \int (v_{ds}^s - R_s i_{ds}^s) dt - \sigma L_s i_{ds}^s \right) \quad (4)$$

$$\lambda_{qr}^s = \frac{L_r}{L_m} \left( \int (v_{qs}^s - R_s i_{qs}^s) dt - \sigma L_s i_{qs}^s \right) \quad (5)$$

Where,

$v_{ds}^s (v_{qs}^s)$  - Stator voltages d axis (q axis)

$i_{ds}^s (i_{qs}^s)$  - Stator currents d axis (q axis)

$\Psi_{ds}^s (\Psi_{qs}^s)$  - Stator flux d axis (q axis)

$\lambda_{dr}^s (\lambda_{qr}^s)$  - Rotor flux d axis (q axis)

$R_s (R_r)$  - Stator resistance (rotor)

$L_s (L_r)$  - Stator inductance (rotor)

$L_m$  - Magnetization inductance

$\sigma = 1 - \frac{L_m^2}{L_r L_s}$  - Leakage Co-Efficient

$T_r$  - Rotor Time Constant

The superscript 's' represents variables in the stationary reference frame.

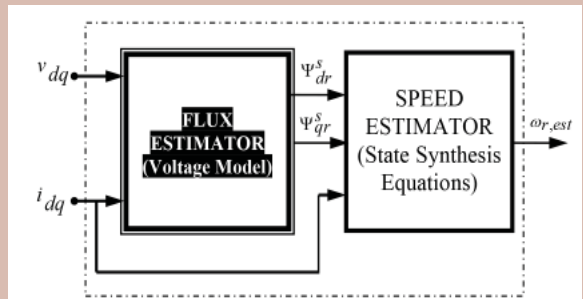


Fig. 3. Block Diagram of state Synthesis Equations based Speed Estimation Scheme showing the importance of Flux Estimator

### Application of Flux Estimator in Model Reference Adaptive System based Speed Estimator

The Model Reference Adaptive System (MRAS) consists of a reference model (independent of the parameter to be estimated) which determines the desired states and adaptive (adjustable) model (dependent on the parameter to be estimated) which generates the estimated values of the states. The error between these states is fed to an adaptation mechanism to generate an estimated value of the rotor speed which is used to adjust the adaptive model. This process continues till the error between two outputs tends to minimum. The MRAS with rotor flux as the state variable and stator current as the state variable is popularly used now-a-days. The MRAS with rotor flux as the state variable is shown in figure 4. In rotor flux MRAS scheme, the voltage model independent of rotor speed is used as the reference model. The current model dependent on the rotor speed is used as the adaptive model. The error between

two models is minimised using PI-controller, artificial intelligence-based techniques. Thus, both voltage and current model-based flux estimator is required for the good performance of speed estimator.

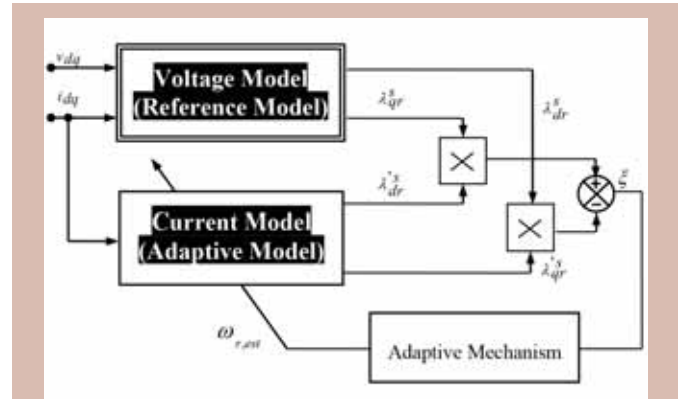


Fig. 4 Block Diagram of MRAS with Rotor Flux as State Variable

In the stator current based MRAS scheme, the stator current is used as the state variable. The reference model

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used is the actual induction motor. The stator current obtained from the reference model is independent of the rotor speed. The adaptive model equations can be derived and presented in (6) and (7).

$$\sigma L_s \frac{di_{ds}^{rs}}{dt} = \frac{L_m}{L_r T_r} \lambda_{dr}^s + \frac{L_m}{L_r} \omega_r \lambda_{qr}^s - \frac{L_m^2}{L_r T_r} i_{ds}^{rs} + v_{ds}^s - R_s i_{ds}^{rs} \quad (6)$$

$$\sigma L_s \frac{di_{qs}^{rs}}{dt} = \frac{L_m}{L_r T_r} \Psi_{qr}^s - \frac{L_m}{L_r} \omega_r \Psi_{dr}^s - \frac{L_m^2}{L_r T_r} i_{qs}^{rs} + v_{qs}^s - R_s i_{qs}^{rs} \quad (7)$$

The equation (6) and (7) depends on the flux. Here also current model cannot be used. The voltage model-based flux estimator can only be used. The block diagram of stator current based MRAS showing the importance of flux estimator is presented in figure 5. Thus, in this MRAS scheme also, flux estimator is required.

