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Publisher's letter

Power electronics is a critical element in advanced smart grid and renewable energy systems. It plays an important role in the areas of energy saving, electric vehicles, renewable energy systems, and grid energy storage. The power electronics market in India is expected to witness significant growth owing to government pushing for electric vehicle adoption and encouraging setting up large-scale solar power plant projects in the country. This time we take a closer look at the varied aspects of power electronics technology.

On the energy generation front, the world is moving from the fossil energy era to the renewable energy era and India has a unique advantage: the abundance of renewable resources including solar and wind. Accordingly, the government has set an ambitious target of having 175 GW of clean energy capacity by 2022, including 100 GW solar and 60 GW of wind energy. Further, it aims to exceed its renewable energy target of 275 GW in 2027. This edition presents to you a comprehensive review of solar power technology in terms of its market potential, technology innovations etc.

The 2019 edition of Renewable Energy India will open its doors on 18th September in India Expo Mart, Greater Noida. The congregation of global renewable energy players will exhibit cutting-edge technologies and products. Electrical India, being the media partner, will be present at this event. We look forward to see you there.

Till then, happy reading.

Do send in your comments to me at miyer@charypublications.in

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INDIA'S RE SECTOR AT THE CROSSROADS

The renewable energy sector has made tremendous strides in the past five years. According to a joint study by Paris-based International Energy Agency (IEA) and Council on Energy, Environment and Water (CEEW), the country's renewable energy sector investments has doubled over the last five years to around $20 billion in 2018, surpassing the capital expenditure in the thermal power sector.

Moreover, India had set a target of 175 GW renewable energy capacity by 2022 and has already installed 80.47 GW, of which solar and wind comprises 29.55 GW and 36.37 GW respectively.

However, of late, the solar power sector is witnessing slowdown primarily due to looming uncertainty over power purchase agreements (PPAs) being honoured and lack of financing. Weak availability of long-term, fixed-rate debt and decreasing profitability are causing steep fall in interest from investors. As per a 'Bridge to India' report on Indian solar sector, "Capacity addition fell to 4,810 MW in FY 2019, down a steep 47 per cent over previous year as the sector struggles with execution and financing challenges including land and transmission bottlenecks, safeguard duty, increase in financing costs etc."

Notably, last two reverse auctions floated by Solar Energy Corporation of India (SECI) went undersubscribed. This mirrors the challenging scenario for the industry.

At this juncture, proposed removal of priority sector lending limit for the renewable energy sector by RBI may yield positive results for both developers and long-term investors.

Subhajit Roy
Group Editor

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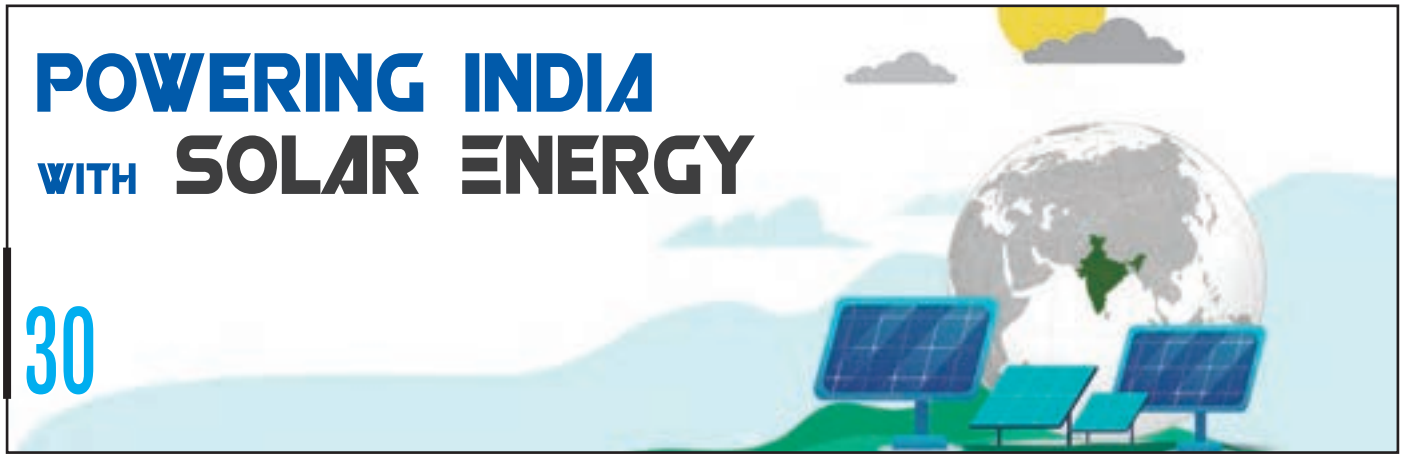

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Metering industry capable of delivering 240 mn smart prepaid meters: IEEMA

The 8th edition of Metering India, an International seminar organised by IEEMA Meter Division was held on August 8-9 in New Delhi. The theme of the conference was 'Widening Horizons.'

The conference highlighted key challenges and knowledge sharing on various aspects of metering including communication systems, emerging technologies, design and testing, and data acquisition and management.

Harish Agarwal, President, IEEMA, said, "Smart meters can bring efficiency to how India manages its electricity, by checking data-entry errors and billing efficiencies and cutting the costs of manual meter reading through web-based monitoring system."

Ashish Tandon, Chairman, IEEMA Meter Division, said, "The Indian Metering Industry is fully capable of delivering 240 million smart prepaid meters. We have all the desired capacity and capabilities to design, develop, manufacture and ship these meters from state-of-the-art manufacturing units within India, which is fully aligned with Make in India. However, we require support from the utilities and the ministry to fulfil this vision; firstly, a realistic time frame to be laid down so that the goal can be achieved practically. Secondly, consolidation of technologies is required." EI

Russia completes core supply for Kudankulam Unit 3

The supply of the main equipment for the third unit of the Kudankulam Nuclear Power Plant in Tamil Nadu (India) was completed. Andrey Lebedev, Vice-President for projects in India of ASE, Russia`s Rosatom State Atomic Energy Corporation Engineering Division, said that all main equipment items located within the red line of the reactor pit installation have been supplied.

Rosatom State Corporation is main equipment suppliers and technical consultants for the Kudankulam Nuclear Power Plant project.

The shipment consisted of the molten core catcher, embedded parts of the reactor pit, dry protection, heat-insulation of the cylindrical shell, truss buckstay, reactor vessel. These are part of the enhanced safety features in VVER-1000 reactors. A thrust truss and devices for neutron flux monitoring chambers allocation are expected to be delivered by the next shipload.

A core melt localisation device (CMLD), or a "core catcher," is one of the most important passive safety systems of modern nuclear power plants of Russian design. CMLD is installed at the bottom of the plants's protective shell. It is designed to localise and cool the molten core material in case of a hypothetical accident that could lead to damage to the core.

"Taking into account that four steam generators, a pressuriser, main coolant pipelines and a bubbler were delivered earlier, ASE has mostly completed the procurement of the containment equipment for the third unit to ensure uninterruptible and continuous operations for the reactor plant construction which is on the critical path of the project," said Andrey Lebedev. EI

Govt approves proposal for ocean energy as RE

In a decision that would give boost to the ocean energy in India, Union Minister of Power and New & Renewable Energy (MNRE) R K Singh approved a proposal to declare ocean energy as renewable energy. Accordingly,the MNRE has clarified to all the stakeholders that energy produced using various forms of ocean energy such as tidal, wave, ocean thermal energy conversion etc. shall be considered as renewable energy and shall be eligible for meeting the non-solar Renewable Purchase Obligations (RPO).

Oceans cover 70 per cent of the earth's surface and represent an enormous amount of energy in the form of wave, tidal, marine current and thermal gradient. A variety of different technologies are currently under development throughout the world to harness this energy in all its forms. Deployment is currently limited but the sector has the potential to grow, fueling economic growth, reduction of carbon footprint and creating jobs, an official statement said. EI

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NTPC awards contracts to GE Power for emissions reduction

GE Steam Power has got three contracts from NTPC to supply and install Wet FGD systems for a combined value of Rs 2,311 crore (USD 335 million). The three power plant projects are IGSTPP Jhajjar (3x500 MW) by Aravali Power Company Private Limited (APCPL), Simhadri Super Thermal Power Station Stage I (2x500MW) & Stage II (2x500 MW) by NTPC, and Sipat Super Thermal Power Station by Stage I (3x660 MW) by NTPC.

GE's scope of work includes design, engineering, civil work, supply, erection and commissioning of Wet FGD systems along with auxiliaries including limestone and gypsum handling systems and wet stack on full turnkey basis. In addition, GE's scope for IGSTPP Jhajjar (3x500 MW) also includes ten years of operation and maintenance including the supply of spare parts.Prashant Jain, Managing Director of GE Power India, said, "SO2 emissions reduction systems will play an instrumental role in transforming power plants and helping to reduce their environmental impact. With these projects, GE will help NTPC to treat 35 million cubic meters per hour of flue gas and will remove up to 108,400 tonnes per year of SO2 which will be converted into gypsum by-product for use in the construction industry. These new contracts are in addition to the earlier awarded Wet FGD projects.

R K Srivastava takes charge as ONGC Director

Rajesh Kumar Srivastava took charge as the new Director (Exploration) of Oil and Natural Gas Corporation (ONGC) on 2nd August. He takes over the reins of exploration of India's flagship explorer upon superannuation of A K Dwivedi on 31st July.

Speaking after assuming office, Srivastava shared his views in regard to future potential for improvement in exploration and development to realise the goals set by ONGC. He emphasised the need to focus on play-based exploration as the way forward to further energy search by bringing in new areas under the ambit of exploration. He shared that priorities for exploration fraternity would be to open up the new plays, consolidate the successes for early monetisation, acquisition of new acreages including NSP covered areas, besides working for field growth opportunities.

Srivastava called for a unified effort from all quarters to march towards a better tomorrow and a sustainable growth of the organisation. He earnestly hopes from all the stakeholders for convergence in realising the goal of the company. With over 35 years of experience, Srivastava is an expert in up-stream hydrocarbon exploration from well site operations (on-land and offshore), development geology, seismic data interpretation to monitoring and planning of exploration.

Fly ash-based Geopolymer concrete used in Telangana road construction

NTPC has taken several initiatives to make the environment clean and green. Team NTPC Ramagundam (Telangana) Project in association with NETRA (NTPC Energy Technology Research Alliance) has demonstrated the use of fly ash based Geopolymer concrete for the construction of the road. The Geopolymer road, constructed inside the Telangana Project, provides an approach to CHP area.

A team led by ED-Ramagundam & Telangana Dr P P Kulkarni inspected the construction site and appreciated the team for achieving the target on schedule on 31st July. Being a demonstration project, the team carried out around 300 trials of concrete mixes and 20 trials of process optimisation and completed the 500 metre length of Geopolymer road and thus, achieved the MoU target. The cement-free fly ash based Geopolymer provides opportunities for sustainable construction material for the construction of the road with negligible CO2 emission and low water consumption besides paving the way for bulk fly ash utilisation.

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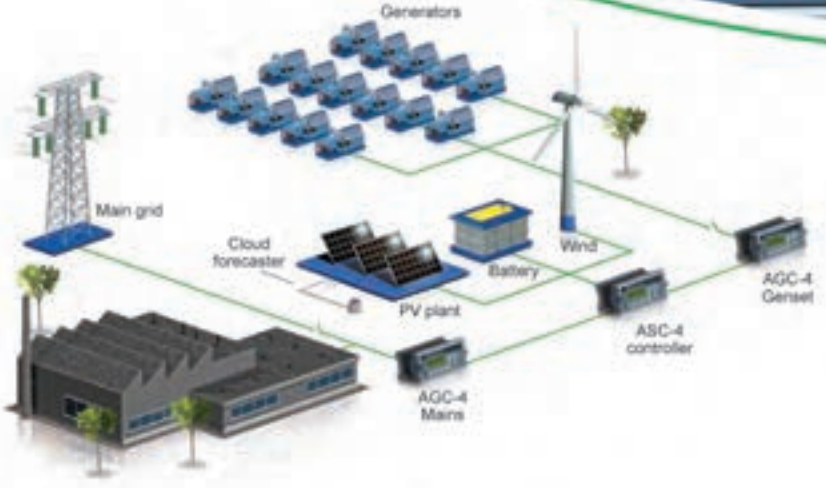

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Luminous Power Technologies forays into auto battery

Luminous Power Technologies, one of the leading home electrical and power storage companies in India, announces its foray into the auto batteries business. Luminous will now cater to models of passenger car vehicles as part of its portfolio expansion. This is a strategic move in sync with the company's vision to passionately innovate and offer an all-encompassing product portfolio.

The company claims that auto batteries from Luminous are made with advanced silver alloy technology for increased battery performance and longer life. These batteries are set to redefine the convenience aspect in the auto battery segment as they are ready to install and maintenance free with up to 30 per cent increased cold starting power.

Vipul Sabharwal, Managing Director, Luminous Power Technologies, said, "With this new venture, we plan to further strengthen our overall growth trajectory and offer a comprehensive power solutions portfolio to Indian market. The auto battery market is estimated to grow at 15 per cent CAGR over FY17-20 and we are hopeful of gaining a significant market share through our proven expertise in the power solutions segment."

The company is targeting a 5 per cent market share in the near future. The auto batteries will be available in all the 60,000 sale points of Luminous across the country.

L&T's power business wins orders from DVC

The power business of Larsen & Toubro (L&T) has bagged significant EPC orders from Damodar Valley Corporation (DVC) to set up Flue Gas Desulphurisation (FGD) systems in three power plants of DVC - Durgapur Steel Thermal Power Station (2x500 MW), Mejia Thermal Power Station (2x500 MW) and Raghunathpur Thermal Power Station (2x600 MW) in West Bengal. This is in continuation to the orders L&T had received earlier from NTPC for setting up FGD systems. Installation of FGD systems in existing and upcoming thermal power plants has been made mandatory by Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, to curtail SO2 emissions. Commenting on the FGD orders, Shailendra Roy, CEO & Managing Director, L&T Power and Whole-Time Director, L&T, said, "We are delighted to have secured orders from a prestigious client like DVC. L&T is fully equipped to provide solutions for SOx and NOx control to its clients. Considering the deadline endorsed by the apex court, other power plants will have to hasten the process of FGD award to meet the scheduled timeframe. L&T will continue to play a significant role in this market of SOx and NOx reduction." The Ministry of Power has set December 2022 as the deadline for existing thermal power plants to comply with revised emission norms.

Honeywell joins GCA for advanced cybersecurity

Honeywell has joined the Global Cybersecurity Alliance (GCA) created by the International Society of Automation (ISA), as a founding member. The company will collaborate with GCA participants to build awareness, provide education, share best practices, and accelerate the development and adoption of cybersecurity standards.

"Cybersecurity is the great equaliser for any company," said Matthew Bohne, Vice President and Chief Product Security Officer, Honeywell Building Technologies. "All companies should thoughtfully incorporate cybersecurity into the products and services they sell. The entire industry and connected world at large need to operate with the confidence that our digital infrastructure is robust and secure, whether it is utilities or facilities and even specific products we use every day. This is core to our collective future, and the GCA provides the platform and partnership to make it happen."

Mary Ramsey, ISA Executive Director, said, "The ISA/IEC 62443 standards outline what's needed to secure automation systems. Now we need to move from what to how, providing the practical direction, tools and support to guide how the standards are applied."

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Numeric introduces Rack Tower Convertible UPS

Numeric, one of the leading UPS (Un-interruptible Power Supplies) manufacturers and a power quality solution providers in India, has launched the rack-tower convertible UPS – Daker DK Plus. The new single-phase UPS is designed to meet the specific needs of businesses where real estate space utilisation is a key factor.

With the reversible screen, this convertible UPS can be used both in tower and 19" rack configuration. It also comes with a user-friendly LCD display screen where the main parameters of the system and the status of the UPS, including the battery charge level and faults can be viewed.

The uniqueness of DAKER DK PLUS lies in its flexible configuration, rotatable screen, intuitive user interface, higher efficiency, unity power factor, compact footprint and with integrated communication software thereby, making it a perfect match for businesses. The sleek looking product is not only aesthetically appealing but also scores high on all parameters of a power backup solution.

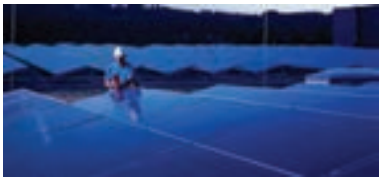
EESL installs over 5 lakh smart meters

Energy Efficiency Services Ltd (EESL) has successfully installed over 5 lakh smart meters in Uttar Pradesh, Delhi, Haryana, Bihar and Andhra Pradesh, under Smart Meter National Programme (SMNP). The meters will enhance consumer convenience and rationalise power consumption.

Saurabh Kumar, Managing Director, EESL said, "To overcome challenges including billing inefficiencies, unauthorised power consumption, and reduce DISCOMs' financial woes, the government is accelerating adoption of smart meters. Thrust on such efficient systems is critical for consumption and growth in a sustainable manner. It will also enhance consumer experience through improved service delivery."

Smart meters are part of the overall advanced metering infrastructure solution (AMI) that measures and records consumers' electricity usage at different times of the day and sends this information to the energy supplier through GPRS technology. It offers consumers better access to information and enables them to make more informed decisions on the use of power at their homes. It can immediately control AT&C losses, due to power pilferage, bypassing meters, defective meters. Every kilowatt of power drawn from the grid is thus, accounted for – and billed, thereby, boosting discoms revenues.

Waaree Energies ships 2.5 GW of solar modules



Waaree Energies announced that it has recently cemented its position as the largest module supplier in India. Having a whopping annual production capacity of 1.5 GW, Waaree manufactures 4 MW solar modules every day. They have already supplied almost 2.5 GW of modules globally, marking its dominance in the solar power industry. Waaree solar modules have been shipped to 6 continents, across 68 countries. With more than 120 tests performed at various stages of manufacturing, Waaree maintains its global standard quality. Waaree modules are trusted and financed by over 25 leading banks and NBFCs globally. With the recently extended manufacturing capacity of 1.5 GW, the comapny claims.

Sunil Rathi, Director Sales & Marketing, Waaree Energies, said, "Waaree Energies has witnessed an increasing demand for clean energy in India and abroad. This is primarily due to the various awareness drives by the RE 100 mission. Moreover, conventional sources of energy will now have to attain solar grid parity due to the cost effectiveness and this proposition has become a hit in the corporate segment."

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Unit 2 of Bangladesh Nuclear Power Plant completed

Concrete works of the turbine hall foundation slab at Unit – 2 of Bangladesh's maiden Rooppur Nuclear Power Plant (RNPP) has been completed on August 6, 2019. The structure required 3,782 tons of rebars and 23,550 cubic meters of concrete. According to Sergey Lastochkin, Vice-President of the Rooppur NPP construction Project, this is an important stage of construction that will be followed by the erection of walls of the turbine hall. Necessary preparation has begun for the next stage job.

Turbine hall houses steam generators and the turbine. Heat is removed from the reactor core by coolant; it may be a liquid or gaseous substance which passes through the core. This thermal energy is used to produce water steam in the steam generator. Steam's mechanical energy is supplied to the turbine generator where it goes into electricity and further moves to users by wires. The Rooppur NPP will have two units, each with a Generation 3+ Russian VVER-1200 reactor, with active and passive safety systems. Construction works of the project are progressing, according to the schedule. The first unit is scheduled to be commissioned in 2023 and the second in the following year. Engineering division of Rosatom State Atomic Energy Corporation of Russia is the general contractor.

Reliance, BP JV in India for fuel retail service

BP and Reliance Industries Limited (RIL) announced that they have agreed to form a new joint venture that will include a retail service station network and aviation fuels business across India. Building on Reliance's existing Indian fuel retailing network and an aviation fuel business, the partners expect the venture to expand rapidly to help meet the country's fast-growing demand for energy and mobility.

RIL and BP's venture will incorporate and build on RIL's current fuel retailing network of over 1,400 sites across India, which the partners aim to grow rapidly up to 5,500 sites over the next five years.

Mukesh Ambani, Chairman and Managing Director of Reliance Industries Limited, and Bob Dudley, Group Chief Executive of BP, signed heads of agreement for the venture in Mumbai. Mukesh Ambani said,

"This partnership is a testimony to the strong ties between BP and Reliance. Our robust partnership in developing gas resources in India has now expanded to fuel retailing and aviation fuels."

Bob Dudley said, "India is set to be the world's largest growth market for energy by the mid-2020s. BP is already a large investor here and we see further attractive, strategic opportunities to support this growth."

The partners have agreed to set up a new joint venture company, held 51 per cent by RIL and 49 per cent by BP.

ANDRITZ to modernise Shivasamudram hydropower plant

International technology group ANDRITZ has signed a contract with the Indian state utility company Karnataka Power Corporation to refurbish and renovate the Shivasamudram hydropower plant located in the southern state of Karnataka. Shivasamudram is one of Asia's oldest hydropower plants and was built in 1902.

The ANDRITZ scope of delivery includes the supply of equipment for the turbines and auxiliaries, spiral casing, draft tube elbow and cone, and the cooling water system, as well as refurbishment of the electrical system, excitation, governor, protection, and control systems. Additionally, ANDRITZ will perform inspection work as well as overhauling and test the existing 10 generators. The order will be executed by ANDRITZ Hydro India with its state-of-the-art manufacturing facilities in Mandideep (near Bhopal) and Prithla (near Faridabad).

By securing this prestigious contract, ANDRITZ has once again confirmed its position as a leading player in the refurbishment and modernisation of hydro projects in India.

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ABB names Björn Rosengren as CEO

The Board of ABB has unanimously appointed Björn Rosengren as Chief Executive Officer. He will join ABB on February 1, 2020 and succeed CEO, Peter Voser, in this role on March 1, 2020. At that time Peter Voser will revert to his position at ABB solely as Chairman of the Board.

Björn Rosengren (60), a Swedish citizen, is a highly experienced, international executive and leader of industrial businesses. He has been the CEO of Sandvik, a high-tech global engineering group, since 2015. Prior to that, he was CEO of Wärtsilä Corporation, which manufactures and services power sources and other equipment for the marine and energy markets (2011-2015) and spent some thirteen years in a variety of management roles at Atlas Copco. CEO-designate, Björn Rosengren, said, "I am honoured to have the opportunity to join ABB. At such a pivotal time for manufacturing industries, ABB must continue to best serve the needs of global customers with a unique technology and digital solutions portfolio to help enhance their productivity."

Shell uses solar energy for lubricant plants

Shell is installing solar photovoltaic panels on the roofs of seven lubricant plants in India, China, Italy, Singapore and Switzerland. Combined, the panels are expected to generate over 7,500 MWh of electricity annually and can result in the avoidance of greenhouse gas (GHG) emissions of approximately 4,500 tonnes on a CO2-equivalent basis per year. In India, the panels will be installed at the company's lubricants plant in Taloja, Maharashtra. Shell will be working with Cleantech Solar for the installation of approximately 1,700 panels, which is expected to generate 683 MWh of electricity annually, and can result in the avoidance of 500 tonnes of annual GHG emissions. As for the funding model for the Taloja solar panels, Shell has signed a subsidy free purchase power agreement with Cleantech Solar. As part of the agreement, Cleantech Solar will design, build, finance, own, operate, and maintain the solar facility for the Taloja plant in India. Shell acquired a 49 per cent equity stake in Cleantech Solar. "Using solar energy to help power our lubricant plants enables us to reduce the carbon intensity in our lubricants supply chain," said Richard Jory, Shell's Vice President, Lubricants Supply Chain. "Every industry has to do its part in developing cleaner ways of working and this is part of our commitment to run a safe, efficient, responsible and profitable business."

The solar energy generated will be used to help power operations at these lubricant plants, lowering operating costs in the long-run and reducing reliance on the grid.

Flovel collaborates with Seabell to create green community

Flovel Energy has signed a business collaboration agreement with JAG Seabell company, which is a group company of Japan Asia Group aiming to create a green community. Flovel is a manufacturer of hydraulic turbines and valves, a full-line supplier of electromechanical equipment & services for small & medium hydropower plants including renovation, modernisation, upgrading and after-market services for existing power plants. Flovel is based in India.

In Japan Hydroelectric power plants has been working for more than 100 years. Hydro Power plants in Japan are operated by big corporations. Nuclear power plants make up for large share of electricity production in Japan. Recently, the government policy focuses on renewable sources of energy including hydro.

Under this business cooperation agreement Flovel grants to Seabell exclusive rights in Japan to sell Flovel water turbines and related equipment and services.

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K Sreekant appointed as CMD of Powergrid

The government has cleared the appointment of K Sreekant, Director (Finance) Powergrid Corporation as Chairman and Managing Director, Powergrid Corporation. Earlier he was serving as Director (Finance) in the company. He also served as General Manager (Finance), NTPC.


K Sreekant

Sreekant is BCom (Hons), CMA and PGDM (Finance) from Management Development Institute, Gurgaon. He has more than thirty-one years of experience in the power sector involving all facets of finance and accounting function and in particular, long-term financial planning, investment appraisals, formulation of capital budgets, resource mobilisation from domestic and international markets and corporate accounts. He was appointed as a Director on the board in September, 2016.

Subhash Chandra Garg assumes charge as Power Secretary


Subhash Chandra Garg

Subhash Chandra Garg has assumed the charge as Secretary, Ministry of Power. Prior to this, he was serving as the Secretary, Department of Economic Affairs in the Ministry of Finance. He is a Rajasthan cadre IAS officer of 1983 batch. After assuming charge as Power Secretary, Garg said that his decision to apply for VRS has nothing to do with his appointment as Power Secretary as he had already discussed the same with higher authorities on 18th July, 2019. Highlighting the importance of power sector, he said that the goal of Rs 5 trillion economy will not be achieved unless power sector performs. So, his focus will be on improving efficiency, bringing down costs and improving the health of power sector.

