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From the Publisher's Desk

Decentralized Power Generation is a Necessity

Of late India has experienced several cyclones, when the power systems got badly affected, and there is no dearth of examples where it took more or less a week to restore the power supply. As far as the centralised power system is concerned, such situations not only pose challenges to the power distributors but also the power generation companies are affected by these unforeseen natural disasters.

Also, in this phase of COVID – 19 pandemic, manual collection of meter readings from all end-users' places is a big on-going challenge. Although we have started deploying smart meters in the country that will gradually eliminate the need for physical checking of the meters completely, it is still at the nascent stage.

In such circumstances, I realise the appropriateness of the concept of decentralised power generation. In fact, in a country of vast geographical expanse like India, decentralised power systems can truly offer some very tangible benefits. 'Small is beautiful', and particularly in this context, solving local problems locally will not only speed up the restoration work, stop unnecessary long-distance movement of technical personnel and help the growth of local economy through creation as well as boosting of the local employment. Of course, when I say decentralized power generation, I particularly emphasize on solar power generation, which will also mitigate air pollution.

In fact, towards the turn of the previous year, Svati Bhogle, President, CLEAN, a non-profit organisation committed to support, unify and grow the Decentralized Renewable Energy (DRE) sector in India, said, "With COVID-19 taking its toll on CLEAN Members, employment has dropped and so has investor interests. However, the potential and need for decentralized solutions has never been greater." I completely agree with this statement.

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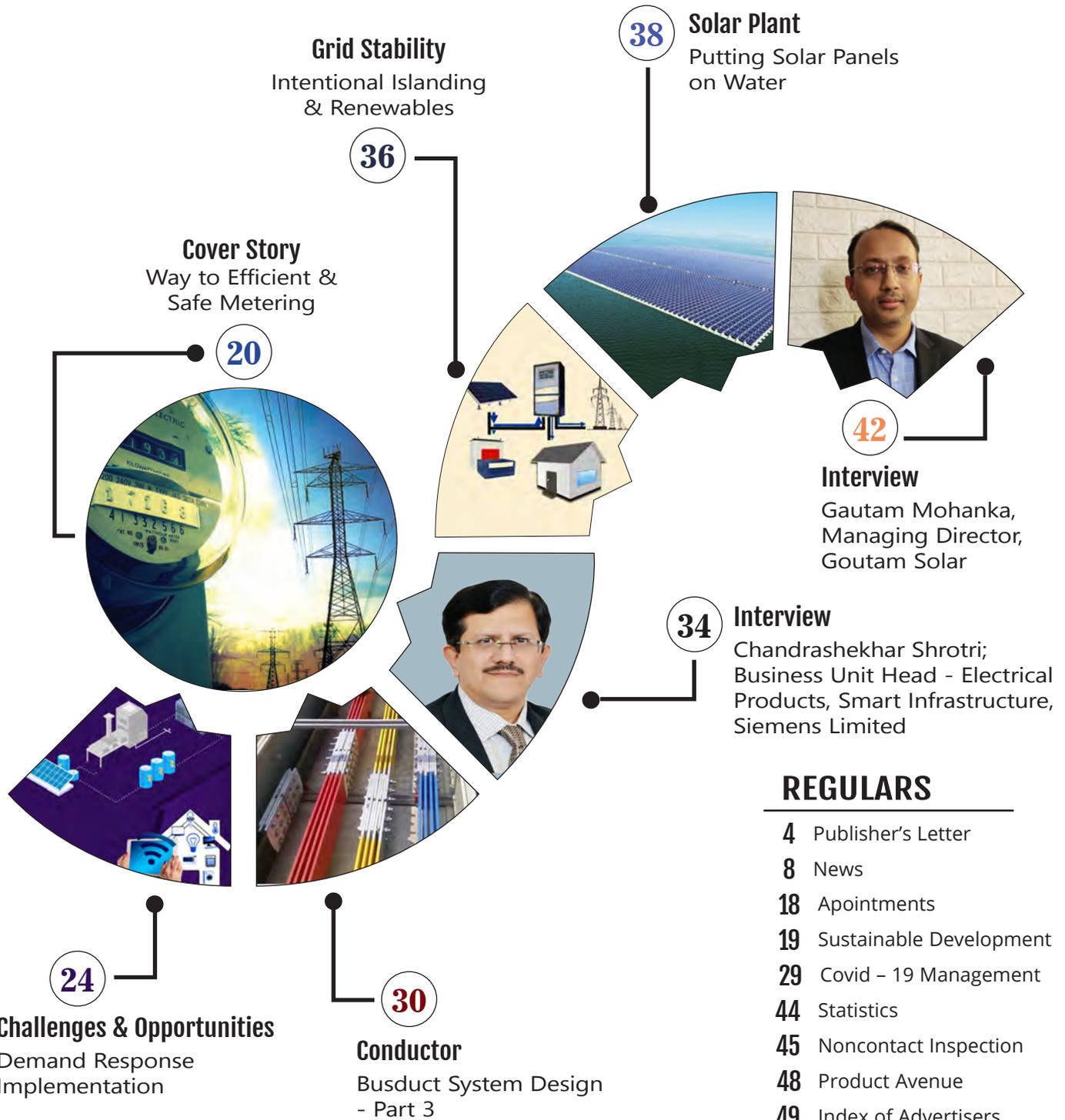


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NTPC MOUDA SETS EXAMPLE WITH ITS CSR INITIATIVE

NTPC, the Central Public Sector Undertaking under the MoP, in Mouda (Maharashtra) has helped over 150 villages in and around its operational area to overcome water crisis through ground water rejuvenation project. As part of its CSR initiative, NTPC Mouda is supporting the Jalyukta Shivar Yojana project, which has successfully managed to turn Mouda into a water-surplus tehsil. This project was carried out by the Maharashtra wing of Art of Living along with aid from few other organizations and the state government.

Earlier Mouda, was one of the most water-deficient tehsils in Nagpur. The project, which started in 2017 has covered more than 200 km in Mouda, Hingna and Kamptee tehsils. In the last around four years,



A comparison between the previous and the present situation at Mouda...

over 150 villages have benefited from it. NTPC Mouda had contributed 78 lakhs for the fuel charges of machinery and equipment involved. For a similar rejuvenation project of five ponds over an area of 1000 acres, an amount of 1 crore is also being provided by NTPC Mouda.

The 'Trap the rain where it falls' technique involves the creation of ponds and nullahs throughout the stretch of the river, so that rainwater can be held for a long period. Earlier, the rainwater would run off the ground, but now the water gets sufficient time to percolate deep into the ground. This has led to a massive increase in groundwater levels. Earlier, the farmers there were struggling for water, now the stored rainwater has come to their rescue.

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POWERGRID RECEIVES SRINAGAR-LEH TRANSMISSION SYSTEM FROM THE MINISTRY OF POWER

The J&K government gave approval to the State Power Development Department to sign an MoU with the PGCIL in this regard in 2016...

Ministry of Power, Government of India has transferred the prestigious 220 kV Srinagar-Drass-Kargil-Khalsi-Leh Transmission System to Power Grid Corporation of India Limited (POWERGRID), a Maharatna CPSU of Government of India. With its registered office at New Delhi and corporate centre at Gurugram, the company is operating under Ministry of Power as the Central Transmission Utility (CTU) of the country, responsible for planning, coordination and development of InterState Transmission system. The vision of the company is to be "World class, Integrated, Global Transmission Company with Dominant Leadership in Emerging Power Markets Ensuring Reliability, Safety and Economy".

The transmission system was dedicated to the nation by Prime Minister in February 2019, and it connects

the Ladakh region to the national grid, ensuring quality and reliable power supply. Built at a height of around 3000-4000 metres, this 335-km long transmission line traverses snow-bound difficult hilly terrain. It consists of four new state-of-the-art 220/66 kV Gas Insulated Sub-stations and 66 kV interconnection systems at Drass, Kargil, Khalsi and Leh.

The project was executed by POWERGRID on consultancy basis under Prime Minister's Reconstruction Plan (PMRP) Scheme. Subsequent to reorganisation of the erstwhile state of Jammu & Kashmir (J&K) into UTs of J&K and Ladakh, the 220 kV Srinagar-Leh Transmission System has been re-designated as Inter State Transmission System (ISTS) and transferred to POWERGRID with effect from 31.10.2019, the date of formation of the two UTs of J&K and Ladakh.

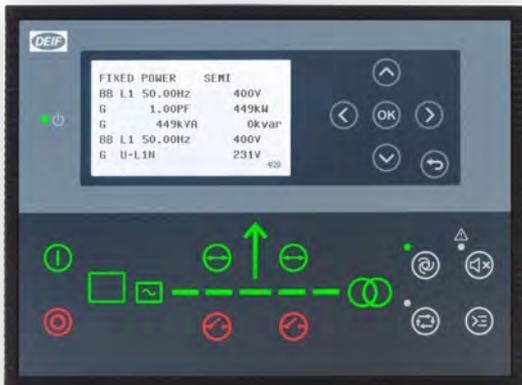
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IREDA RECEIVES 'GREEN URJA AWARD' FROM THE INDIAN CHAMBER OF COMMERCE

Indian Renewable Energy Development Agency Ltd. (IREDA) has been conferred with 'Green Urja Award', for being the leading public institution in financing institutions – for renewable energy development this year, by Indian Chamber of Commerce (ICC). The award was received by Pradip Kumar Das, Chairman & Managing Director (CMD), IREDA from Dr. Ajay Mathur, Director General, International Solar Alliance in presence of Anil Razdan, Chairman, ICC National Expert Committee on Energy in a virtual ceremony held recently.

IREDA gets the award for the pivotal and developmental role it plays in green energy financing. "The award recognises our immense contribution in development of Renewable Energy Sector in line with the Hon'ble Prime Minister's vision of Atma Nirbhar Bharat," said Das.



Pradip Kumar Das, CMD, IREDA receives the award...

IREDA under the administrative control of Ministry of New & Renewable Energy (MNRE) is the only dedicated institution for financing Renewable Energy (RE) & Energy Efficiency (EE) projects in India. Since its inception, the company has played a catalytic role in developing market for financing RE & EE projects. IREDA has over the years sanctioned loans aggregating to Rs. 96,601 crores, disbursed Rs. 63,492 crores and supported more than 17,586 MW of RE capacity in the country till date.

Despite pandemic time, IREDA has ended the year 2020-21 on a strong note and disbursed the second highest (since inception) amount of loan amounting to Rs. 8,827 crores. On this occasion, CMD, IREDA also highlighted the unique initiatives taken by it to contain COVID-19. E1

MOP'S NEW INITIATIVE TO REDUCE CARBON FOOTPRINT IN THE COUNTRY

The mission would have full time officers from CEA, NTPC, DVC and NLC or other participating organisations...

With a view to addressing the issue of air pollution due to farm stubble burning and to reduce carbon footprints of thermal power generation, Ministry of Power (MoP) has decided to set up a National Mission on use of biomass in coal based thermal power plants. This would further support the energy transition in the country and India's targets to move towards cleaner energy sources.

The "National Mission on use of biomass in thermal power plants" will have the following objectives: i) to increase the level of co-firing from present 5% to higher levels to have a larger share of carbon neutral power generation from the thermal power plants; ii) to take up R&D activity in boiler design to handle

the higher amount of silica, alkalis in the biomass pellets; iii) to facilitate overcoming the constraints in supply chain of bio mass pellets and agro- residue and its transport up to the power plants; iv) to consider regulatory issues in biomass co-firing.

It is being envisaged that the Mission would have a Steering Committee headed by the Secretary (Power) comprising all stakeholders including representatives from Ministry of Petroleum & Natural Gas, Ministry of New & Renewable Energy etc. The Executive Committee would be headed by the Member (Thermal), CEA. NTPC will play a larger role in providing logistics and infrastructure support in the proposed mission, whose duration will be minimum five years. E2



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GE TO SUPPLY 42 ONSHORE WIND TURBINES TO CLEANMAX

GE Renewable Energy will supply 42 units of 2.7-132 onshore wind turbines for the onshore wind hybrid projects to CleanMax totaling 110 MW. These wind farms will contribute significantly to India's commitment to harness the majority of its electricity from renewable sources – meeting its target of 175 GW of renewable energy (with 60 GW coming from wind) by 2022.

GE's 2.7-132 wind turbine is well suited to meet the needs of customers due to its efficiency in capitalizing on India's low wind speeds. These projects will leverage GE's significant local footprint in India with product design taking place primarily at GE's Technology Centre in Bengaluru, blades being manufactured in GE's plants in Vadodara and Bengaluru and assembly at the GE Multi-modal Manufacturing Facility in Pune.



A view of the GE's wind turbine in action...

Commenting on the business engagement, Gilan Sabatier, Regional Leader for GE Renewable Energy's Onshore Wind Business in South Asia and ASEAN, said, "This marks the beginning of what we hope will be a long-lasting partnership positioning GE Renewable Energy as a trusted renewable energy partner for companies and governments. It is a landmark project

that demonstrates what we can achieve with new economic models, and we are thrilled and thankful to have formed a new relationship with CleanMax." "We are delighted to partner with GE for the first deliveries of their new generation 2.7 MW wind turbines in India under our multi-year framework agreement with GE Renewable Energy," said Kuldeep Jain – Founder and Managing Director, CleanMax. 

HPL ELECTRIC AND POWER LTD SECURES BIG ORDER

HPL has been a major supplier of electrical equipment to the government infrastructure and private housing sector...

Recently, HPL Electric & Power Ltd., has bagged two orders worth over Rs. 372 crores for its switchgear, wires and other related accessories for housing projects in the state of Andhra Pradesh. This is a big step by the company to increase its presence in the low-cost affordable housing segment. The current total order book of the company stands at Rs. 700 crores.