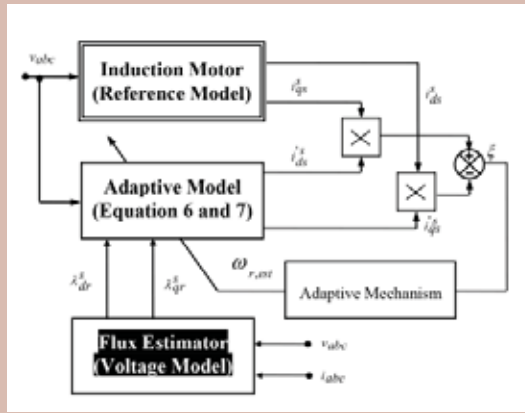


Fig. 5 Block Diagram of MRAS with Stator Current as State Variable

#### Application of flux estimator for Rotor Resistance estimation in Indirect Vector Controlled IM drives

The indirect field orientation utilises an inherent slip frequency and speed relation for field angle computation. The equation for field angle ( ) and slip frequency ( ) is presented in (8) and (9).

$$\theta_e = \int (\omega_{sl} + \omega_r) dt \quad (8)$$

$$\omega_{sl} = \frac{L_m R_r}{\psi_r L_m} i_{qs}^e \quad (9)$$

The calculation of the slip depends on the rotor resistance. Rotor resistance may vary up to 100 per cent due to rotor heating and recovering this information with a thermal model or a temperature sensor is difficult and not desirable. Hence, rotor resistance is estimated. Similar to rotor speed estimation methods, the rotor resistance estimation methods can be used and use the knowledge of flux.

#### Application of Flux Estimator in State Synthesis equations-based Rotor Resistance Estimator

The rotor resistance can be estimated through state synthesis equations (10).

$$R_{r,est} = \frac{\left[ \left( \Psi_{dr}^s \frac{d\Psi_{qr}^s}{dt} - \Psi_{qr}^s \frac{d\Psi_{dr}^s}{dt} \right) - \left( \omega_r \sqrt{(\Psi_{dr}^s)^2 + (\Psi_{qr}^s)^2} \right) \right]}{\frac{L_m}{L_r} (\Psi_{dr}^s i_{qs}^s - \Psi_{qr}^s i_{ds}^s)} \quad (10)$$

It is obvious from the equation (10) that the rotor resistance to a large extent depends on the accuracy of flux estimation. In this application also, current model cannot be used because it depends on the rotor resistance. Hence, voltage model can only be used because it is independent of the rotor resistance. The block diagram of this scheme is presented in figure 6. The speed required is obtained through speed sensor. Thus, flux estimator plays a vital role in this rotor resistance estimation scheme.

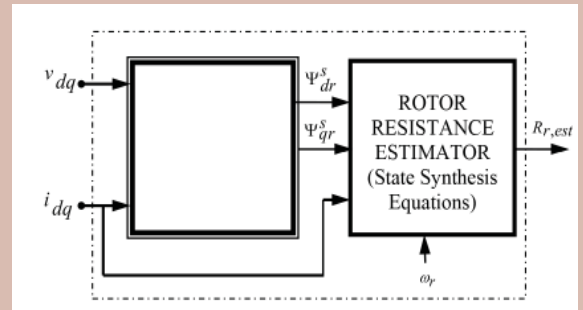


Fig. 6. Block Diagram of state Synthesis based Rotor Resistance Estimation Scheme showing the importance of Flux Estimator

#### Application of Flux Estimator in Model Reference Adaptive System based Speed Estimator

For rotor resistance estimation, the MRAS with rotor flux



as the state variable is the popular scheme. The block diagram of MRAS with rotor flux as the state variable for rotor resistance estimation is shown in figure 7. Both the voltage and current model are used. The voltage model is used as the reference model as it is independent of rotor resistance.

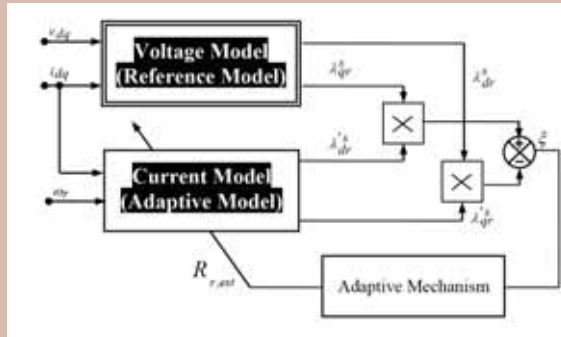


Fig. 7. Block Diagram of rotor flux-MRAS based rotor resistance estimator showing the importance of Flux Estimator

The current model is used as the adaptive model as it is dependent on the rotor resistance. The speed required is obtained through speed sensor. The error between the reference and adaptive model is minimized using adaptive mechanism. Thus, in this scheme also, both voltage and current model-based flux estimator is required for proper operation of MRAS.