P M Prasad takes charge as CMD of BCCL


P M Prasad

P M Prasad, Director (Technical, Project & Planning), Northern Coalfields Limited (NCL) has assumed charge of Chairman-cum-Managing Director at Bharat Coking Coal Limited (BCCL), a subsidiary of Coal India Limited on 2nd August 2019. Prasad was also in additional charge of Director (Technical) BCCL. Public Enterprises Selection Board (PESB) had recommended the name of Prasad for this post in April this year.

Prasad had assumed his charge as a Director (Technical, Project and Planning), NCL in February' 2018. During his more than one-year stint, he has been instrumental in the company's planning activities that led the company in the new league of coal production and productivity. For a short span during this period, he also served CIL subsidiary Western Coalfields Limited (WCL) as Director (Technical) additional charge.

With more than 34 years of experience in opencast and underground coal mining, Prasad was heading NTPC's coal mining division as Regional Executive Director (Coal Mining) from May 2015 before joining as NCL Director (Technical, Project and Planning). The biggest challenge for him was to start production of coal in NTPC's coal projects especially from Pakri Barwadih coal mine in Jharkhand, where rehabilitation and resettlement was one of the major issues. With his leadership and multi-faceted skills, the production of coal from this mine got started after 12 years of allocation. Graduated as mining engineer in 1984 from Osmania University, Prasad started his services as a mining engineer the same year in CIL. He earned M. Tech degree in Open Cast Mining from ISM Dhanbaad in 1991.

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Offshore inspection device from Scotland wins 2019 manus award

A reason to celebrate for the Scottish mechanical engineering company ToolTec: Its offshore inspection device wins the 2019 manus award – a prize that has been awarded for the ninth time by the motion plastics specialist igus for the creative use of high-performance plastics in bearing technology. Second place went to a floating catamaran, and the third place to an assistance system where people with disabilities can drive a car.

More and more bearings made of high-performance plastic are being used worldwide, in industrial environments and far beyond, for example in asparagus harvesters, whirlpool covers and in gearboxes of church clocks. There are many reasons for this: Tribo polymer bearings are lubrication-free and maintenance-free, lightweight, corrosion-free and save costs. And so it is hardly surprising that 445 inventors from 32 countries had applied for the 2019 manus award. The jury comprising representatives from industry, business and research fields selected three applications from among the applicants that stand out for their technical and economic efficiency and creativity.

The winner of the 5,000 euro manus award is ToolTec. The Scottish mechanical engineering company has developed a device that allows operators of underwater oil and gas platforms to clean and inspect pipelines. So far divers had to do this job. The offshore inspection device will wrap around the pipe like a cuff and move forward on rollers. While moving, the machine cleans the pipeline and inspects for weak spots. In the design, only polymer bearings were considered by the engineers. Metallic bearings would have been susceptible to corrosion and required intense maintenance. That's why the experts opted for igus' high-performance plastics – including iglidur plain bearings, drylin linear guides and an e-chain for safe cable guidance, which makes a 360-degree rotary movement. The components enable a lubrication-free and thus maintenance-free dry operation and are resistant to seawater.

The iFLY 15 got the second place. The sports catamaran of the Munich manufacturer CEC Catamarans GmbH at first glance indeed acts like an ordinary catamaran. But that changes when the boat picks up speed.

The bronze medal of the 2019 manus award was won by the French company Kempf, which enables people with disabilities and wheelchair users to drive. This is where Darios comes in – a control ring mounted on the steering wheel. If the driver presses the ring, he can accelerate the vehicle very accurately. It can be braked via a hand service brake beside the controls. He is no longer dependent on the classic pedals. EI

Powergrid gets three awards for best performance

Powergrid for the second year in succession won the Dun & Bradstreet PSU Awards 2019 event. In a repeat of last year, the company won three awards, including the Award for 'Best Navratna Overall'.

The other awards were for 'Electricity Sector: Transmission' and Best Navratna Services'. They were bestowed upon by Union Minister of Heavy Industries and Public Enterprises, Arvind Sawant. Director (Personnel) Ravi P Singh and Director (Operations) Seema Gupta received the awards on behalf of the company. Secretary (Power), Subhash Chandra Garg was the guest of honour at the event. EI

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Global EV Market to scale 10.79 mn units by 2025

The major factors behind the growth of electric vehicle sales are government support in the form of grants, subsidies, and tax rebates, increasing environmental consumer awareness, improving charging infrastructure and increasing vehicle range

According to the new market research report 'Electric Vehicle Market by Propulsion (BEV, PHEV, FCEV), Vehicle (PC, CV), Charging Station (Normal, Super, Inductive), Charging Infrastructure (Normal, Type-2-AC, CHAdeMO, CCS, Tesla SC), Power Output, Installation, and Region - Global Forecast to 2025', published by MarketsandMarkets, the global electric vehicle sales are projected to grow at a CAGR of 32.57 per cent from 1.50 million units in 2018 to 2025 to reach 10.79 million units by 2025.

The major factors behind the growth of electric vehicle sales are government support in the form of grants, subsidies, and tax rebates, increasing environmental consumer awareness, improving charging infrastructure and increasing vehicle range.

Electric passenger car segment: Expected to dominate the EV market

Technological advancements and increasing focus on research and development activities by leading OEMs to launch affordable and premium quality electric passenger cars. The models in the electric passenger car segment such as the Tesla model S, Nissan Leaf, BYD Tang, and Mitsubishi Outlander are some of the top selling electric passenger cars in 2016. Availability of subsidies and tax rebates, features such as increasing vehicle range and improved charging infrastructure, reduction in charging time, and the decreasing price or EVs are the major factors driving the global EV market.

BEVs: Expected to dominate the EV market

In 2018, the sales of electric vehicles comprise of BEV and PHEV crosses 2 million units mark. Refillable batteries can fuel the market for electric vehicles market. It can be refuelled in minutes at a huge network of converted gas stations. Governments prefer BEVs as these are zero emission vehicles. Various governments around the world support the sales of BEVs with subsidies and tax rebates. BEVs are also the most preferred vehicles in China in 2017. It is expected that the continuously improving charging infrastructure, reducing charging time and existing government support would help the make the BEV segment to dominate the other EV propulsion systems such as PHEVs and FCEVs.

Asia Pacific: Largest market for EVs

The Asia Pacific region is the largest market for EVs due to government support in the form of grants, subsidies and tax rebates and continuously improving charging infrastructure in countries such as Japan and China. The governments in both the major markets i.e. Japan and China provide subsidies and other non-financial benefits such as access to number plate, car pool lane access, and road tax exemptions for EV users. Continuously improving charging infrastructure and increasing vehicle range are the major factors which have contributed to the Asia-Pacific to be the fastest growing market. Additionally, the alarming pollution level in economies such as Japan and China have fuelled the demand for zero emission vehicles in such countries thus creating huge demand for EVs in such countries. Additionally, in 2018, the sales of electric vehicles comprise of BEV and PHEV in China crosses 2 million units mark. Further, the Volkswagen Group sells about 4,000,000 vehicles in China and requires 400,000 NEV credits in 2019. EI

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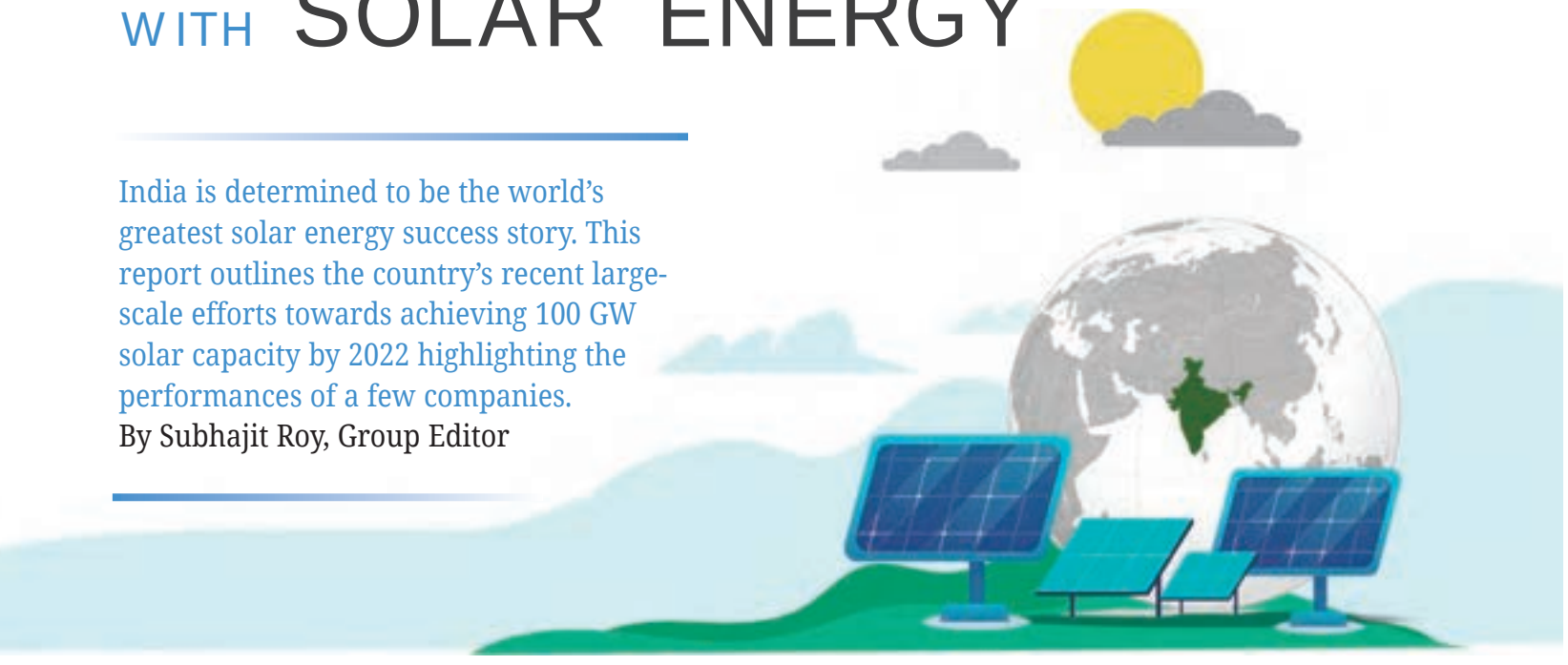

India is determined to be the world's greatest solar energy success story. This report outlines the country's recent large-scale efforts towards achieving 100 GW solar capacity by 2022 highlighting the performances of a few companies.

By Subhajit Roy, Group Editor

Going beyond incremental growth, India is all set for quantum leap in increasing renewable energy capacity. The country's renewable power capacity soared by almost 150 per cent in the last five years to 77.6 GW. Now the government has set a target of 175 GW renewable energy capacity by 2022 which includes 100 GW from solar. India is also formulating a policy to build a 30 GW local capacity for manufacturing solar cells and modules by 2024.

Further, the Ministry of New and Renewable Energy (MNRE) has issued guidelines for roll out of the Rs 34,422-crore Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) scheme that entails setting up of 25.75-GW solar capacity by 2022. This is expected to encourage farmers to generate solar power in their farms and use the clean energy to replace their diesel water pumps.

Early transmission schemes of renewable power

Of late, the Power Ministry has approved proposal for early regulatory nod by CERC for transmission schemes for 66.5 GW renewable energy generation in order to fast track green projects in the country.

"In a major decision to fast track the deployment of renewable energy in India, Union Minister of State for Power and New & Renewable Energy RK Singh has approved a proposal for early regulatory approval by Central Electricity Regulatory Commission (CERC) for transmission schemes identified for 66.5 GW National Renewable Energy Mission projects," a Power Ministry statement said. As of May 2019, about 80 GW of renewable energy generation has already been commissioned and the balance 95 GW has to come up in the next three years.

Commenting on this development, Manu Karan, Vice President, CleanMax Solar, says, "The government's decision to give an early regulatory nod for transmission scheme of renewable power is a welcome move for developers.

The government's decision to give an early regulatory nod for transmission scheme of renewable power is a welcome move for developers.

MANU KARAN,
VICE PRESIDENT,
CLEANMAX SOLAR

Some of recent constraints for constructing large-scale solar energy projects is the unavailability of sufficient transmission facility at the allocated solar park locations. The decision to develop the transmission infrastructure will help in better grid connectivity, improve evacuation facility and give impetus to developers for setting up projects without having to address the transmission or grid curtailment issues."

Solar Achievers

Vikram Solar achieves 1.1 GW annual PV Module production capacity

Vikram Solar Limited, formerly known as Vikram Solar Pvt. Ltd., is a leading solar energy solutions provider, specialising in PV module manufacturing and comprehensive EPC solutions.

Kuldeep Kuman Jain, BU Head - EPC, Vikram Solar, said, "Our efforts and contributions have been noticed by the World and within 13 years after inception, Vikram Solar has now become one of the leading solar energy growth contributors in the nation and in the overseas market. We have enhanced our manufacturing capacity to 1.1 GW per year and standing with 1040 MW of solar portfolio."

Recently one of Vikram Solar's iconic utility scale solar plants, NTPC's 50 MW solar plant in Madhya Pradesh has showcased cumulative over 650 MWH in excess generation than guaranteed value in one of the toughest terrains in solar.

In 2019, the company has already commissioned more than 200 MW of solar projects including:

- 200 MW project for APGENCO at Andhra Pradesh
- East India's largest single shed rooftop project in Eastern India (2.152 MW capacity project for Keventer Agro Ltd)
- 2x10 MW projects for WBSEDCL
- 5 MW solar plant for BDL (SECI) which was recently inaugurated by Minister of Defence Rajnath Singh at Ibrahimpatnam, Hyderabad
- 5 MW solar plant for ONGC in Ankleshwar
- 5 MW solar plant for BDL in Hyderabad.

Recently, Vikram Solar has received high scores in solar panel assessment by renowned PVEL LLC and Black & Veatch (B&V).

Some of Vikram Solar's key projects under execution:

- 140 MW project from NTPC
- 1 MW floating solar from Hindustan Zinc Ltd
- 1 MW ground mounted project from Kolkata Port Trust
- 5 MW project from Maruti Suzuki.

Adani Green records 40% revenue increase

Adani Green Energy Limited (AGEL), the renewable energy arm of Adani Group, has announced its financial report for the first quarter (Q1) of the financial year (FY) 2020, ending June 30, 2019.

In the quarter, the company's total revenue stood at Rs 661 crore which is up by 40 per cent year on year. The company announced a revenue of Rs 554 crore from power generation for Q1 of FY 2020, an increase of 17 per cent year-over-year. Commenting on the company's performance, Jayant Parimal, CEO, Adani Green Energy Ltd said, "The last quarter has seen significant growth for the business with solar and wind. AGEL is among the largest renewable energy generation companies in India, and with our

We have enhanced our manufacturing capacity to 1.1 GW per year and standing with 1040 MW of solar portfolio.

KULDEEP KUMAN JAIN,
BU HEAD - EPC,
VIKRAM SOLAR

focus on new technology evaluation, we plan to commission a total of around 800 MW of new capacity of wind and solar projects in FY2020."

The total portfolio of AGEL is 5,290 MW at present, out of which 2,220 MW of renewable energy capacity is operational. The company won bids for 130 MW of wind and 600 MW of hybrid projects in Q1 FY 2020.

Freyr Energy targets 100% y-o-y growth

Freyr Energy, a Hyderabad based full-service solar company, is in the business of designing, installing and maintaining rooftop solar systems across India for homes and businesses. "The uniqueness of our approach is the differentiation provided by our revolutionary software, SunPro+ that enables us to access customers through a channel network," said Saurabh Marda, Co-Founder & Managing Director, Freyr Energy.

We are targeting to grow at 100 per cent y-o-y for the next 3 years. We currently stand at FY 17-19, 4 times revenue growth, 8 times EBITDA growth and 1.3 times growth in terms of team size.

SAURABH MARDA, CO-FOUNDER & MANAGING DIRECTOR, FREYR ENERGY

Marda further claims, the platform is an enhanced mobile and web tool that has a simple and easily adaptable interface, which empowers the company's Channel Partner network to understand customer requirements and offer custom solutions instantly, reducing customer acquisition costs by 90 per cent.

In November last year, Freyr Energy announced that it has raised an investment of Rs 27 crore. This Series-A round was led by C4D Partners, a Netherlands-based Impact Investment Fund.

Freyr Energy has so far installed more than 1,300 solar projects across 19 states, that include rooftop (residential, commercial, industrial and government), solar water pumps, solar petrol pumps and microgrids. "We are targeting to grow at 100 per cent y-o-y for the next 3 years. We currently stand at FY 17-19, 4 times revenue growth, 8 times EBITDA growth and 1.3 times growth in terms of team size," informs Marda.

Some of Freyr's recent clients include reputed names like Shree Cements (repeat order), Hyderabad Public School, Indian Oil Corporation Limited, Century Mattresses, National Sports Academy (Manipur), Central Agricultural University (Manipur), Telangana State Southern Power Distribution Company Limited, police stations in Punjab, and street lighting in Sikkim.

Project	Capacity
Hyderabad Public School, Hyderabad	120 kW
MEDA (Maharashtra Energy Development Agency)	1 kW for 115 schools
APSRTC, Chittoor Bus Stand	100 kW
Shree Cements, Bewar, Rajasthan	1 MW
IOCL, Guwahati	150 kW

Some of Freyr Energy's upcoming projects in India

Hartek Solar installs over 25-MW rooftop PV plants

Hartek Power Pvt Ltd, the flagship company of diversified conglomerate Hartek Group, is one of India's leading EPC companies and has connected more than 1.5 GW of solar projects to the grid across the country. Also, Hartek Group's rooftop solar vertical, Hartek Solar Pvt Ltd, has installed over 25-MW rooftop PV plants so far. Introducing his company, Simarpreet Singh, Director, Hartek Solar Pvt Ltd, said, "Our small-scale solar division, Hartek Solar, operates through two strategic business units — Rooftop Solar, Energy Storage. Our vision is to work very closely with customers and provide them the right technology solution with an aim to systematically build infrastructure and products."

Within just a year of launching its customised small-scale solar solutions, Hartek Solar has executed rooftop projects in more than 150 households in Chandigarh alone.

Last year, Hartek Solar introduced customised rooftop solar kits, which come with an option of a unique remote sensing technology tailor-made for small-scale solar plants. The remote sensing technology has broadly remained confined to large rooftop solar installations owing to its non-viability for small-scale solar from the commercial viewpoint. Hartek Solar has now made this technology

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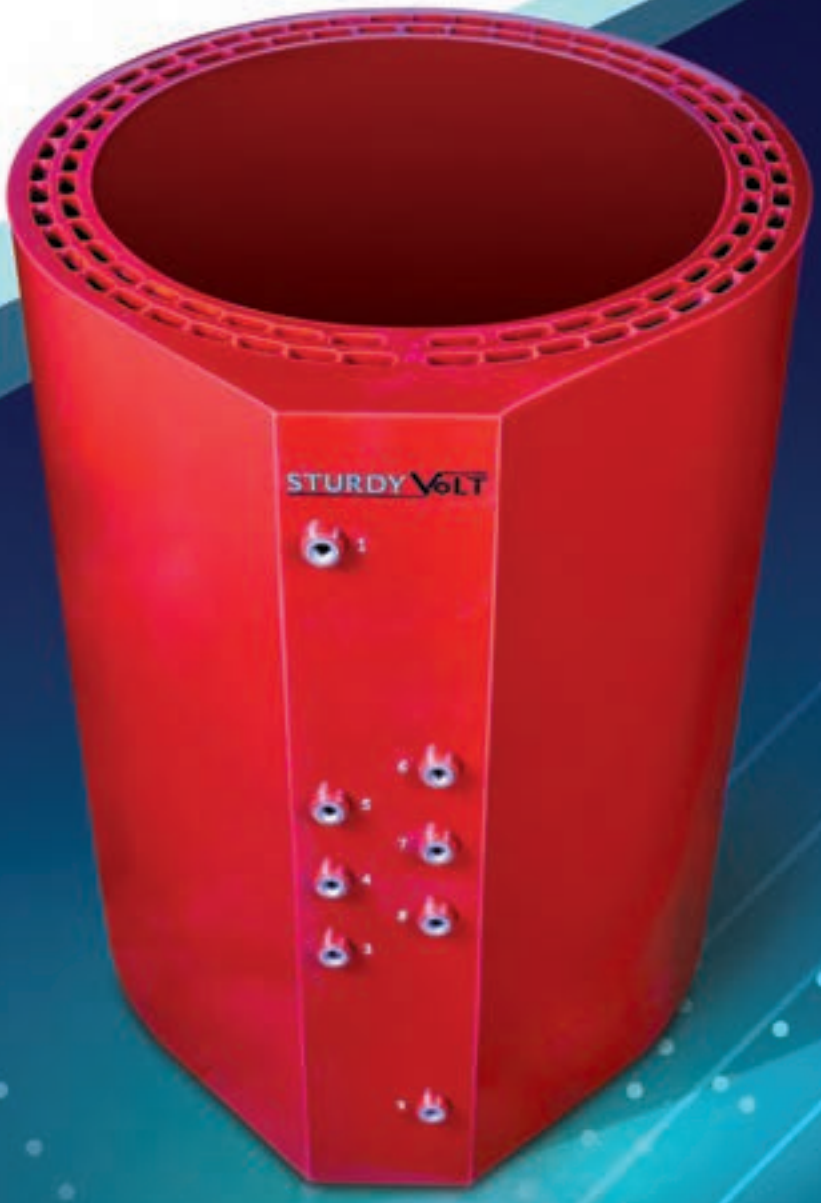

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Continued from page 32

commercially feasible for small-scale plants as well by linking remote sensing with consumers' Wi-Fi or GPRS SIM card to get alerts on cleaning and maintenance as well as real-time data on energy generation and savings. The remote sensing technology aids lower downtimes and has quicker fault detection tools aimed at optimising generation.

Some of Hartek Solar's most important projects under execution include:

- 220 KV substation with a capacity of 130 MW for a leading solar developer in Rajasthan
- 132 KV substation with a capacity of 50 MW for a leading solar developer in Uttar Pradesh
- 400 KV project for Power Grid Corporation of India.

Challenges & road ahead

As of March 2019, India has achieved 30 per cent of its aggressive 175 GW target with a 4 per cent increase in solar installation in Q1 of 2019 over Q4 of 2018. However, taking yearly installations into account, India's solar installation have shown a 49 per cent year-on-year decrease in solar installations. This sluggishness has been caused due to the general elections conducted this year, which in turn has led to hurdles in government approvals, opines Sunil Rathi, Director, Waaree Energies. He said, "Utility-scale projects still contribute the maximum to India's solar capacity but the industry expects the rooftop segment to bloom in this coming year. Currently, rooftop segment makes up 12 per cent of India's solar installations but is expected to contribute 40 per cent to the 2022 target."

Our vision is to work very closely with customers and provide them the right technology solution with an aim to systematically build infrastructure and products.

SIMARPREET SINGH, DIRECTOR, HARTEK SOLAR

Mr Rathi adds, "The latest policy change in the US in terms of taxation of Indian solar products, the domestic manufacturing segment is expected to witness a slowdown due to the loss of a significant market. The lack of clarity in the timeline of the exemption on bifacial modules in the US market will only provide a brief respite to the situation and the dependency of Indian solar manufacturers on the domestic market will increase significantly."

Mr Jain of Vikram Solar also admits: "Recent developments like safeguard duty, lack of focus on solar in budget, lack of investment in solar, lack of focus on domestic manufacturing, US trade policies, and shrinking number of solar tenders have brought forward new challenges for us."

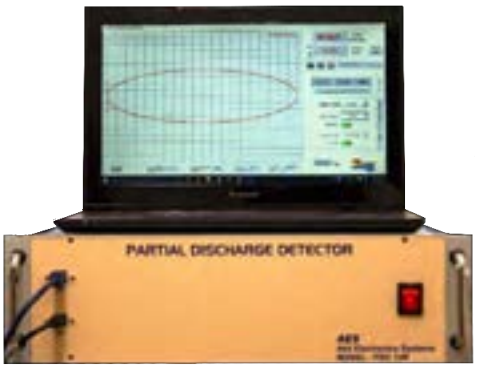
In addition, bid cancellations remains a major hindrance in the growth of the Indian solar industry, especially considering the large size of the cancelled projects. Reports state that in FY 2018-19, approximately 8,000 MW solar capacities worth Rs 40,000 crore were cancelled. According to Mr Rathi, "The reason for such bid cancellations are mainly due to lack of consensus on tariff rates. Additionally, the lack of clarity in GST rates is another big cause for the high bid cancellations the industry is witnessing today. This scenario is leading to disappointment in the potential of the growth of solar industry, especially from the global perspective." He believes, clarity in GST rates in the case of solar projects will lead to a significant change in the market.

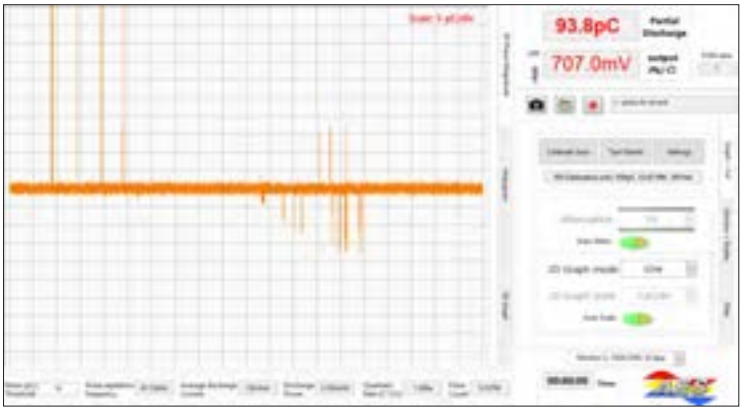
Currently, rooftop segment makes up 12 per cent of India's solar installations but is expected to contribute 40 per cent to the 2022 target.