Commenting on winning the orders Gautam Seth, Joint Managing Director, HPL Electric & Power, said, "This is a big win for us and enhances our position as one of the leading electrical equipment manufacturers in the country. We have a diversified portfolio of electrical equipment to cater to various needs of the market. Our manufacturing facilities

are state-of-the-art equipped to undertake larger production to meet the present and emerging needs of the country. We also have a strong R&D base with a focus on developing technological advancement in electrical equipment solution for various categories and requirements."

The Government of India and the various state governments are working towards creating low-cost housing solutions to enhance the various standards of living for the citizens especially the economically weaker segment. This push will give a big boost to the electrical equipment industry in long term. With the rise in demand for electrical equipment to be made available to the housing sector, there is a huge market in the country to be tapped. 



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AGEL GOES FOR THE LARGEST ACQUISITION IN THE RE SECTOR IN INDIA

Adani Green Energy Limited (AGEL), has recently signed share purchase agreements for the acquisition of 100% interest in SB Energy India from SBG (80%) and Bharti Group (20%). SB Energy India has a total renewable portfolio of 4,954 MW spread across four states in India. The transaction marks the largest acquisition in the renewable energy sector in India. The transaction values SB Energy India at an enterprise valuation of approximately USD 3.5 billion.

The target portfolio consists large scale utility assets with 84% solar capacity (4,180 MW), 9% wind-solar hybrid capacity (450 MW) and 7% wind capacity (324 MW). The portfolio comprises 1,400 MW operational solar power capacity and a further 3,554 MW is under construction. All projects have 25 year PPAs with sovereign rated counterparties such as Solar Energy



Gautam Adani, Chairman, Adani Group...

Corporation of India Ltd. (SECI), NTPC Limited and NHPC Limited.

The operating assets forming part of the portfolio are primarily solar park based projects and have been built following best in class governance, project development, construction and operations and maintenance practices, resulting in this being one of the highest quality renewable portfolios in the country. With this acquisition, AGEL will achieve total renewable capacity of 24.3 GW and operating renewable capacity of 4.9

GW. This acquisition demonstrates AGEL's intent to be the leader in sustainable energy transition globally and makes it one of the largest renewable energy platforms in the world. The closing of the transaction is subject to customary approvals and conditions. **EI**

TATA POWER WORKS TO MITIGATE IMPACT OF 'YAAS' IN ODISHA

Based on the probability of damage to the assets, the company had strategized and planned several operations on a war-footing...

Tata Power had identified the circles and divisions that were expected to be impacted by the severe cyclonic storm 'Yaas', well in advance. This has helped the power company to reinstate electricity in many parts of the network quickly, while working towards restoring power to the highly impacted locations across the state.

In order to access the on-ground network disruption and to restore power supply quickly, TPCODL and TPNODL mobilised over 13,000 workers at different sites to ensure the quick restoration of power supply in the severely-affected areas. As the cyclone was due to affect the upper regions, TPWODL deployed 20 groups of workforce along with TPSDOL who also shared its resources to help out the teams in TPNODL.

TP Northern Odisha Distribution Ltd (TPNODL) has been severely impacted and an assessment of the damage is in progress while power restoration process has started in Balasore, Bhadrak, Jajpur, Kendrapatra town. TPNODL have been working round the clock to ensure power supply to COVID care centres and hospitals. The company deployed separate teams and set up a dedicated control room for them to closely monitor the situation. Power supply to all hospitals, COVID Care Centres, ICU units and Oxygen Plants were provided within a record time of 2 Hrs. Power supply at all District HQ's/CHC was also restored on a priority basis. Teams at TPCODL was able to restore 70% of the power supply within eight hours of landfall. **EI**

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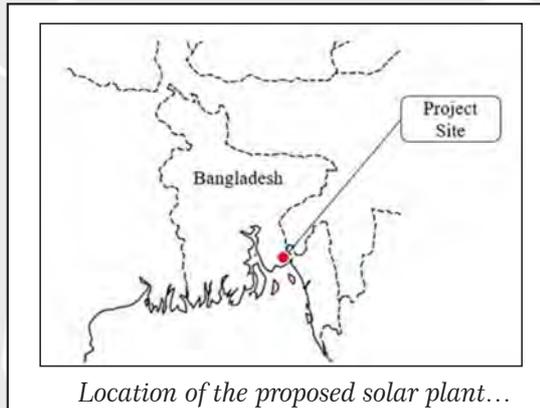
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MARUBENI, EGCB SIGN MOU TO DEVELOP SOLAR PLANT IN BANGLADESH

On May 20, Marubeni Corporation (Marubeni) signed a Memorandum of Understanding (MoU) with Electricity Generation Company of Bangladesh Limited (EGCB), an electricity and utility company owned by the Bangladesh Development Board (BPDB). The MoU is regarding the joint development of the 100MW Solar PV Power Plant Project in Chittagong, Feni, southeast of People's Republic of Bangladesh.

In line with its strong economic growth, the generation capacity of Bangladesh is continuously increasing, and the government aims to expand its renewable energy capacity to 10% of the country's total generation capacity. The MoU was also approved by the Bangladesh Ministry of Power, Energy and Mineral Resources, an organization operating above EGCB and BPDB.



Marubeni has a track record of installing approximately 1,300 MW of gas-fired power plants and hydropower plants in Bangladesh. If this project is realized, it will become one of the largest scale solar power plants in the country, and the first Independent Power Producer project for Marubeni in the country.

Marubeni owns stakes in power projects across 19 countries (including Japan) for a total net capacity of about 12 GW. Also, as part of the company's activities for enhancing sustainability, Marubeni issued the Notification Regarding Business Policies Pertaining to Sustainability in Relation to Coal-Fired Power Generation Business and Renewable Energy Generation Business in September 2018, and set the Marubeni Long-Term Vision on Climate Change in March 2021 for the purpose of contributing to solving global climate change. 

CONSORTIUM FORMED TO DELIVER GREEN INDUSTRIAL HYDROGEN PROJECTS

These hydrogen projects, which will use HydrogenPro's leading technology, are part of Mitsubishi's strategy to provide short- and long-term energy storage solutions...

HydrogenPro, H2V Industry and Mitsubishi Power Europe have entered into an MoU (Memorandum of Understanding) forming a consortium that will develop and deliver green industrial hydrogen projects. This MoU will form a long-term partnership, combining the value proposition and expertise of H2V Industry, HydrogenPro and Mitsubishi Power Europe supporting the European and French initiatives to reach the decarbonisation goals. Through this MoU, the consortium partners will develop and deliver large scale hydrogen projects, including currently on-going projects.

H2V Industry will take on a lead role in the development phase, whereas HydrogenPro and Mitsubishi Power Europe will contribute with their expertise in the design, engineering, system and components, as well as their procurement

competence. The current projects are founded on HydrogenPro's 100MW high pressure modular system and represent the first large industrial scale projects, positioning the partnership in a global leading position. The partnership will also establish schemes to provide significant European supply content. An investigation has been started to determine European sourcing, manufacturing and/or assembly in France.

H2V Industry, owned by the France-based Samfi Invest group (Samfi), is a leading player in the hydrogen space in France. It is actively pursuing several green industrial scale hydrogen projects, with the present ones, where HydrogenPro has been contracted to supply the electrolyser installations for these sites. H2V Industry will further reinforce its technical and economical offerings through this partnership. 

BARAKAH NUCLEAR POWER PLANT UNIT 1 COMMENCES COMMERCIAL OPERATION

Toshiba Energy Systems & Solutions Corporation (Toshiba ESS) has recently informed that the Barakah nuclear power plant Unit 1, which is a commercial nuclear power plant of Emirates Nuclear Energy Corporation in the United Arab Emirates, has started commercial operation this time. Toshiba ESS has designed and manufactured steam turbine, generator and auxiliary equipment of the plant's Unit 1.

Barakah nuclear power plant Unit 1 uses Korean designed 1,400 MW class PWR (APR-1400). Toshiba ESS has delivered its main model 52-inch turbine and generator to Korea Electric Power Corporation (KEPCO), the main EPC contractor through Doosan Heavy Industries & Construction, which is in charge of turbine system. Toshiba ESS has also completed delivery to KEPCO the order of large breaking capacity



An overview of Barakah Nuclear Power Plant Unit 1...

80kA 400kV Gas circuit switch gear and related equipment in switchyard next to Barakah nuclear power plant.

The nuclear development and usage plan of the United Arab Emirates has started since 2009. Barakah nuclear power plant will contribute for energy security and carbon neutral to supply approximately 5,600 MW electricity in total by four units. The four units are

expected to generate 25% of the total national power demand of the UAE.

Toshiba promotes efforts in a wide range of business domains, including construction, maintenance, support for the restart, decommissioning and dismantlement of nuclear power plants, fuel cycle and future energy source development, such as next generation reactors and fast reactors. The company contributes to energy sustainability, security and protection of the global environment. 

HITACHI TO DEMONSTRATE DEMAND RESPONSE PROJECT AT THAILAND

This demonstration project centers around the DR system design of Chulalongkorn University, which is Thailand's oldest national university...

Hitachi, Ltd. and Hitachi Asia (Thailand) Co., Ltd. {Hitachi Asia (Thailand)}, a local corporation in the Kingdom of Thailand have recently been selected for participation in a 'Demand Response' (DR) demonstration project driven by the Electricity Generating Authority of Thailand (EGAT), as system vendors of the EGAT-adapted DR management system (DRMS).

The project aims for system design and implementation to optimize power supply and demand balance in accordance with the comprehensive energy policy plan, Smart Grid Development Master Plan that is led by the Thai Government.

At present, thermal power stations are the principal domestic energy source in Thailand. Considering global warming, the Thai Ministry of

Energy aims in the Thai Power Development Plan 2018 (PDP), which was issued in 2019 and applies to the 2018-2037 period, to realize an energy source balance that reduces greenhouse gas emissions and otherwise lightens the environmental load. It lays out a policy of more or less keeping current natural gas dependence, lowering thermal power dependence to about 10%, and adopting actively solar energy and other renewable energy sources.

With the expansion of renewable energy, the difficulties of operating systems will become apparent in adjusting power demand in response to sudden changes in weather or other factors. Then, it is expected to increase the importance of measures to stabilize systems that maintain the demand and supply balance. This new DR system is an example of such measures. 

DR. U. STUHEC HAS BEEN INDUCTED BY MAHINDRA & MAHINDRA



He was previously instrumental in launching autonomous shuttles in Texas and Japan...

Dr. Uli Stuhec has joined Mahindra & Mahindra as the Vice President and Head of Global Born Electric Platform. Recently, Mahindra has consolidated its e-mobility business in two focused verticals, called Last Mile Mobility (LMM) and Electric Vehicle Tech Centre. The new Born Electric Vehicle (BEV) platform will be underpinning a number of e-SUVs in the future from the company.

Dr. Stuhec will be a part of the Electric Vehicle Tech Centre at the

Mahindra North American Technical Centre (MNATC) in Detroit, USA. His team will work to attain the goal of the company to go for higher electrification and creating electric vehicle products and technology.

Dr Stuhec will hold the responsibility of planning and execution of the BEV product development strategy, based on customer requirements. The BEV platform team will be working in collaboration with Mahindra Research Valley (MRV) in Chennai. **EI**

DR. M. JURYTKO BECOMES THE MD & CEO OF 'CELLCENTRIC'



He'll see all aspects of fuel cell development for heavy-duty vehicle applications...

Dr. Matthias Jurytko, currently Plant Manager and Head of Production at the Mercedes-Benz plant in Wörth, will move to 'cellcentric', the fuel cell joint venture of Daimler Truck AG and the Volvo Group, as of 1 June 2021. He will take over the role of Managing Director and CEO there.

"The transformation of the transport industry and our company is one of the most important tasks ahead of us. I am therefore very pleased that

we have been able to win Matthias Jurytko as CEO for 'cellcentric'. With his many years of management experience, he possesses important skills for this task: extensive expertise in the truck business, coupled with experience in the management and further development of our plants," says Martin Daum, Chairman of the Board of Management of Daimler Truck AG and Member of the Board of Management of Daimler AG. **EI**

L. BRUNET HAS BEEN RE-ELECTED AS PRESIDENT OF LIGHTING EUROPE



He has proved his capability to convey the voice of the lighting industry very efficiently...

On 26th March, the General Assembly of Lighting Europe has elected a new Executive Board for a two-year mandate. The Executive Board consists of an equal number of representatives of national lighting associations and corporate members of Lighting Europe and has the role of implementing the Lighting Europe strategy and work plans. Accordingly, on the same day, the board has re-elected Lionel Brunet as President of Lighting Europe, for a second term of two years.

Brunet is the CEO of the French lighting trade association "Syndicat de l'Éclairage" since 2013, and previously he had a long international career in the chemicals and mechanical industries, and a global trade association.

"I am honoured to be re-elected President and look forward to continue collaborating with the Board and with regulators and customers to foster trust in the professionals of Europe's lighting industry and our capacity to deliver quality lighting for all," says Brunet. **EI**



DUBAI'S VENTURE TO PRODUCE ENERGY FROM WASTE

By converting non-recyclable municipal waste to renewable energy, Dubai Municipality will not only supply power to 120,000 homes but also reduce the city's carbon footprint considerably...

World's largest Energy from Waste Plant in Dubai; which is also significant as one of the various projects for the conservation of natural resources, rationalized consumption, and the inclusion of alternative and renewable energy resources in Dubai's energy mix – will use 30 modules of Air Cooled Condensers (ACCs).

With the Dubai Strategic Plan 2021, the UAE National Agenda 2021, and the Dubai Integrated Energy Strategy 2030, Dubai is making great strides in the field of sustainability. These strategic plans aim at protecting the environment and ensuring sustainable development.