### Application of flux estimator for Field Angle and Resultant Flux Estimation in direct Vector Controlled IM drives

The block diagram for the DVC IM drive is shown in the figure 8. Generally, through a PI controller, the speed error signal is processed and the torque command is generated. Using the torque command, the reference torque producing component of stator current is generated. Using the PI controller, the flux error signal is processed and the flux command is generated. Using the flux command, the reference flux producing

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Table I: Suitability of Flux Estimator for various Applications in High Performance Drives

Applications of Flux Estimator		Type of Speed Control Method	Type of Flux Estimator
Rotor Speed Estimation	State Synthesis Equations	Sensorless Drives (either vector control or direct torque control)	Only Voltage Model can be used
	MRAS with Rotor Flux as state variable		Both voltage model (reference model) and current model (adaptive model) are used
	MRAS with Stator Current as state variable		Only Voltage model can be used
Rotor Resistance Estimation	State Synthesis Equations	Indirect Vector Control with speed sensor	Only Voltage Model can be used
	MRAS with Rotor Flux as state variable		Both voltage model (reference model) and current model (adaptive model) are used
Field Angle and Resultant Flux Estimation		Direct Vector Control with speed sensor	Either Voltage or Current Model can be used
Electromagnetic Torque, Field angle and Resultant flux estimation		Direct Torque Control with speed sensor	Either Voltage or Current Model can be used

component of stator current is generated. The current error signals are processed through PI controllers and the corresponding two command voltages are generated. The two command voltages are combined to common reference voltages. The reference is used to produce the PWM pulses to trigger the voltage source inverter and control the voltage and frequency applied to the IM drive. The principal vector control parameters  $i_{ds}^*$  and  $i_{qs}^*$ , which are dc values in synchronously rotating frame, are converted to stationary frame as phase current commands for the inverter with the help of a field angle. The field angle & resultant flux can be computed using equation (11) and (12) through the flux components  $\Psi_{dr}^s$  and  $\Psi_{qr}^s$ .

$$\theta_{r,est} = \tan^{-1} \left( \frac{\Psi_{qr}^s}{\Psi_{dr}^s} \right) \quad (11)$$

$$\Psi_{r,est} = \sqrt{(\Psi_{dr}^s)^2 + (\Psi_{qr}^s)^2} \quad (12)$$

The performance of DVC IM drive to a large extent depends on the accuracy of field angle and resultant flux and in turn depends on the flux estimation as it is clear from equation (11) and (12). In this application, either voltage or current model-based flux estimator can be used. To make direct vector control speed

sensorless, then current model cannot be used. Only voltage model can be used as it is discussed earlier in the section 2.1

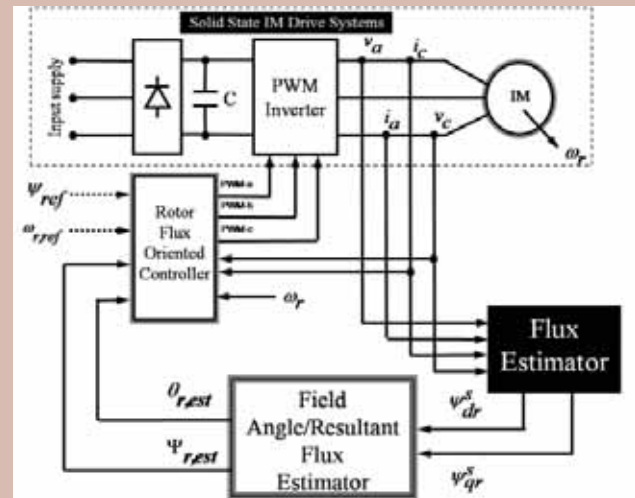


Fig. 8 Direct Vector Controlled IM Drive showing the Requirement for Flux Estimator to compute Field Angle and resultant flux

#### Application of flux estimator for Electromagnetic Torque, Field Angle and Resultant Flux Estimation in direct Torque Controlled IM drives

The block diagram of Direct Torque Control (DTC) is shown in figure 9. The direct torque requires the knowledge of electromagnetic torque, field angle and resultant flux for speed control. These parameters can

be computed using (13), (14) and (15) respectively. It is again obvious that these equations depend on the flux. In this application, either voltage or current model can be used. But for speed sensorless DTC drives, the current model cannot be used. Only voltage can be used.