SUNIL RATHI, DIRECTOR, WAAREE ENERGIES

"We are holding on to our dream of aiding India and the world in solarisation and hope to see the Government of India reciprocate in creating favourable environment for solar manufacturers in India," concludes Mr Jain.

Partial Discharge Measurement System





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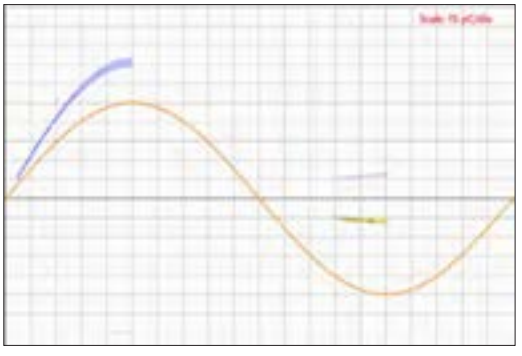

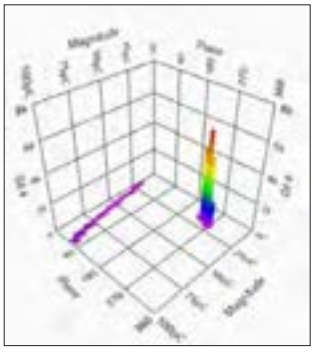

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Power Electronics in Smart Grid

Power electronics plays a vital role in smart grid implementation and its development. This article outlines the various applications of power electronics in smart grid.

The biggest technological revolution in the last decade is "Smart Grid". As compared to the conventional grid, smart grid is automated, highly integrated, technology driven and modernised grid. In coming years smart grid will have a key role in transforming the electrical networks, its topology and power system operation. Energy efficiency, electricity supply and sustainability are the foundation pillars of smart grid technology.

The reliability of electric supply has become the utmost priority of consumers in developed as well as developing countries throughout the world. Through smart grid implementation, monitoring, control and real time measurement of generation, transmission and distribution of electrical energy has become possible and hence reliability of electric supply is improved. Smart grid has the potential to reduce the carbon footprints by integration of renewable energy sources, energy

storage and plug-in hybrid electric vehicles with the main grid.

Power electronic devices such as Metal Oxide Silicon Field Effect Transistor (MOSFET), Insulated Gate bipolar Junction Transistor (IGBT), Integrated Gate Commutated Thyristors (IGCT), Gate turn off Thyristor (GTO), Triode as an AC Switch (TRIAC) etc. has high current carrying capacity and high voltage handling capacity also. They have higher switching frequencies which is useful characteristics for voltage magnitude conversion and frequency control. These devices are used in converters. Depending upon the converter topology these converters are able to control the power flow also. Power electronics therefore plays a vital role in smart grid implementation and its development.

Applications of power electronic devices in Smart Grid

Volt-Var Optimisation

Power electronic voltage regulators using TRIAC are used to regulate the voltage on the distribution feeders. The capacitor banks are used to boost the voltage of the line by generating Vars.

For integration of renewable energy sources

Exponential growth of renewable energy has been enabled in recent years, this is only because of technological advances in 'Power Electronics' devices and their ability to control power flow. Power electronics based Flexible AC Transmission (FACTS) technologies and automation technologies are necessary for smooth integration of renewable energy sources with the main grid.

Different energy sources are integrated with power electronic interfacing technologies as follows:

- Large wind farms have been connected increasingly with the grid using technologies such as Power Electronic Voltage Source Converters (VSC), HVDC systems consisting of Dual Converters, FACTS and Static VAR compensators (SVC) with energy storage system. Now a days, Full scale converters are used as power electronic interface which is placed between the wind turbine generator and the main power Grid as shown in Figure 1. This interface satisfies the generator and grid side requirements. These converters always ensure that the turbine speed is adjusted so that maximum power can be generated. Also, on the grid side, regardless of the speed of wind, this power electronic interface, controls frequency, active, reactive power as well as voltage. The wind turbine generators, whether it is Double-Fed Induction Generator (DFIG) or variable speed Permanent Magnet Synchronous Machine (PMSM) rotate at asynchronous speed with respect to the frequency of the grid. DFIG uses Partial scale converters which are two-level Pulse width modulation Voltage source converters (VSC) and which have 30 per cent capacity of the wind turbine. These converters work at optimum operating points of the machine to produce electrical energy at 50/60Hz.Technically it shows full power controllability with a simple structure which is reliable and cost effective. For off-shore applications, Wind turbines with Permanent Magnet machines always require full scale converters. These converters are mostly three-level Neutral point diode clamped back-to-back converters. These converters respond to frequency changes on both sides of DC link. The output power of the converters can be adjusted to maintain the system frequency. These types of converters give one more output voltage level and less dV/dt stress as compared to two-level converters. Therefore, it is possible to convert power at medium voltage level and lower current and use smaller filter size. These power electronic converters are simple modular structures

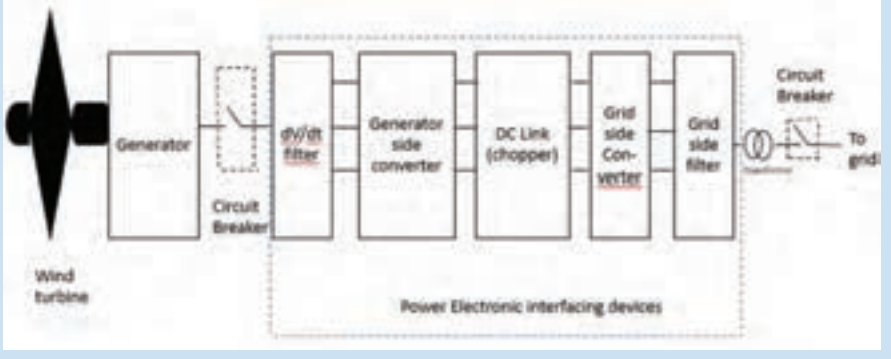

Figure 1: Basic structural diagram of full scale, three-level wind-power converter.

with compact designs based on high power semiconductors, Integrated Gate Commutated Thyristors (IGCT) or Insulated Gate Bipolar Junction Thyristors (IGBT). Due to their compact design, these converters can fit inside the turbine tower along with the grid harmonic filters and generator harmonic filters.

- In case of photovoltaic (PV) system, its output power is DC and therefore a power electronic converter (DC-AC inverters) are required to energize the AC load. The power electronic interface for PV systems has two main functions i.e to convert the generated DC voltage into a suitable AC current for the grid (Inverters DC/AC); the other (DC/DC Converter) is to control the terminal conditions of the PV module(s) so as to track the Maximum Power Point (MPP) for maximising the energy capture. The PV systems composed of a storage device with mode of operation as stand-alone or grid connected is as shown in Figure 2. In stand-alone mode, if the available power from the PV panel is more than the required power, the PV panel should supply the load power and the excess power should be used to charge the storage device. The storage device with the controller should provide the power difference when the available power from the PV panel is smaller than the required power at the load bus. In grid connected mode also, the load draw power from the grid when PV panel system cannot produce energy. When PV panel system produces surplus energy, it can be used to charge the battery banks or injected into the grid.

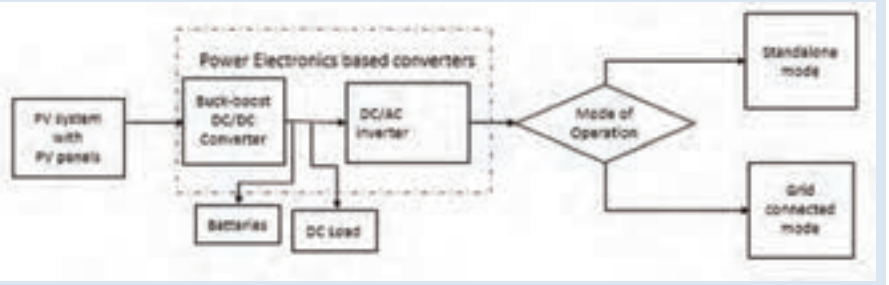

Figure 2: A simple Power Electronic devices for interfacing of PV system in stand-alone or grid connected mode.

In Microgrid

Microgrid is becoming more popular technological advancement nowadays. Microgrid can reduce the cost of grid extension, provide a very reliable power supply as well as reduce the carbon emissions. In this microgrid architecture Power Electronic converters play a very vital role. They are used in the Energy management system for voltage control by "droop control" method. The output power from the Distributed Generators can be controlled by these converters. They are used for interfacing the loads with the Sources and also control the active loads in stand-alone mode and grid connected mode. Similarly, different energy resources like fuel Cell, Hydro-storage pumps, Bio-gas energy source, Combined Heat and Power (CHP), Combined Cooling Heat and Power (CCHP) systems require the Power Electronics based conversion (Rectifiers/Inverters) system as per the requirements of DC and AC load and the distribution system as shown in Figure 3.

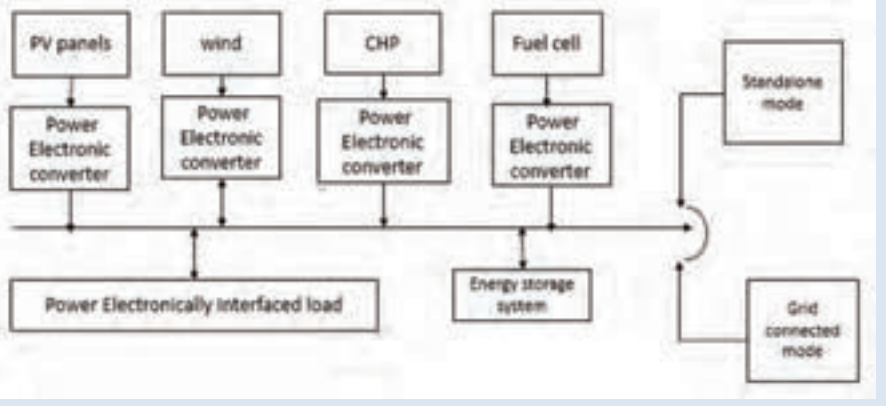

Figure 3: Microgrid with Power electronically interfaced loads, Distributed generation units in stand-alone and Grid connected Mode

For Electric Mobility in Smart Grid Environment

The main Purpose of Electric Vehicles is to fulfil all mobility needs at the costs equivalent to those of the conventional vehicles taking into consideration green-house gas emission reduction. The power train system of Electric vehicle consists of power electronic building blocks as shown in Figure 4. such as voltage

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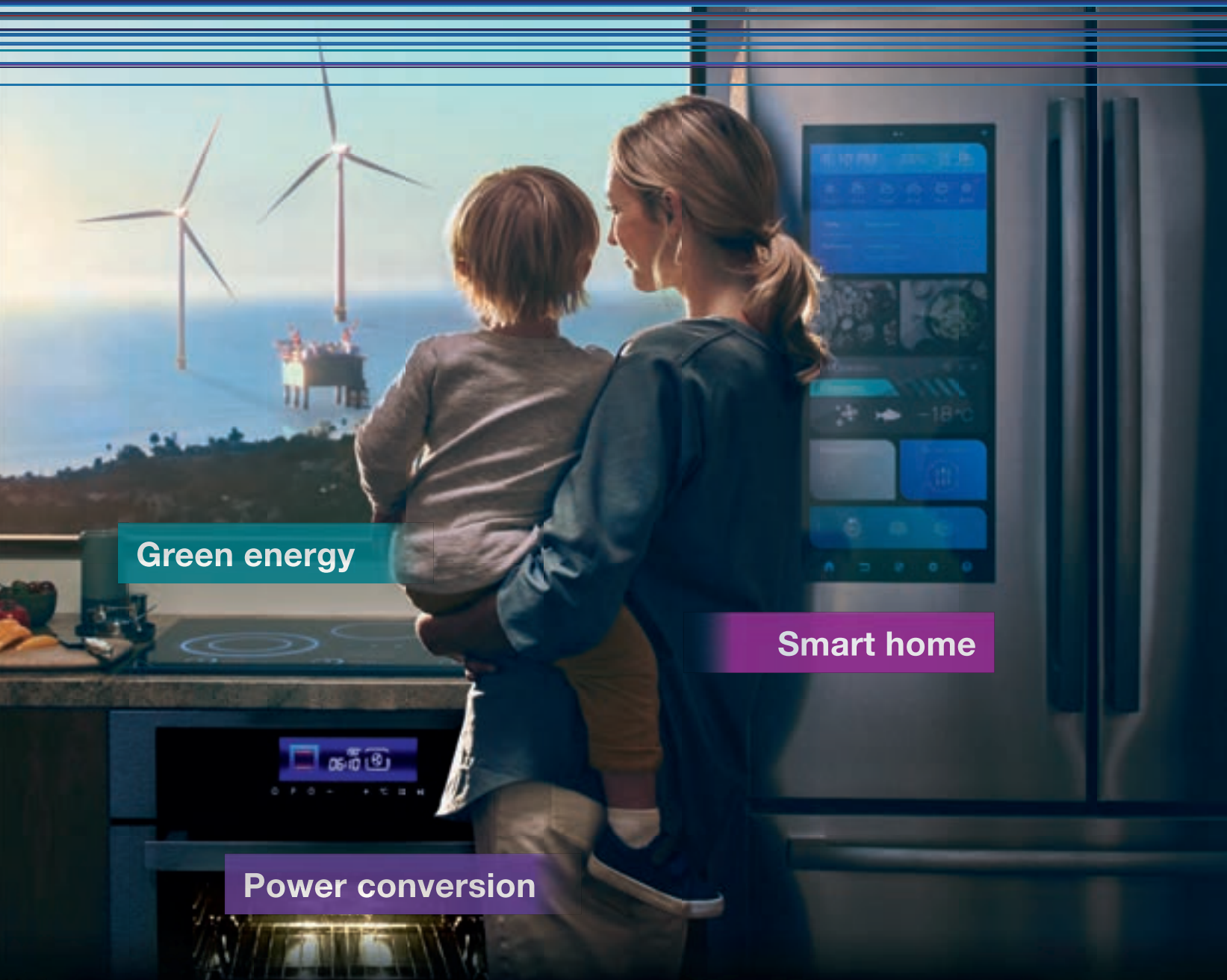

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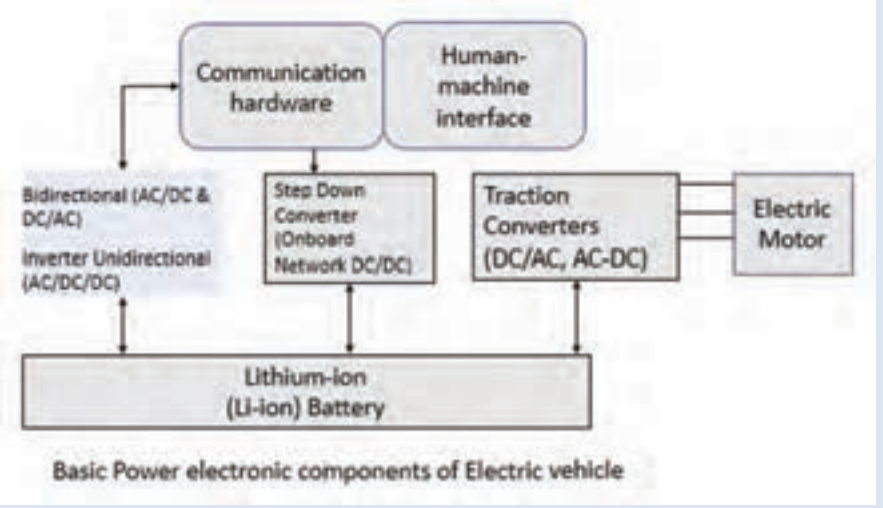

Figure 4: Basic power electronic components of Electric Vehicle

regulators, Choppers (DC-DC converters), Traction Inverters (DC-AC converters), on- board charger etc. Alternators require Voltage regulators are required to produce constant voltage at the battery terminals by modulation of field current. Choppers (DC-DC Converters) are used for soft-switching where the switches are subjected to low stress and therefore give longer -life. These covert 400 V to 12V in electric vehicle. As AC motors have high efficiency instead of DC motors, AC motors are used in Electric vehicles. Traction Inverters (DC-AC inverters) are used for to supply power, to AC motors which is stored in batteries of the Electric vehicle. On -board chargers are power electronic converters in rectification mode used to convert AC to DC in order to charge the batteries in the electric vehicle. All other components also like ignition switch, control module, vehicle speed sensor, steering sensor etc are power electronics devices.

Low voltage DC Grid for LED lighting system

The low voltage DC grid is proposed to overcome the disadvantages of DC-AC conversion and AC-DC Conversion. As compared to conventional AC power grid the LV DC grid is a more efficient way to provide DC power for the electrical LED lighting system. Not only LED lighting but also other power electronic loads such as computers, printers, cell phone chargers etc. working on 3V,5V,9V,12V or 24 V can be benefited from this LV DC grid of 24 Volts/48 Volts. A single power electronic conversion system between AC power source and LV DC grid is sufficient and can bring in reduction in conversion losses and can be very cost effective.

Thus, for implementing all the important features of smart grid, power electronic interfacing devices are necessary. As discussed, whenever control of power flow and conversion of power from AC/DC or DC/AC is required there is no other efficient alternative than power electronic devices.

Prof. Kalyani Kurundkar
Electrical Engineering Dept.
PVG's COET, Pune

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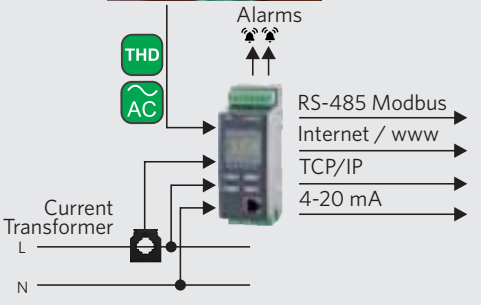

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HOW TO ACHIEVE TRANSFORMER RELIABILITY

Transformer failures can potentially lead to unplanned power outages, in addition to costly and time-consuming repair and replacement.
- Dr. Murhari Sopanrao Kele, Chairman-cum-Managing Director, Tripura State Electricity Corporation Ltd

In an interview with Subhajit Roy, TSECL's Chairman-cum-Managing Director Dr. Murhari Sopanrao Kele explains how to achieve reliability in terms of transformer performance. Dr. Kele has varied and rich experience of over 30 years in power sector across Maharashtra State Electricity Board, Torrent Power Ltd, MSEDCL, Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited, and presently handling TSECL from North Eastern region.

How important is distribution transformer for a distribution company?

Electric power is the basic infrastructure for economic development of any developing country like India. Distribution transformer is soul for any distribution company as it plays very important role of voltage transformation in upward and

downward direction level as per requirement of system. Distribution transformers is contributing approximately 20 per cent of total asset value of a distribution company (DISCOM). Fortunately, Tripura State Electricity Corporation Limited (TSECL) is working with generation, transmission and distribution under one umbrella, thus we are dealing with all types of transformers in system. Nowadays, the demand of distribution transformers is increasing due to increase in generation capacity of both conventional and non-renewable sources due to increase in per capita consumption of electricity, new centrally-aided projects like IPDS, DDUGJY, Saubhagya schemes and new avenues like electric vehicle charging stations etc. Replacement of old transformers with energy efficient transformer is one of the key activities which is going on presently.

How much attention one needs to pay to make a transformer reliable?

Transformer failures can potentially lead to unplanned power outages, in addition to costly and time-consuming repair and replacement. Even though every equipment is important in power system, transformer plays very critical role to maintain reliable power supply to consumers. Every consumer knows about transformer, so its common complaint of common consumer about transformer. It is the only part where we need more attention to keep system reliable. Any DISCOM needs proper attention to maintain quality and quantity of transformers. Starting from the design of transformer of transformer, its core, material used for winding, cooling system, energy efficient capability, specifications and standard needs, type tests, protection system, etc. need to be kept in mind while purchasing of transformers by any utility.

Moreover, transformer oil level, neoprene gaskets, transformer conservator tank or transformer body, HT and LT bushings, HT and LT terminals, and silica gel in breather provided to transformers should be proper externally. About earthing issues, neutral and transformer body of the transformer shall be provided with two distinct earth connections to one earth electrode using adequate size earth leads. Regarding protection, use of AB switches for isolation, lightening arresters, proper size of DO fuses from HT side, use of distribution box with MCB will also play important role in betterment of transformers in power distribution utility.

What are the kinds of distribution transformer failures in your area and what are the key reasons?

Failure of distribution transformers is the headache for any utility as it affects reliability of power supply. TSECL is facing very big challenges due to its geographical conditions and natural calamities faced by north east region. In the area of TSECL there are very peculiar problems which include storm or cyclone prone area, heavy lightening strokes, 60 per cent forest area, transportation, manufacturing defect, lack of testing facilities of transformers, lack of maintenance, poor repair of transformer, overloading or unbalance loading, lack of protection, earth fault due to tree branches, oil leakage, theft of oil, less oil, improper connections and other various reasons.

How can these failure issues be addressed and what are the steps being taken by TSECL to resolve these issues?

Generally, every year, from the month of March, our transformer failure starts increasing up to July, it reaches at peak in the month of May and June. We are having DTR failure 12 per cent as compared with national average of 8 per cent. It is subject of worry for us. Condition monitoring, online monitoring, routine diagnostic, scheduled maintenance, and condition-based maintenance (CBM) are some of the most common transformer asset management methods. We are taking proper measures for reduction failures in transformers. We have first sensitised our field engineers for preventive routine maintenance as per schedule, we have discussed with manufacturers and repairers of transformers and taken suggestion from them for improvement. We have arranged workshops and seminars with the help of CBIP, CPRI, Indian Transformers Manufacturers Association of India, Indian Copper Association of India, oil manufactures, etc which have created awareness in our engineers and upgraded their knowledge by giving exposure to them. We have given them task and also wanted to start incentive or award scheme for less failure of transformers. Before monsoon and before Durga Pooja, we are taking care of proper maintenance of system. Proper monitoring and stock position are monitored at higher level.

What are your views on the quality control order? And has it helped distribution transformer companies in improving the benchmark for making their asset quality better?

Standard technical specifications by utilities, energy efficient provisions decided by Bureau of Energy Efficiency, EESL parameters, use of good-quality material, experiments in design of transformers, protection issues, transformers health monitoring system, etc. should be considered by manufacturers.

As no load losses of AMDTs are less than CRGO core distribution transformers, these distribution transformers may be preferred in villages where peak load comes for a short period and most of the time distribution transformer remains lightly loaded. Use of newly introduced oil is used in utilities like Tata Power, demonstration of use of copper winding in Indore and other places by ICAI has given better results but cost benefit analysis should be done properly as it will be easy to adopt new technology by public utilities.

Also, to maintain quality there should be three tire system for testing of transformers. First material should be tested by third party agency before assembling, thereafter type test or routine tests should be carried out by inspectors and thirdly, after receipt of transformers at utility's store minimum 10 per cent sampling checking with well-established laboratory is needed. It will avoid failure of transformers due to manufacturing defect within guarantee period.

When you repair a distribution transformer, do you think active repair can be adapted for legacy transformer?

The lifetime of a transformer highly depends on its insulation condition owing to a higher probability of insulation failure compared with its other components. Moreover, aging of transformer insulation is a function of insulation moisture, oxygen amount, and internal temperature specifically at the hottest spot, which is mainly governed by transformer loading and ambient temperature. The effect of temperature, thermal aging factors, and electrical aging factors on transformer insulation is experimentally analysed.

Any electrical equipment can be failed in system. Transformer is also major component in system which contributes major investment. Approximately more than 20 per cent may be the cost of transformers in system. Every time installation of new transformer in system in place of failure is not possible due to cost constraints. For system strengthening new transformers are added, some transformers capacity is augmented, new infrastructure is created but what we thought about replacement of failed transformers? How many times old, failed transformers can be repaired? These are points of discussion. As per my views after two times of repair, it should not again be repaired as it will contribute to increase in losses and its capacity may be de-rated by repairers.