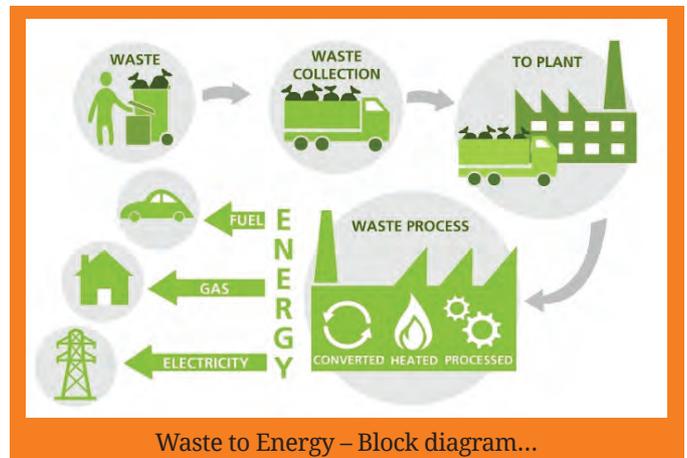
Dubai Municipality is keen to strengthen efforts nationally and across the UAE to achieve the targets for minimizing the volume of municipal waste disposed of in landfill, and for developing alternative energy sources through the speedy implementation of projects for the sustainable management of waste, energy, and the environment.

Use of ACC modules

Hitachi Zosen Inova AG has offered the contract to



An artist's impression of the Dubai's ACC-Hitachi plant...



Waste to Energy – Block diagram...

Hamon to supply those 30 ACCs. The ACC designed by Hamon will ensure various plant load operating cases. The company's scope of work includes the design, delivery and erection works with a limited final lay-down area availability.

The facility, located in Warsan, will treat 5,000 tons of non-recyclable municipal solid waste from the Dubai area per day, with a total of 1,825,000 tons a year that will be converted into renewable energy. The 171 MW of electricity generated will be fed into the local grid as baseload energy and will power around 120,000 homes.

Benefit

As the population is increasing and using products that require packaging, it is assessed that a typical person produces one ton of trash in a year, causing adverse effects on the environment. By processing waste into biofuel, Waste-to-Energy plants release considerably less carbon and methane into the air than having waste decay away in landfills.



WAY TO EFFICIENT & SAFE METERING

Energy metering is the most important pillar of the power business, and in the last two decades or so several changes or transformations have been witnessed in this field. In today's situation, when the COVID – 19 pandemic protocols are suggesting social distancing and staying at home as far as possible, physically checking energy meters at each and every corner of a



*In a vast country like India, smart metering is absolutely essential to ensure efficient transmission and distribution while monitoring energy usage and efficiency. In this COVID-era, we would have been much benefited, if we could complete 100% installation of smart meters before March 2020. However, as it could not be done, in the coming days we have to accelerate our pace of smart meter installation – so that we remain ready to counter such situations in future...
P. K. Chatterjee (PK)*

country is not only difficult but also apparently impossible. However, because of compulsory stay-at-home situation domestic energy consumption is increasing at most of the individual consumer's residence. With such backdrop, there cannot be any ambiguity but to opt for Smart Metering.

Smart Meters

According to a nice definition from Wikipedia, "A smart meter is an electronic device that records information such as consumption of electric energy, voltage levels, current and power factor. Smart meters communicate the information to the consumer for greater clarity of consumption behaviour, and electricity suppliers for system monitoring and customer billing. Smart meters typically record energy near real-time, and report regularly, at short intervals throughout the day. Smart meters enable two-way communication between the meter and the central system. Such an Advanced Metering Infrastructure (AMI) differs from Automatic Meter Reading (AMR) in that it enables two-way communication between the meter and the supplier. Communications from the meter to the network may be wireless, or via fixed wired connections such as Power Line Carrier (PLC). Wireless communication options in common use include cellular communications,



Example of a smart meter based on Open Smart Grid Protocol (OSGP) in use in Europe that has the ability to reduce load, disconnect-reconnect remotely...
 Source: https://commons.wikimedia.org/wiki/File:Intelligenter_zaezler_Smart_meter.jpg

Wi-Fi (readily available), wireless ad hoc networks over Wi-Fi, wireless mesh networks, Low Power Long-Range wireless (LoRa), Wize (high radio penetration rate, open, using the frequency 169 MHz) Zigbee (low power, low data rate wireless) and Wi-SUN (Smart Utility Networks).”

Development of Smart Meters

Wikipedia also presents, “In 1972, Theodore Paraskevakos, while working with Boeing in Huntsville, Alabama, developed a sensor monitoring system that used digital transmission for security, fire and medical alarm systems as well as meter reading capabilities. This technology was a spin-off from the automatic telephone line identification system, now known as Caller ID.

In 1974, Paraskevakos was awarded a U.S. patent for this technology. In 1977, he launched Metretek,

Inc., which developed and produced the first smart meters. Since this system was developed pre-Internet, Metretek utilized the IBM series 1 mini-computer. For this approach, Paraskevakos and Metretek were awarded multiple patents.”

Market Growth of Smart Meters

Before the world slipped into the dark era of COVID – 19, the usefulness of smart meters was realised by the electrical energy measuring experts in almost all countries. Thus, its commercial production also was gaining momentum. However, the COVID-era has accelerated the pace of its growing demand.

As per the latest finding of Research And Markets, “Among the many benefits of smart meters are monitoring of electric system in real time & provision of responsive data for balancing electric loads; reduction of waste by forecasting energy demand more efficiently. The advanced metering infrastructure holds several merits over conventional metering and supports bi-directional communication. Smart meters are increasingly replacing traditional electric meters, mainly in developed countries, and enabling power system to undergo notable transformation in terms of efficiency and reliability.

These devices provide utilities with the opportunity to exploit data to ensure efficient use of energy, reduce wastage, and minimize human intervention. Smart metering devices in homes deliver accurate readings and eliminate incorrect billing or irregularities. By monitoring gas, water or electricity consumption, these devices allow users to reduce consumption and save on utility bills.

Smart meters represent a revolutionary technology for utility companies that allow them to ensure efficient transmission and distribution while monitoring energy usage and efficiency. These meters integrate three primary components that include an electricity meter, processing unit and communication module.

While the electricity meter measures power consumption and translates the readings into usable data, the processing unit processes and stores the data. In addition, the processing unit controls the electricity meter and the communication module. The communication module, usually found integrated into the smart meters or installed in external slots, facilitates the communication of meter data with the utility and the customer. Among the three components, the meter part is

List of State/ DISCOM versus Smart Meter installations

Sr. No	Name of State/ DISCOM	Smart Meter installations by EESL
1	NDMC	56,220
2	Uttar Pradesh	7,78,631
3	Haryana	73,933
4	Andhra Pradesh	780
Total		9,09,564

Source: PIB India/dated 14. 01. 2020

highly regulated one and in most cases needs to conform to a set of standards placed by regulatory authorities. The technology has gained extensive adoption among utilities and is receiving support from various countries.

Governments are investing in smart metering infrastructure to gravitate towards smart grids and accommodate renewable energy. Smart meters technology is poised to experience large-scale installations in North America, Europe and Asia-Pacific, with the latter holding a key role in driving global adoption of smart meters. The increasing adoption of smart meters is attributed to their various benefits such as energy usage monitoring, energy saving, reduction in energy wastage, tab on power thefts and reduction in carbon emissions.”

India and Smart Meters

Aiming to bring efficiency in the distribution system leading to better service delivery, in the last financial year (2020-21), the Ministry of Power (GoI) had issued guidelines to all states to convert all existing consumer meters into smart meters in prepaid mode. Operation of smart meters in prepaid mode would allow consumers to pay as per their own financial convenience and electricity consumption requirements.

EESL, a Joint Venture (JV) between CPSUs in the power sector, has been providing smart metering services to various utilities as per MOUs signed with them. EESL has also established innovative financing arrangements for the smart metering projects that would enable them to provide smart metering services to the DISCOMs without requiring any outright CAPEX funding from the states or utilities. The recoveries against the funding towards smart metering installations would be taken as a monthly annuity from the utilities over a period of seven to eight years.

Accordingly, apart from installations in NDMC for 50,000 consumers, EESL has also started installation of smart meters in Haryana, Uttar Pradesh, Bihar and Rajasthan. Out of these states, the maximum installation is in the state of Uttar Pradesh, where more than 7.78 Lakh smart meters have already been deployed across 11 cities.

Conclusion

As per the available information through* Capgemini; the French multinational Information Technology (IT) services and consulting company with a strong presence in India; which is globally working with EDF International Networks – a group entity that exports electricity network activities internationally: “Between 2014 and 2019, the deployment of smart metering in Europe increased from a 24% penetration rate to around 50%, compared to 65% in North America. This rate is expected to exceed 70% in both regions by 2024. At the same time, projects are multiplying in Asia. India is entering the race, aiming to deploy more than 250 million smart meters in the coming years.” (*From a report by Berg Insight: “SMART ELECTRICITY METERING 2020 - THE CURRENT STATE OF PLAY)

Although, India is a bit late in its smart meter initiative, in last year itself, it successfully completed installation of 10 lakh smart meters under the Smart Meter National Programme (SMNP) (PIB report posted on 25. 02. 2020). Nobody expected the sudden arrival of this COVID-era. Otherwise, we would also have progressed much in our mission to install smart meters. However, this is an experience that will guide us to accelerate the process of installing smart meters everywhere as soon as possible. We are in the right direction. 



DEMAND RESPONSE Implementation



India's growth plans need seamless power supply. However, instead of continuously adding generation facilities, we can readjust the demand pattern to match with the available supply. This article deals with different aspects of creating demand-supply balance...

The economic growth of the country has led to an increase in power demand but it is affected by limited energy resources, which have led to overexploitation of the resources. The focus in India is shifting towards restructuring of the power sector i.e., instead of generation adapting to demand, demand can be made flexible or altered as per generation requirement for demand-supply balance, thus relieving stress on power infrastructure. In a restructured power network with the integration of distributed energy resources, the role of consumers has changed with the capacity to consume as well as generate power. Demand-

Side Management (DSM) is a combination of long-term demand reduction and short-term energy management for supply/demand balance to incorporate renewable energy resources integration. Demand response and energy efficiency are two major components of DSM. Demand Response (DR) is offsetting the load consumption pattern of consumers in terms of time and quantity in response to some signal from a utility. DR helps utility in their load management and provides financial benefits, service incentives to the consumers for their participation. Reduction in consumption patterns by end-user related to service curtailment is measurable, predictable, reliable, and has a faster response time compared to generation. Reduction in capacity requirements due to DR implementation translates into a reduction in CO₂ emissions helping the environment. Effective DR Programs are keys for smart grid deployment as well as the promotion of green and clean energy resources.

Various state utilities in India pay high prices for peak hour procurement and cannot keep pace with the growing demand for electricity threatening security and reliability of power. Whenever the government looks for new investment in the electricity sector, DR can be looked at an equal footing with power generators as an option for meeting demand. Deployment of DR programs across utilities in India requires certain infrastructure like hardware, software, control and communication systems. The Government of India has come up with various policies, standards, and regulations for the inclusion of DSM and DR in the power sector. Social awareness about DR is still at a minimum level in India even among elite consumers. For effective implementation of DR in India, various regulatory, financial, and social issues have to be tackled by state utilities.

Types of DR programs

DR programs are classified based on control strategy, price and load. The type of DR program adopted depends upon factors like response frequency of participation from consumers, motivation and driving factors made available to consumers, supporting infrastructure available for implementation, and potential impact on the level of energy services. Types of programs depend upon power and information flow among the DR participants i.e., utility, aggregator, system operator and consumer. In centralized control response decisions

for load activation and deactivation are taken by the power utility. The decision to control the load profile is from a network security and congestion point of view. In decentralized control, response decisions are taken by consumers, utility only gets information about the net consumption of consumers through an aggregator. Utility designs incentive/price signals to motivate and influence consumers and these are communicated to them regularly. This type of control is much faster as compared to centralized control and the privacy of users is secure. The classification of DR programs is shown in figure 1.

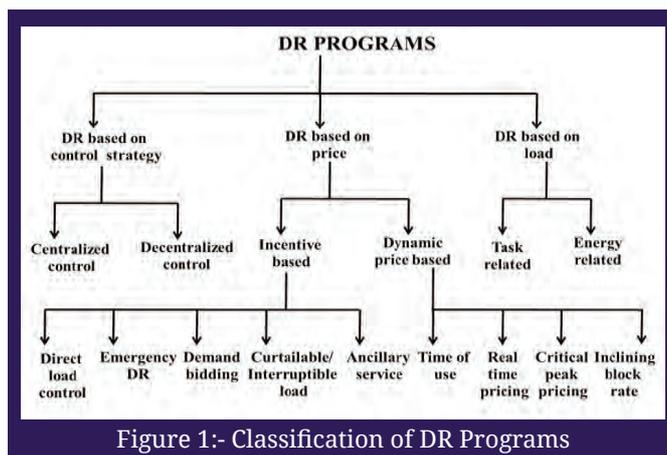


Figure 1:- Classification of DR Programs

DR based on price is classified as incentive/penalty based and dynamic price based. In an incentive-based DR program utility has a contract with the consumers for their participation in the adjustment of system peak. The type and magnitude of incentives are usually specified in the contract. In incentive-based programs, consumers get rewards for giving DR providers some level of control over electrical equipment of consumers whereas, in dynamic price-based DR depending on price signals, consumers schedule their loads voluntarily. The utility offers fixed or time-varying incentives that obey DR contracts during system stress. Penalty-based DR program also levies a penalty on customers for disobeying contract. In direct load control utility or system operator such as aggregator has direct control over the electrical equipment of consumer and manage the operation of load scheduling and curtailment. Incentives are in the form of monthly bill credits or rebates for each load curtailment. In Emergency, DR Program consumers receive incentive payments for demand reduction when the system is short of reserves for helping the

Challenges & Opportunities

utility in maintaining system reliability. In Capacity market program consumer or end-users offers load curtailment in the form of system capacity which acts as an alternative for expansion of existing infrastructure for utility. Consumers receive an incentive in the form of monthly bill credits or rebates for providing load reduction. For interruptible/curtailable load (IL/CL) program consumers are offered discounted rates or bill credits for adjusting their load demand during scheduled or unscheduled system outages. In ancillary services DR schemes large consumers reduce their capacity as an operating reserve in the form of bids in wholesale power markets.