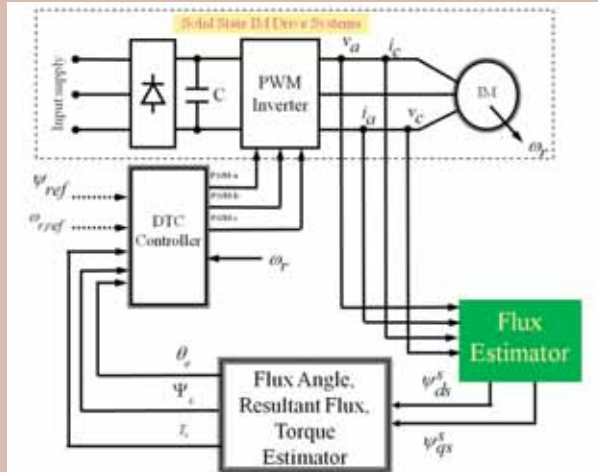


Fig. 9 Direct Torque Controlled IM Drive showing the Requirement for Flux Estimator to compute torque, Field Angle, resultant flux

$$T_e = \frac{3P}{4} (\lambda^s ds i^s qs - \lambda^s qs i^s ds) \quad (13)$$

$$\theta_e = \tan^{-1} \frac{\lambda^s qs}{\lambda^s ds} \quad (14)$$

$$\psi_s = \sqrt{\lambda^s 2 ds + \lambda^s 2 qs} \quad (15)$$

Thus through this review, it is understood that the flux estimator is required in almost all the applications in high performance drives. The type of flux estimator used for various applications in high performance induction motor drives is tabulated in the Table I.

## CONCLUSION

The detailed survey of flux estimator applications for the high-performance Induction motor drives is carried

out and presented. From the study, it is understood that the flux estimator finds enormous applications in both vector and direct torque-controlled IM drives and it plays vital role in various applications of high-performance drives. Thus, the study and addressing the issues involved in the design of flux estimator for various applications in high performance IM drives is still challenging, emerging area and open area of research.



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A Venkadesan

Assistant Professor, Department of Electrical and Electronics Engineering, NIT Puducherry.

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# SOLAR INNOVATIONS

The article aims to assess the application of renewable energy sources particularly solar PV system in generation of electricity and also gives a brief review of current and cost-effective technologies applicable to the manufacturing of solar cells.

Solar cells are considered as one of the key factors towards a sustainable energy supply. In ancient times, solar cells have been used in situations when there is an absence of power supply from grid, such as in remote area power systems, Earth orbiting satellites and consumer systems. Due to the advancement in technology coupled with the environmental concerns such climate change, global warming and non-biodegradable waste led to the installation of grid interfaced solar PV system and standalone solar system. Private investments

along with favourable government tariff policy regimes aim to generate competitively priced Solar Thermal and Solar Photovoltaic Power. According to the recent reports of Ministry of New and Renewable Energy (MNRE) solar capacity increased by 370 per cent in the last three years from 2.6 GW to more than 12.2 GW. World's largest renewable energy expansion program will be an installed capacity of 175 GW till 2022. Between 2014-2017 approximately 1.1 lac solar pumps have been installed for the green electricity expansion. A record low

solar tariff of Rs. 2.44 per unit is achieved by Bhadla Solar Park of Jodhpur district. Photovoltaic cells are electronic devices that transform the sun's energy into electricity. In recent years, PV cells have become one of the fastest growing non-conventional technologies which are going to play a significant role in the future global green energy generation. Solar PV is utilised to power the mini and micro grids to bring electricity access to people who do not live near power transmission lines, particularly, in developing countries with abundance of solar



Picture Courtesy: [www.envirogroup.com.au](http://www.envirogroup.com.au)

energy resources. Manufacturing cost of solar panels has declined remarkably in the last decade, making them more affordable for domestic and commercial usage. Solar panels have a lifespan of roughly 30 years, and available in variety of shades depending on the type of material used in manufacturing. The graph shown in figure 1 provides a comparative overview on prices of solar PV modules in European market from year December 2017-2018. The classification is based on the type of materials used for fabrication and it also depicts the significant reduction in the prices till end of year 2018.

The cost of electricity has declined by three quarters from 2010-2017. Focusing on the global weighted average trends for utility scale PV projects by year, the levelised of cost of electricity (LCOE) reduced by 73 per cent from 2010-2017. The given graph in figure 2 provides an overview on latest global trends in renewable energy costs.

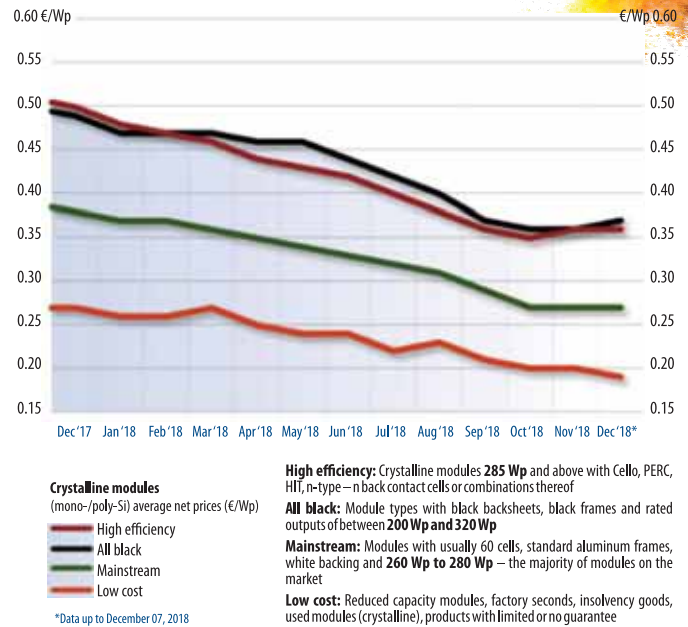


Figure 1: Average solar PV module prices by technology (2017-2018) (Source: [www.pvexchange.com](http://www.pvexchange.com))