When I was Director (Technical) in Madhya Pradesh Indore DISCOM, we had implemented a very good best practices maintenance program and due to which DTR failure rate was also reduced from 18.6 per cent to 9.5 per cent within one year. Testing facilities were increased and eight transformers manufacturing agencies were blacklisted for three years for not supplying quality transformers. EI

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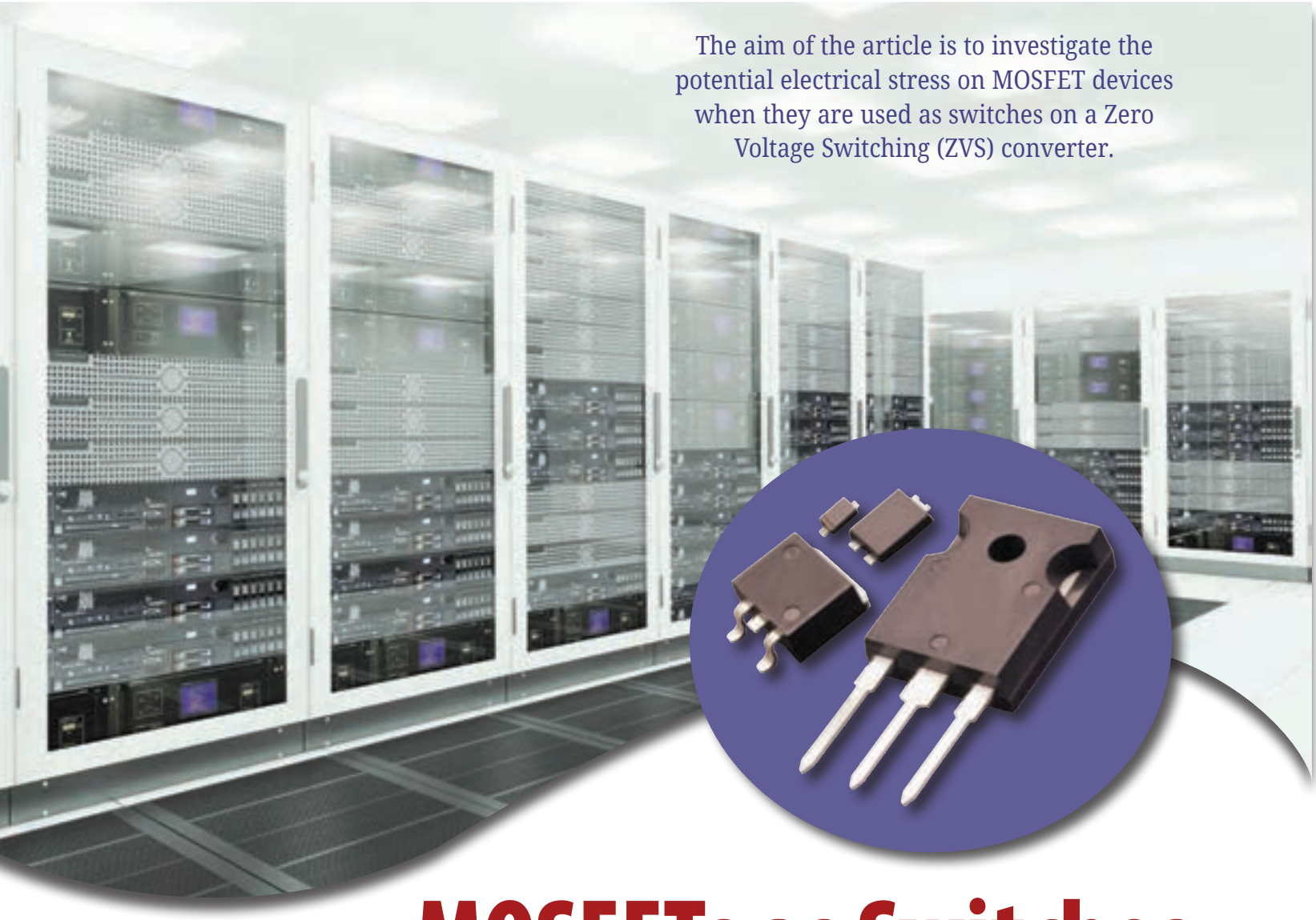

The aim of the article is to investigate the potential electrical stress on MOSFET devices when they are used as switches on a Zero Voltage Switching (ZVS) converter.

MOSFETs as Switches on ZVS Converter

The ZVS phase shift converter is addressed to the market of power applications like telecom power supplies, main frame computer-servers and any applications where power density and high efficiency are a must. To reach this target, one must minimise power losses and reactive size, and this is possible by increasing the switching frequency of the converter. High switching frequency means more switching losses, which is in opposition to the target of efficiency. The solution is represented by topologies driven to operate ZVS or Zero Current Switching (ZCS) converters. The technique guarantees in the switches that voltage or current is zero before the transition, and in particular, the ZVS guarantees zero voltage across the switching device before turn on, thereby, eliminating any power losses due to the simultaneous overlap on the switch current and voltage.

Benefits such as constant-frequency operation with linear control, integration of the stray components in the power circuit, low EMI are opposed by drawbacks like complex phase-shift controller, ringing and overshoot across the rectifier, and loss of soft switching at light load. Recently, the problem of the complex controller has been alleviated by the introduction of integrated controllers while the solution for the light load conditions is offered by a dedicated selection of switches. Some electrical characteristics of the MOSFETs used in the converter can help the system, reducing the failure risk. This article reports the operation sequences where the risk occurrence is most probable.

ZVS Topology Description

The basic circuit of the phase-shifted converter is composed of four switches: two for each leg. Due to the operation mode, the switching transitions on one leg always happen before the other one. The first is usually named 'leading leg' the other one lagging leg. In figure 1, the leading leg is represented by the switches Q1 and Q2 and the lagging leg by Q3 and Q4.

The control of the power delivered is obtained by setting the shift time between the two phases, and in particular, a short time is set to deliver high power while a long one for the low power level. This technique allows control of the powering phase.

Looking the signals sequence reported in figure 2, it is very easy to understand that the devices in the Q3 and Q4 positions change their states after the complete transition of the other two devices. In other words, devices Q3 and Q4 in the leading leg complete their transition from ON to OFF or vice versa always in advance compared to devices Q1 and Q2. Due to the switching sequence, the devices in the 'leading leg' are submitted to a freewheeling phase not visible in the 'lagging leg.' The sequence is summarised in the following table 1.

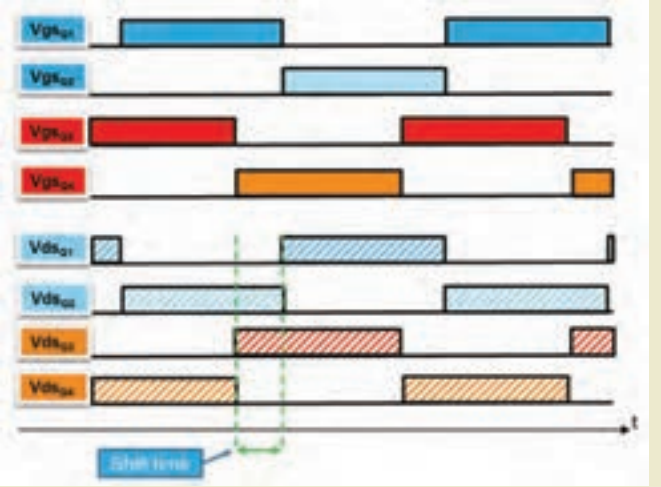

Fig. 2. Commutation Sequence

	Device	Powering	Freewheeling	Powering	Freewheeling
Lagging	Q1	ON	ON →	OFF	OFF
	Q2	OFF	OFF →	ON	ON
Leading	Q3	ON →	OFF	OFF →	ON
	Q4	OFF →	ON	ON →	OFF

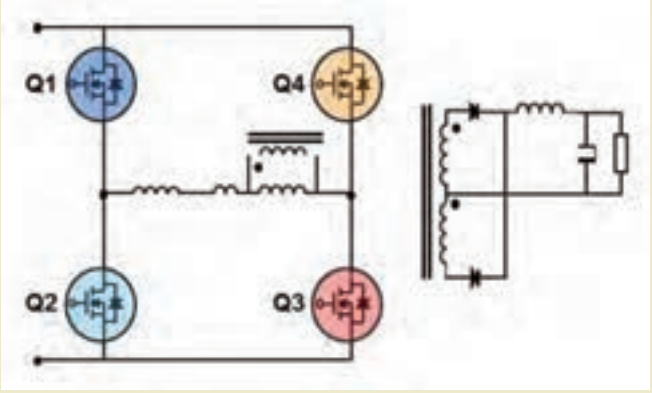

Fig 1 Phase-shifted ZVS full bridge circuit

This control technique allows the reduction of the switching losses because the operations are managed so as transitions occur from OFF state to ON only when the voltage across to the devices is zero. In figure 3, typical waveforms on a Phase-Shift (P-S) ZVS converter are shown.

As highlighted in figure 3, if attention is focused on Q4 signals and in particular on its current, it is possible to note that it is made up of two parts. In the first part, the current flows through the device from source to drain shared by the channel and body diode, while in the second one, the current flows only inside the MOSFET channel from drain to source. Current inversion happens as soon as voltage across the transformer changes its polarity. Taking advantage of this sequence, the lagging device Q2 is switched during this phase, and then it starts to conduct with its voltage equal to zero realising the ZVS transition. Particular attention must be given to the current in the Q4 device. When its current inverts the direction, the

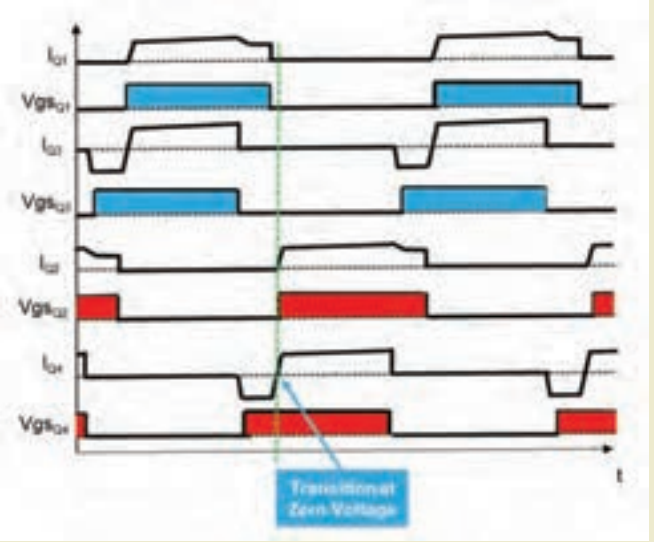

Fig. 3. Typical waveforms in a P-S ZVS FB converter DC/DC

voltage applied is low. Since the current is composed of two parts, the time duration (trr) of the removal of the minority carrier in the body diode is lower compared to a typical test. The concentration of the minority carriers is mainly linked to the lifetime of the recombination. For this reason, devices with fast recovery time are usually proposed for this topology.

The next section reports the possible failure risks that arise due to this aspect.

Failure Risk for Switch Device

As reported in the previous section, during the ZVS transition, the internal body diode of the MOSFET Q4 is involved in the operation, and its conduction time is fixed by the load level. In order to regulate the power delivered, the shift time between the two legs is variable, and consequently, the body time conduction changes

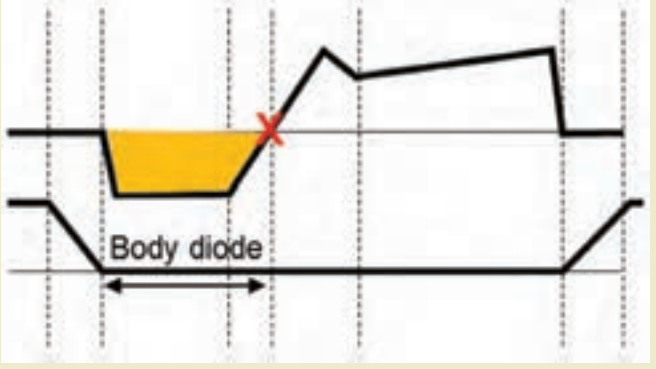

Fig. 4. Typical waveforms with high load

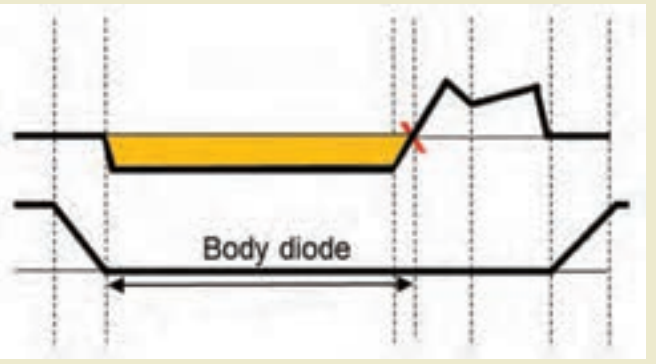

Fig. 5. Typical waveforms with low load

from a short time for high power level to a short time for low load level.

If one compares the two cases, it is clear that in the case with low load level shown in figure 5, the time available for the recombination is lower compared to the case reported in figure 4, and it could be less than that requested to complete the operation. Focusing attention to this instant, one can see that the light load condition represents the most critical working operation for this kind of risk.

As reported in figure 6, the red dash lines show different recovery times, and consequently, the case of the potential risk if an improper device is used. Three different lines are reported to simulate three different recovery times. Two of them represent safe cases while the third is a potential case of failure. In the last case, the time available is not enough to completely recover the minority carriers inside the MOSFET.

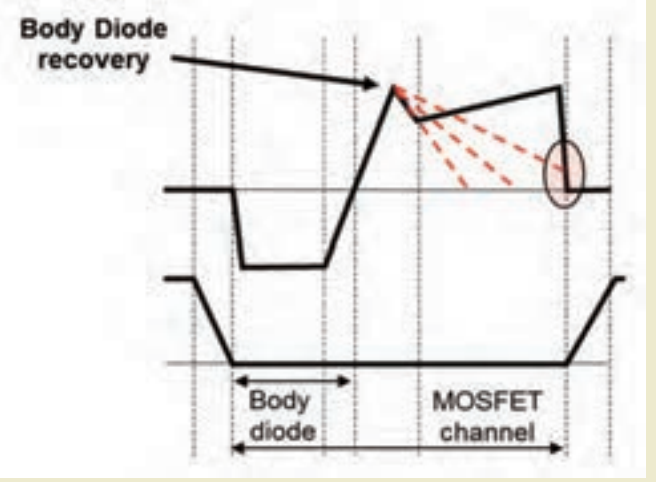

Fig. 6. Typical waveforms on leading device

To reduce the failure risk caused by this electrical stress, MOSFET devices with low trr and Qrr parameters

Continued on page 50

Continued from page 48

are selected. Several silicon technologies are presented to solve the above-mentioned failure modes in the ZVS topology, and there are several MOSFET devices with fast reverse recovery time and better dv/dt ruggedness suitable for higher frequency ZVS full-bridge applications. This choice is also usually made by the SMPS makers to increase the reliability of their systems. Figure 6 refers to the current waveform on the device placed in the 'leading leg.' The same analysis can be done for the 'lagging leg' devices. As for the devices in the 'leading leg,' the conduction phase of the 'lagging leg' devices includes a recovery operation of their internal body diodes. In this case, if the devices selected are the same as those of the 'leading leg,' no issue can be observed (figure 7) since there is more time available to the recovery phase than in the previous case.

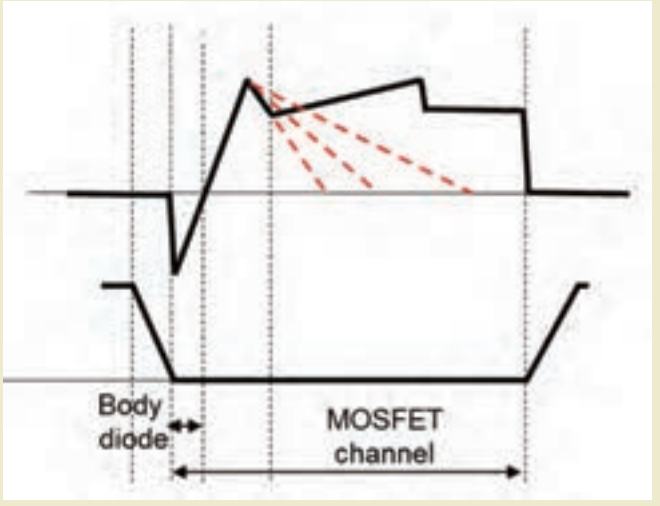

Fig. 7. Typical waveforms on lagging device

Conclusion

The document has presented a study of the potential risk for MOSFET devices when used in a P-S ZVS converter. Analyzing the transition sequence of this specific topology, the study has highlighted the critical working operations where failures could happen and the positions in the topology are more sensitive to the electrical stress. Dividing the topology in two sections labeled "leading leg" and "lagging leg" due to the sequence of the operations, some electrical characteristics of the MOSFET are been investigated, and a thesis for the device selection was formulated. The devices have to take into account the constraints requested of the "leading leg" in terms of trr and Qrr. The proper choice allows the improvement of the system's reliability, reducing the failure risk and obtaining a solid design.

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EARTHING OF CONTROL PANELS

Earthing is carried out to facilitate electromagnetic compatibility between systems and to avoid the occurrence of electrical shock to person working in the vicinity of that electrical system during ground faults. This article presents the need of earthing in control panels.

Need for Earthing

Equipment in automotive industries where control panels are situated are of high frequencies which when interfere with other electrical components cause malfunction. Generally, devices like controllers, communication devices and digital measuring devices when exposed to electromagnetic interference fail to provide effective output & pose threats of electric shocks during fault conditions.

During fault condition, high current flows through the system and there is a possibility that current does not flow through its intended path instead flows through metallic body of machines or panel. When a person comes in contact with such an electric circuit or source of electric energy, he/she is prone to an electric shock. An electric shock may result in either no injury at all or one which can prove to be fatal, causing death. Possibilities of shock increases if the electrical system is not well protected or insulated from its high voltage environment.

In order to safeguard operating personnel and system from:

- Electromagnetic interference due to high frequency components and
- Electric shocks.

It is necessary to provide a path to divert the fault current, this calls for the arrangement of earthing systems.

What is Earthing?

As per IEEE 80-2000, a conducting connection, whether intentional or accidental, by which an electric circuit or equipment is connected to the

earth or to some other conducting body of relatively large extent that serves in place of the earth is called Earthing. A safe grounding must fulfil the below mentioned objectives:

- To provide means of carrying electric currents to earth under normal and fault conditions without exceeding any operational limits or affecting service continuity.
- To assure that a person in vicinity of grounded facilities is not exposed to the danger of critical electric shock.

Earthing of Electrical Panels

When earthing an electrical panel, the following applies:

Earthing a main panel: The ground bar is bonded internally which must be of proper dimensions as per IS or NEC norms and to be earthed at two ends.

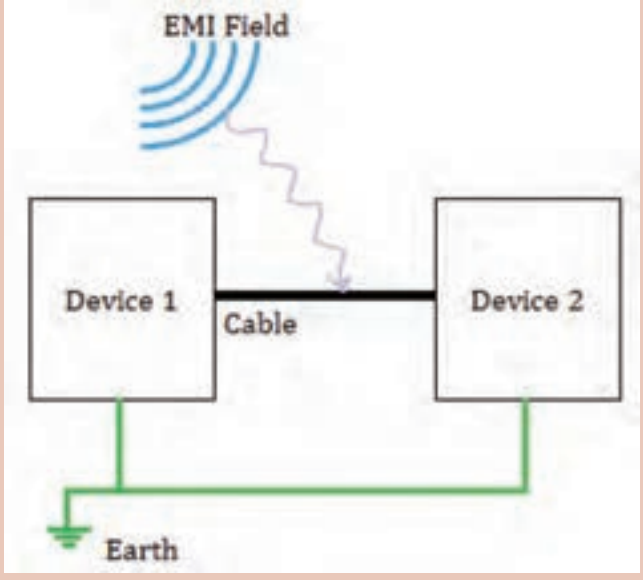

Figure 1: EMI and grounding

Earthing a sub-panel: Sub-panels are grounded through the cable that provides the secondary-feed circuit power. A secondary-feed cable will have two insulated power conductors, one insulated neutral conductor and one ground wire. The ground wire is bonded at the main panel to the ground system. The secondary-feed wiring type and size will depend on the specific application and the applicable local building codes.

What should be measured at earthing point?

Earth Resistance: A very few standards mention the exact value of ground resistance, ideally the value must be zero ohms. Standards like IEEE recommend a ground value of less than 5.0 ohms.

The earth resistance must be measured periodically to make certain that our system is grounded properly and ensures human safety during faults, because if ground resistance is high fault currents will flow through human body when in vicinity.

Earth Voltage: It is recommended that the earth must be at zero potential. But due to neutral connection, a small amount of earth to neutral voltage is present. It must not exceed more than 2V, where 5V is the upper limit leading to circulation of ground currents.

How will you test earth resistance?

There are different methods of testing earth resistance, some of the popular methods are:

- Fall-of-Potential method
- Dead earth method
- Clamp-on test method.

Figure 2: Earthing cable and bar in control panels

The first method is commonly used and gives accurate results than the dead earth method which is not so common and practised only when a quick-check is required. The last method is generally not recommended by experts due to its limitations.

The resistance to earth through an electrode can be easily calculated by Ohm's Law, $I = \frac{V}{R}$

Where $R = \rho \frac{l}{A}$

and

ρ = Resistivity of earth in ohm-cm

l = length of conducting path

A = Area of cross-section

Fall-of-Potential Method

The most common method is the Fall-of-Potential Method. A rigorous procedure is to be followed to accurately measure earth resistance. According to the area or land mass and other factors the task can be

Figure 3: Ground pit with earth electrode

tiresome and lengthy. Dodge in carrying out the process may lead to inherent errors.

To measure the earth/ground resistance of a single earth electrode at "Rod 1", a current is forced to flow through Rod 1 by driving an auxiliary test probe - current probe or Rod 2 into the ground at a certain distance away from the Rod 1 electrode and connecting the Rod 2 to a current source. In this case the ground resistance test meter is the current source which generates an alternating current. An electrical circuit is formed between Rod 1 and Rod 2 with current flowing between them in the ground.

At points between Rod 1 and Rod 2 electrical potentials are created; there is a resistance path between Rod 1 and Rod 2 so a voltage will develop at points along this path due to the current. A second auxiliary test probe - potential probe or Rod 3 is driven into the ground between Rod 1 and Rod 2 to measure electrical potential (voltage). This voltage varies along the path between Rod 1 and Rod 2; maximum voltage occurs at Rod 1 and zero at Rod 2. Current is measured between points 1 and 2 and voltage across point 1 and 3. If the position of Rod 3 is changed in a straight line then different values of voltage are obtained. Using Ohm's law one can calculate different values of earth resistance. When these values are plotted on a graph of distance versus resistance a curve is obtained, as shown in figure 5. The inferences are as follows:

- Value of resistance increases gradually as Rod 3 is moved away from Rod 1 but at a certain point this resistance is almost constant (~20Ω).
- Value of resistance increases sharply after a certain point where Rod 3 is near to Rod 2.

In order to achieve optimum results, the three electrodes must be well placed and the distance between earthing electrode and potential probe must be 61.8% of the distance between earthing electrode and current probe. This concept comes from a careful mathematical development particularly for the case of a hemispherical electrode, published by Dr. G.F. Tagg in 1964.

Dead Earth Method

In areas where use of ground electrode is impracticable, the 2-point or Dead earth method can be used. With this method, the resistance of two electrodes in series is measured by connecting P and C terminals together to reference ground electrode; and E connected to a separate all-metallic grounding point (water pipe or ground steel rods of building) as reference earth electrode, shown in figure 6. This is the simplest method to obtain earth resistance but not as accurate as Fall-of-Potential method and should only be used as last resort.

Agam AET-23

The Agam earth tester, AET 23 is capable of performing measurements of both earth resistance in ohms and also calculates AC earth voltage from 0-200V. Earth resistance testing can be performed across three ranges: 0-20 Ohms, 0-200 Ohms and 0-2000 Ohms.

It is handy and very simple to use; it can work on both the Fall-of-Potential and Dead Earth method.

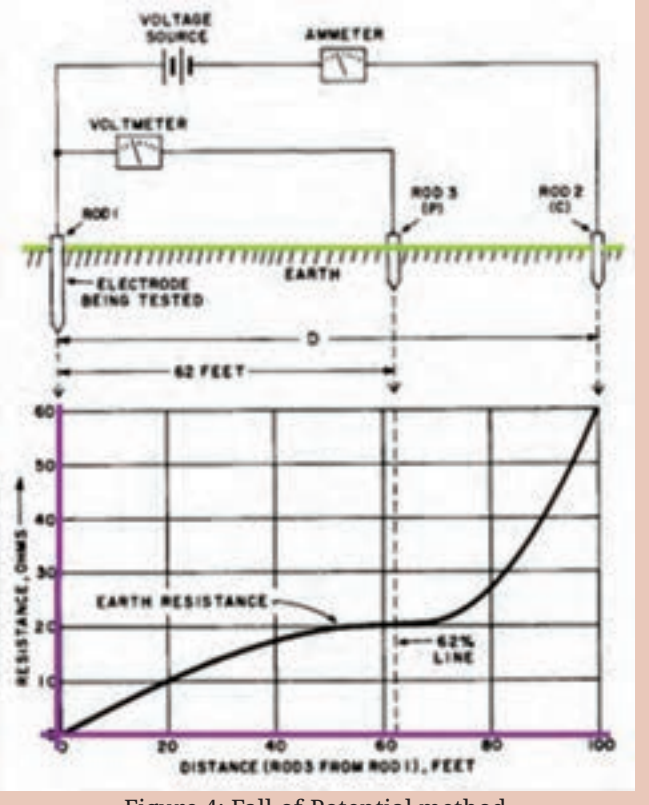

Figure 4: Fall-of-Potential method

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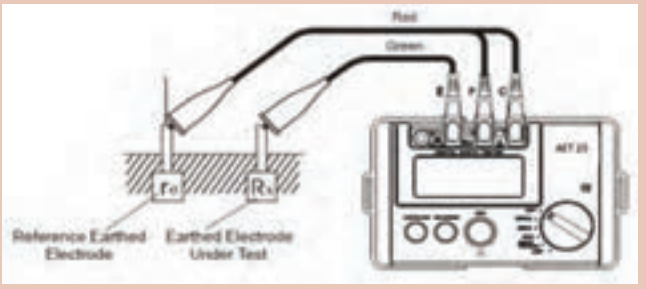

Figure 5: Dead Earth method

Features of Agam AET 23

- **Wide range of measurement with very fast response:** Measurements of earth resistance across three ranges are 0-20 Ohms, 0-200 Ohms and 0-2000 Ohms.
- **Gives better idea on safety:** Measures AC earth voltage from 0-200V.
- **Easy viewing in dark areas:** 2000 count large-size LCD display with integrated backlight.
- **Easy connections:** Rotary dial testing selection and clearly labelled ports for V, E, P and C connections.
- **Conserve battery life:** Automatically powers off after ten minutes of inactivity.
- **Indicates time to replace battery:** Low battery indicator.
- **Temporarily stores last value taken:** Data hold function.
- **Easy recall of readings:** Memory storage up to 20 records.

Fig. 6. Agam AET 23

- **Test method flexibility to the user:** 2-wire and 3-wire testing procedures possible.

Therefore, Agam AET 23, a product by Rishabh Instruments, has been developed to ensure good earthing at control panels in industries. It complies to IEC 61557-1 and -5 and is CE certified. It is rated for CAT III 600V and well suits the application of industrial earth testing, substation earth testing and earth voltage testing.