For Dynamic Price-based DR schemes pricing mechanisms are designed according to the load level of the entire system. Consumers are provided with time-varying prices that are decided based on the cost of electricity in different periods. In a time of use (TOU), pricing mechanism end users are given different price slabs for energy usage during different hours of the day. The price arrived is a reflection of the average cost of generating energy corresponding to the complete duration of the day. Most of the states in India have commissioned TOD tariffs. In a real-time pricing program (RTP) the prices vary dynamically for every demand interval based on demand-supply dynamics. Energy prices are updated at very short notice of either 15 minutes or hour time block based on market dynamics in wholesale electricity markets. Consumers benefit by taking advantage of low market prices by deferring their usage period. Critical peak pricing (CPP) is a combination of both TOU and RTP. It is the superimposition of real-time related rates on time of

use pricing. In peak load pricing program, different price is set for energy usage for each period in a day. Numbers of such periods in the day are identified and prices are informed to consumers in advance prior to one day before implementation. Based on average power consumption in each period price value for each period is calculated.

Based on how the load is scheduled or curtailed and their effects on net energy consumption DR programs are further classified as task-related DR and energy-related DR.

For all of these above-mentioned DR programs, the basic infrastructure needed are load control switches, smart meters, advanced metering systems, communication systems and data computation facilities. Based on the motivating factors in these DR schemes, options for Indian consumers are suggested. DR pilot projects in India have been evaluated based on dynamic pricing options like TOU, CPP, and RTP. Table 1 highlights various features of DR programs.

DR implementation in India

DR Barriers and Enablers

Barriers to DR implementation can be broadly classified into three types, financial, regulatory, and knowledge-based. Lack of information and effective communication technology, deficiencies in sensing and computation, lack of market structure /mechanisms, advancement required for changes in the role of stakeholders, ownership, and trust related to the privacy of consumer data are the major issues. Creating awareness and understanding of DR concepts have a significant impact on DR implementation. Improving the functioning of

Table 1: DR Programs Features

Feature	DLC	Emergency	Capacity Market	IL	Ancillary Service	TOU	CPP	RTP
Triggering Criteria	Peak Demand forecast	Supply Reserve deficit	Demand supply deficit, a Price spike	Insufficient operating reserves	Frequency drop, Insufficient capacity	Tariff rates during peak/off-peak	Extreme weather, Loss of generation, transmission	Power market dynamics
Target consumer category	Residential/ Agricultural	Industrial/ large consumers	Industrial	Residential /commercial /Industrial	Large consumers	All types of consumers	All types of consumers	All types of consumers
Event Duration	Day-ahead	Day of (Minutes to an hour)	Day-ahead/day of	Day of	Day of (Minutes to Hour)	Well in advance	Day-ahead/ day of	Day of
Participation choice	Mandatory	Voluntary	Voluntary	Mandatory	Voluntary	Voluntary	Voluntary	Voluntary



markets related to DR, design of effective contract bids for motivating consumer participation, exchange of DR as a resource among multiple parties, and advancement in technology for DR aggregators participation are various steps towards enabling DR over market barriers. To ensure a minimum payback period various schemes such as contracts for difference, transaction costs distribution among participants, standard procedures for enforcement needs to be taken care of. Automation is a key enabler, the use of smart devices, smart controllers, HEMS by consumers will help their participation without human intervention. Correct and clear information by the DR provider as well as confidentiality regarding data security to end consumers is also a key enabler.

Major hurdles for DR implementation in India are lack of awareness among consumers, lack of technical ability of utility staff, lack of investment/ finance for DR project, subsidized prices of electricity for certain sections of domestic and agricultural consumers, lack of enforcement standards, regulations by government institutions. DR participants need to install smart meters, smart equipment, HEMS, communication infrastructure, information management system which needs investment. Need for secure, reliable, and high bandwidth communication infrastructure between end-users and utilities for transmitting information regarding bid data, the price signal is a challenge for state utilities in India. Lack of persuasive incentives, no standard measurement, and verification procedures for DR evaluation are challenges to evaluate exact DR benefits. Proper coordination strategies and schemes need to be developed among utility, load aggregators, system operators, regulators end consumers for the success of DR implementation in India.

Potential DR benefits

DR deployment can create a lot of opportunities in the area of energy, economics, and the environment for the country. A peak power demand deficit exists in the country and the traditional approach of meeting peak demand by utilizing expensive generation units is not a feasible option. DR as a power resource can address the issue by deferring generation capacity, delay in augmenting transmission network, reducing congestion and integrating renewable resources. DR can also improve the resource efficiency of electricity

production as well as address the load shedding problem. The dispatchable nature of DR is an effective tool for capacity addition as the gestation period of this resource can be from instant, hourly to daily variation thus helping in maintaining reliability and stability of the network. The Government of India has the plan to add 175 GW of power through renewables by the year 2022. Due to ramping up and down the nature of renewable sources, DR can help to augment the stochastic nature of RES and provide necessary capacity addition. Effective DR Implementation can provide environmental benefits at an affordable cost helping in meeting emission targets set for the country during COP 21 in the Paris climate conference. Successful implementation of DR pilot projects in the country will help in ensuring trust among consumers regarding data privacy, data use based on regulations. Projecting the realizable technical and economic potential of DR creates interest among stakeholders for their participation in DR programs. Many state utilities across India have initiated the process of the consumer survey, load research, and market research to find out the technical and economic potential of DR.

Framework for demand response implementation in India

The objective of the framework is that it will help the state utilities throughout the country to identify the potential of DR and to undertake various steps for the design and implementation of appropriate DR strategy in the future. Various steps for the DR framework for implementation in the country are discussed.

- **Studying demand-supply variation of electrical load:** - Detailed analysis of demand-supply variation of a load will help in identifying timings for curtailment or enhancement of load during the DR event. With the analysis of rising time and fall time in the load curve, it is possible to identify the loads taking time to start up as such types of loads cannot be dispatched easily during the DR event. Renewable energy potential available in each state needs to be worked out to find out the scope for DR potential and implement an effective DR program.
- **Load forecasting and determining sector-wise load pattern:** - Accurate forecasting of the load has a significant impact on operation and control of utility in a restructured and competitive

Challenges & Opportunities

power environment. When a forecasted load does not match with an installed capacity of generators other alternatives such as demand response and energy efficiency can be utilized. Load forecasting helps in getting an estimate of additional generation capacity required to meet demand, getting insights of various load patterns and end-use operations contributing to peak load.

- **Estimating the technical and economic potential of DR:** - To compare the cost-effectiveness of DR with other alternative feasible options, it is important to identify its technical and economic potential. The technical potential is load curtailment volume, which is realized based on technical constraints. If data regarding both technical and economic potential is established by utility various loads can be targeted. Hardware and control strategies for different load categories like critical, thermostatically controllable, dispatchable, deferrable loads have to be identified. Managing A/C load is one of the most effective and easier ways of load curtailment and can be promoted among Indian consumers.
- **Deciding policies regulations and incentives for DR inclusion:** - For the inclusion of DR programs in the power sector government of India has initiated steps in terms of the development of policies, standards and regulations. DR technologies' penetration in a country will see accelerated growth once policies and standards are in place. The Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commission (SERC) have a role to frame regulatory policies. Policies will help to develop standards to meet interoperability, communication and security challenges of DR. Various policies and initiatives like Accelerated Power Reforms Development Program (APDRP), Integrated Power Plant Scheme (IPDS), Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) scheme that will connect 250000-gram panchayats on fibre network will help in setting up the necessary infrastructure for effective DR implementation among stakeholders.
- **Impact assessment and participation evaluation:** - Assessment of consumer participation in the DR program both through voluntary and mandatory means need to be

thoroughly investigated by utility or third party appointed by the utility. Such an investigation will help in estimating the level of DR expected from targeted participation at reference price/incentives. Mapping up of sector-wise consumers, different load categories depending upon end-user needs to be taken up by demand-side management cell. Effect of monetary, service incentives and other policies on the amount of peak load shifted has to be evaluated.

- **Transaction costs evaluation:** - Implementation of DR program across will incur the cost for developing hardware, software, and communication infrastructure, cost of up-gradation of billing systems, and consumer education costs. Operating costs to the utility will consist of administrative costs and incentive payments to participating consumers. Economics has to be worked out whether these costs can be distributed across all stakeholders or can be borne by the utility itself. The upfront cost for DR infrastructure has to be justified through energy bill savings for end consumers, brokerage fees from load aggregators and reduction in purchasing power during peak hours by the utility in terms of Rs. /MWh or Rs./ MW shifted.

Conclusion

Energy savings, lower energy prices, energy security and environmental benefits are key drivers for DR implementation in India. DR technologies like smart appliances, smart metering systems, data management systems, software, control and communication systems are keys for the development and adaptability of DR. Implementation of DR in the Indian power grid can enhance grid capacity, improve quality and reliability of power as well as reduce the carbon footprint of the nation. ❶



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Exemplary Assistance to Employees During the Tough Time

In this unexpectedly bad-phase of COVID -19, Hindustan Power has decided to help its existing and deceased employees in different ways...

Hindustan Power is extending financial support for all employees including contract staff who succumbed to Covid-19. The company is providing one-time support of Rs 8-10 lakhs per employee to each family and also continuous financial support for the well-being of the family due to loss of the earning member. The company will also make an additional monthly payment in the range of Rs 35,000-Rs 50,000 for next three years. This too will help the families cover living expenses besides support the education of the children left behind.

For employees, who have recovered from Covid, in addition to health care insurance benefits, the company is providing interest free financial loans and special paid leaves. Hindustan Power has been providing critical medical equipment to all its employees and it has also created hospitalization facilities in its plant at

Anuppur, Madhya Pradesh. The company has already organized three vaccination camps in Delhi and several in Anuppur for vaccination of its employees, contractors and their families.

Conveying the company’s mission, Lalit Jain, President – Thermal, Hindustan Power said, “We stand firmly with our employees and are committed to their well-being and social security. Employee welfare and care of their loved ones is our top priority in these difficult times.”

The company has announced a comprehensive Covid Care Policy Plan for the benefit of all its employees, staff and their immediate family members, which have been implemented with immediate effect. Every effort is being made by the company in the shortest possible time to facilitate and help all its employees or staff and family members in need of any Covid related assistance. 



Some of Our Product lines:

- LT Jointing Kits
- 11 and 33 KV Terminations
- 11 and 33 KV Straight Joints
- Tab Off Connectors for AB Cables
- AB Accessories
- Anti-Track Tubing
- HS Components
- Jointing Services
- Consultancy & Troubleshooting

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- Anti-track Red Tubing
- Good Insulation Thickness
- Rain Skirts for Creepage
- 3 Finger Breakouts



Photographs (in clockwise order from top right)
1. Frontec Outdoor Termination Kit ~ 2019
2. Frontec Indoor Termination Kit ~ 2018
3. Frontec Straight Joint during installation

COMPONENTS & SPECIALS

Due to in-house manufacturing expertise, Frontec is able to innovate and develop products which have immense practical utility and are greatly appreciated by the end user.