## Recent Solar PV Cells Inventions

As per the latest reports of American Technion Society, researchers at the Israel Institute of Technology

have developed a technology that could improve the efficiency of photovoltaic cells by nearly 70 per cent. Photovoltaic cells optimally utilise a very narrow range of

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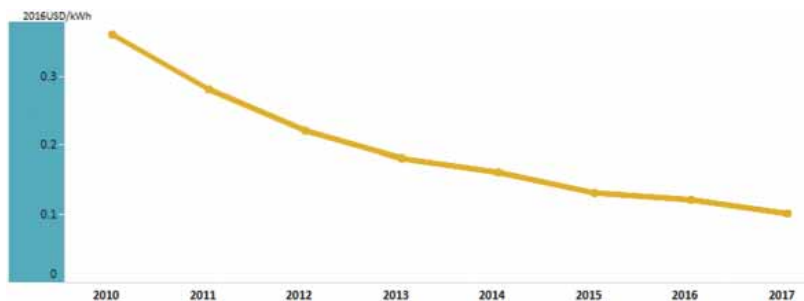


Figure 2: Price in USD/KW hr of LCOE from year 2010-2017  
(Source: International Renewable Energy Agency IRENA -2017 report)

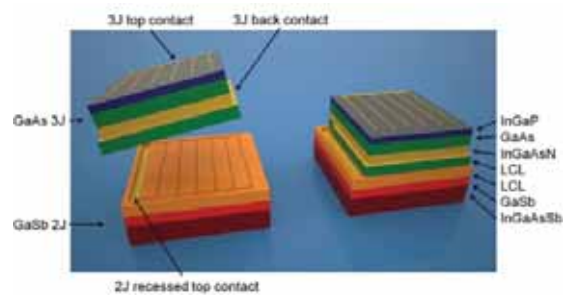


Figure 3: Stack of multiple solar cells  
(Image Source: George Washington University)

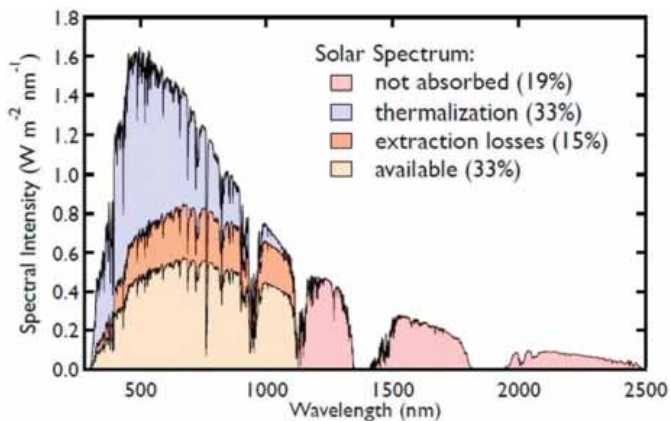


Figure 4: Spectral solar energy distributions

the solar spectrum. Radiations cannot warm these cells effectively thereby, reducing the efficiency modules by 30 per cent. A recent American research described an intermediate process that happens between sunlight and the photovoltaic cell. The photoluminescence material is created to absorb the radiation from the sun, and converts the heat and light from the sun into an ideal radiation, which illuminates the photovoltaic cell and enhances the conversion efficiency from 30 per cent to 50 per cent. The inspiration for the technology comes from optical refrigeration, where the absorbed light is re-emitted at higher energy, thereby, cooling the emitter.

A George Washington University researcher designed a prototype for a new solar cell as shown in figure 3 that combines multiple cells stacked into a single device capable of capturing nearly all of the energy in the solar spectrum with an efficiency of 44.5 per cent. The new device uses concentrator photovoltaic (CPV) panels that use lenses to concentrate sunlight onto micro-scale solar cells.

## Solar Cell Technologies

The mismatch of radiations between the solar cells and sun rays is the key factor for restricting their efficiencies. Various materials exist in the nature which can enhance the incident sunlight properties to optimise the absorption process of cells. The spectral modification to solar cells put high impact on solar PV devices. Figure 4 shows the percentage of solar spectrum represented as energy loss that occurs in silicon cell. Solar cell efficiency is fundamentally hampered by non-absorption of low-energy photons, thermal losses from the absorption of high-energy photons and extraction losses due to unavoidable charge carrier recombination.