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Today's world uses around 80% fossil fuels to meet its total energy needs, which generate enormous greenhouse gases resulting in increase of the average temperature of our planet earth. Such unabated increase of temperature will lead to irreversible weather change and in the long run extinction of life from planet earth. This has necessitated shifting towards renewable energy by the whole world.

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Dilip Dev,
Chairman, HD Wires

Indore based H. D. Wires Private Limited is one of the reputed manufacturers of a wide range of galvanised wires. In the electrical and power sector, the company delivers top-quality raw materials to most of the key wire and cable players. In an interview with Electrical India, **Dilip Dev, Chairman, HD Wires** talks about the company’s journey so far and the road ahead.

HD Wires celebrated its 25th anniversary of operations this year. How has the journey been so far?

The late famed tennis player Arthur Ashe once said, “Success is a journey, not a destination. The doing is often more important than the outcome”. So, for us at HD Wires, from a humble beginning to on the threshold of crossing Rs 500 crore landmark, the journey has been full of varied times – both highs and lows.

How has your business evolved over the years?

Over the years, the business models have changed and now it is evolving faster with the advent of IoT (Internet of Things). Being a developing nation and with per capita consumption of steel is much lower than the developed world, we are sure that the domestic consumption will continue to fuel industrial growth. As far as the relationship with customers and suppliers is concerned, it has become a partnership with price competitiveness as the primary component, but with no compromise on quality and delivery commitments.

Brief us about your product range for power sector and name a few key clients.

We are a leading manufacturer of cable armour wire, ACSR core wire, G.I. cable

Key milestones

First forwarded integration	: 2004
Galvanising Plant	: 2006
Job work tie-up with Tata Steel	: 2007
Capacity doubling of galvanising	: 2014
Cable Tape	: 2019
Mesh for concrete Reinforcement	: 2019

tape, stay wire, earth wire, high carbon wire etc. Also, we are manufacturing products for construction industry like M.S. welded mesh, G.I. welded mesh, binding wire and barbed wires for fencing, mesh for concrete reinforcement. Some of our key clients from cable and wire industry are Finolex, Havells, KEI Industries, Polycab Wires, RR Kabel, Thermo Power, and UCL.

Tell us about your business network.

We have a PAN India presence thanks to our diversified product portfolio. However, majority of our sales come from states like Maharashtra, Gujarat, Jharkhand, West Bengal, Odisha, Uttar Pradesh, Rajasthan, and Madhya Pradesh.

Further, we have been exporting to our neighbouring country Nepal for more than a decade and have made significant inroads in to the Middle East and South Asian markets during the past 2-3 years.

What's your production capacity?

Currently we have a production realised of 5,000 metric tonne per month which will get increased to 7,500 metric tonne by January 2020.

Earlier this year, you made an announced about doubling production capacity of Indore plant. Is the expansion still intact?

We are on track with our expansion plans and by October we will be equipped for commercial production of the enhanced capacities. Let us hope that market demand factors support the move. As we believe recession is the best time to expand. Currently our production capacity is around 5,000 metric tonne per month and planning to cross 15,000 metric tonne per month by 2022.

ALL SET FOR REI EXPO 2019

A sneak peek into the upcoming mega event of renewable energy sector.
- Supriya A Oundhakar, Associate Editor

Climate change deal at COP 21 in Paris has committed to use 40 per cent of non-fossil fuel-based energy by 2030 in order to curtail the impact of greenhouse gas emissions. As a result, the world has been witnessing a transition from fossil fuel to renewable energy. India is blessed with abundance resources of renewables including solar and wind. Moreover, the government has ambitious plans of generation of 175 GW of green energy by 2022 including 100 GW of solar and 60 GW of wind energy. The government has approved the construction of green energy corridor to promote the renewable energy apart from development of 35 solar parks.

Renewable Energy India (REI) Expo 2019, the mega event on renewable energy brings together the entire gamut of renewable industry in order to tap the growth opportunity and raise the industry's concerns. The 13th edition of REI 2019 will be organised by UBM from 18 to 20 September at India Expo Centre in Greater Noida. This amalgamation provides a platform to network and interact with the like-minded professionals and the decision makers, engaging in thought-provoking discussions. REI 2019 will power the conglomeration by showcasing latest products, technology, solutions, and offerings across various segments in solar, wind, biomass or fuel, energy efficiency and energy storage sectors for national as well as international audience.

REI 2019 will witness a string of workshops and technical seminars, enhancing knowledge of the visitors. The event provides the ultimate business solutions for the meetings and events, uniting an elite class of buyers from India and around the world. Exhibitors benefit from the opportunity to meet with a range of international and regional buyers who have the authority to place real business. Over the years, the show has established itself as the must-attend event for the Asia-Pacific region with more than 30,000 industry visitors.

REI Expo attracts the related audience and is the most effective means of communicating with them, says Narayan Khushalani, Vice President – Marketing Business Development, Solar Division, Polycab.

REI Expo also creates an opportunity to interact with international players. We can easily interact with the manufacturer, traders, small scale industries and consumers in same event. It enhances our valuable clientele, states Arvind Patel, Director, Amrut Energy.

Here's a sneak preview of the products and technologies to be displayed at REI Expo 2019.

Amrut Energy

Ahmedabad-based Amrut Energy is a manufacturer of solar power systems and battery. The company is basically into manufacturing of solar pumps and solar street lights. In pumps, it has introduced voltage-based AC design that is more efficient as compared to other pumps. "In REI Expo, we are introducing BLDC pumps along with the controllers as our new development. Our pump can run on solar power as well as grid power (EB). In solar street lights, we are introducing semi-integrated and integrated (all in one) solar street lights," informs Arvind Patel, Director, Amrut Energy.

He informs that his company participated in REI Expo 2018 and got massive response more than expected. Patel expects the gigantic response this time also.

Polycab

For Polycab, manufacturer of solar products apart from wires and cables, this is the fourth consecutive year of participation in REI. "After the stupendous success of our on-grid inverters, solar DC cables and solar DC MCBs, we are now poised to launch PV modules, off-grid inverters, MC4 connectors, junction boxes and harnesses," informs Khushalani.

The company is optimistic of getting added business growth by offering a one stop solar solution to its customers who have tremendous faith in the brand.

CHiNT Power India

CHiNT Power (India) is a specialised subsidiary of the CHiNT group and is engaged in the PV power station development and PV module production. REI 2019 generates the opportunity for the industry by exhibiting the cutting-edge technologies from the leaders in all product segments. The company is demonstrating its latest Higher Power String inverters 125 kW + (1500 V) & 125 MW Container Solution for the utility markets. Rauf Javid, Country Head, CHiNT Power (India), informs, "Our sharp focus remains on the rooftop market. For this market segment, we are also launching our newest addition of 100 kW (1000 V-Multi MPPT Inverter). Even more exciting segment is the storage business, which we are following very keenly and would be happy to discuss on our Storage PCS for utility storage market."

Javid expects that the event will provide great quality platform to interact with all the stockholders across countries under one roof. Further, it provides product demonstrations in a friendly and professionally organised environment and creates awareness and develops relationship with new prospects.

Shakti Pumps

Shakti Pumps is a manufacturer in pumps and motors segment. The company is participating in REI Expo 2019 to create awareness about its products. The company is exhibiting its indigenous Hybrid inverter Kalpavriksha and Sunshakti.

Sunshakti Hybrid Inverter series is high performance, high switching frequency-based system that comes with IP65 ingress protection. The framework works with multiple energy sources like PV, battery, grid and diesel generator. The system not only ensures uninterrupted power to load but also harvest energy from PV panel to charge battery and back feed the grid. Hybrid inverter's intelligent digital control co-ordinates with all energy sources connected to it and ensures maximum energy harvesting from PV. The system comes with unique user experience where it can be controlled and monitored by SPL mobile app, elaborates Manoj Modi, BU Head - Electronics & Control, Shakti Pumps.

Shakti Pumps wants to expand its footprint in the industry with participation in REI 2019. "We also expect to see new and innovative technologies at the Expo within our segment," expects Modi.

Vikram Solar

Vikram Solar is one of the leading solar energy solutions providers, specialising in high efficiency PV module manufacturing and comprehensive EPC solutions. The company will showcase its latest technologies and services at REI 2019. The company believes that REI platform is serving as the hub for knowledge and inspiration that can accelerate nationwide energy development process with ease.

Kuldeep Kuman Jain, BU-Head, EPC Vikram Solar, informs, "Renewable energy in India needs support of new ideas, strategies, and innovations to make it out of its cocoon of traditional energy choices. Our objective by participating at the upcoming REI is to uphold the priorities of solar industry to enhance growth."

Vikram Solar has elaborate plans to utilise REI platform to take in new ideas while showcasing its findings to the market. "We expect that REI 2019 will enable us to analyse the market growth, demand, and ultimately orchestrate our plans towards future," states Jain.

Goldi Solar

Goldi Solar is one of the growing solar PV manufacturing companies and solar EPC contractors. The company believes in innovation and superior quality in the products and services that it offers to set the benchmark in the industry.

Goldi Solar is showcasing its exclusive range of exclusive range of PV modules i.e. 72 cell Mono PERC crystalline, 72 cell polycrystalline, 144 half cut cell and glass-to-glass. "Our state-of-the-art 72 cell Mono PERC Module with 380Wp offers better performance, higher specific yield and low O&M cost," informs Bharat Bhut, Director, Goldi Solar. The company acknowledges the event as a gateway to enter the industry. "REI has been a stepping stone for the renewable energy industry and Goldi Solar. REI sets the standards wherein; expectation vs reality is justified and we are able to outreach our participation. We are looking forward for a strong footfall of audience and industry with a high-octane knowledge sharing platforms to enhance the industry future with best possible practices," states Bhut

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ABILITY TO WITHSTAND

SHORT-CIRCUIT TEST ON INVERTER-DUTY TRANSFORMER

FOR SOLAR APPLICATION

Escalating demand of solar application increased the use of Inverter-duty transformers especially of multi winding type. For design verification, short circuit withstand test is to be conducted on these transformers. This article describes the procedure of short circuit withstand test on multi winding Inverter-duty transformer as per national and international standards (IS, IEC, ANSI/IEEE, etc.)

While proceeding towards the reticulated use of electricity to supply the human needs attention on utilisation of natural forces has always been locked up in fossil fuels. The magnitude of the fossil fuels which is on the verge of depletion swung our concentration towards the renewable sources of energy. In recent decades, harnessing energy from solar has been enhanced due to the efficient photo voltaic technologies.

Figure 1: Basic architecture of solar power plant

Due to concern of environmental quality, today photo voltaic power plants (PV) are rapidly spreading all over the countries. In a traditional PV plant, a large number of PV modules are series connected in long strings whose output is provided as input to single centralised inverter for the voltage inversion. Basic architecture of solar power plant is shown in figure 1. Step-up transformers are required to boost the 350 to 690 V inverters output voltage to the 11 or 33 kV of the medium voltage utility network. More sophisticated architectures have been developed where PV modules are arranged in strings, or even substrings, each one connected to the step-up transformer through a dedicated inverter, or a dedicated DC/DC converter and a centralised inverter.

Inverter Duty solar Transformers

For pumping of electrical power to the utility network inverter duty type solar transformers are widely used, either singly or paralleled. There are different types of solar transformers including distribution, station, sub-station, pad mounted and grounding. All solar transformers have specialised needs that impact costs. The inverter-duty solar transformer which is a key element of a PV system, are generally manufactured with multiple LV windings, that enables to connect several PV

panel strings to the grid with less number of transformers in total.

While designing inverter-duty transformers having three-windings or five-windings for grid connected photovoltaic systems, special care is taken in design and manufacturing to address the harmonics that are usually appear in the transformer windings.

Inverter windings are specifically designed to withstand voltages excursions that arise due to pulsed mode inverter operation. Inverter windings are capable of withstanding voltages with high rate of rise (dV/dt).

The special feature of Inverter duty transformers is offering galvanic isolation between the input power circuit (PV array) and the grid so as to prevent dangerous DC faults to be transmitted to the AC side.

An earthed screen is normally installed between the primary (inverter winding) and secondary (MV) windings of Inverter duty solar transformers. Electrostatic shield between inverter winding and MV winding decouples capacitive nature of primary and secondary winding so as to eliminate the effects of high frequency transients on the other winding.

During normal lifetime, these transformers are subjected to a variety of electrical, mechanical and thermal stresses. One of the most critical situations is that caused by external short circuits, which produces high currents in the transformer windings and hence high internal forces in the windings. Thus, before installing these multi secondary winding transformers, one of the transformers should undergo short circuit withstand test for design verification.

Role of CPRI

CPRI is a pioneer testing organisation in India with six decades expertise in the short circuit and dielectric testing, short circuit design data reviews, quality control checks and stage inspection of various power system equipment. Presently, CPRI is expanding its testing activities globally with international institutions such as ASTA Intertek UK and also as a member of STL for testing and certification of various LV and MV Switchgears and Power & Distribution Transformers as per International Standards. CPRI is continuously engaged in testing of various types of switchgear equipment from last six decades and issuing test certificates and test reports as per national and international standards.

To prove the satisfactory performance of these inverter-duty solar transformers, various tests have been carried out as specified in the international and national standards. In last four years, different rating of inverter duty transformers of various manufacturers for solar application came for short circuit dynamic withstand test at CPRI.

Ability to withstand short circuit test

The short circuit test is carried out to verify the integrity for stresses, primarily mechanical, developed when short circuit current flows through the transformer. Due to the speed at which short circuit faults appear and are cleared, the current exert electro-dynamic forces onto the windings that causes mechanical stresses in the radial direction (tending the inner turns to compressive stress and outer turns to tensile stress) and in axial direction (with pulsating compressive forces). Radial forces regularly leads to bucking of the winding, axial and radial forces have been observed to result in spiralling and/or tilting of the turns. Permanent deformation of the winding may lead to immediate damage or long-term issues like deterioration of insulation, obstruction of oil flow, material weakness or loosening of mechanical structures, etc.

Short circuit test procedure

The standards which are used for short circuit testing and evaluation of transformers are as follows:

- IS 2026-part 5: 2011
- IEC 60076-part 5: 2006
- IEEE/ANSI C57.12.90
- IEEE/ANSI C57.12.00

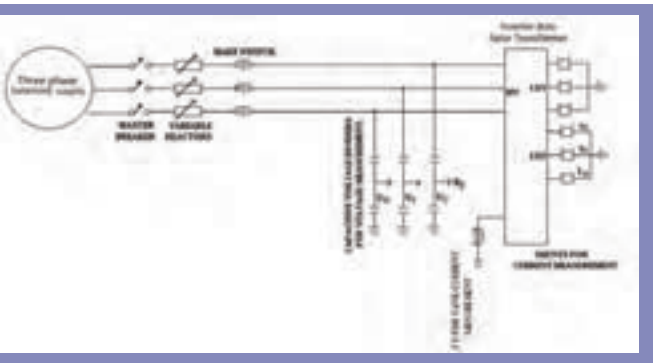


Figure 2: Schematic of test circuit diagram

Preparation of test Transformer prior to short-circuit tests

The short circuit test must be carried out on a new transformer ready for service, protection accessories such as Buchholz relay and pressure relief device must be mounted. Test Set-up of the inverter duty solar

transformer undergoing short circuit withstand test is shown in figure 3. Routine Tests that must be carried out prior to short circuit test according to the standards are as follows:

- Measurement of winding Resistance
- Measurement of voltage Ratio & check of phase displacement
- Measurement of short -circuit impedance and load loss
- Measurement of no-load loss and current
- Dielectric Routine tests such as Separate Source AC withstand voltage test and Induced AC voltage tests

If windings have tappings, the reactance and resistance must be measured for the tapping positions at which the short circuit test will be carried out.

Figure 3: Test Set-up of The inverter duty solar transformer undergoing short circuit withstand test.

Short-Circuit Current calculation

Fault currents flowing through transformers are significantly higher than the rated currents of the transformers. In worst case, the current would be as high as the current that would flow if system voltage was applied to the primary terminals while the secondary terminals are shorted – limited by the transformer impedance only. These currents produce both mechanical and thermal stresses in the transformers. Thus the r.m.s. value of the symmetrical current If that is intended to flow through the transformer during short circuit test shall be calculated as follows

$$I_f = \frac{U}{\sqrt{3}(Z_t + Z_s)}$$

Where U is the rated voltage of the winding under consideration,

Zt is the short-circuit impedance of the transformer referred to the winding under consideration,

Zs is the short-circuit impedance of the system

Test current peak value

Forces resulting from the currents passing through the transformer act on the conductors as a function of the peak asymmetrical current (the highest peak value of any cycle of the current), which is usually at its highest during the first half cycle of the fault. The transformer manufacturer needs to ensure these forces do not damage the transformer. So, the test shall be performed with current holding maximum asymmetry as regards the phase under test. The amplitude î of the first peak of the asymmetrical test current is calculated as follows:

where factor k accounts for the initial offset of the test current

$$\hat{i} = I_f \times k \times \sqrt{2}$$

Duration and number of tests

The thermal stress is caused by the high current causing heating in the transformer. Both the RMS symmetrical current magnitude and duration of the fault contribute to the heating of the transformer. The transformer manufacturer needs to ensure the components of the transformer do not become hot enough to be damaged.

Thus, the duration of each test shall be:

- -0.5 s for transformers rated up to 2500kVA,
- -0.25 s for transformers rated more than 2500kVA.

The recommended number of tests for short circuit withstand ability test on three-phase transformers are nine (With regard to tap-changer position, test sequence shall be three tests in the position corresponding to the highest voltage ratio, three tests on the principal tapping and three tests in the position corresponding to the lowest voltage ratio).

Detection of faults and evaluation of test results

During each test, recordings shall be taken of the applied voltages, the phase currents, and Tank current. After each test, the oscillograms taken during the test shall be checked, the gas-and oil-actuated relay need to be inspected and the short-circuit reactance has to be measured.

The figure 4 shows a recording of applied voltages, LV side phase currents, Tank current of Inverter duty Solar Transformer which has undergone short circuit withstand test.

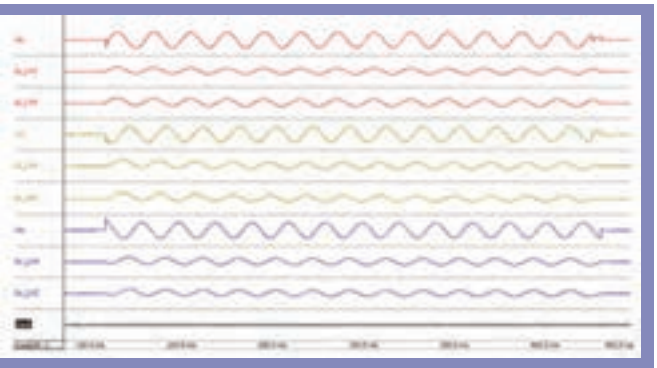


Figure 4: Oscillogram of inverter duty solar transformer showing Current & Voltage waveforms

Criteria to pass the test

The results of the short-circuit reactance measurements and the oscillograms shall not indicate any anomalies. The dielectric tests and other routine tests when applicable have been successfully repeated.

The out-of-tank inspection does not reveal any defects such as displacements, shift of laminations, deformation of windings, connections or supporting structures, so significant that they might endanger the safe operation of the transformer. No traces of internal electrical discharge to be found.

For transformers rated up to 100 MVA, reactance variation should not be more than 2 per cent for transformers with circular concentric coils and sandwich non-circular coils and 7.5 per cent for transformers with non-circular concentric coils.

Conclusion

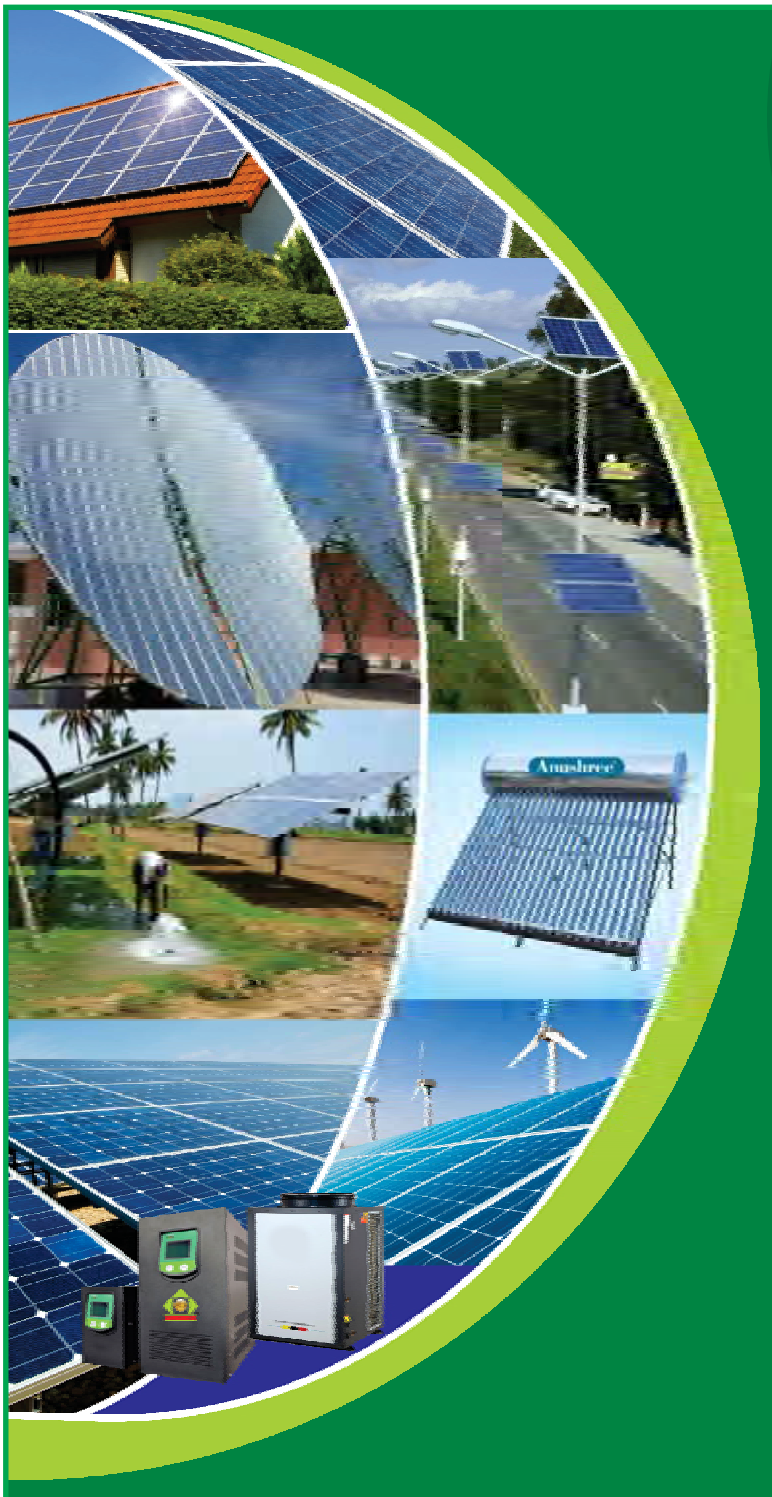
CPRI is always inclined towards meeting our nation's strategic energy objectives such as secure and environmentally responsible energy system by certifying qualitative LV and MV switchgears, distribution and power transformers as per National and International standards.

Yugal Agrawal

Joint Director STDS, Central Power Research Institute, Bhopal

K. Sharath Kumar

Engineering Officer Gr-II,
STDS, Central Power Research Institute, Bhopal



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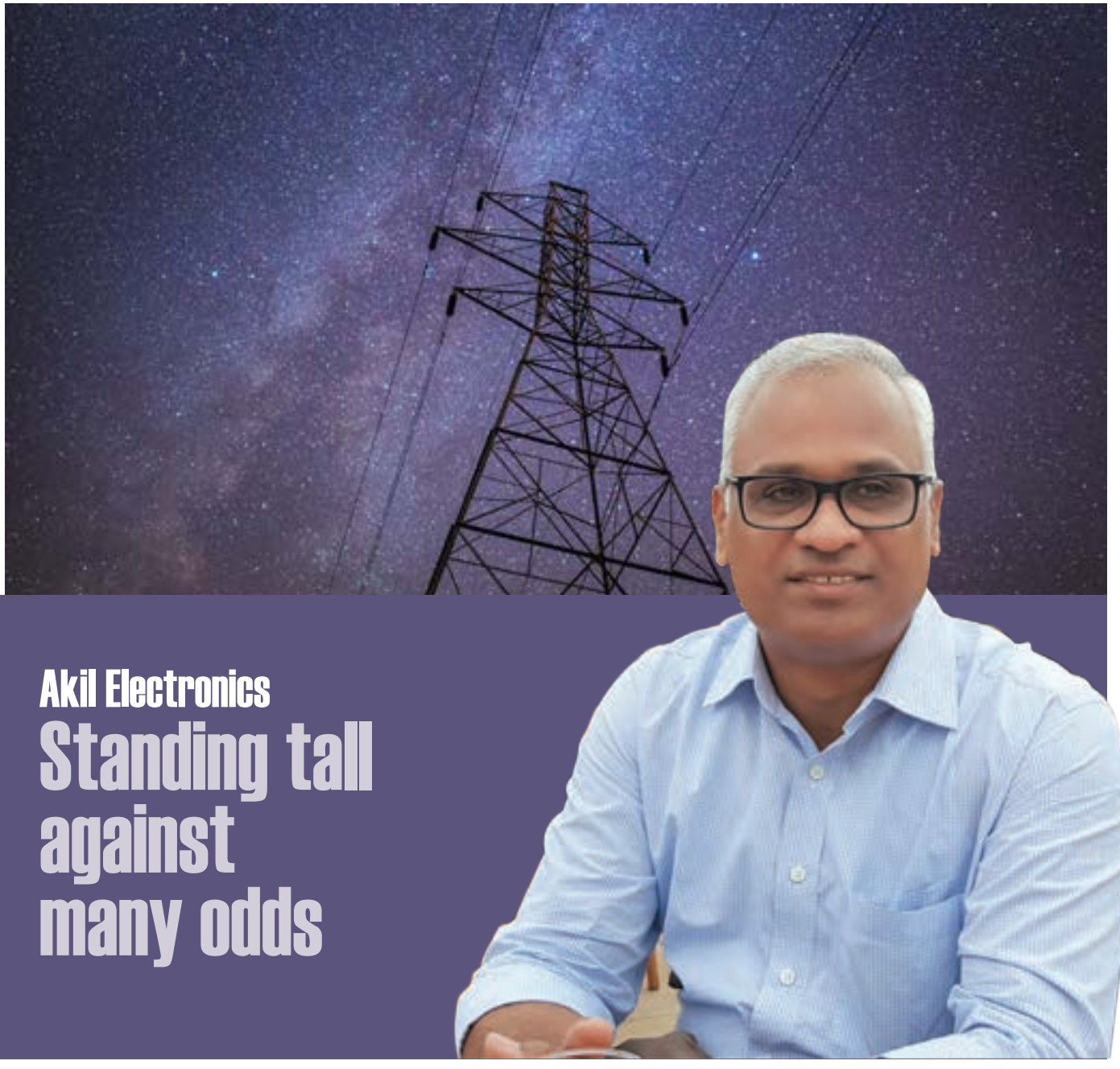


Akil Electronics

Standing tall against many odds

Akil Electronics Systems is a proprietorship firm, renowned as a prominent manufacturer, exporter, importer and retailer of a comprehensive range of high voltage testing equipment, automatic controller. **Kamarajan Jagadeesan, Proprietor, Akil Electronics** gives a glimpse of company, its products applications, opportunities generated due to momentum in renewable energy in an interaction with **Electrical India**.