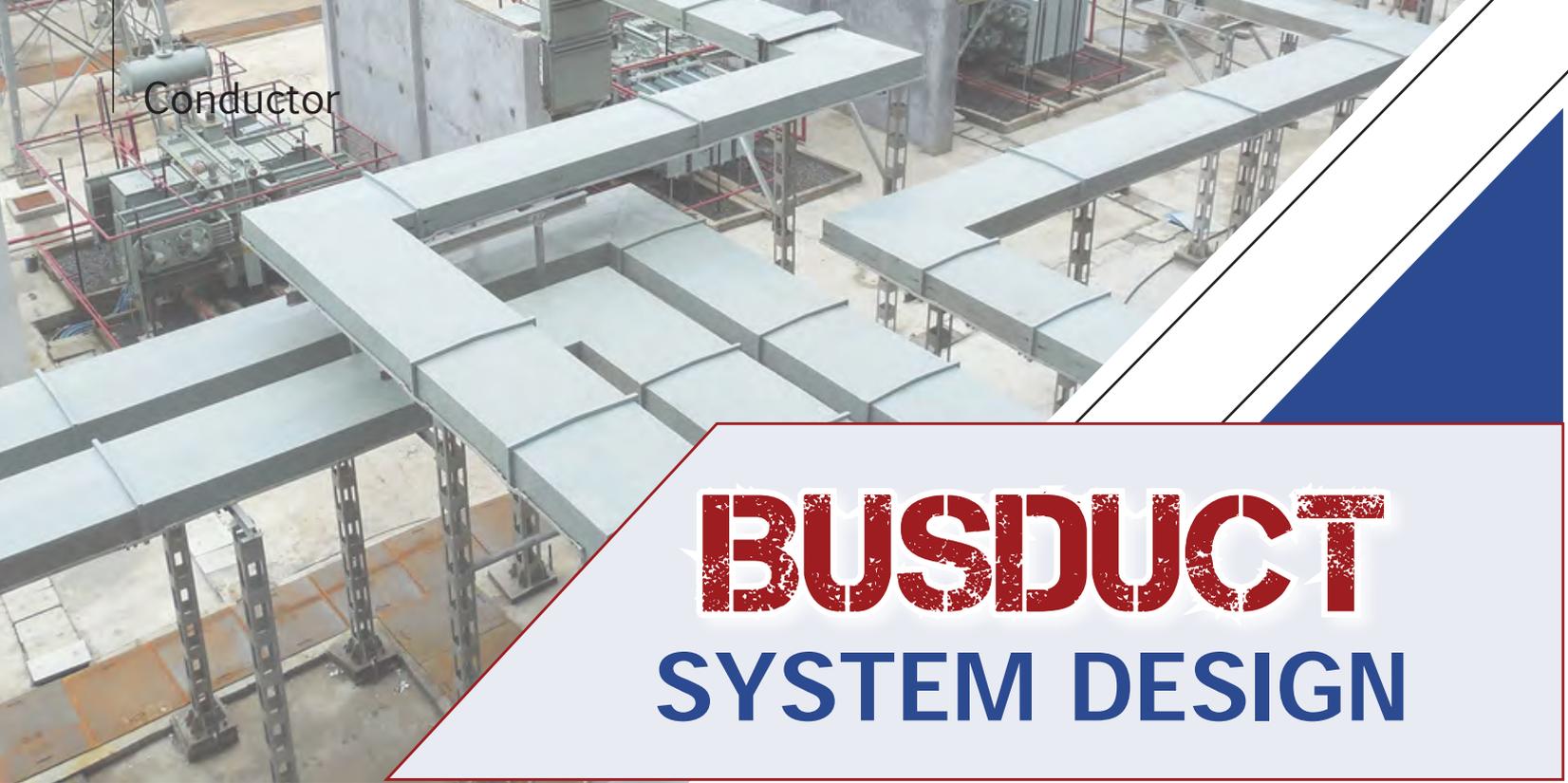
Namaste Joint Covers:
Developed for a project in Goa, A removable and reusable piece to cover back to back bolted lugs in upward facing terminations. This is intended to prevent bird faults as well as insulate exposed portions.



Constant Force Roll Springs:
Soldering of the earth to screen is prescribed by jointing kit manufacturers, but seldom practiced. These Roll Springs ensure constant firm contact, without danger of damage due to overtightening.

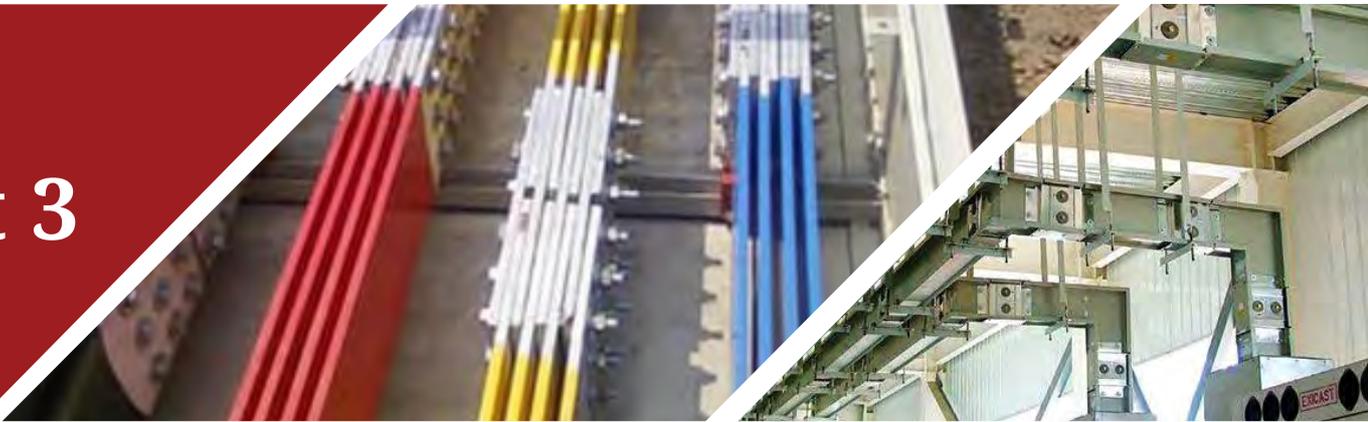


Conductor



BUSDUCT SYSTEM DESIGN

Part 3



www.electricalindia.in

In order to have low losses and enhanced reliability in the distribution system, bus-ducts are preferred over cables for higher current ratings and shorter lengths at different voltage levels. Though Sandwich Bustrunking System with rated operational voltage (U_e) 1000 Volt are easily available, when it comes to economics—Air insulated bus ducts have an edge. This article focuses on the types of air insulated busducts and their selection guidelines, design requirements, de-rating factors and sizing requirement...

The reactance thus obtained can be doubled for single phase systems. For a three phase system the configuration of the three phases with respect to each other will play a significant role and the linear centre spacing S has to be modified to an effective or geometric mean spacing S_e .

$S_e = (S_a \cdot S_b \cdot S_c)^{1/3}$ for the configuration shown in figure-10

$$S_a = S_b = S$$

$$S_a + S_b = S_c$$

$$S_c = 2S$$

$$S_e = S \cdot 2^{1/3} = 1.26 S$$

Example-4:

Considering example-3, for determining the effect of proximity

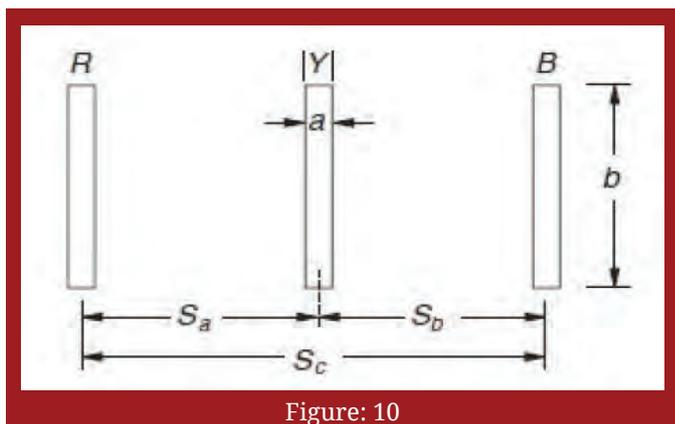


Figure: 10

$$a/b = 44.45/101.6 = 0.4375$$

$1.26 * S / (a+b) = 1.59$ then X_a due to the proximity affect from the graph = $125 * 10^{-6}$ ohm/m = 0.125 ohm/1000m per phase Impedance,

$$Z = \sqrt{0.0186^2 + 0.125^2} = 0.126 \text{ohm}/1000\text{m per phase}$$

Voltage drop considering a length of busbar as 20m and current rating as 4000A

$$= 4000 * 0.126 * 20 / 10000 = 10.08\text{V which is } 2.43\% \text{ for } 415\text{V system which is acceptable}$$

Proximity effect on the enclosure:

The electric field produced by the current carrying conductors of each phase in addition links the metallic bus enclosure, its mounting supports and its structures existing in the vicinity, parallel and around the axis of the current carrying conductors. It causes induced currents in such structures which therefore leads to resistance and magnetic losses.

The electrodynamic forces between the enclosure and the conductors will be small because the enclosure, which is non-continuous, will carry much less current when compared to conductors. They therefore need not be considered separately, as the metallic structure will have sufficient strength to bear them.

In a non-magnetic enclosure, such as Aluminium or stainless steel, only resistance losses occur. In a magnetic enclosure, such as mild steel, there will also be hysteresis and eddy current losses in addition to resistance losses. All these losses appear as heat in the enclosure and the metallic structure. Depending upon the current rating, the configuration of the busbars, the choice of the material of the enclosure should be such that it minimizes these effects as far as possible. Since the spacing in an HT system is already large, an HT system generally not effected by the proximity effects.

Current ratings	Center spacing	Approximate derating
(i) Flat busbar		
(i) LV systems	Normal spacings	5%
(1) Small ratings up to 1600 A		
(2) 2000-3000		
(3) Large ratings upto around 6500 A*	$S \geq 4b$	15%
(ii) For HV systems 2000-3000 A	Generally $S \geq 4b$	5%

Table-5: Approximate deratings due to proximity effect

Minimizing the proximity effect:

Maintaining greater spacing between the phases

This can be achieved by providing adequate clearances between the conductors and inside the enclosure. In thicker sections or where a number of smaller sections are used together to form a phase, the current will accumulate at the outer surfaces only rather than the centre. Therefore, to achieve an almost zero proximity effect condition, it is desirable to provide a space of 300mm and more between the extreme outer surfaces, rather than between centres. But to keep the phase conductors completely out of inductive effect of the other phases, it may require very large enclosures, particularly at higher ratings (above 2000A) which may not be practical.

Phase interleaving

This is highly efficient and more practical method for large ratings and offers the utilization of conductors. It provides an almost balanced and a low reactance system. Each phase, comprising of a number of conductors, is split into two or more groups. It is however suggested to limit the number of groups to only two taking into

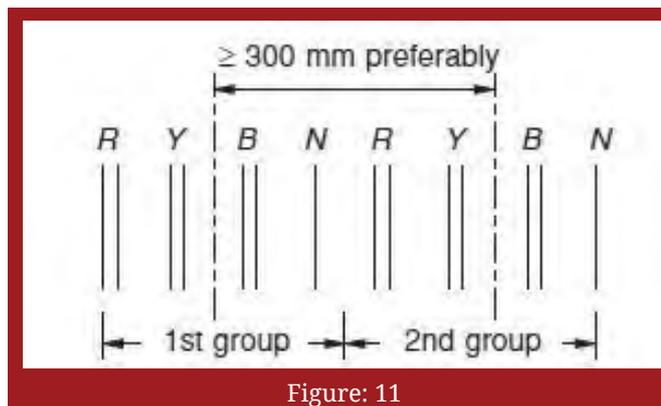


Figure: 11

Conductor

account of size and the cost of enclosure. In four conductors, two groups each with two conductors per phase can be arranged as shown in figure-11 to establish a low reactance system as a result of the smaller spacings between the split phases on the one hand, and two parallel paths on the other. The two parallel paths will further reduce the total reactance to one half. The field produced by each split phase would now become half and fall out of the inductive region of the other. The arrangement would thus provide a system with a low proximity effect.

Since the conductors in each phase are now arranged as close as dielectrically possible, the electrodynamic forces on each group in the event of fault on considering the spacing would be high as a result of the smaller spacing between the phase conductors. But the overall forces would become much less compared to the conventional arrangement because of two or more parallel current paths, each carrying a reducing amount of current, depending upon the number of parallel paths so formed. Moreover, the mounting supports will also become stronger than before, because there are as many mounting supports as the number of parallel paths, each sharing the total force equally. The method of interleaving will therefore require no additional reinforcement of the busbar supports or the mounting structures. As a result of the low reactance obtained the arrangement will provide a quite inductively balanced system. The reactance of the conductors can be calculated on an individual group basis and then halved when the conductors are split into two halves.

The arrangement will also minimize the skin effect to a very great extent, as the current of each phase is now shared by two or more independent circuits, each of a thinner section than a composite phase.

Example-5: Considering example 2, using four sections of 101.6 x 6.35mm Al conductors, now interleaved

as shown in figure-12., the improved reactance and resistance would be?.

$a/b = 0.1875$ and space factor = $1.28 \times S / (a+b) = 0.98$ Xa from graph of figure-9 = $90 \times 10^{-6} \text{ohm/m}$ and for two parallel circuits = $90/2 = 45 \times 10^{-6} \text{ohm/m}$ or 0.045 ohm/1000m as against $125 \times 10^{-6} \text{ohm/m}$ with the conventional arrangement

Skin effect: Area of cross section per split phase = $2 \times 101.6 \times 6.35 = 12.9 \text{ cm}^2$

$b/a = 101.6/19.05 = 5.33$

from the graph $R_{ac}/R_{dc} = 1.13$

$R_{dc} = 0.056 \text{ ohm} / 1000\text{m}$ per conductor for

$R_{dc} = 0.056/4 = 0.014 \text{ ohm} / 1000\text{m}$ per 4 conductors

$R_{ac} = 0.014 \times 1.13 = 0.158 \text{ ohm} / 1000\text{m}$

Impedance $Z = \sqrt{0.0158^2 + 0.45^2} = 0.0477 \text{ ohm} / 1000\text{m}$

Voltage drop for 20m of bus length

= $2000 \times 0.0477 \times 20 / 1000 = 3.82\text{V}$ which is even less than 1% for a 415V bus system.

