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of Energy"

Status of Power Generation in India

Market Watch:
Smart Lighting Market
worth 20.98 Billion USD by 2023



Underground Cables
Complete Solution of Urban
Distribution Network



**Renewable Integrated
Microgrids**



**Light Emitting Diodes
with Plasmonics**



**Changing Landscape
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Hello and welcome once again to *Electrical India*. Development of any country is often closely linked to the consumption of energy. With over a quarter and billion people, the consumption of energy in India is sixth in the world and the thirst for energy is not over and will not be over if we have to keep pace with the developed world. More power generation would mean more stress on the environment. No doubt, the government is committed to solve this problem and is inclined to generating electricity by renewable, more so by solar.

Nevertheless, efficient use of electricity and conserving as much as possible will assume greater importance. Today, the concept is not of energy saved is energy generated as we have been propagating since the sixties but energy saved is twice energy generated. Our country can easily save about 30,000 MW of electricity just by using the electrical equipment properly and by constructing our buildings more energy-efficient.

According to government statistics, buildings - both commercial and residential - consumed almost 35% of our total electricity last year. In short, our buildings are nothing but energy guzzlers. With more and more citizens moving to cities this is bound to increase. With cost of energy going up there is a clear necessity for businesses to go for more green business strategy and practices and thereby reduce energy consumption in commercial buildings. After all energy bills can be a big burden financially and today organizations are finding ways to reduce their energy bills. Cooling buildings are one of the major cost factors in a commercial building.

New and improved usage of LED lighting can reduce the energy consumption substantially. This also generates less heat and so less load on air conditioning. Another important aspect is proper maintenance of HVAC. We still do not follow the already-existing Energy Conservation Building Code while constructing buildings. The authorities responsible to enforce this rule have had limited success thus far. It must be made mandatory just like there are strict guidelines for fire safety and structural standards without which occupancy certificate is not given to the building on completion of construction. This has to be implemented on top priority.

We look forward to receiving your comments and suggestions and I hope you enjoy reading this issue as much as we have in bringing this to you. Do send me an email at miyer@charypublications.in

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ADB, ISA commit to promote Solar Energy in Asia & Pacific Region

The Asian Development Bank (ADB) and the International Solar Alliance (ISA) signed a cooperation arrangement to promote solar energy deployment in Asia and the Pacific, including solar power generation, solar based mini-grids, and transmission systems for integrating solar energy into grids.

The signatories to the arrangement were Upendra Tripathy, Interim Director General of ISA, and Bambang Susantono, ADB Vice-President for Knowledge Management and Sustainable Development, in the presence of India Finance Minister and ADB Governor Arun Jaitley.

Both parties agreed to cooperate on knowledge sharing and developing technology roadmaps for the promotion of solar energy, develop financing instruments to support solar energy deployment, and conduct studies and consultations to explore mobilisation of concessional financing through trust funds or special funds administered by ADB.

ISA, headquartered in Gurugram near New Delhi, is now a treaty-based intergovernmental organisation that was established following the Paris Declaration as an alliance dedicated to the promotion of solar energy among its member countries. 


BHEL wins order for Supercritical Power Plant in Jharkhand

Amidst stiff international competitive bidding (ICB), Bharat Heavy Electricals Limited (BHEL) has won a Rs.11,700 Crore order for setting up a 3x800 MW supercritical thermal power plant in Jharkhand.

The order for setting up the 3x800 MW Patratu Super Thermal Power Station Expansion, Phase-I (3x 800 MW) has been placed on BHEL by Patratu Vidyut Utpadan Nigam Limited (PVUNL - a subsidiary of NTPC Ltd. in Joint Venture with Jharkhand Bijli Vitran Nigam Limited).

Significantly, this is the single largest order ever placed by NTPC or its subsidiaries and the second

largest order ever won by BHEL. Located at Patratu in Ramgarh district of Jharkhand, the project will be executed by BHEL on Engineering, Procurement and Construction (EPC) basis.


The project will significantly contribute to the nation's quest for clean and eco-friendly power in multiple ways. It will reduce fuel consumption by employing high efficiency equipment working at higher operating parameters. The commissioning of the project would also lead to phasing out of the old fleet of sub-critical units presently installed at Patratu, enabling a quantum leap in efficiency of the station. 

IREDA & EIB sign Euro 150 million loan agreement

European Investment Bank (EIB) and Indian Renewable Energy Development Agency (IREDA) Ltd. have signed a loan agreement for a second line of credit (LoC) of Euro 150 million on non-sovereign basis here, today. The line of credit is for tenure of 15 years including a grace period of 3 years, and it will be used for financing Renewable Energy and Energy Efficiency projects in India. More than 1.1 million households are expected to benefit from clean energy produced with these funds.

The loan agreement was signed by K S Popli, Chairman and Managing Director, IREDA and W. Hoyer, President, EIB in the presence of R K Singh,

Union Minister of State (IC) Power and New & Renewable Energy and Anand Kumar, Secretary, MNRE. R K Singh said, "There are villages in Ladakh and Arunachal Pradesh where you track on foot for three to four days to reach. Our aim is to bring electricity to even these remote places.... We have decided to go green, as we have a responsibility to future generations and the planet."