How has been the journey so far?

We manufactured our first partial discharge detector in the year of 2001. It was very difficult to compete with the multi-national companies who had established themselves very well then. The mindset of Indian customers could not accept the fact that Indian companies can design and manufacture a good product. It is very sad to note that certain Indian power utility companies and even the government owned

agencies insist that their suppliers should use certain specific brands of test equipment imported from other countries. It is the kind of attitude one has to face in our country which hurts the industry and economy.

We worked really hard to establish our product against many odds and today we have the largest installation of partial discharge detectors and high voltage test equipment with more than 400 customers. We have launched our products in European markets at the Hannover (Germany) Messe in April, 2019 and the response was excellent.

What are the PD measurement products from Akil Electronics Systems?

We have different types of PD measuring systems for laboratory and onsite testing. Our PD detector Model-PDC13 is one of the most advanced PD measuring system ever made by an Indian company. This has a very powerful measurement and analysis software meeting IEC standards.

We also manufacture PD free high voltage testing transformers up to 800 KV. The other important product is the PD test set up for voltage transformers at higher frequencies. We offer complete solution for any type of PD measurement.

What are its applications?

These are used for the routine and type testing of high voltage equipment like power transformers, CT & PT, lightning arresters, power cables, GIS, switchgears and rotating machines. They are also used for onsite condition monitoring of HV equipment. Partial Discharge monitoring together with Tan Delta measurement is one of the best methods to find out deterioration of insulation for the HV equipment in service.

As the renewable energy is gaining momentum, how do you look at the scope for your business?

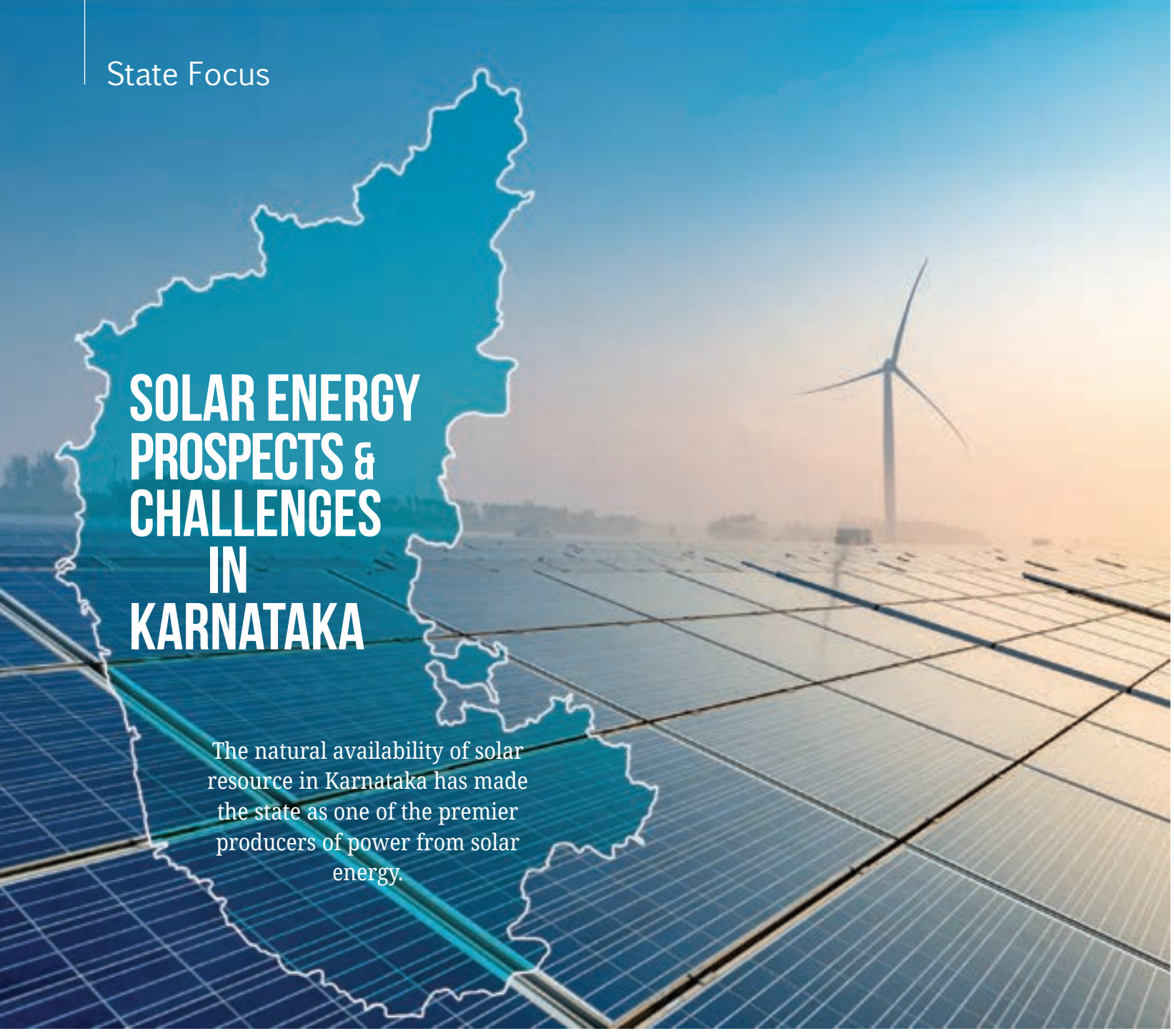
The future is renewable energy. There will be a massive change in the way we generate, transmit and distribute power. The conventional methods would be obsolete and the recent innovations and developments in this area promise clean energy at affordable cost. We are hopeful of adapting to the new demands and our business will definitely grow with the energy sector.

What are the new products in pipeline?

We have developed advanced online monitoring systems for the partial discharge and Tan Delta measurement. We will be launching them in the market soon. Another important development is the sophisticated high voltage measuring system with very high accuracy and linearity up to 1000 KV with a suitable HV divider.

What kind of growth do you envisage for your company for the next three to four years?

Being a capital equipment manufacturer, we do not see very high growth or demand. We have built a new facility to manufacture high voltage testing equipment where all our products will be manufactured at a single facility. We do hope to gain more customers abroad as part of our expansion plans in Europe and other western countries.



SOLAR ENERGY PROSPECTS & CHALLENGES IN KARNATAKA

The natural availability of solar resource in Karnataka has made the state as one of the premier producers of power from solar energy.

The energy sector is one of the fastest growing sectors in the present context as every developmental aspect related to our day-to-day life is directly or indirectly related to it. As most of the required energy comes from the electricity due to the ease of conversion and better controllability, the electrical energy sector happens to be the backbone of any country's economy. Needless to mention that the prosperity of any country is directly related to the quantum of energy consumption in that country. Particularly in India, the recent decade has seen a phenomenal transformation in the electrical energy sector. The booming renewable energy sector, the aiding government policies, the rapid technological advancements and enhanced awareness among general public about the innovations in the sector, are some of the major reasons for this transformation. Several states in India have become front liners in adopting the innovations in the field of renewable energy technology after having been blessed with abundant resources that are very essential to harvest the electrical power. So far as Solar Energy sector is

concerned, the Jawaharlal Nehru National Solar Mission (JNNSM) launched by the Centre is targeting 20,000 MW of solar energy power by 2022. Karnataka is one of the leading states in India in the effective harvesting of electrical power from renewable energy sources, particularly from solar and wind energy. However, there have been, there are and there will be many challenges for the effective harvesting of electrical power from these renewable energy sources. The changing scenario in the form of demand for power, technological developments, government policies, the physical structure of the power system have mainly imposed several challenges for effective harvesting of the electrical power from renewable energy sources.

Present solar power scenario in Karnataka

Karnataka covers an area of 191,976 square kilometres which is 5.83 per cent of the total geographical area of India. It is the sixth largest Indian state by area. The total installed power capacity in the state has been 28,789.99 MW with 1,116.22 units per capita availability. The observed peak deficit and energy deficit have been 5.85 per cent and 3.43 per cent respectively during the latest financial year (Source: Karnataka's Electricity Sector Transformation India's Leading Renewable Energy State. Institute of Energy Economics and Financial Analysis- June 2018). Karnataka has become number one state in India in terms of energy harvesting from renewable with an installed capacity of about 13,500 MW particularly after having installed a record 3.9 GW capacity addition in 2017-18. The figure 1 shows the Indian national solar energy potential map with the clear indication about the fairly good opportunities for the solar energy in Karnataka.

A solar power potential of 24,700 MW is available in Karnataka whereas the installed capacity has been 5,966.6 MW as on 30th June 2019 against the total installed capacity of all non-conventional energy sources of 13,656.69 MW amounting to about 45 per cent. In Pavagada of Tumkur district a massive solar park of capacity of 2,000 MW has been commissioned as a joint initiative of KREDL and Solar Energy Corporation of India (SECI) with a tariff as low as Rs. 2.97/unit. The table 1 shows the installed capacity of solar power plants in different districts of Karnataka. As per the solar energy policy of Government of Karnataka, a minimum 2.75 per cent and 3 per cent of the total energy supply is expected to come from solar energy only, during the years 2019-20 and 2020-21 respectively. This clearly shows the expected contribution from solar energy to the energy sector of Karnataka in the coming years also.

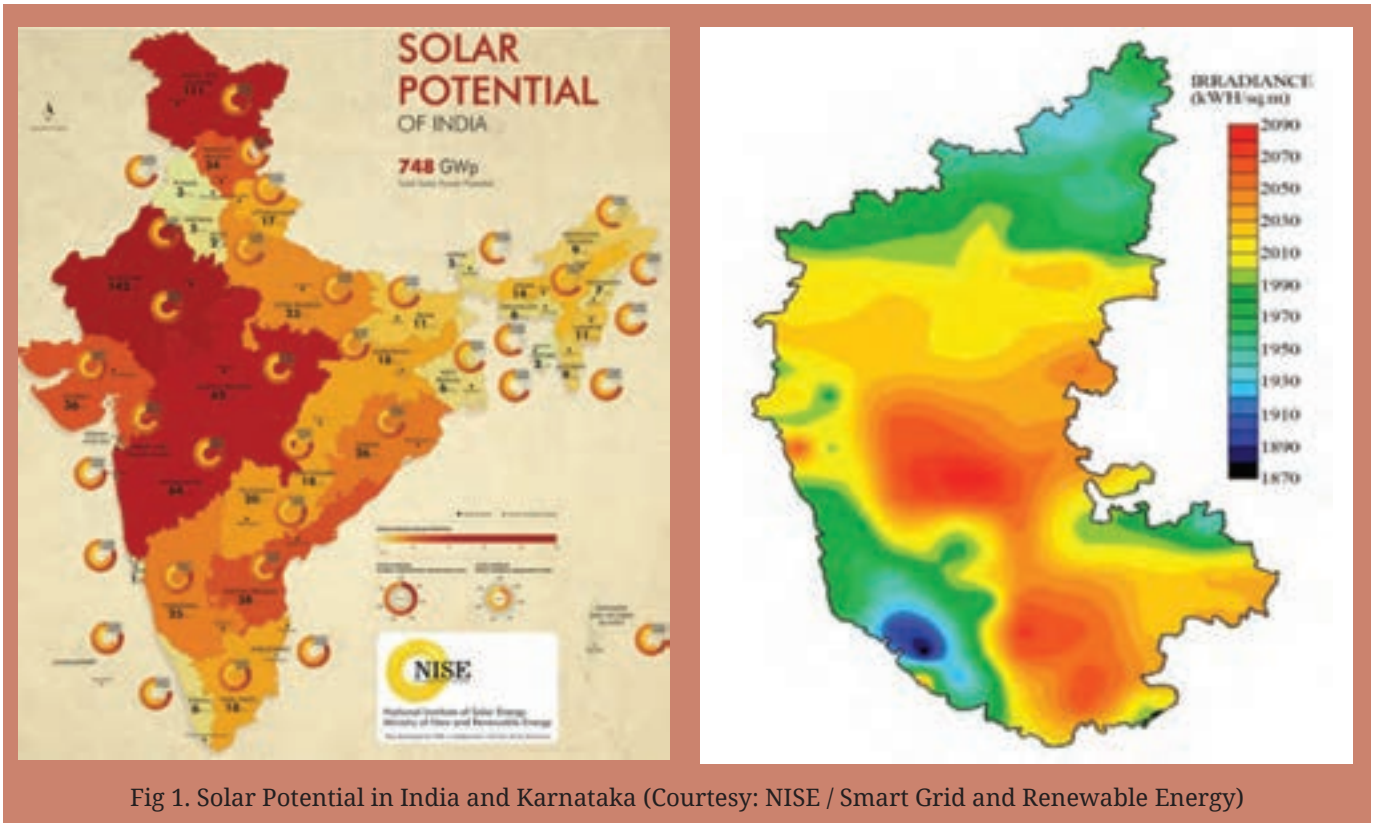


Fig 1. Solar Potential in India and Karnataka (Courtesy: NISE / Smart Grid and Renewable Energy)

Table 1: District-wise solar power installed capacity

District	Installed Capacity in MW	District	Installed Capacity in MW
Bagalkot	101	Haveri	53
Bellary	431	Kalaburgi	301
Bengaluru Rural	12.5	Kodagu	0
Belagavi	255	Kolar	71
Bengaluru Urban	1	Koppal	258
Bidar	410	Mandya	59
Chamrajnagar	227	Mysuru	45.5
Chikballapur	47	Raichur	283
Chikmagluru	0	Ramanagara	96.5
Chitradurga	680	Shivamogga	1
Dakshina Kannada	0	Tumkur	1920
Davangere	73	Udupi	0
Dharwad	10	Uttara Kannada	0
Gadag	208	Vijayapura	240
Hasan	20	Yadgiri	142.5

It can be observed from the table 1, the central and northern parts of Karnataka, by virtue of reasonably higher amount of solar input, have more number of solar power plants commissioned. More than 60 per cent of the total installed capacity can be seen in these places. Excluding Pavagada Solar Park, then most of the grid connected solar installations can be found in these regions. In the identified solar potential also, these regions have maximum share. With the anticipated reduction in the AT&C (Aggregate Technical and Commercial) losses, grid losses and energy efficiency techniques net expansion in the electricity production required by the end of next decade (2027-28) is expected to be about 40 TWh. Out of this about 13 TWh (25 per cent) is expected from the solar sector itself. This prediction looks fully viable with the recent trends in solar auctions that are taking place in Karnataka. But if the trend and corresponding materialisation of the sanctioned projects is to be continued without any technical glitches, several issues and challenges need to be addressed.

Limited transmission infrastructure

Several solar power auctions have been delayed due to the concerns about the limited transmission system capacity. The unpredictable power generation from solar power installations has always been challenging for the efficient utilisation of the existing transmission resources. The seasonal excess generation from solar power plants might create contingencies in the transmission system. This concern has become more stringent especially with the interstate transmission system capacity. Lack of transmission infrastructure could be one of the possible hindrances for the effective harvesting of electrical power from solar energy resource. As the new solar projects can be commissioned in lesser time span compared to that required for setting up transmission systems, the quicker execution of transmission projects is very essential for overcoming the hindrances. The cost of setting transmission corridor comes to be somewhere between Rs. 50 Lakh to Rs. 1 crore per MW depending on the locations. Therefore, it may so happen that the sanctioned solar projects might get shifted to the other places which are ready with the required transmission corridor. Presently in India about 32 transmission corridor projects are being undertaken both inter and intrastate, with an approximate budget of Rs. 13,000 crore.

There have been several proposed transmission lines of different voltage ratings and also the substations. In Karnataka, over the next few years, KPTCL (Karnataka Power Transmission Corporation Limited) aims to install a total of 451 substations – 208 at the 66 kV level, 172 at 110 kV, 58 at 220 kV and 13 at the 400 kV level. The KPTCL also plans to install transmission lines of 15,152 circuit km with 4,346 circuit km at 66 kV, 3,496 circuit km at 110 kV, 4,470 circuit at 220 kV and 2,840 circuit km at 400 kV. According to KPTCL, the outlay for the projects in 2018-19 is Rs. 3,000 crore. Once these projects are materialised without any delay the solar resources with the remaining potential could be effectively tapped. The other challenges associated with transmission system are related to the rooftop solar power projects in Karnataka. As per KREDL (Karnataka Renewable Energy Development Limited) about 2,300 MW grid connected solar rooftop systems targeted by 2022 in Karnataka. The integration of rooftop solar PV systems to the low voltage distribution system is really challenging task as the transmission utilities are better equipped to manage the integration of large-scale power stations with higher voltage levels. This necessitates the integration of rooftop solar PV system to the grid with more emphasis on the technicalities.

Wheeling charges

According to the solar policy of government of Karnataka, all the solar power producing agencies were exempted from the wheeling charges till 2017. As of now KERC (Karnataka

Continued on page 76

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Renewable Energy Corporation) has now directed that they should all pay 25 per cent of the charges applicable to conventional power transmission. The order has been in effect since April 1, 2018 and will be in effect till March 31, 2020. These renewable energy projects will also be liable to bear the losses incurred in the applicable line, as approved by the KERC, by deductions from the net injected energy. KERC has also directed these renewable energy projects to pay two per cent in banking charges. As the results of this, the solar developers have contended that the new order would increase his costs by Rs. 1.19 per unit of power produced which is against 37 Paise of as calculated by KERC. However, in its detailed order, KERC has calculated that the increase on the imposition of transmission and wheeling charges would be 37 Paise, while line loss costs would be another 14 Paise. Nevertheless, the whole confusion regarding the wheeling charges is required to be overcome. However, the matter has already entered into a legal battle and the developers have got some relief from the High Court. A clear and strong policy with the objectives of safeguarding the interests of the investors and consumers is required to be formed.

Solar PV module costs and import constraints

The cost of the PV module lies somewhere between a third and a half of the total capital cost of a PV system, depending on the size of the project and the type of PV module. The histrionic reduction in the cost of solar photovoltaic (PV) modules, which has fallen by 99 per cent over the last four decades, is often considered as a major reason for the quick success of solar energy in India. So far as Indian solar projects are concerned, the government has mandated the investors to use the solar PV modules manufactured in India only, to avail the subsidies from the government. But due to the infant Indian solar PV module manufacturing sector against the Chinese or the other developed counterparts, it may be difficult to enjoy the subsidy benefits due to the considerable differences in the costs and the other modalities related to the PV modules manufactured in India and those exported. Besides, with the exception of a few leading firms that are expanding their capacities to meet increasing demand, most firms operate below full capacity. Module manufacturing is more diversified than cell manufacturing in India, because it is cheaper and less technology intensive to set up. India's director general of trade remedies (DGTR) recommended in July 2018 the imposition of a 25 per cent duty on solar cells, assembled into modules or not, imported into India from China and Malaysia in the first year, followed by a gradual reduction to 20 per cent in the first six months of that second year and then to 15 per cent in the latter half of the second year. This will likely raise the capital cost of Indian solar projects in the near term by 10-15 per cent, likely offsetting the expected decline in imported module prices over the coming year. On the other side, the state policies have very little to do with overall cost of solar PV modules as they are governed by the policies made at the national level. Yet, it is observed that, as per the industrial policy document of each state, Karnataka has the highest cost of module manufacturing at Rs. 31.91/ Wp as it provides only capital subsidy and an exemption on stamp duty against the top ten highest cumulative solar installed states in India. In view of this it is really the high time for the state policy makers to look into these aspects and amend the policies so that they become conducive for the investments in the solar PV module manufacturing sector. With the 'Make in India' and 'Skill India' initiatives likely to take big momentum in the coming years to come, it is very essential to provide such a platform for the investors to have a completely indigenous solar technology.

Conclusion

The natural availability of solar resource in Karnataka has made the state as one of the premier producers of power from solar energy. The state stands first among all the states in India in the power production from renewable sources. However, in view of the future prospects and requirements, certain issues related to the solar energy sector need to be addressed. The existing transmission capacity has to be enriched for the encouragement of the power producers to sell the power across the state borders. The various liabilities on the power producers in the form of wheeling, banking charges, interest rates are to be restructured keeping in view of the future of the sector. A strong and clear policy in this regard, without giving any scope for the escalation of conflicts in the form of legal issues, is desirable. The industrial policies should be made more conducive for the investors to invest in the solar PV module manufacturing sector to meet the objectives of the 'Make in India' and 'Skill India' initiatives.

Shravankumar Nayak

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TIPS

TO EXTEND BATTERY LIFE

- Ajay Sabharwal, Director, Everon Energy Systems Pvt. Ltd. explains the most efficient ways to extend battery life.

Battery is the most misunderstood product. Its performance is judged by its electrical parameters, where as it lies in its electro-chemistry. Judging a battery by its discharge current or its end cell voltage is a mistake and results in millions of batteries being replaced or junked, causing a massive financial and environmental impact.

Proper understanding of the battery behaviour and timely implementation of remedial measures can avoid millions of batteries getting scrapped and avoid environmental damage. The current new sale vs. replacement ratio for industrial/ domestic/UPS batteries is 60:40, that means a large chunk of supplies go towards replacement market is proportional stress on the environment. Replacement decisions are devoid of environmental and economic prudence.

Research shows that 90 per cent batteries get replaced due to capacity degradation caused by suphation of its plates. Battery plates are prone to hard lead sulphate crystal deposits, increasing its internal resistance, is the cause of sudden shut down of your backup system.

These sulphate deposits can be treated electronically with high frequency low energy pulses riding over the charging current. The sulphate deposits are forced to detach from the plates and dissolve back in the electrolyte, slowly recovering the battery capacity back to original. If this regeneration process is adopted by the industry a major cause of environmental degradation is avoided.

Even a partially sulphated battery is bad for any application. Increased internal resistance of a battery increases energy losses by square of the charging/discharging currents, is a dormant burden. Identifying and treating a sulphated battery at an early stage is ideal and promises a much longer battery life.

An individual sick battery in a battery bank infects other batteries in a battery bank by interfering in the charge discharge cycle. Timely identification of the sick cell is the key to avoid a complete shutdown and a hectic decision to replace the entire set. While battery suppliers limit their scope to the warranty clause and UPS or charger vendors do not generally cover the battery in AMC. Routine battery maintenance ensures a much longer service life. Like an old saying, “stich in time, saves nine”.

Prevention is a good cure

- Use of battery management systems to keep a watch on battery cell performance under charge

and discharge cycles. Battery end cell voltage and Temperature parameters are logged. Minute changes in the battery behaviour are logged or reported. Alarm Thresholds are user defined.

- Do not install batteries in high temperature environment.
- While installing a new battery set, do at least two charge – discharge cycles. Ensure individual cell voltages in the Battery Bank remains within 0.05 volt during charge and discharge cycles. Ensure that cells belong to the same batch of manufacture and have same IR.
- Give cooling delay between charge and discharge tests. Ensure full battery capacity recovery. Monitor temperature of individual cells. A heated cell/battery indicates higher IR.
- Repeat a full charge – discharge – charge cycle every six months followed. Find out cells that are differing from their original voltage levels.
- Plan for a scheduled battery test and locate the weaker cell for treatment.
- Using the battery beyond its discharge rating has a damaging effect, with temperature rising square times the discharge current.
- In solar, high temperature, applications use only flooded tubular batteries. They can last up to 20 years if maintained well.

A few applications which heavily depend upon battery

Fork Lifts

Fork lifts run purely on battery power, it's a cyclic application i.e. the batteries have on an average a 24-hour charge/discharge cycle and are highly investment intensive. Average battery life recovered from a given battery set is 3 years against a design life of over 12 years. Batteries often remain idle for a long time and suffer misuse. Timely corrective intervention can increase its life. A typical 48V, 300 Ah battery bank costs Rs. 1 lakh if replaced after three years the service life vs capital cost is Rs. 33,000.00 per annum. Assuming that the regeneration process is adopted by the user @ 35 per cent of the capital cost and achieved 5 years' service life. Thus, the service life vs capital cost comes to Rs. 27,000.00 or less, add interest on the postponed repurchase capital investment, is a win-win case. A long-term approach to battery health management simply prevents investment pressure and generation of hazardous waste.