The maximum theoretical efficiency of a 1.1 eV band gap silicon solar cell was calculated to be approximately 30 per cent. Today, there are a range of solar technologies which use new materials apart from silicon wafer based modules. These include second generation thin film and third generation nano structured devices whose efficiencies are much more than that of traditional solar cells. Despite promising progress, if the efficiencies could be further enhanced in a non-expensive manner, then the price of solar electricity could be further reduced which would ease the transition to a sustainable global economy. The various technologies along with their

Table:1 Solar PV technologies and their efficiencies and cost per watt

Technology	Maximum efficiency (%)	Cost per Wp (\$)
Silicon (mono-crystalline)	25.0	1.10–1.40
Silicon (multi-crystalline)	21.3	0.80–0.90
Silicon (amorphous)	13.6	0.45–0.53
Copper Indium Gallium Selenide	22.1	0.55–0.65
Cadmium Telluride	22.1	0.50–0.60
Dye Sensitized	11.9	0.25–0.40
Perovskite	22.1	0.20–0.30
Concentrator Multijunction	46.0	1.50–2.30





efficiencies and cost per peak watt are shown in Table 1.

Perovskite solar cells are popular in solar cell research. Dye-sensitised solar (DSS) cells, thin film solar cell and silicon solar cell accounted for easy fabrication process but at lower efficiencies. Perovskite solar cells promise the enhanced output of about 21 per cent from about 9.7 per cent. The issue of degradation of perovskite and its stability should be addressed for good reproducibility and long-life time with high conversion efficiencies. Organic-inorganic hybrid perovskite solar cells have attracted unprecedented attention in recent years due to their high power conversion efficiency, ease of fabrication and potential to yield low cost photovoltaic modules.

## Conclusion

A brief discussion on technological developments in solar PV system has been carried out here. The enormous potential of renewable energy sources coupled with the government subsidies in generating green power has led to growing research in maximising the efficiency of solar modules. The spectral modification is used to achieve greater solar cell efficiencies with the low cost, which is an important research area in the context of environmental issues and current engineering limitations



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# Why you should check your voltage/potential transformers

Over the service life of a voltage/potential transformer, various tests are useful for ensuring safety, quality, and operation that fall in line with the specifications.

**T**he accuracy of instrument transformers is essential for the reliable operation of relay systems, as well as correct energy metering and billing. For the accuracy of a transformer, upper limits for the error (amplitude and phase) are stipulated in standards for a range of operating points in relation to the input quantity (voltage) and the nominal load. Other specific requirements must be fulfilled depending on the class, such as parameters relating to the transient behaviour of capacitive voltage/potential transformers.

In addition to transmission accuracy, the insulating function of voltage/potential transformers also plays an important role. In order to reliably separate parts carrying high voltage and ground potential, the quality of the transformer insulation must be retained after many years of operation.

## Why are voltage/potential transformers checked?

The accuracy of a transformer may deteriorate due to various factors, though this is almost impossible to detect during continuous operation. For this reason, it is important to guarantee its accuracy through testing in order to avoid damage culminating in the failure of the substation and significant material damage.

These factors include the aging of the transformer and external influences, such as overloading or underloading. Other possible causes are design faults (incorrect dimensioning of the transformer core or insulation) and manufacturing defects

(short-circuits, insulation defects). Operation beyond the specifications and influences from grid operation (lightning and switching impulses, over-voltages) can also lead to faults. Leaks and the ingress of moisture or oxygen impair the quality of the insulation and can cause fires or explosions, potentially resulting in personal injury and material damage. In the case of capacitive voltage/potential transformers, the divider capacities are subject to aging, which has a negative impact on accuracy.

## When should you check voltage/potential transformers?

Over the service life of a voltage/potential transformer, various tests are useful for ensuring safety, quality, and operation that fall in line with the specifications.

Incorrect dimensioning and manufacturing processes involving a high degree of manual work can lead to faults. Tests performed during the production process enable the condition and performance data to be determined at various stages of production. As a result, defective or imprecise devices can be identified at an early stage and the efficiency of the process is enhanced.

Once production is complete, compliance with the specifications stipulated in the standard should be checked by thorough tests. Reference measurements that can be used later for comparison as “fingerprints” are also recommended at this stage.

Any transportation-related damage can be identified before commissioning at the site. During commissioning, suitable tests are carried out to ensure the system





has been correctly installed and is functioning correctly in the operating environment.

Tests should be performed as part of a regular maintenance program throughout the service life of voltage/potential transformers. Being aware of the condition of the transformer helps avoid risks to persons and installations as well as expensive faults, failures, and subsequent lengthy service interruptions. For instance, in some cases, such as the conversion of switchgear, the accuracy will need to be verified again using laboratory tests or on-site measurements.

### What is the best way to check voltage/potential transformers?

For the purpose of insulation diagnosis, tests comparable to those on the bushings of power transformers are also performed on voltage/potential transformers, such as power/ dissipation factor measurements, dielectric response and partial discharge measurements.