Highlighting the fact that renewable energy (RE) has now become economically viable, he said that companies bidding for RE projects are getting funds from all over the world.... Today, many countries want us to share our experience in this field. 



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IBC SOLAR connects 3 MW Solar power to the grid in India

IBC SOLAR, a global leader in photovoltaic (PV) systems and energy storage, has widened its business in India. Yesterday, 13.03.2018, the inauguration ceremony took place at the plant site in Tamil Nadu.

The project is part of India's Open Access Policy. With the Electricity Act (2003) the government confirms open access to the transmission lines as an encouragement to private investors to enter the electricity generation sector. Under this provision every person, who has constructed a captive



generating plant is entitled to open access to the transmission lines for carrying electricity from their plant to the destination of its use. It is similar to a self-consumption plant with some distance between generator and consumption point.

The now inaugurated project is IBC SOLAR's first solar park under this provision. LNB Renewable Energy executed the complete project development, approvals and transmission line works whereas IBC SOLAR performed the EPC.

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NTPC IIMA joins hands for World Class Institute in Energy Management

India's power sector leader NTPC and top business school IIM-Ahmedabad revealed a joint initiative to create a world class research institute at NTPC School of Business for policy prescription and churn out management graduates with focus on energy sector.

"We are proud to have entered an agreement, under which India's marquee business school -- Indian Institute of Management, Ahmedabad - will hand hold NTPC School of Business to replicate its management



At the occasion

degree courses beginning this year with special focus on energy verticals not only for NTPC but for the entire power sector," Saptarshi Roy, Human Resource Director of Maharatna PSU, said

on the occasion of the alliance.

"This is the first time we are tying up with a leading academic institution for degree and other specialised courses on the lines of IIM-A," IIM-A's HRM Area Chair and Strategic Management Professor Sunil Kumar Maheshwari said.

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One Million solar study lamps scheme successfully implemented

A new project for distribution of 70 lakh solar study lamps in the states of Assam, Bihar, Jharkhand Odisha and Uttar Pradesh which was sanctioned by the Ministry of New and Renewable Energy (MNRE) in December 2016, is currently under implementation. The One Million Solar Study Lamps Scheme which was sanctioned in January 2014 for empowering underserved communities of Rajasthan, Madhya Pradesh and Maharashtra has been successfully completed. Following this the Ministry sanctioned 5 lakh solar study lamps in various states in May 2016.



In Rajasthan a total of 3.06 lakh solar study lamps have been distributed and 927 persons including 360 women have been trained for local assembly and repair of the solar study lamps. The MNRE also has a separate skill development programme 'Surya Mitra' for imparting training in the field of solar energy for installation and repair and maintenance of solar power systems.

This information was provided by the Minister of State (IC) for New and Renewable Energy and Power R. K Singh in a written reply to a question in Rajya Sabha.

15



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Inox Wind wins 50MW in the Maharashtra State auctions

Inox Wind, one of India's leading wind energy solutions providers, has won 50MW in the Maharashtra state auctions. The bid was won at a fixed price of Rs2.86/unit for 25 years. This win is on back of the 300MW order win from SECI-1 auctions, 300MW in SECI-2 auctions and 200MW from SECI-3 auctions. This win enhances our auction based order book to a sector leading 850MW.

The 50MW project would be executed over the next 12-15 months and Inox Wind will be responsible for the development, construction and commissioning and will provide long-term operations and maintenance services. Our wins in SECI and



Maharashtra state auctions are the testament to our competitiveness in the auction regime. Our low-cost structure makes us one of the lowest cost producers of wind turbines and places us in an ideal position under this regime. We would also highlight that our order book can be higher from the Maharashtra auction if we are selected by other winning IPPs. 

L&T JV secures order for Nuclear Steam Generator Forgings

L&T Special Steels and Heavy Forgings, a joint venture of Larsen & Toubro (L&T) and Nuclear Power Corporation of India Limited (NPCIL), has a state-of-the-art facility and is qualified to produce a wide range of critical heavy forgings for the nuclear, hydrocarbon, oil & gas and strategic sectors. It has received an order worth `442 Crore from NPCIL to supply forgings for steam generators.



Shailendra Roy

the critical equipment for six new indigenous 700 MWe Pressurised Heavy Water Reactors (PHWRs). This requirement is part of the Government of India's ambitious plan to put up 10 PHWR units.

Commenting on the forgings order, Shailendra Roy, Whole-Time Director (Power, Heavy Engg. & Nuclear), L&T, said, "This prestigious order from NPCIL reinforces L&T's standing in the country as

These forgings will be used in the manufacture of a major player in the nuclear power sector." 