Electrodynamic forces:

For a system fault level of 50kA maximum forces on each group

$$F_m = k \cdot \frac{16 \cdot I_{sc}^2}{S} \times 10^{-4} \text{ N/m}$$

For conventional arrangement:

K for a space factor of $S-a/a+b = (184.45-44.45) / (44.45+101.6) = 0.958$ corresponding to $a/b = 0.4375$ from the graph is $K = 0.96$

$$F_m = 0.96 \cdot \frac{16 \times 50,000^2}{184.45} \times 10^{-4} \text{ N/m}$$

$F_m = 20819 \text{ N/m}$

For the improved interleaving arrangement:

K for a space factor of $S-a/a+b = (94.45-19.05) / (19.05+101.6) = 0.62$ corresponding to $a/b = 0.185$ from the graph is $K = 0.87$

$$F_m = 0.87 \cdot \frac{16 \times 50,000^2}{94.05} \times 10^{-4} \text{ N/m}$$

$F_m = 9250.4 \text{ N/m}$

F_m on both supports = $2 \times 9250.4 = 18500.8 \text{ N/m}$

This is less than the force developed with the conventional arrangement. ⓑ

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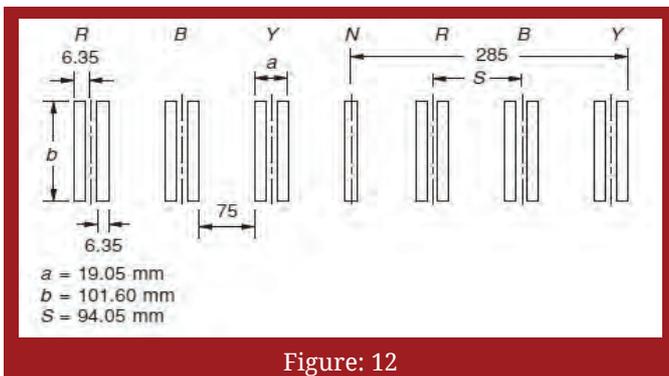


Figure: 12

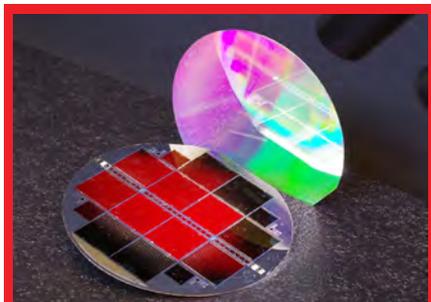


Chanukya Annepu

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Increasing Solar Cell Efficiencies

During last 40 years, Fraunhofer ISE has been conducting cutting-edge research in photovoltaics. It has several significant contributions in reducing the costs of solar electricity...



The new III-V//Si tandem solar cell has 35.9% efficiency. The top subcell glows red, which is a sign of outstanding material quality. The nanostructured back side of the cell shimmers in rainbow colours...
© Fraunhofer ISE / Photo: Michael Schachtner

Photovoltaics, along with wind energy, is the central pillar of the energy transition. Aiming to further reduce the area required for PV installations as well as material use, Fraunhofer ISE is focusing on tandem photovoltaics. This cell technology allows the traditional efficiency limits to be exceeded by selectively combining different solar cell materials. The Freiburg researchers have succeeded in setting a new world record with a monolithic tandem cell made of III-V and silicon semiconductors.

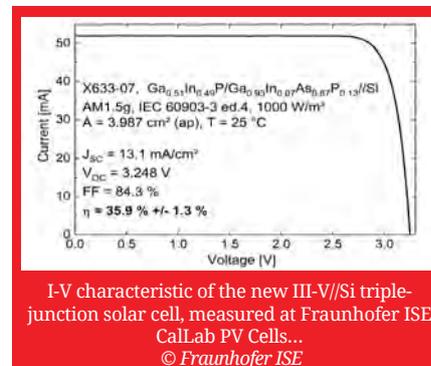
The new monolithic triple-junction solar cell – or more specifically, a III-V//Si tandem solar cell – converts 35.9% of sunlight into electrical energy. This value measured under the terrestrial AM1.5g spectrum, sets a new world record and demonstrates the potential of silicon-based tandem photovoltaics. In the new record-breaking cell, the III-V semiconductor layers are connected directly to the silicon subcell on the atomic level. From the outside, the record cell resembles a two-terminal conventional solar

cell. This two-terminal cell achieves the same efficiency as the best four-terminal solar cells with mechanically stacked structures, as published jointly by NREL, CSEM and EPFL in 2017. “The use of a new compound semiconductor (GaInAsP) for the middle cell was a key step in our success in achieving the improved efficiency value. The new material allowed us to further improve the lifetime of the charge carriers and thus achieve a higher cell voltage. It’s great to see how our material development has successfully contributed to improvements in III-V//Si triple-junction solar cells,” said Patrick Schyguilla, doctoral student in the Department of III-V Photovoltaics and Concentrator Technology at Fraunhofer ISE.

Initial applications for high efficiency III-V//Si tandem cells are found where the power generation per area plays an important role, for example, in electrically powered aircraft and drones. Today, the production costs of the new cells are still significantly higher than conventional single-junction crystalline silicon



The rainbow colours show the diffraction of sunlight by a mirror with a nanostructured grating, which was applied to the back of the silicon subcell. The sun’s spectrum is thus captured even better in the silicon bottom cell...
© Fraunhofer ISE / Photo: Michael Schachtner



solar cells. This is due to the complex epitaxy step of the III-V layers and the many additional semiconductor processes required to manufacture the cells. The researchers at Fraunhofer ISE are working intensively to make the production more cost-effective in the future and thus also address the terrestrial photovoltaic market.

“Combining III-V semiconductor materials on silicon is one of the approaches that we are pursuing with tandem structures (i.e., the combination of different high-performance materials) in order to achieve higher solar cell efficiencies. It will be a few years before any PV modules made from the type of solar cell presented here are available on the market; however, this is an important, forward-looking path in the context of the photovoltaic expansion, which is necessary for a sustainable energy supply,” explained Prof. Andreas Bett, Institute Director of Fraunhofer ISE.

Initial applications for high efficiency III-V//Si tandem cells are found where the power generation per area plays an important role, for example, in electrically powered aircraft and drones.

“THE SELECTION CRITERIA FOR LOW-VOLTAGE SWITCHGEARS HAVE EVOLVED...”



With a focus on electrification, automation and digitalization, Siemens India stands for engineering excellence, innovation and reliability. In an exclusive e-interview, Chandrashekhar Shrotri; Business Unit Head - Electrical Products, Smart Infrastructure, Siemens Limited describes some recent facts on the low voltage switchgear business in India to P. K. Chatterjee (PK). Excerpts...

How is the demand growing for low voltage switchgears in India?

The demand for low-voltage switchgears in India has been growing at a healthy CAGR of approximately 8-9% for the past 10-15 years. The slower growth witnessed last year due to the global pandemic is temporary. Despite the on-going disruptions, we expect the market to maintain the high-growth trajectory in the medium to long term. We believe that the various government measures announced to boost the economy and investments in infrastructure segments such as renewables, railways, data centers, metro rail, pharmaceuticals & hospital projects



will spur growth. The main drivers of demand on the industry side will be steel & cement industries.

Do you feel that the selection criteria are changing among the customers or end-users?

The selection criteria for low-voltage switchgears have evolved over a period of time. End-users are no longer making decisions based on purchase price alone but are mindful of the 'lifetime cost' of the products. Customers are giving due importance to the value-added services that switchgear OEMs offer to them apart from the product itself. The value-added services could be in the traditional post-purchase area such as servicing, training or the innovative area of pre-purchase topics such as optimized product selection or system configuration. Also, safety is fast evolving into an important selection criterion – be it equipment or plant safety or operator safety.

Do you see any new trends in this business?

One of the trends that has caught up well due to awareness and focus on safety is acceptance of fully type-tested panels by the end users. The Bureau of Indian Standards has also revised the standard for LV panels (IS-61439) to facilitate this change towards the fully type-tested panels. Due to the combination of these factors, the business of fully type-tested panels has seen a steady growth in the last five years.

The main challenge faced by the customers is of seamless integration of various digitally enabled products such as switchgear, instrumentation and building automation. These products follow different protocols and need to be brought on the same platform.

In power distribution, a clear trend is visible with customers opting for microprocessor-based circuit breakers (ACB & MCCB). Modern circuit breakers offer enhanced protection & energy transparency. Another trend that is noticeable particularly in process industry is adoption of intelligent motor control centers (i-MCC) in place of age-old conventional motor control centers (c-MCC).

Apart from these factors, panel builders are now looking for modular systems for faster assembly of control cabinets / machine panels, as a result of rise in wages and limited availability of skilled manpower.

What is the effect of COVID - 19 on this business?

COVID-19 has temporarily dampened the market

growth. However, we still see potential in mid- to long-term growth. The pandemic has brought focus on remote operations and services, which would accentuate the technological shift and focus on digitalization. New social distancing norms are here to stay and adherence to these norms will necessitate lean workforce. Modular switchgear systems will help panel builders to maintain their output despite a lean workforce because of the higher throughput possibility.

Has Siemens launched any new series of LV switch gears in the recent past?

At Siemens, product innovation is a continuous process. We regularly bring out new products with enhanced features. Recently, we introduced a new generation of soft-starters with innovations such as 'pump blockage' protection, 'pump dry-run' protection, 'emergency mode' operation and 'auto-parameterization' feature that improves system reliability & saves commissioning time. We also introduced a new range of ACB and MCCB, which is an ideal fit for infrastructure applications.

How has digitalization played a role in the current scenario for your business?

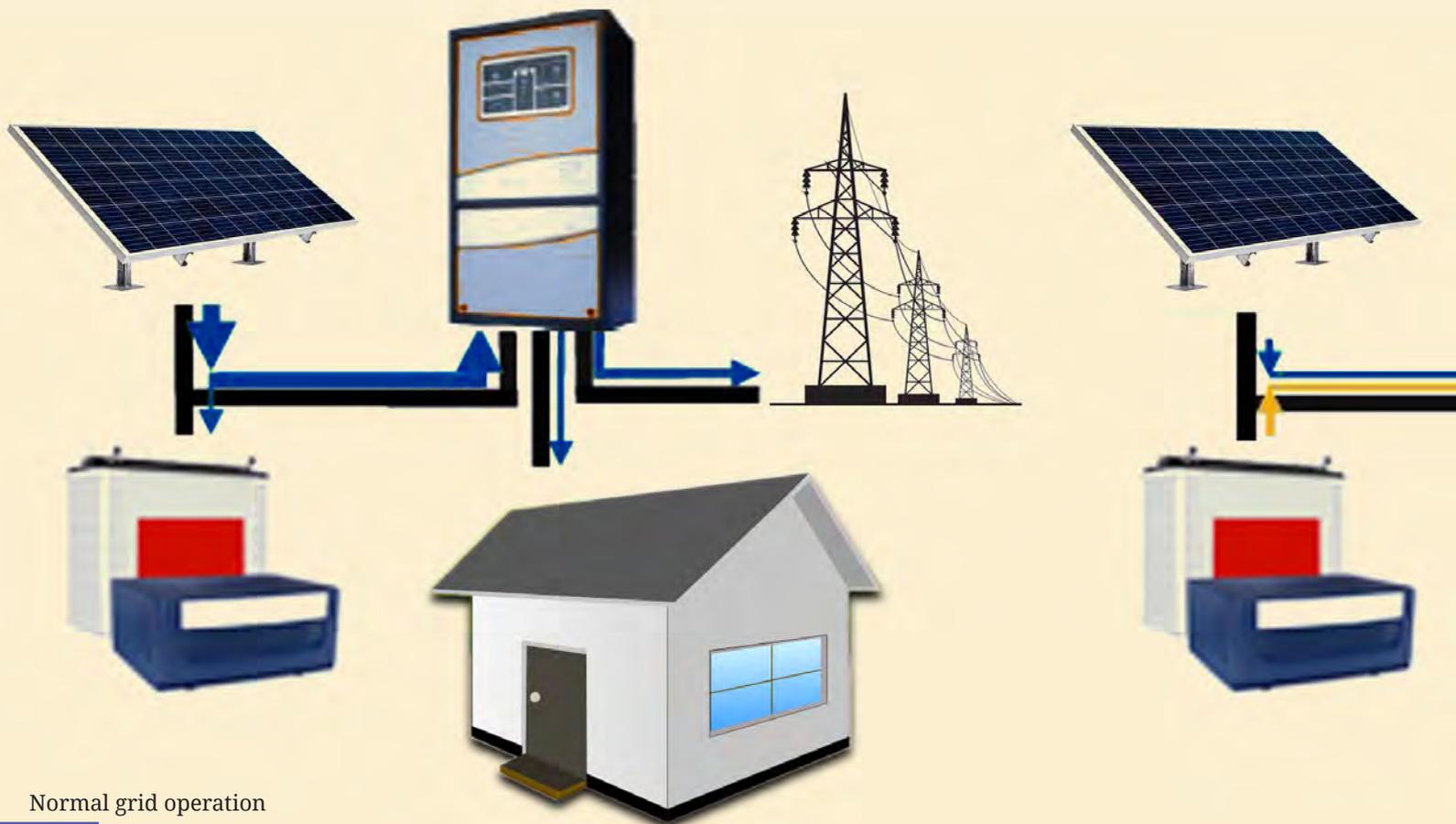
Digitalization has provided the industry with unparalleled opportunities for value creation. This technological shift is helping achieve higher productivity, quality and efficiency. Siemens is a pioneer in driving digital transformation in industry and infrastructure. Low-voltage switchgears are increasingly becoming interconnected, from ACB right down to MCB or a push button. Communication-capable digital panel meters along with Energy Management software help customers get total transparency of energy consumption and offer energy-saving possibilities.

Would you like to communicate any message to the readers of Electrical India?

Like any market, our switchgear market evolves with the support and collaboration among all its stakeholders. Continuous feedback from panel builders, OEMs, consultants, and end users with the switchgear manufacturers helps in building better products with new technologies. In this constantly changing environment, our most important goal should be to safeguard our health and wellbeing. I would urge everyone to always follow safety protocols.



INTENTIONAL ISLANDING & RENEWABLES



Normal grid operation

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At first glance, this condition seems a favourable one with respect to energy self-sufficiency. But when we look from the side of grid stability & reliability, islanding, if not detected at site and corrective measures are taken, can result in a whole range of electrical issues...

Islanding is an electrical system phenomenon in which distributed generators, say Diesel Generators (DGs), continue to power a site or location in the absence of external grid power or grid outage situations.