A test voltage is applied to the primary side of the transformer in order to determine the ratio and polarity.

This is done to make sure that it is functioning correctly. Nominal voltage is applied or a model-based method is used to perform an accuracy test.

For many years, it was only possible to carry out accuracy tests using high voltages and heavy equipment. Nowadays, modern test sets are capable of using a model-based testing approach, which enables lightweight and portable measuring instruments to achieve more or less the same level of accuracy. These instruments take an automatic series of measurements and model the voltage/potential transformer on the basis of its equivalent circuit diagram. This method provides detailed test data, such as ratio accuracy, turns ratio, polarity, and excitation curve.

21



**Felix Feustel**

Application Engineer  
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### Transformer Test

#### Routine Test

- Measurement of Winding Resistance
- Measurement of Voltage Ratio & Check of Phase Displacement
- Measurement of Short Circuit Impedance
- Measurement of No-Load Loss and Current
- Measurement of Insulation Resistance
- Induced over Voltage Withstand Test
- Separate Source Voltage Withstand Test
- Pressure & Vacuum Test
- Oil Leakage Test

#### Type Test

- **Lightening Impulse Test**
- Temperature - Rise Test
- Pressure & Vacuum Test

#### Special Tests

- Determination of Sound Level
- No Load Current at 112.5% Voltage
- BDV & Moisture Content in Oil
- Paint Adhesion Test

#### Other Test

- Harmonics of No Load Current
- Permissible Flux Density and Over Fluxing
- Zero Phase Sequence Impedance

#### Test As per CBIP

- Magnetic Balance Test at Low Voltage
- Magnetizing Current at Low Voltage
- Unbalanced Current

#### Lightening Impulse Test on

- Insulator
- Bushing
- Current Transformer
- Potential Transformer



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# Distribution Transformer Inspections

Temperature monitoring using advanced diagnostic thermal imaging cameras can increase reliability of distribution networks.

## The Customer's Challenge

Distribution transformers are a key part of low-voltage distribution networks. If a transformer overheats and fails, it can be devastating to the utility. A widespread outage might disrupt power to thousands of customers, and the cost to repair or replace equipment is expensive. An overheating transformer might be evidence of an improper machinery condition, progressive deterioration of the electrical isolation or machinery elements, or bad operating parameters, such as current, voltage, and temperature. With so many possible sources of the problem, it can be difficult to pinpoint the exact cause.

## A Solution

Temperature is a key element in ensuring the working status of distribution transformers. Regular temperature monitoring using advanced diagnostic thermal imaging



cameras

can help

you catch impending failures before they occur. By using FLIR handheld thermal cameras, you can easily inspect and monitor the temperature distribution on the outside surface of each transformer. It will show you what the naked eye can't see – hot spots that indicate overheating parts – so you know where to investigate further. The high performance FLIR T660 is an ideal solution to help you find hidden signs of electrical resistance and mechanical wear, so you can begin repairs immediately. The FLIR T660 features options with a 24-degree or 45-degree lens, which will give you a larger field of view when you have limited space in front of your transformers. This thermal camera can measure temperatures up to 2,000-degree C (3,632-degree F), and it provides 640 x 480 thermal resolution for superior image quality and clarity.

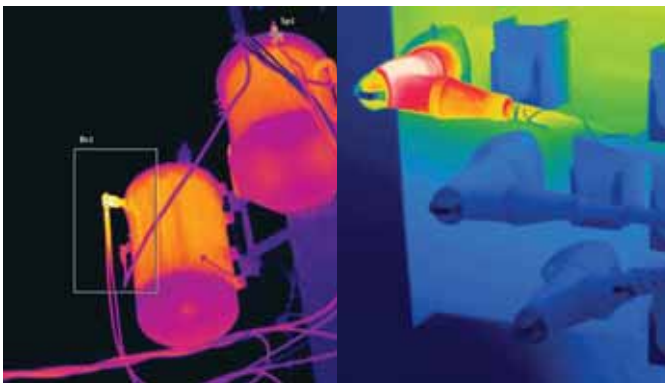
## The Results

Repairing or replacing a transformer is expensive. A thermal camera pays for itself when you consider the money saved by having the ability to fix a problem before it results in a shutdown. Through regular thermal inspections, you can rapidly detect and locate overheating areas on the surface of a transformer or hot spots on electrical connections. Once you determine that something is overheating you can investigate further, such as with ultrasonic, vibration, or oil analysis. The benefits of catching hot spots early include extending the life of otherwise well-functioning equipment; prevention of equipment failures that could lead to widespread outages, reduction of costs through maintenance as opposed to replacement of damaged equipment, and improved safety by reducing the risk of fires or explosions that may result from transformer failures. <sup>18</sup>

For more information about FLIR in electric power distribution, visit: [www.flir.in/power-distribution](http://www.flir.in/power-distribution)



Typical distribution transformers where maintenance and monitoring are critical



Thermal images can help quickly locate overheating surfaces on a transformer or see hot spots on electrical connections

(Imagery for illustration purposes only)

# Kyoritsu's 6315 Power Quality Analyser

Kyoritsu's 6315 power quality analyser is used to measure the power in W, kWh or to analyse and measure harmonics. Apart from being used as energy-measuring devices, power analyser can also be used for network analysis and determination of harmonics.