Telecom

Battery regeneration is akin to health insurance for humans. Early detection and or prevention saves cost saves life. Service industries carrying performance pressure need to be convinced about the need for a proactive preventive maintenance for the batteries. It is wrong to assume that the maintenance free batteries need no maintenance. Scientific studies suggest otherwise.

UPS Systems

UPS is a typical service critical item, installed by various users in various environments. It is a known fact that batteries installed in air-conditioned environments last longer and as much as 8 years, and even this can be extended as under cooler environs, the battery aging process is slowed down. Batteries are not dehydrated. If subjected to routine maintenance can lead to meeting its design life of 10 years.

Design Life

Battery life also needs to be viewed in terms of its design life and is often proportional to the warranty period offered by the manufacturer. Ni-Cd batteries are known for their long service life, but not in a maintenance-free regime. If maintained well, one can expect service life of more than 20 years. Similarly lead acid flooded tubular 2V cells bear a design life of 20 years, and sealed lead acid maintenance free batteries 8 -10 years.

Battery chemistry is extremely sensitive to changes in temperature, humidity, discharge derating and charging voltage and current limitations. Other than end cell voltage, internal resistance of the battery is the key indicator of its health and it varies with temperature and charge conditions. A new battery has IR or the order of a few milliohm where as an old sulphated battery have IR greater than 30 milli-ohm. Higher IR means higher losses and greater chances of battery failure.

Case Studies

A number of case studies indicate that the batteries, lifted from the junkyard were treated for de-sulphation and fitted back into the same application. De-sulphation is not a new idea. Researchers all over the world were working on discovering the most efficient ways to de-sulphate the battery for the past 50 years. Now that some international companies have commercialised and patented their technologies, the idea of battery life extension is gathering acceptability.

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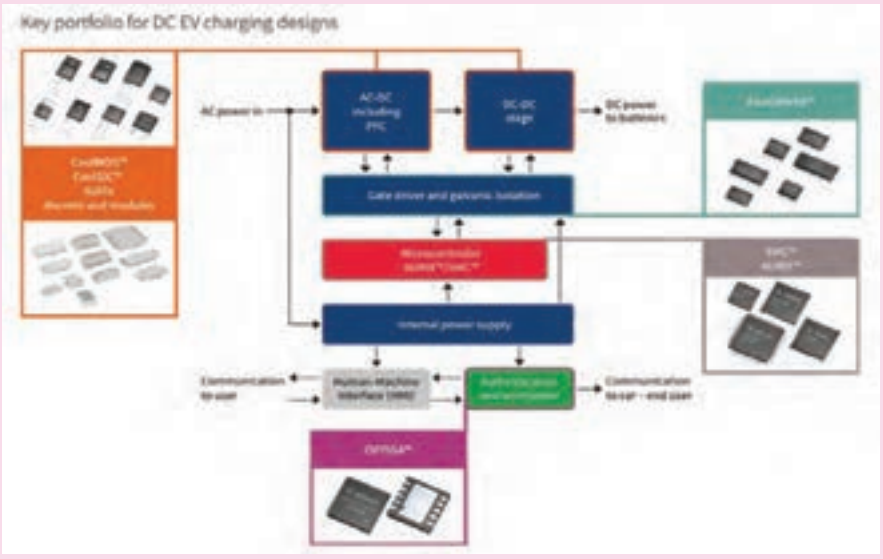
Fast EV Charging

As fast charging and battery technologies continue to evolve and improve in the near future, experts anticipate the charging time to drop even further.

As e-mobility increasingly becomes part of daily life, there is a growing need for more efficient charging solutions. Fast electric vehicle (EV) charging stations equipped with powerful DC chargers are currently the answer. DC EV chargers are an attractive choice because they allow much faster charging than the standard AC EV ones that many EV owners have at home. Today, a DC charger with 150 kW, can put a 200 km charge on an EV in around just 15 minutes. As fast charging and battery technologies continue to evolve and improve in the near future, experts anticipate the charging time to drop even further.

The Fast Charging Market

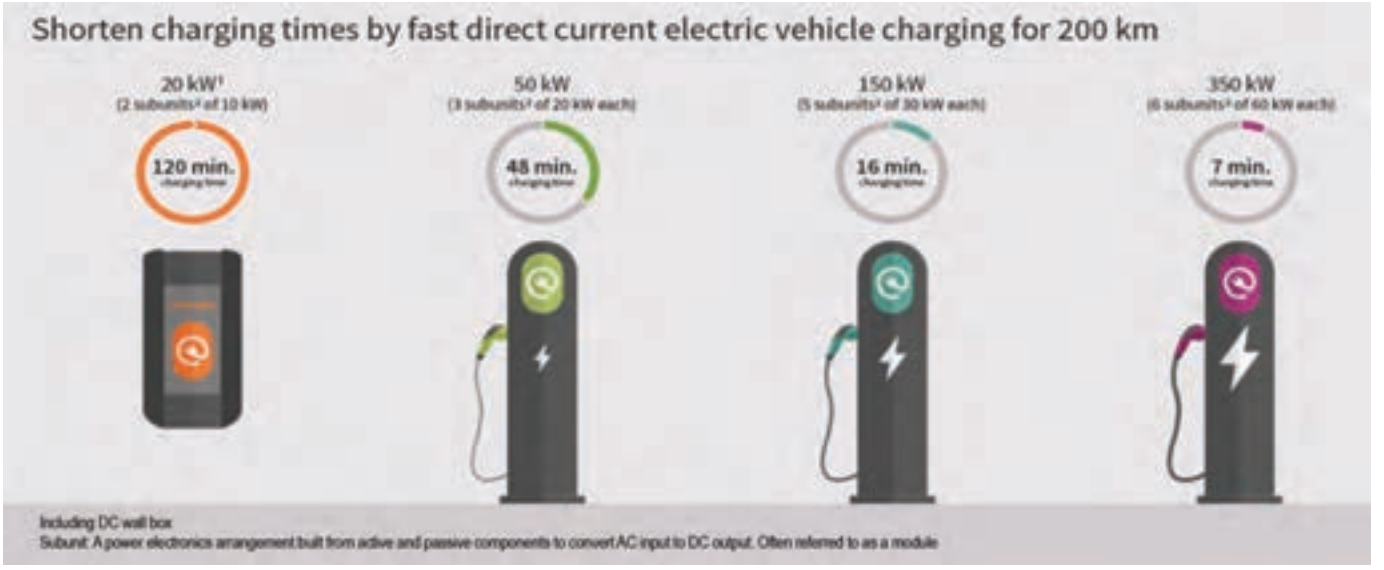
Some key driving forces are shaping and advancing the EV charging market



DC EV charging designs

today. One is stricter government regulation of CO2 emissions. The target to achieve zero emissions by 2050 in most major cities worldwide relies in part on greater EV usage and better fast charging infrastructure. Certainly, the high pollution index in cities, detrimental to inhabitants' health and quality of life, is a motivation to reach this target. Zero or low emission mobility can help stem the prevalence of air pollution related health problems, such as cardiovascular disease and asthma.

The good news: by 2025 over 100 new EVs are set to launch on the market. This step in the direction of improved urban air quality adds pressure to develop and implement the charging infrastructure required to accommodate additional EVs on the road. Finally, as battery manufacturers optimise their cost structures and economies of scale, EV battery costs are decreasing. The result: electric vehicles have never been more attractive to purchase.



Infineon's expertise, customers' benefits

With a one-stop shop of high-quality components and solutions, and complete application and technology know-how, Infineon enables its customers to overcome all fast EV charging design challenges. The company's broad portfolio covers power ranges from kilowatt to megawatt, and includes power semiconductors, microcontrollers, gate drivers and authentication solutions.

The full spectrum of complete EV charger solutions

As a market leader in power electronics, Infineon helps to bring energy-efficient DC fast charging designs to life. Its CoolMOS and CoolSiC MOSFETs are ideal in a wide range of DC EV fast charging designs. Their advantages include high frequency operation, high power density and reduced switching losses, allow you to reach high levels of efficiency in any battery charging system.

Fast DC charger architecture

Typically, a high-power DC charger design converts an incoming 3-phase AC supply, using an AC-DC and DC-DC convertor, to the DC voltage the vehicle being charged requires. A channel for data transfer is also included to provide information about the vehicle and the battery's charging status. Vehicle information and owner data are covered by one final element: a secure data channel for billing purposes.

The three primary concerns in DC fast charger architecture are how to minimize the cooling effort, deliver high power density, and reduce overall system size. High power density requires forced air cooling, a standard today. However, next generation charging solutions are exploring the potential of liquid cooling solutions. Compact designs must consider higher switching speeds, in the range of 32 to 100 kHz, to reduce the size of magnetic components.

Chargers from 50 kW to 350 kW

Currently, public charging stations provide power of up to 150 kW in a single installation. In a charging park, a medium voltage transformer from 10 kV to 30 kV is a key component. It uses high-power chargers with up to 350 kW output power each. In this arrangement, all chargers can provide full power simultaneously by using non-isolated topology in each charger.

When choosing the ideal power semiconductor, it is important to know the charger's power level. Ultimately, the selection of suitable devices depends on this factor. Chargers in a power range above 50 kW are commonly built using Infineon's IGBTs and CoolSiC MOSFETs and diode power modules, such as CoolSiC Easy Module, IGBT EconoPACK and the IGBT EconoDUAL family. With subunits from 50 kW to 100 kW, chargers with power ranges higher than 100 kW are built by stacking the subunits.

Infineon's high-quality portfolio of power switches seamlessly works with the Rectifier Diode module. All switches need a driver and all drivers need to be controlled. That is why we also offer the best-fit EiceDRIVER as well as XMC and AURIX microcontrollers for fast EV charging designs. EI

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Vishay ESTA - A Specialist and Market Leader in Power Capacitors

The major focus is on customer-specific high-power solutions and installations. With the latest trends in renewable energy and smart grids, power management requirements and applications are significantly changing. Low-voltage, high-voltage and power electronic capacitors are now more widely used. Vishay ESTA supports customer requirements with the focus on these products.

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Is India Ready for EV?

Indian government is encouraging commercial deployment of battery electric vehicles through the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India (FAME-II) scheme. Does this mean that the country is ready for the next automobile revolution?

Is India ready for EV (electrical vehicle) adoption? In order to answer this pertinent question, we only need to look around for tell-tale signs. Take Mr. Sanjay as an example. He has driven cabs for many years. He underwent the un-learning required to learn to drive an electric car – and is a proud driver for a leading EV-only cabs services company. Sanjay has accepted electric mobility as a source for his daily bread.

Hundreds of thousands of passengers alighting from the Metro stations in Delhi and Gurugram undertake their last mile mobility in electric powered solutions. At the policy and regulatory level, the Indian government has made its intent - to promote clean

mobility – very evident on multiple occasions. The entrepreneurial spirit of the nation has taken note of these developments and we, at Exicom, are proud to be able to not only witness, but also participate in, the rapidly changing landscape of electric mobility solutions.

All these signs, along with the focus on burgeoning pollution levels in the cities – do point towards the reality that India not only needs, but is also ready for electric mobility to take centre stage

Today, we are at the threshold of a paradigm shift in mobility that is going to be 'shared', 'connected' and 'cleaner'. Only time can tell how the Indian mobility landscape would look like in 5 years' time.

This mobility landscape will be dotted with xEVs (term used to refer to the broad spectrum of electric-enabled vehicles ranging from micro hybrids up till battery EVs) and the associated ecosystem. The term ecosystem is used in its widest sense – to encompass not only the spectrum of vehicles and the charging infrastructure, but also the technology-based enablers like app-based mobility solutions, seamless payment gateways, telematics, and IIoT-enabled solutions.

In terms of xEVs, Plug-in Hybrid Electric Vehicle (PHEV) being promoted by several automotive OEMs. In these vehicles, the traction battery can be charged by connecting the vehicles into a charging station. These vehicles (like BMW i3 Rex, Hyundai Ioniq PHEV, Toyota Prius PHV, BMW 330e etc.) also have a (smaller) conventional internal combustion engine. This category of EVs also includes Extended Range Electric Vehicle (EREV) where electric motor(s) power(s) the drivetrain/wheels. Once the battery reaches a certain pre-determined state of charge, the conventional engine kicks-in to charge the battery (example Chevrolet Volt). In recent times, the Government of India has been promoting such 'Strong' hybrids, as well as full Battery Electric Vehicles (BEVs).

In India, the BEV space in passenger cars segment has been populated by Mahindra Electric's e-Verito, e20Tata Motor's e-Tigor. Based on currently available technology under mass production, a simple cost benefit

analysis brings up the fact that BEVs - not only make environmental sense - but under the right ecosystem and running conditions – make commercial sense as well. Exicom is enabling such an ecosystem in India. They are also the end beneficiaries as most of their intra-offices commute has shifted to BEVs – serviced by a promising start-up providing only clean mobility solutions.

The Government of India too has encouraged commercial deployment of BEVs as can be seen in the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India (FAME-II) scheme. Several state governments have concretised plans to allow and deploy mass mobility and goods delivery solutions driven by electric motive force. We are very excited about the traction that the technology is seeing in recent times – and are working very hard and round the clock to design, develop, and deploy solutions per the speed of demand!

2019-20 is expected to be the year when electric mobility takes much deeper roots in our society – not just in the metros – but in the hinterlands as well. If one studies the growth story of one of the earliest movers in battery electric two wheelers in India, around 90% of their sales is in towns and villages and not metros.

While the global EV market is rapidly gaining momentum towards the target set by Electric Vehicle Initiative (EVI) of global deployment of 20 million EVs by 2020, EVs in India are beginning to gain traction. While the government's positive push (in form of demand incentives like subsidies) is seen as a move that will help jump-start the EV ecosystem across the country, it is our belief that the unit economics for the right use cases have already started making commercial sense. Several state governments have realised this potential and have released final and draft versions of their respective EV (and related) policies. 12 states have also introduced separate electricity tariff for EV charging. With these actions, the government's ambitious plan to introduce 6-7 million EVs by 2022 does not seem unachievable. Ministry of Power too has taken cognizance of the need for public charging infrastructure and released a forward-looking policy in 2018 (December). The government has already de-licensed the setting up of public charging stations. Sustainable business models for running charging stations are evolving almost daily. It is also considering reducing registration fees and other taxes on EVs which will further improve the economics for those already planning to go electric.

The government is rightly pushing for a full transition of three-wheelers, and the sub-150 cc scooters and motorcycles to electric by 2023 and 2025 respectively. The Town and Country Planning Organization, Ministry of Housing, and Ministry of Urban Affairs have released amendments to Model Building By-Laws (MBBL) to provide for EV charging infrastructure for residential and other buildings (including group housing buildings).

According to these amendments, any charging station installed at a public or private area or building premises of any category that caters to the commercial mode of charging of EVs will be considered as a "Public Charging Station."

Conclusion

India has the right talent, a promising consumer base that is pro-clean mobility, and now the rightly demonstrated regulatory commitment – a concoction that will drive the industry to solve specific mobility needs that are best solved by EVs.

Priyank Agarwal,
VP – Strategy and Business Development (Mobility), Exicom Tele-Systems Ltd

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TÜV SÜD EYES EXPANSION IN INDIA

We intend to expand our team and support in India to increase our reach to domestic as well as to international customers. We will also continue investing in manpower, new labs and testing facilities in India.
- Bratin Roy, VP, Industry Service, TÜV SÜD South Asia, Southeast Asia, Middle East, and Africa Region

India is already a competency centre for Germany's TÜV SÜD group for advisory and critical inspection services related to power and oil and gas sector. Now the company plans to increase its footprint in the country, informs Bratin Roy in an exclusive interview with Subhajit Roy. Excerpts:

TÜV SÜD is a leading German training, inspection, consultancy, testing and certification company having significant presence in India. What's your comment on the 'Made in India' power and electrical products in terms of performance and reliability?

Owing to competition with the global market players, it is imperative to say that performance and reliability will be two extremely critical aspects for Indian manufacturers of power and electrical products. Indian Electrical Equipment Industry Mission Plan (2012-22) aims to make India a preferred country for production of electrical equipment. If we look at some interesting statistics, only the domestic demand for generation equipment industry is expected to be in the range of US $25-30 billion. If we include transmission and distribution industry, it is estimated to go up to US $70-75 billion. In addition, there is an incentive in capacity addition, be it conventional or renewable power, and 'Make in India' push will be extremely crucial to achieve this goal. Having said that, we should be aware that power sector

is highly capital-intensive and any disturbance in equipment and products can create massive problems for generation companies, utilities and investors.

Why is it essential for companies to have compliance with international standards?

It's important for companies to comply with international standards mainly because of two reasons. Firstly, our domestic standards are in tandem with international standards in terms of requirements and obligations. Secondly, if these companies want to become global players in this segment, they must upgrade and comply with international standards for production, quality control and quality assurance.

How do you help companies in raising their competitiveness?

Competitiveness can only improve when you have skilled manpower and efficient production and support system. We have a large pool of human resources and adequate workforce available for the sector. It's extremely important for companies to upgrade the skills of their workforce, if they want to gain a competitive edge. We provide specialised need-based trainings to fulfil this requirement. Also, our experts provide services like inspection, testing and witnessing critical testing which will help companies to achieve zero defect and cost-effective production process.

Brief us on the services you provide.

TÜV SÜD South Asia is the leading consulting, testing, inspection and certification (TIC) company with presence across India and Bangladesh. It is present at 33 locations including 14 labs across two countries. For process and manufacturing industry, we provide inspection, certification, machinery assessment, supply chain services, energy efficiency audit, water audit and non-destructive testing (NDT) services. Also, for the investors, we offer technical feasibility, technical due diligence, environment and social due diligence services which helps them to

understand and mitigate risk. We conduct product testing for food and beverages, cosmetics, leather and textile, toys, utensils, jewellery, medical health devices and others. Our laboratories are accredited by national as well as international accreditation schemes which can help companies to achieve product conformity as per domestic and international market requirements. Our management system certification team helps companies to achieve the required system adherence as per various standards of quality, environment and safety.

In India, as the renewable energy has gained momentum, how do you see the testing and certifications business evolving?

Since the beginning, we are quite involved in renewable energy sector in India, especially in solar and wind sectors. For sure, role of third-party testing, inspection and certification companies like us have also evolved over a period of time. We initially started with testing and certification of the components and critical parts and have now evolved as a complete life-cycle service provider. Need for involvement of an independent company like us is gaining prime importance to ensure project reliability, safety and certainty. Slowly but appropriately, our business offerings have graduated from component reliability to holistic project reliability.

What kind of training services does the company offer?

Our training programmes address critical business issues and improve company's performance while gaining new skills and knowledge. Through effective and targeted training, individuals and organisations are better equipped to handle exciting challenges ahead.

TÜV SÜD's e-learning programmes are cost-optimised and interactive to engage participants while learning about relevant standards. With the ability to easily monitor the progress of employees worldwide, TÜV SÜD's Digital Academy can contextualise training solutions according to your business needs. We can also customise existing course content or develop new courses based on your training needs.

TÜV SÜD's instructor-led training programmes are developed by experts with years of experience and in-depth knowledge of relevant standards, providing an opportunity to interact and discuss ideas and industry issues with the experts first-hand. By helping individuals and organisations drive business performance, our training programmes cover the entire gamut of safety and security aspects in accordance to the relevant norms and standards.

How automation can play a pivotal role in optimising power plant performance?

Automation plays a very pivotal role in the power sector. It not only helps in power plant performance optimisation but also lends an overall reliability to the entire power plant network, starting right from generation to end-to-end transmission and distribution. Important benefits of automation, if implemented successfully are many! It helps to improve quality of service, reduce manpower requirements and improve reliability with minimal maintenance and operating costs. It will also help owners and operators to make informed decisions on shut down, maintenance, turnaround time and will help to fetch accurate and reliable information based on proven analytics and prediction. On the planning side, automation will improve enterprise information accessibility which will enable decision makers to take correct and early steps. On the distribution side, automation will help to reduce overall cost of operation for distribution network, improve service reliability and quality and enhance consumer service.

What's your roadmap for the Indian market?

Developing new value-added services by offering solutions for rapid, sustainable, and efficient growth in power, oil and gas and related sectors is a clear roadmap for us for the future. We intend to work for entrepreneurs, business leaders, investors, owners, operators, manufacturers and government as a holistic one-stop-solution provider. We will help these stakeholders achieve profitable growth, assist them in solving a wide set of challenges which they may face during operation and help them secure their investment by offering our complete due diligence and project management services. India is already a competency centre for our group for advisory and critical inspection services related to power and oil and gas sector. We intend to expand our team and support in India to increase our reach to domestic as well as to international customers. We will also continue investing in manpower, new labs and testing facilities in India. Our recent investment related to advanced NDT and material testing lab is already under operation now and we intend to do further investment in this sector in coming 3-5 years, focusing heavily on services related to digitalisation, inspection and testing.

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Robust electrical and automation systems are the backbone of economic growth and social progress. Your industrial unit must be safeguarded against inconvenient, unwanted breakdowns, while maintaining productivity and efficiency of a high order. This can be done through monitoring, modernisation and upgrade.

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TRANSMISSION SECTOR ON THE MOVE

The article focuses on growth drivers of the transmission sector that is witnessing the upward trajectory movement.

The transmission network in India has grown significantly over the past few years driven by the need to support the growing load and provide connectivity to generation projects. India's power transmission segment is growing mainly due to the thrust provided by the recent policy and regulatory development, as well as government initiatives. Between 2012-13 and 2018-19, the transmission line length grew at a compounded annual growth rate of over 7.5 per cent and substation capacity grew at about 11.8 per cent. The pace of expansion is expected to continue in the

future to meet the government's renewable energy targets and 24x7 power for all consumers. A conductive policy framework has helped the transmission sector to develop consistently at a significant growth rate. The growth is likely to continue over the next few years to meet future peak load, which is expected to reach 235 GW by 2021-22. Further, significant renewable energy capacity is likely to be added in the next few years against the backdrop of the government's 175 GW by 2022 target.

The renewable energy characterised by variability and uncertainty and a short gestation period. Hence, aside from a robust transmission network, major investments will need to be made to address intermittency or variability in the system through renewable energy management centers. The power transmission segment is currently the most attractive infrastructure investment in India. The key drives will be increasing demand for power, addition of generation capacity including renewable, and new technology adoption for grid modernisation, as well as the need to reduce congestion and enable free flow of power regions. At the intra-state level, the key focus is on upgradation and modernisation of existing networks to cater to the increasing demand since not much network can be added owing to right-of-way issues.

As per National Electricity Plan, 2016- Transmission, a line length addition of 105,580 circuit kilometer and substation capacity addition of 292,000 MVA have been envisaged during thirteen plan period. Corresponding to the addition of lines, a major part of the investment will be on the erection of towers. On an average towers account for more than 35 to 40 per cent of the cost involved in the construction of transmission line. Along with their foundations, the towers constitute almost half the cost involved in the construction of transmission line. Therefore, market opportunities for technology providers and transmission tower players are likely to grow significantly in the coming years.

With the increasing renewable energy generation, the grid is

expected to extend to far-flung areas. As the gestation period of renewable energy projects such as solar and wind is short, the associated transmission projects need to be completed at a fast pace in order to facilitate the evacuation of energy. This requires speedy development of transmission lines and towers using advanced technologies such as light detection and ranging for surveying drones for patrolling and helicopters for tower erection and stringing.

Key Drivers

Key drivers for development of transmission infrastructure in the country are as follows:

Renewable energy integration

An ongoing initiative for enabling the integration of large-scale renewable energy into the grid is that of the green energy corridors. Government has devised two schemes for the creation of highways for renewable power transmission, the green energy corridor I and green energy corridor II. Green energy corridor I comprises two systems, one starting from Gujarat, travelling Rajasthan and ending in Punjab, and the other in Tamil Nadu. These have been designed in the potential wind and solar rich areas. Green energy corridor II, on the other hand, focuses on tapping power from the ultra-mega solar parks in different states such as Andhra Pradesh, Madhya Pradesh, Karnatak, Rajasthan and Gujarat.

Under the green energy corridor projects, advance technologies or systems are also being implemented to maintain grid stability. SVCs and STATCOMs are used to improve power quality by ensuring stablised voltage levels and an enhanced power transfer capability of the transmission line. To further enhance stability and facilitate energy balancing and scheduling mechanism is being implemented at the renewable energy monitoring centers. The government has planned to build 11 renewable energy monitoring centers across the country, alongside the state load dispatch centers and an REMC at the national level. These would work in tandem with their state load centers or national load dispatch centers to enable smooth grid operations.

Cross-border links

Significant projects to strengthen the cross-border electricity exchange have also been executed in recent years and some are in the pipeline. In August' 2017, India and Nepal inaugurated two new transmission lines for higher levels of electricity transfer. These will add 100 MW to the 350 MW power that India already supplies to Nepal. Keeping in view the number of hydro power projects in the pipeline, India is planning high capacity east-west transmission corridors in Nepal and would connect the projects located in Nepal to the load centers in India. India has also planned several interconnections with Bangladesh, including the second Baharampur-Bheramara interconnection. In addition, the two countries have signed MoU for the supply of 1600 MW through dedicated high voltage direct current transmission lines. The country is also implementing several interconnections with Bhutan. These cross-border links will drive the growth of transmission infrastructure in India.

Rail electrification

Another key growth driver for transmission expansion is expected to be the electrification of railways. Indian Railways unveiled its Railways Mission 41k initiative in January 2017 with the objective of saving Rs 41,000 crore over the next 10 years through an integrated energy management system. Under this, 38,000 route km of rail track will be electrified between 2017-18 and 2021-22, to ensure 100 per cent electrification of its broad-gauge rail routes. In order to meet its targets, it is focusing on the setting up of transmission lines, sub-stations and transformers. Around 8,000 km of transmission lines will be needed by Indian Railways to provide reliable and secure supply for the Golden Quadrilateral in the first phase. This is expected to fuel growth in the transmission segment, as well as create huge opportunities for transmission equipment manufacturers in the country.