To understand this, let's start with a basic grid-connected system. We have electrical power lines coming from the grid, the many devices & systems at the site using the incoming power (collectively termed as load) and an auxiliary power source(s) at the location (like the generally seen diesel generators). These local sources of power come under 'distributed generators',



Grid failure operation

which are present for on-site backup power in case of blackouts, grid outages & any other transmission or reception issue with grid lines. They can also be used in ramping the input power up in cases of increased load or grid power insufficient to satisfy the said load. So, whenever there is a grid issue and input power shuts off, the DGs turn ON and ensure that the circuit is complete & producing enough power to meet the site load. This is what islanding means, the continued functioning by creating a 'micro-grid' type scenario wherein on-site power generated satisfies on-site load.

At first glance, this condition seems a favourable one with respect to energy self-sufficiency. But when we look from the side of grid stability & reliability, islanding, if not detected at site & corrective measures are taken, can result in a whole range of electrical issues. If DGs continue to run when the grid power is restored, there will be an imbalance between load & generation. Along with this, issues resulting in abnormal frequencies and voltage levels can potentially threaten grid power stability. Hence, from a regulatory standpoint, it is advised that any islanding be detected and DGs immediately disconnect the circuit which is called 'anti-islanding'.

Although anti-islanding is a valid grid-side argument, there is much anticipation if the Indian grid is prepared to accommodate the forecasted boom in distributed energy systems. Energy security & self-sufficiency, even at a local level, has gained much traction, especially with our traditional grid infrastructure stagnating. It is argued that in a nation like ours, with our inadequacies in meeting peak loads & frequent grid outages (especially in the summertime when grid stability & reliability are seriously tested), anti-islanding policy needs a rethink. There is also increasing voice put behind 'intentional islanding', especially in the rapidly rising renewable space.

This increasing role of renewables is evident in the many green projects undertaken to create hybrid power systems, even some of them replacing DGs with solar PV, wind and such. Though this serves good for the consumer load, this poses an interesting challenge in making our grid functioning robust enough to accommodate these changes. One major issue is that of the intermittent & unreliable generation from renewables. Solar PV only works when daytime irradiance is good and wind turbines rely on shifty wind patterns whereas DGs are fueled by diesel and can give a stable power supply. So, reliable estimation of renewable power (to ensure grid stability) & storage solutions (to meet load requirement) are needed to effectively transition into intentional islanding. ¹³



Vijay Bhaskar

The author is a Senior Associate, Analytics, Amplus Solar.



Fig. 1: 60MWp floating solar PV system on Tengeh Reservoir, Singapore...



Fig. 2: Floating Solar PV Plant - Yamakura Dam, Japan...

PUTTING SOLAR PANELS ON WATER

Although very helpful as far as carbon neutralisation is concerned, land acquisition for putting Solar Plants is a very costly affair these days. Thus, the latest trend is putting floating solar plants. However, there are other risk factors involved. Can we overcome those?



Fig. 3: Image: Solar Power Plant Business / Nikkei Business Publications, Inc...

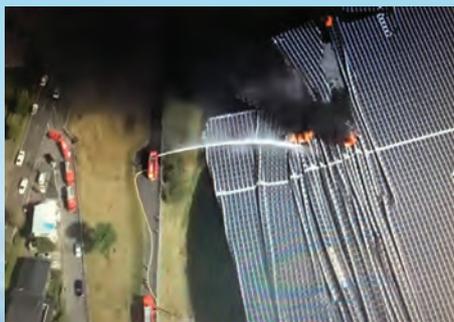
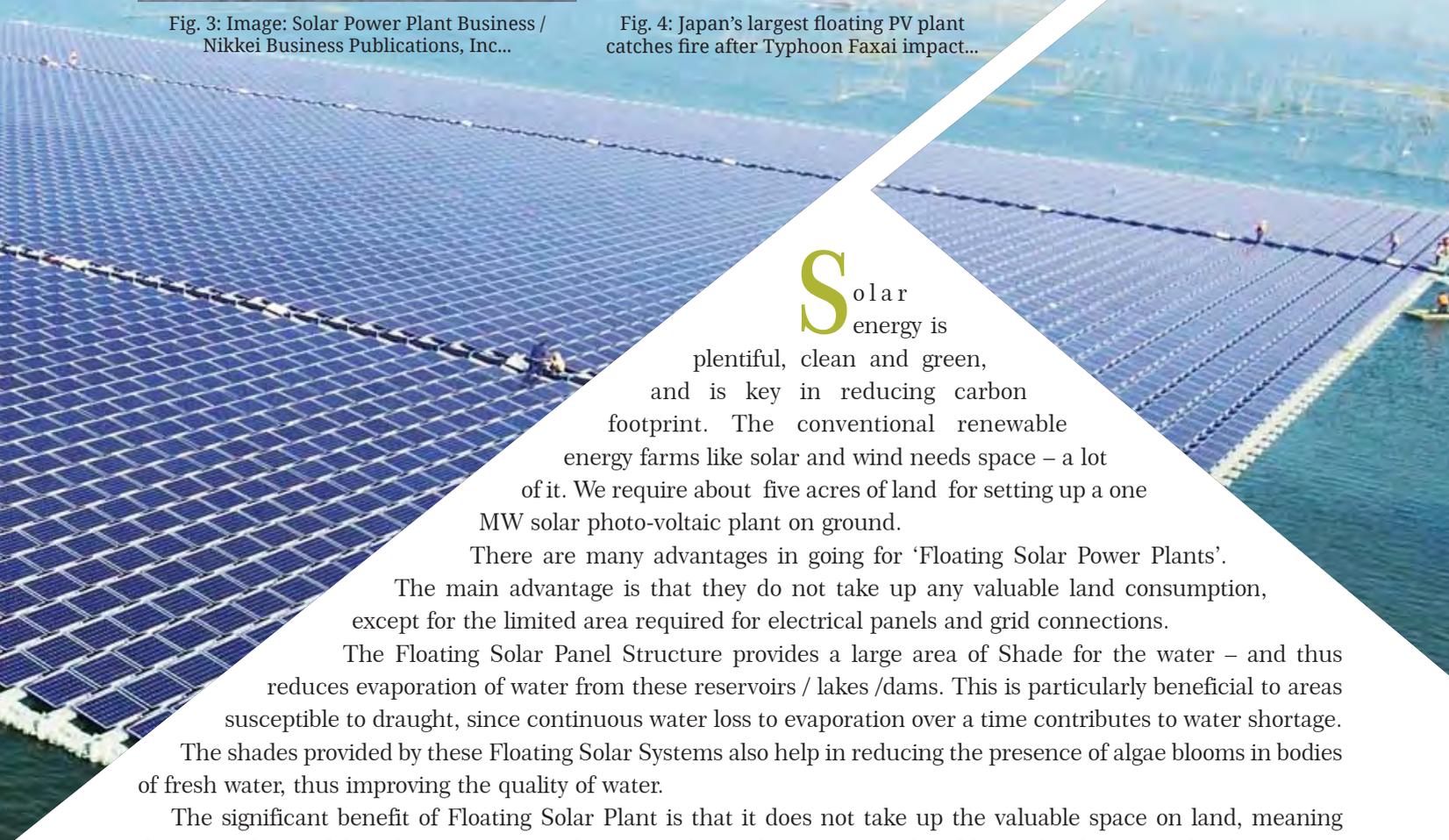


Fig. 4: Japan's largest floating PV plant catches fire after Typhoon Faxai impact...



Solar energy is plentiful, clean and green, and is key in reducing carbon footprint. The conventional renewable energy farms like solar and wind needs space – a lot of it. We require about five acres of land for setting up a one MW solar photo-voltaic plant on ground.

There are many advantages in going for 'Floating Solar Power Plants'.

The main advantage is that they do not take up any valuable land consumption, except for the limited area required for electrical panels and grid connections.

The Floating Solar Panel Structure provides a large area of Shade for the water – and thus reduces evaporation of water from these reservoirs / lakes /dams. This is particularly beneficial to areas susceptible to draught, since continuous water loss to evaporation over a time contributes to water shortage.

The shades provided by these Floating Solar Systems also help in reducing the presence of algae blooms in bodies of fresh water, thus improving the quality of water.

The significant benefit of Floating Solar Plant is that it does not take up the valuable space on land, meaning that it can be used for other purposes such as agriculture, Construction of Buildings, development of Industry etc.

Another advantage is that the presence of water exerts a cooling effect, which improves the performance of Solar PV Panels by 5-10%. Solar PV Panels being themselves water proof, rain or floating water can't damage them.

Floating solar PV system on Tengeh reservoir

Singapore is one of the smallest countries in the world, and it is also among the biggest per capita carbon dioxide emitters in Asia. Renewable energy is a challenge for this country with no rivers for Hydro Electricity & no wind that is strong enough to power Wind Turbines. In a bid to tackle climate change, the country is building one of the world's largest floating solar farm.

The conventional renewable energy farms, like Solar and wind, need space – a lot of it. This important factor places a bottleneck on the green energy ambitions of Singapore, an island state with a population of 5.63 million and a land area of 724 sq. kms. The high levels of urbanization and the towering metropolis are not favourable to solar and wind farms.

Singapore's National Water Agency, & Sembcorp Floating Solar Singapore, which are partnering to build a 60 Mega Watt- peak (MWp) Floating Solar PV system on Tengeh Reservoir; with 122,000-panels solar farm, will be one of the biggest in South-East Asia covering an area, the size of about 45 football pitches.(Fig.1). Despite there is some delay in the project

Solar Plant

execution due to the pandemic situation, it is likely to be commissioned before end of 2021.

To ensure operational excellence, sustainability and safety of the large scale project, every component of the Floating Solar System has been carefully chosen & designed. This includes the need to maximise energy generation, minimise environmental impact, and be durable enough to last its entire life span of 25 years.

Another very important factor in selection of this project was to overcome Singapore's Land Constraints in pursuit of greater renewable energy generation, thus contributing to the national climate change mitigation. The aim is to reduce reliance on fossil fuels, cut emissions and build climate resilience. The Singapore Government recently unveiled a wide-ranging 'green plan' that includes steps such as planting more trees, reduce the amount of waste sent to landfills and build more battery charging points to encourage the use of electric cars.

The energy generated from this floating Solar project is sufficient in greening the Singapore's water works, that is, the energy generated is sufficient to meet the needs of Singapore's water works, which will be one of the few in the world to be 100% green. This is equivalent to the reduction of carbon emission equivalent to 7000 cars.

The floats are made of UV-resistant High Density Polyethylene (HDPE), and the solar panels are made of double-glass modules to increase their durability and life span. PV panels are tilted for efficient energy generation and rainwater drainage. They are also coated with anti-reflective materials to minimize glare. The floats are anchored to the reservoir beds using steel cables / chains.

Currently, many countries are going in for Floating Solar PV projects. Kyocera Corp. of Japan, has come up with a smart way to build and deploy floating solar power plants without gobbling up precious agricultural land in space-challenged Japan, by building the plants on freshwater dams and lakes. This Japanese 13.7 MWp floating photovoltaic plant sits behind the Yamakura Dam at Ichihara in Chiba Prefecture. It can power nearly 4,700 homes and is saving more than 7,800 tonnes of CO₂ a year. It consists of 50,000 solar panels. It is located in 13 ha of water area. This project, which is Japan's largest floating PV power plant, was inaugurated by Kyocera in March 2018 at the Yamakura Dam in Ichihara City, Japan. (Fig.2)

Unfortunately, during the second week of September 2019, part of the above Floating Solar Plant at Yamakura Dam was damaged by the 125 mph wind brought by the

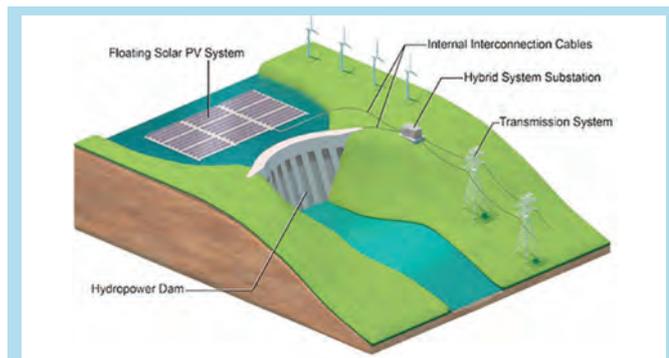


Fig. 5: A schematic of a hybrid floating PV & hydropower system...

Typhoon Faxai. Then it caught fire. It was suspected that the high speed wind, tore several floating modules of the project and stacked them one above the other. This is suspected to be an anchor failure. The fire fighters were of the opinion that the contact between live loose panels and those that remained moored to mounting structures, might have caused short circuit / overheating of the modules, creating the conditions for a fire. This incident need to be kept in mind when planning Floating Solar PV Plants in areas experiencing high speed winds & typhoons. Properly designed and strengthened anchoring of the panels is a must to avoid such incidents. (Fig.3)

After the outermost row had ripped off, the wind-facing edge did not have any ballast anymore to counter uplift from wind. The modules and floaters began to curl-up with the result of an electrical fire. (Fig.4)

India's biggest floating solar power plant is coming up in Telangana

National Thermal Power Corporation (NTPC) has a 2,600 MW Super Thermal Power Station at Ramagundam, Telangana. This project has its own water Reservoir meeting the requirements of the Thermal Power Plant. Now NTPC is setting up India's biggest Floating Solar Power Plant in this reservoir, with a capacity of 100 MW, which is expected to become operational in Telangana soon. This floating solar project, spread over 450 acres, will have 4.5 Lakhs PV panels, at a cost of Rs.423 crores.

Conventional Solar PV plants when located on land, require about five acres of land per MW capacity. Given the challenges in land acquisitions, NTPC is going for the floating method. Further, NTPC is planning a 92 MW Floating Solar plant at Kayamkulam Gas plant in Kerala, as well as a 25MW Floating Solar Plant at Simhadri Power Plant in Vizag. This is in line with our country's commitment towards development of Renewable Energy.