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- Measurement with high accuracy.
- Remote monitoring on PC and Android device.
- Various clamp current sensors.
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# New 3-Phase Encapsulated Transformer for Industrial & Harsh Environments



**H**ammond Power Solutions Inc. (HPS), a manufacturer of dry-type transformers and magnetics, has announced the availability of an improved line of three phase encapsulated transformers for industrial and harsh environments – HPS Titan N.

HPS Titan N offers an innovative design with technological improvements. The transformer is completely encapsulated in epoxy and silica, providing excellent protection from airborne contaminants and prevents the ingress of moisture.


Enhanced electrical performance such as 10kV BIL, lower inrush current, and higher impedance, improve safety and minimize equipment damage. Improved thermal performance and a broad range of temperature classes makes this transformer adaptable for a variety of applications.

The new enclosure design offers enhancements such as front entry, removable hinged door, textured powder coating, as well as both wall and floor mount on select kVA's.

“A common question we are asked from our customers is: How does your product save me money?” stated Sanela Ligata, Product Manager. “We explain that the higher impedance design lowers inrush and short circuit currents allowing the use of less costly protective devices, reduces number of hours spent on installation and maintenance, and has a broad selection of temperature classes available, all of which result in dollar savings for the customer.”

HPS Titan N's improved electrical and thermal design also results in a more efficient product. Although not mandated by DOE 2016 or NRCan 2019, HPS Titan N meets or exceeds the current minimum efficiency level for ventilated transformers. It is also seismically qualified and O.S.H.P.D certified.

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The readycable product finder from igus with its newly integrated service life calculator ensures fast delivery starting from 24 hours.



With the advanced readycable product finder, the user can now quickly find their optimum solution from 4,200 harnessed drive cables according to 24 manufacturer standards, calculate the service life and order them to the required length.

Using the igus “readycable product finder” online tool, harnessed drive cables used in the energy chain can be easily selected and ordered from igus. The newly integrated service life calculator now expands the service and predicts the lifetime of the cable. In this way, the user can choose their special design for energy chains, to the required length, from over 4,200 ready-to-connect drive cables.

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For more details, visit [www.igus.in](http://www.igus.in)


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[www.aiss.org.in](http://www.aiss.org.in)

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Renaissance Hotel, Mumbai

[www.world-petroleum.org](http://www.world-petroleum.org)

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ENCO 2019

Vigyan Bhawan Auditorium, New Delhi

[www.enco2019.org](http://www.enco2019.org)

**21-22 Feb 2019**

ICSEE-2019

Hindustan Institute of Technology & Science, Chennai

[www.ii-icsee2018.com](http://www.ii-icsee2018.com)

**21-23 Feb 2019**

Renewable Energy Expo - Chennai

Chennai Trade Centre, Chennai

[www.renewableenergyexpo.biz](http://www.renewableenergyexpo.biz)



**22-24 Feb 2019**

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[www.futureenergyexpo.in](http://www.futureenergyexpo.in)

**24-27 Feb 2019**

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Race Course Ground, Rajkot

[www.rajkotexpo.com](http://www.rajkotexpo.com)

**25-27 Feb 2019**

EV India Summit

Holiday Inn, New Delhi

[www.evsummitindia.com](http://www.evsummitindia.com)



**26 Feb-01 Mar 2019**

IEEE International Conference on Sustainable Energy Technology

KIIT University Bhubaneswar, Bhubaneswar

[www.icset-ieee.org](http://www.icset-ieee.org)



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### RURAL ELECTRIFICATION

Transmission Lines, Distribution Transformers, Metering, Energy Management, T&M, Switchgears

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## Electrical Test & Measuring Solutions



Digital Micro Ohm Meter



Contact Resistance Meter 200A



Turns Ratio Meter



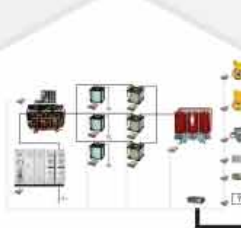
Winding Resistance Meter



Current Transformer Tester



Standard CT



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Cast Resin Standard PT



Battery Analyzer



75 KV AC High Voltage Test Set



Automatic Portable HV Tester

### Our Product Range

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- Turns Ratio Meter
- Digital Micro OHM Meter
- Contact Resistance Meter
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- Standard Voltage Transformer
- Transformer Loss Measuring System
- Automatic Transformer Test-System
- Online DGA
- Static Frequency Converter (EPS)
- Mobile EPS
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