Smart grid and electric vehicles

Another key area for transmission infrastructure expansion would be smart grid. An initiative to make the transmission grid smarter has been the Unified Real Time Dynamic State Measurement project, which is being implemented by Powergrid. Further, with the increasing penetration of electric vehicles in the grid over the next few years on the back of the government's ambitious plans to move to an all-electric fleet, the Indian grid will experience some serious challenges due to electric vehicle charging. These are increase in harmonics, line losses and increased reactive power consumption, among others, which could potentially impact power system equipment and create voltage stability issues. This would necessitate investments in grid monitoring and automation, besides investment in reactive power compensation capabilities, which would prevent overloading of

the grid. The government is also planning to provide several incentives and regulatory framework to promote e-vehicles in the country.

Private sector participation

Promoting competition in electricity sector is one of the aims of the Electricity Act, 2003. In the spirit of encouraging competition, various reform measures have been initiated by the Central and State Governments. Ministry of Power came out with competitive bidding guidelines were put in place for enabling competition in power transmission to enable private sector investments in the sector which allowed price discovery through market-based mechanism. This ensured that private transmission companies are allowed equal platform and opportunity to access the market as the public companies but most importantly it ensured competitive prices to benefit both, the consumers and the market. The initiatives undertaken by the Government of India and various states have led to competition in power transmission. India is one of the few countries where Transmission Sector has been opened up for private participation and has garnered significant interest from private players. However, the spirit of competition and private participation in the Indian electricity transmission sector is still in the nascent stages. With the huge generation capacity addition and improved generation with fuel issues getting sorted out for existing capacity, a corresponding increase in transmission capacity is needed to ensure that power generated reaches the end consumer. Major part of the total investment required has to come from private sector. Clearly, successful PPP in transmission would be vital to meet the huge investment and capacity enhancement target in transmission.

Challenges

Despite having more than 350 GW of installed generation capacity, some of the states in the country continuously facing power deficit. One of the major reasons for this situation is the inadequate transmission capacity, not matching the generation capacities and load requirements. Power evacuation is turning out to be a bigger

problem than power generation for the country. Plants supplying electricity to state electricity boards under long term power purchase agreements, lost part of generation due to transmission capacity bottlenecks. The Southern region is anticipated to face a peak-time shortage, whether other regions anticipated surplus power. However, the power transmission constraints do not allow met shortfall by the surplus power. Resource rich states like Chhattisgarh are also unable to evacuate the excess power. With a typical transmission project requiring ~4-5 years to get commissioned and inordinate delays expected in securing forest clearance in the region, it seems that the number of projects running below capacity, owing to transmission bottlenecks, will only increase in the near future.

Several issues are need to be resolved to ensure that the grid expansion plans are on track. Securing right of way remains a pressing concern for both private and public project developers, with varying policies and regulations being adopted by different states. Environmental and forest clearances continue to remain the leading challenges in project development. Further, large-scale capacity addition and connection of millions of new consumers to the grid require robust grid planning and empowering system operators and regulators to ensure the effective implementation of relevant policies and regulations.

Many transmission projects have faced delays because of the developer's inability to acquire land and get timely clearances from all stakeholders. There have been instances of transmission lines being forced to take a different route than planned, resulting in the entire project budget going out of control. Power transmission constraints have also made it difficult to evacuate excess power and channel it to regions that face shortages. Projects have had to purchase power from costlier sources while others remained under-utilised. Hence, there is an urgent need to timely address underlying issues in the transmission sector to ensure power demand is effectively met in the future.

Key issues faced by transmission project developers include delay in land acquisition as well as obtaining right-of-way and environmental clearances. Inadequate investments at the intra-state level, which are restricting the flow of power from surplus to deficit areas, and the ineffective implementation of open access transactions, also pose serious challenges for the transmission segment. There is an urgent need to create liquidity in the market to sustain private interest. State utilities also need to ensure payment security to make their projects as viable as the central level projects. With the shift to higher voltages and improved technologies, new challenges such as asset management hotline maintenance, emergency restoration of towers, augmentation of test facilities and transportation of heavy equipment's via roads also need to be addressed.

Way forward

The transmission grid has expanded at a fast pace in the past few years. Despite significant growth, the transmission segment continues to be plagued by certain issues and challenges such as Right-of-Way transmission congestion and inadequate investment in the sub-transmission networks. Notwithstanding these issues, the utilities investment plans for the next few years indicate significant network additions, and hence, more opportunities for transmission tower and equipment market players. The uptake of modern technologies is also expected to increase as there is greater pressure to deliver transmission projects within strict timelines, lower implementation of risks and optimise costs. Since RoW is the key challenge facing the transmission segment, utilities are increasingly deploying double and multi-circuit lines instead of single-circuit lines in order to minimise their RoW requirement. Utilities are focusing on adopting higher voltage levels, specially designed towers and new technologies to gradually increase the power carrying capacity of transmission to optimise RoW. In addition, tower designers are designing compact towers that need less space. New tower designs are coming up that use less steel, have fewer sections and bends, and are easy to transport and assemble. Insulated cross arms are also being used to reduce both the height and width of towers.

Constructing tower foundations is a challenging task, given the risks posed by geology. The importance of selecting the most suited foundation for towers increases as the transmission network continues to expand across varied terrain. The increasing loads from lines that carry higher voltages also require bigger and heavier tower foundations. Given these diverse requirements, it is importance to focus on building appropriate and robust tower foundations.

Significant advancements have been made in tower designs and foundations to meet the transmission

infrastructure requirements. These have helped in the expansion of the transmission network at a faster pace and in a cost-effective manner. However, for best results, it is essential to identify the right technology solution for a given transmission project taking into accounts the project terrain and RoW requirements, among other things. It is necessary to choose the best-suited tower installation technique that minimise costs and ensure maximum reliability. Tower structures that can be installed using helicopters are becoming popular, especially, at inaccessible locations.

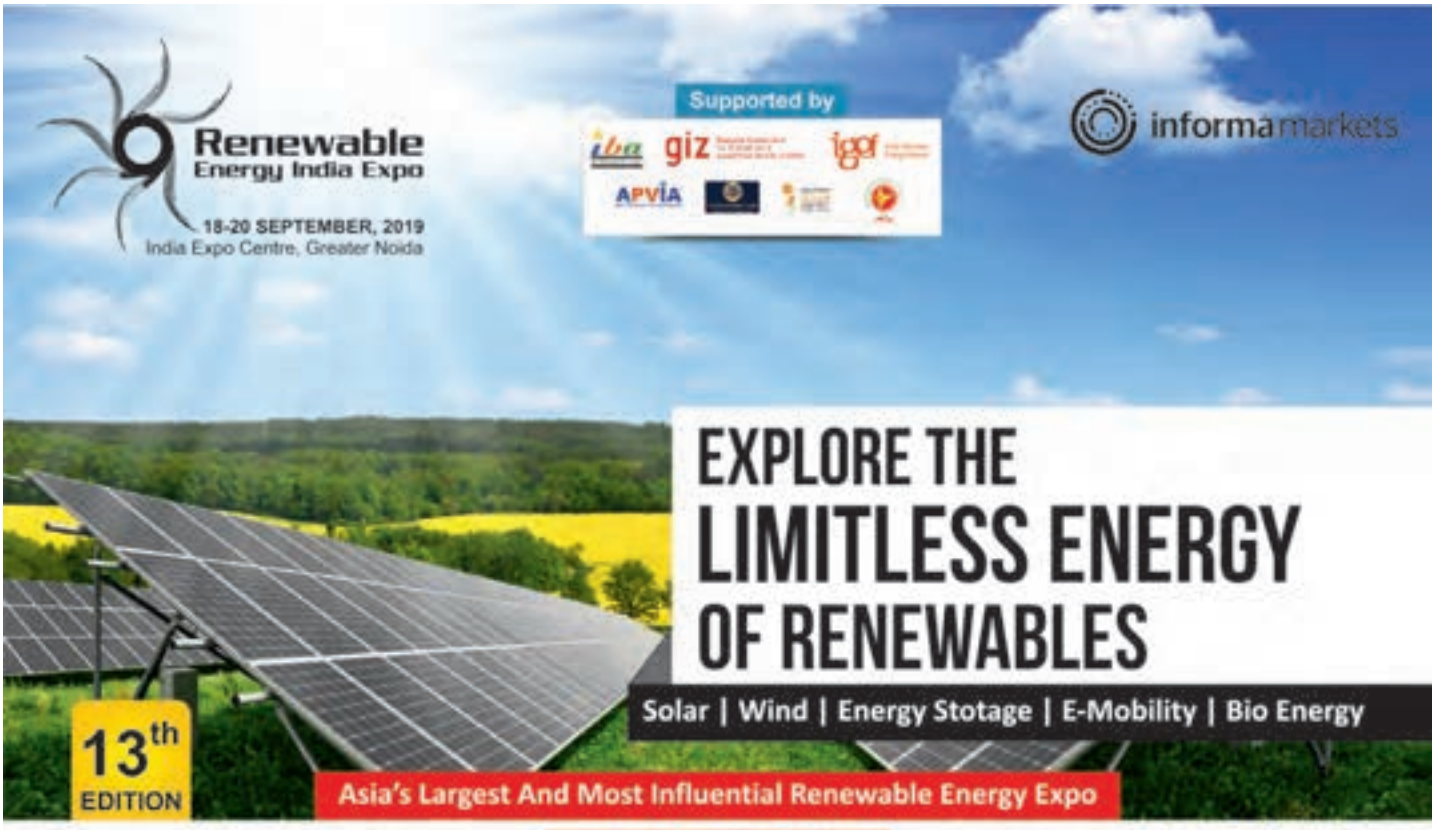
Even within a state boundary, choked transmission networks are leading to underutilisation of generation capacity. Wind energy generation in Tamil Nadu run below capacity, as the transmission capacity available was insufficient. In addition, the state had a net deficit of electricity and had to purchase power from costlier sources. Going forward, the demand side capacity is expected to further increase with the industry moving towards Open Access. Open access will allow every end-user of electricity in the country to choose from all available transmission lines, thereby, increasing transmission load across the country.

Conclusion

The transmission segment should continue growing at this pace in order to meet the government's renewable energy target and 24x7 power for all. This will also guarantee that a strong and reliable backbone grid is ready to support the shift in generation mix and distribution loads. Central and private sector transmission utilities have started adopting global practices for the development of transmission line projects. The state transmission utilities also need to align their approach with international standards as the pressure on the intra-state and inter-state transmission system is expected to increase in the coming years with the growing renewable energy integration and increasing medium or short-term flow of power through the grid. The transmission segment is expected to witness a paradigm shift in terms of how projects are planned and executed in the next few years. EI

Ashok Upadhyay

Dy. Director (Generation), M.P. Electricity Regulatory Commission Bhopal (M.P.)



KEY HIGHLIGHTS

- Participation from 45+ countries
- 40,000 sq. mtrs. of Business Space
- Multiple Conference Sessions
- Business Matching
- Training Zone
- Sunrisers Pavilion
- World of Innovation
- Multiple Workshops
- Country Seminars
- Indian State Seminars
- CEO Conclave/ CTO Conclave
- Finance Leadership Forum

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Vesat Solar harnessing sun energy for various applications

Vesat Solar Energy Systems is promoted by passionate technocrats with cutting-edge technologies in solar energy that covers domestic and industrial electricity needs, water heating systems and tailor-made turnkey projects. The company is an ISO 9001:2008 certified and is in the business of harnessing the solar energy for various applications for the past three decades with clients across educational institutions, hospitals, hotels, SMEs and other major establishments.

Vesat Solar Ongrid Power Plant

Vesat's Solar Power Plant covers the electricity needs of the complete industry. The plant mounted on the rooftop generates electricity in the day. Solar power generated can be utilised directly for daily purposes. In case, the load is more, then shortage of power is drawn from the electricity board. When the load is less and solar power is more, the excess electricity is transferred to the electricity board through a meter. Electricity import from the electricity board meter during the night and rainy day is metered and charged as usual. Investment on the Ongrid Solar Power Plant is repaid by saving of power in four years' time. The industry can also claim accelerated depreciation upto 40 per cent on the first year itself. Solar panels of the plant are warranted for 25 years and the solar inverters for 20 years.

Vesat Solar Water Heating System

Vesat's Solar Water Heating Systems are suitable for the industrial process heat requirements and canteens for the boiler pre-heater water requirements. It can be used to fulfil all hot water needs especially for bathing requirements. Hot water upto 90C can be provided through solar water heaters for process heat and boiler feed applications in the industry and canteens. This saves huge electricity or diesel or LPG cost and the investment on solar water heater can be repaid by saving of the fuel cost in less than two years. Life expectancy of the solar water heater is more than 25 years.

Email: sales@vesatsolar.com

Newtronics gets Rajasthan Green Leadership Award 2019

Newtronics Green Energy, one of the leading solar solution firm, bagged Rajasthan Green Future Leadership award 2019 The Rajasthan Green Future Leadership award recognises leaders who add valuable contribution and make a tangible difference in sustaining the growth of the solar energy sector. Newtronics received this award on the basis of its contribution towards the solar energy sector and customised solar rooftop solutions, solar EPC, solar LED street lighting systems and solar petrol pump etc.

The program was graced by founder of World CSR Congress and many of top industrial players and NGOs. The criteria adopted for this award is:

- Environment strategist and change manager
- Incorporating ethical values
- Develops responsible leaders
- Involvement in communities and protection of the environment
- Strategic perspective and building collaborate relationships
- Reduces electricity bills
- Strategic perspective and building collaborate relationships
- Effective and sustainable mobilisation of resources in support of programme and project work
- Demonstration of efficient management of financial and human resources, good governance practices, transparency, accountability.

Newtronics Green Energy strives with the vision 'To build 'Green India' through harnessing solar radiation and achieve energy security for the country.

Kyoritsu's 3128 insulation testers

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

Kyoritsu range of insulation testers features more than 20 diverse models, with test voltages ranging from 15V to 12KV, and analogue or digital indicators. Battery-powered, compact and user-friendly, each and every product is an industry standard today.

Kyoritsu's 3128 is defacto standard in 12KV insulation testing in this part of the world. The company's endeavour is to provide the best in testing of insulation resistance.

Key Features of 3128

- Microprocessor controlled high voltage insulation resistance tester with Diagnostic functions.
- Suitable for analysing the insulation characteristics of cables, transformers, motors, generators, high-pressure switches, insulators, wiring installations, etc.
- 6 ranges: 500V, 1000V, 2500V, 5000V, 10000V, 12000V
- Fine adjustment of voltage setting at each range is also possible
- Graphic representation of the insulation resistance and leakage current versus time on large display with bar graph and backlight.
- Can be operated from built-in rechargeable battery or from AC line.
- Automatic discharge after test with monitoring of the discharge voltage.
- Internal memory can store about 43,000 data (maximum).
- Robust design for field use with IP64 rating (with lid closed).

Additional features of 3128

- Insulation Resistance up to 35TΩ
- Short-Circuit Current up to Max 5.0mA
- Diagnosis Function of PI and DAR
- Voltage Measuring range DCV : ±30～ ±600V、ACV : 30 ～600V （50/60Hz）
- Current Measuring range: 5.00nA - 2.40mA (Depending on the insulation resistance)
- Capacitance Measuring range: 5.0nF ～ 50.0μF.
- Auto power off available
- Low battery warning indicates
- It comes Standard with a tough hard case
- Filter function reduces noise interference for obtaining stable measurement
- Live voltage warning
- Safety standard IEC 61010-1 CAT IV 600V pollution degree 2, IEC 61010-031, IEC 61326, IEC 60529.

Kyoritsu products are readily available in India and have complete service- and calibration- support set-up too.

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

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Thermography in Photovoltaic Plants

Photovoltaic systems are an important contribution to properly utilise the solar energy and ensure sustainable development. In recent years, they have been one of the greatest sources of power and electricity. But with great results there are some serious threats that tend to jeopardise the power output of the system. This makes the maintenance of the plants a significant aspect to tackle such threats concerning the functioning of a solar set up.

Testo Thermal Imagers for Photovoltaic system application

Potential threats to photovoltaic plants

Even a small technical defect is sufficient to have a considerably negative effect on the solar yield – and therefore the economic viability of a photovoltaic plant. The causes could be like; Carelessness during installation, degeneration of the laminates or slow damage due to years of UV radiation and weathering.

Some of the biggest problems that could be witnessed are:

Hotspots: Shadowed or defective module cells form an internal electrical resistance which can lead to undesired warming hotspot. Also, faulty or unsuitable bypass diodes (where shade is minimal) continue to lead to uncontrollable hotspots.

Delamination: The EVA protective layer may come away due to external influences. Any moisture getting in may lead to cell corrosion and to a performance loss.

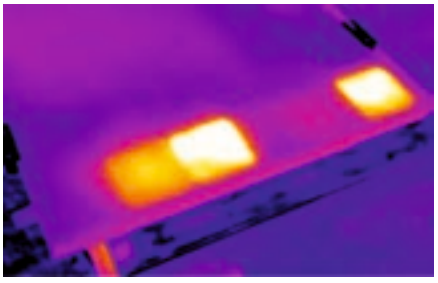
Modules run at open circuit: This may be caused by incorrectly connected modules or cables that have worn through.

Overheating of connection sockets: This can lead to poor operation of modules and typical faulty images for defective individual cells and substrings.

Micro-cracking & cell ruptures: It can occur during transport and installation or due to any external mechanical influences.

Corrosions & loose connections: Aside from the individual cells and modules, electrical components can also have corrosions on electrical components or have loose cables.

These threats consequently lead to decrease in the electricity yield. In few cases, individual cells or the entire module starts consuming electricity instead of generating it. This unwanted electricity consumption heats up the modules and can also lead to a real fire risk.



Thermal defects on solar panel

Revolutionary Tool for Easy Assistance – Testo Thermal Imagers

Checking photovoltaic plants using thermography places very high requirements on the use of a thermal imager. Several criteria must be taken into account when choosing a thermal imager suitable for this purpose:

Infrared resolution of the detector: The geometric resolution describes a thermal imager's capability of recognising objects (e.g. individual faulty modules) from a certain distance. An IR resolution of at least 320 X 240 pixels (76,800 measurement points) are recommended in the case of large PV systems and for measurements from a long distance.

Thermal resolution (NETD): The thermal resolution describes the capability of a thermal imager to detect temperature differences on an object surface. The lower the thermal resolution, the better the IR image generated.

Exchangeable lenses: In order to be able save time measuring large areas, e.g. from an elevated platform, imagers with exchangeable telephoto lenses should be selected that have suitable opening angles.

Camera functions: Includes various features and properties that enable the camera for easy handling and friendly usage such as; Rotating lenses for accurate positioning of imager, solar mode for ambient adjustment, radiometric video measurement etc.

Software: The analysis software (e.g. testo IR Soft) enables the optimisation and analysis of the thermal images, and ensures that the findings in the images are clearly presented and documented.

Bluetooth connectivity with other devices: Interfacing of thermal imagers with temperature, humidity probes and clamp-meter for solar power analysis.

Needs & Benefits of thermography

- Using thermography, it is possible to check whether the quality of the module cells fulfils the requirements or not.
- Incorrectly fitted or inadequately cooled electrical components that

can quickly pose a fire risk can be easily traced.
- Corroded or loose electrical cables indicating thermal irregularities can be easy detected and eliminated by thermography.
- Thermography is a very safe inspection method as it reduces the considerable risk of electric shock to personnel.
- Thermography is a non-contact, visual measurement method. Large-surface solar modules can be scanned very quickly thus saving a lot of time and money as well.

Step ahead in solar thermography with Testo Thermal Imagers

Thermal imagers from Testo are specially designed for solar thermography requirements. They allow solar engineers to offer their customers a valuable after-sales service, while plant operators obtain a reliable statement on the status of their solar plants.

Bluetooth connectivity with other devices

Solar thermography: Overview of applications and benefits

- Early identification of faults, avoidance of yield loss
- Increasing operational safety, prevention of fire danger
- Fast, safe inspections
- Detecting cell rupture, corroded and loose contacts and overheated connection sockets.
- Identification of hotspots, modules at open circuit, short circuits, delamination etc.
- Creation of added value for solar engineers and plant operators.

Practical application tips

- Measure in sunshine and at low outdoor temperatures
- Point the thermal imager correctly, bear reflections in mind
- If possible, measure on the rear
- Carefully analyse the causes of temperature deviations.

Selecting the right thermal imager

- Observe suitable geometric and thermal resolution for the application
- Imagers with exchangeable lenses and rotating display provide more flexibility
- Useful functions such as solar mode and video sequence recording, as well as versatile analysis software, simplify measurement and analysis.

For more details, visit www.testo.com or write to info@testo.in

New igus energy chain generation openable without tools

At the Hannover Messe, igus presented the E4Q, a lightweight e-chain for unsupported lengths and long travels.

Manually assembled in a matter of seconds: the new E4Q e-chain from igus for unsupported and long travels with a lightweight design and QuickLock crossbars

Inspired by nature, designed for the industry: this is the new E4Q energy chain from igus. The chain links of the e-chain have a smooth, contoured design and a completely new crossbar concept with locking straps for weight reduction. These ensure that the new series can be opened and closed in seconds without tools. The energy chain has been specifically developed for the special requirements of unsupported lengths and long travels. The first prototype was presented by igus at the Hannover Messe 2019.

High unsupported lengths and long travels with large fill weight create extreme stress on energy chains. The igus developers have designed the E4Q e-chain intended for such application scenarios. Based on the robust energy chain standard E4.1 from igus, the new series brings along a long service life and a high degree of modularity. In order to optimise material and therefore the weight of the energy chain, shapes inspired by nature are used. The smooth, contoured design can be found on the outside of the chain links as well as on the stop-dogs. Despite material recesses, the new development has a high strength and stability comparable to the E4.1 series.

Tool-free and quick installation with new crossbars

Another special feature of the E4Q are the crossbars. These can be opened and closed completely without tools. On the top of the crossbar, there are two hollows for the fingers, by which the locking hooks can be easily pulled up. Unlocked on both sides, the crossbar can be removed with little effort. This allows the easy opening and closing of the chain even in a guide trough and accelerates the filling of the e-chain by up to 40 per cent. Another advantage: The new crossbar has significantly higher pull-out forces than its counterparts in the locked state, thanks to its innovative type.

Optionally with new additional noise dampening

Due to the special design of the e-chain, this is very quiet in the movement. However, if the user desires additional noise reduction, igus has integrated an optional system in the inner horizontal stop-dog for the E4Q. These are two connected balls that dampen the impact during the radius and extension stop. The balls are made of a new noise-optimised and soft material that further reduces the sound level without restricting the stability of the stop-dogs. EI

For more details, visit www.igus.in

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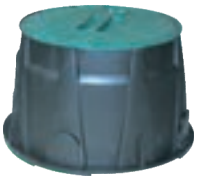

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Guardian Plus

Protection Solutions for HV Power Facilities

AUSTRALIAN MADE

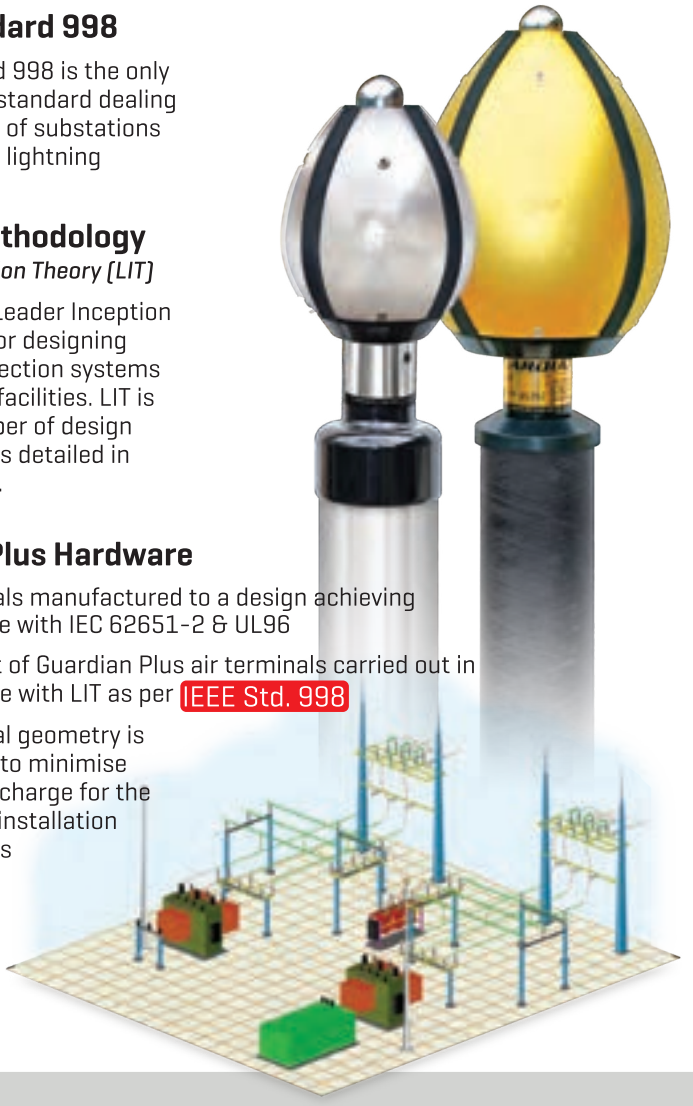
IEEE Standard 998

IEEE Standard 998 is the only international standard dealing with shielding of substations against direct lightning strikes.

Design Methodology

Leader Inception Theory (LIT)

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



Guardian Plus Hardware

- Air terminals manufactured to a design achieving compliance with IEC 62651-2 & UL96
- Placement of Guardian Plus air terminals carried out in accordance with LIT as per IEEE Std. 998
- Air terminal geometry is optimised to minimise corona discharge for the particular installation parameters

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