As per NTPC officials, setting up Floating Solar units on water bodies and huge reservoirs help them in cutting down on the costs. Floating Solar Units prove to be cost effective when compared to Ground- Mounted solar plants.

NTPC in its enthusiasm to expand its power generation by introducing Floating Solar PV Projects, has to keep in mind the damages caused by the typhoon in Japan – and ensure that proper anchoring designs are followed in the Floating Solar Plants to prevent such mishaps.

Hybrid systems

According to the researchers at the US Department of Energy’s National Renewable Energy Laboratory (NREL), hybrid systems of Floating Solar Panels & Hydro Power Plants will hold the technical potential to produce a significant portion of the electricity generated annually across the globe. Floating solar farms on existing hydropower reservoirs could cut solar costs and meet 40% of the world’s energy needs, they found.

Following are the technical potentials of the hybrid systems using Hydro Power Reservoirs for Floating PV panels, instead of using lakes or ponds.

The most important one is that the solar power system can use the existing infrastructure and transmission lines of the hydropower facility, which cuts capital costs. Plus, the two technologies can balance each other since solar power has the most potential during dry seasons – while rainy seasons are best for hydropower. So, at a hybrid plant, operators could store excess solar power using pumped storage hydropower, where electricity is used to pump water to a higher elevation. (Fig.5)

Usage of Floating Solar PV Panels on the reservoirs of Thermal Power Plants, as conceived by NTPC, can also form an Hybrid version which will save lot of land acquisition costs as well as develop Renewable Energy to cut down Carbon Emission. “Putting Solar Panels on Water Is a Great Idea—Yes, it will work.”



C. V. Govinda Raju is a former Executive Director of Karnataka Vidyuth Karkhane Ltd., Bangalore & the Former President of ISPAT group of Company.



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“WE’RE AIMING TO INNOVATE, DESIGN AND MANUFACTURE THE BEST SOLAR PRODUCTS”

In 1998, with the vision of an Ex-Professor of an Engg. College, Goutam Solar started supplying solar components to System Integrators. Later, it set up an R&D Center and four factories in Haridwar for manufacturing solar components in the entire value chain of Distributed Solar. In an exclusive e-interview, Gautam Mohanka, Managing Director of the company, is fielding questions from P. K. Chatterjee (PK) on the growth of the solar components manufacturing segment in India. Excerpts...

Is India capable of indigenously manufacturing world-class solar panels at competitive prices?

I think India most certainly is capable of producing world-class solar panels at competitive prices. However, at the moment we’re still dependent on other countries for sourcing raw materials that go into the production of solar panels. Things are beginning to change though – and government policies are empowering local manufacturing. Perhaps within a year or two, we will be able to produce solar panels in the country, not only to meet our demand but also to scale up our production in

such a way that we become an important player in the global market.

How is the domestic industry shaping up?

The domestic industry is on a growth trajectory despite the adverse situations created by the COVID - 19 pandemic. The industry is scaling up its production capacity to meet the increasing demand as well. The only issue it is facing at the moment is that the prices of raw materials are fluctuating due to broken supply chains. This, in turn, is causing the prices of finished



Caption 1: A view of a project by Gautam Solar...

products to fluctuate. However, I believe as the pandemic becomes more manageable and things settle down within a year or two, the market will start registering tremendous growth.

What kind of support is being obtained from the government's end?

The government has very recently launched the Production-Linked Incentive (PLI) scheme, which is supposed to help the manufacturers. The details about the scheme, though, are still to be announced and we're all waiting for that.

What is Gautam Solar's role in this journey?

Gautam Solar has always played an important role in the growth of the solar industry. From being the very first 100% Indian solar manufacturer that produces everything in-situ to pioneering new products, we've always kept development at the center of our focus. Through our products, we've helped System Integrators (SIs) all over the country. We started with a production capacity of



A view of solar panels fixed on an uneven land...

just 30 MW and now we're at 250 MW. That is a growth of more than 800%, which shows that we've become an integral part of the solar industry.

How is the pandemic affecting the growth of this industry?

The energy demand is continuing to grow and the pandemic has had little effect on that. While procuring raw materials has become a bit of a challenge due to the lockdown situation in many states, we haven't seen a fall in our demand. The System Integrators (SIs) that have been employed by the government for certain projects are still working on those projects, and we're supplying them with the products they need. So, I believe that the demand for solar panels should remain steady despite the pandemic.

What are your plans for the future?

We are always looking to devise new strategies to increase our production capacity to meet the rising demand. Besides that, we're aiming to innovate, design, and manufacture the best, most robust solar products that meet the requirements of the Indian customers (farmers, urban families, commercial and industrial enterprises, and the government sector).

Please tell me about your R&D (Research and Development) efforts.

We have an in-house R&D team that works closely with System Integrators (SIs) to come up with new and innovative products that can solve the problems that the people are facing.

What's your opinion on the next steps that the union government must take to achieve the target of 175 GW of renewable energy capacity by 2022?

I think the government is already doing a commendable job in promoting the development of solar energy in the country, which will constitute 100 GW to the total target of 175 GW. The government has come up with several fiscal and promotional incentives such as accelerated depreciation, waiver of Inter-State Transmission System (ISTS) charges, and losses, financing solar rooftop systems as part of the home loan and permitting FDI (Foreign Direct Investment) up to 100% under the automatic route. We believe that with these measures, we will become successful in increasing renewable energy production in the country – especially in terms of solar energy.

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ALL INDIA INSTALLED CAPACITY (IN MW) OF POWER STATIONS
(As on 30.04.2021)

Region	Ownership/ Sector	Mode wise breakup								Grand Total
		Thermal					Nuclear	Hydro	RES * NRE)	
		Coal	Lignite	Gas	Diesel	Total				
Northern Region	State	16659.00	250.00	2879.20	0.00	19788.20	0.00	5888.25	725.51	26401.96
	Private	22425.83	1080.00	558.00	0.00	24063.83	0.00	2916.00	17642.46	44622.29
	Central	15742.56	250.00	2344.06	0.00	18336.62	1620.00	11484.52	379.00	31820.14
	Sub Total	54827.39	1580.00	5781.26	0.00	62188.65	1620.00	20288.77	18746.97	102844.39
Western Region	State	21500.00	900.00	2849.82	0.00	25249.82	0.00	5446.50	569.28	31265.60
	Private	32847.17	500.00	4676.00	0.00	38023.17	0.00	481.00	28388.87	66893.04
	Central	19972.95	0.00	3280.67	0.00	23253.62	1840.00	1635.00	666.30	27394.92
	Sub Total	74320.12	1400.00	10806.49	0.00	86526.61	1840.00	7562.50	29624.45	125553.56
Southern Region	State	20322.50	0.00	791.98	159.96	21274.44	0.00	11774.83	586.88	33636.15
	Private	12747.00	250.00	5340.24	273.70	18610.95	0.00	0.00	43512.10	62123.05
	Central	11835.02	3390.00	359.58	0.00	15584.60	3320.00	0.00	541.90	19446.50
	Sub Total	44904.52	3640.00	6491.80	433.66	55469.99	3320.00	11774.83	44640.88	115205.70
Eastern Region	State	7450.00	0.00	100.00	0.00	7550.00	0.00	3537.92	275.11	11363.03
	Private	6153.00	0.00	0.00	0.00	6153.00	0.00	96.00	1309.63	7558.63
	Central	14249.45	0.00	0.00	0.00	14249.45	0.00	1005.20	10.00	15264.65
	Sub Total	27852.45	0.00	100.00	0.00	27952.45	0.00	4639.12	1594.74	34186.31
North Eastern Region	State	0.00	0.00	466.36	36.00	502.36	0.00	422.00	233.25	1157.60
	Private	0.00	0.00	24.50	0.00	24.50	0.00	0.00	107.08	131.58
	Central	770.02	0.00	1253.60	0.00	2023.62	0.00	1522.00	30.00	3575.62
	Sub Total	770.02	0.00	1744.46	36.00	2550.48	0.00	1944.00	370.33	4864.80
Islands	State	0.00	0.00	0.00	40.05	40.05	0.00	0.00	5.25	45.30
	Private	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.87	24.87
	Central	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10	5.10
	Sub Total	0.00	0.00	0.00	40.05	40.05	0.00	0.00	35.22	75.27
ALL INDIA	State	65931.50	1150.00	7087.36	236.01	74404.86	0.00	27069.50	2395.27	103869.64
	Private	74173.00	1830.00	10598.74	273.70	86875.45	0.00	3493.00	90985.01	181353.46
	Central	62570.00	3640.00	7237.91	0.00	73447.91	6780.00	15646.72	1632.30	97506.93
	Total	202674.50	6620.00	24924.01	509.71	234728.22	6780.00	46209.22	95012.59	382730.02

Figures at decimal may not tally due to rounding off

Source: CEA

High - Performance Thermal Camera with Viewfinder FLIR T800-Series



FLIR T800-Series thermal imaging cameras provide a noncontact inspection method with a tilting optic design, making it easy to safely and comfortably assess the condition of critical electrical and mechanical

equipment. Advanced features such as 1-Touch Level/Span contrast enhancement and sharp laser-assisted autofocus ensure the camera takes accurate temperature measurements every time. Plus, the T865 offers temperature measurement accuracy as good as $\pm 1^{\circ}\text{C} / \pm 1\%$ to help professionals make decisions quickly. T800-Series cameras are compatible with FLIR AutoCal interchangeable lenses, for simplified transition from scanning wide areas with the 42° lens to inspecting distant targets with the 6° telephoto lens. Adding a FLIR T800-Series camera to a condition monitoring/predictive maintenance program can help reduce maintenance costs, improve system efficiency and reliability, and prevent lost production and downtime due to outages. ¹⁵

For further information: E-mail: manpreet.Kaur@teledyneflir.com, Website: www.fir.com/T-Series



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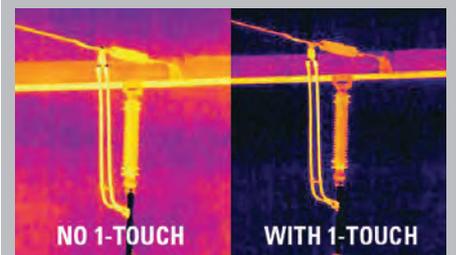
- Develop and download routes to the camera via FLIR Route Creator* for streamlined inspections of critical assets
- Acquire temperature data and thermal and visual imagery in a logical sequence for faster preventative/predictive maintenance procedures
- Automate data management and reporting through easy transfer of organized files to FLIR Thermal Studio*



WORK SAFELY AND COMFORTABLY

Assess the state of equipment from a safe distance, at any angle, or in any lighting condition

- Use the camera in any environment – indoors or out – with a large, vibrant 4-inch color LCD display and an integrated eyepiece viewfinder for working in bright sunlight
- Image targets overhead or down low without strain thanks to the 180° rotating optical block and ergonomic design
- Accurately measure small targets over long distances or in large scenes by pairing the high-resolution IR sensor with the optional 6° telephoto lens



MAKE CRITICAL DECISIONS QUICKLY

Save time and share data faster to increase in-field efficiency

- Ensure precision measurement with laser-assisted autofocus, 1-Touch Level/Span, and exceptional temperature accuracy†
- Avoid diagnostic errors with industry-leading image clarity from FLIR Vision Processing, combining MSX, UltraMax, and proprietary adaptive filtering algorithms
- Optimize workflows with reporting features such as built-in voice annotation, customizable work folders, and Wi-Fi sync to FLIR mobile apps

*All new purchases include a three-month trial of FLIR Thermal Studio Pro and the FLIR Route Creator plugin. At the end of the trial period, users who choose not to purchase a full-year subscription will be transitioned to FLIR Thermal Studio Starter.

†Accuracy as good as $\pm 1\%$ with T865, see specs for more details

RIGHT information for RIGHT Industry



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3 YEARS	18	2000.00	2900.00	3500.00	2000.00	3900.00	4500.00
5 YEARS	30	3000.00	4500.00	5500.00	3000.00	6000.00	7000.00
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3 YEARS	18	3200.00	4100.00	4700.00	3200.00	5100.00	5700.00
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Fast Connect cable from igus reduces harnessing time by 46 per cent

New flexible chainflex Profinet cable saves time-consuming stripping with knife and pliers...

igus now offers a new chainflex Profinet cable for fast cable harnessing in the field. For this purpose, igus relies on Fast Connect technology, which ensures that the cable can be stripped easily in just a few steps. This allows assembly time to be reduced by 46 per cent. At the same time, the new Profinet cable has a long service life, especially in dynamic use in the energy chain, and a guarantee of up to 36 months.

Thanks to Profinet technology, even large amounts of data can be transmitted at up to 100 Mbit/s on the basis of the Ethernet protocol. Profinet cables are often used in combination with an RJ45 connector in machine tools, packaging technology or in the field of handling. While many machine and plant operators already rely on ready-to-connect readychain energy chain systems, users in the field need cables from the drum which they adapt to the length and harness themselves. This may be the case, for example, if the cable has to be guided through a screw connection into the switch cabinet. Here, the only thing that fits through is the cable but not the connector. To



quickly join the connector to the cable, igus has now developed Fast Connect technology for its highly flexible chainflex Profinet cables. It ensures that the new CF898.061.FC can be stripped and fitted with a connector in just a few steps.

Fast Connect

The cable, a connector and a stripping tool: that's all the electrician needs for the harnessing. For this purpose, igus has designed the inner jacket, the shield and the outer jacket in such a way that the user only has to set the tool once, then remove the cable, insert the connector and close it. The whole process saves 46 per cent time compared to the conventional stripping of a classic cable with pliers and a knife. "With the new Profinet cable, we can offer users a highly flexible cable solution that is quick to assemble and at the same time has a long service life in moving applications", explains Andreas Muckes, Head of Product Management chainflex cables at igus GmbH. E1

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