Legrand India reveals its experiential centre-Innoval in Ahmedabad


Legrand India, a global leader in electrical and digital building infrastructure inaugurated their state of the art experience centre Innoval in Ahmedabad. Innoval will host its India group company products – Legrand, Numeric & Valrack. Globally Innoval's are present at France, Greece, Chile, Brazil, Colombia, Dubai, and made its first-time entry in the Asia Pacific region with its launch in Mumbai, India. The company is now all set to amaze the Ahmedabad market with its experiential centre launch today. Legrand India plans to have eight Innoval



Sameer Kakkar, Director Sales, Legrand India along with Palash Nandy, CEO, Numeric India at the launch of Innoval Experiential Centre in Ahmedabad

experiential centres by end of 2018 in India.

Innoval is Legrand's global brand of product showcases. The name Innoval is a reflection of Legrand's brand value of developing ranges of innovative products. The narrative at Innoval is based on the concept of 'Source to End Usage', where the products are arranged in relation to each other and according to where they fall on the energy and data

distribution grid. Keeping in mind the vastly different profiles of visitors, the products are arranged as per the business verticals. 



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Schneider Electric India inaugurates a Solar Lab in the capital

Schneider Electric India Foundation (SEIF) – the social commitment arm of Schneider Electric India, the leader in digital transformation of energy management and automation, revealed the inauguration of a world class Solar Lab in the capital city, as a part of its robust ongoing skilling mission.

The project further strengthens the organisation's commitment towards supporting government of India in its efforts towards skilling the youth of the country for better employability in the Smart City era.



Venkat Garimella

The solar lab project will be part of New Delhi Municipal Council's (NDMC) Pradhan Mantri Kaushal Kendra (PMKK) Smart City Center, and will be educating youth on various facets of renewable energy sector in India, particularly solar.

Venkat Garimella, Vice- President, CSR & Energy Efficiency, Schneider Electric, said, "At Schneider, we believe that access to sustainable energy is a basic human right.

Considering the growing climate concerns, renewable energy is becoming a key source of energy generation world-wide."



Siemens installs state-of-the-art steam turbine

Siemens Limited completed the supply, installation and commissioning of an 8.5 MW steam turbine, gear box and related control panels for Kolkata-based Shakambhari Ispat & Power Limited, one of the leading manufacturers of steel and supply of power. This installation is in addition to an 8 MW steam turbine that was delivered in a record time of three months.

The industrial power sector has witnessed a remarkable growth in the last couple of years. The demand for power and energy continues to rise and



Shakambhari Ispat steam turbine

related energy costs have kept pace. The efficient utilisation of available energy sources has become essential and many industrial companies are prospecting for opportunities and solutions for improving efficiency or reducing costs.

Siemens Steam turbines can be instrumental in meeting targets of improved efficiency or reduced costs in industrial power plants. Deepak Kumar Agarwal, CMD, Shakambhari Ispat & Power Limited, said, "The association with Siemens has given us access to a wide variety of technically superior solutions."



Suzlon wins 75 MW repeat order from a leading IPP

Suzlon Group, revealed its order win for development of 75 MW wind power project from a leading Independent Power Producer (IPP) through Maharashtra State Electricity Distribution Company Limited (MSEDCL) bid. Suzlon will install around 36 units of S111-140m wind turbine generators (WTGs) with rated capacity of 2.1 MW each. The project will be located in Maharashtra and will be commissioned as per MSEDCL bid guidelines.

Suzlon will execute the entire project on a turnkey basis and will also provide comprehensive operation



J.P. Chalasani

and maintenance services for the complete project lifecycle.

J.P. Chalasani, Group CEO, Suzlon Group, said, "We are glad to partner with the leading IPP yet again for their MSEDCL bid project. We are encouraged by the trust and confidence demonstrated by them in Suzlon's technologically advanced and innovative products and services. With our two decades of experience, proven

technologies, comprehensive product portfolio, and end-to-end solutions along with integrated maintenance and services."



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Turkey's TEIAS relies on ABB technology to integrate renewables

The Turkish electricity transmission company TEIAS is striving for greater sustainability and reliability of electricity transmission with the help of ABB technology. Altogether, 5,000 modern protection and control relays from Relion will secure the electricity transmission for about 30 million citizens and contribute to the smooth integration of renewables into the Turkish transmission grid.

TEIAS, one of the largest electricity transmission companies in Europe, with an installed capacity of



Buyukbakkalköy 154kV/36kV is one of the substations where the ABB relays are successfully in use

over 80 GW, has chosen ABB to strengthen the intelligence of its electrical grid as a part of Turkey's ambitious 2023 renewable integration targets.

Electricity demand in Turkey is expected to grow up to five percent annually, and the Turkish government intends to diversify its energy sources through the increased use of renewables, such

as wind and solar power. For wind specifically, the government aims to install 20 GW of wind capacity by 2023. 151

Photon Energy expands its Hungarian Pipeline

Photon Energy NV revealed the expansion of its project pipeline by 5 additional projects in Fertőd as well as the acquisition of 5 project companies for the construction of 8 PV plants- with a total installed capacity of 5.5 MWp near the North-Western Hungarian municipality of Tata. The announced new projects increase Photon Energy's photovoltaic project pipeline in Hungary to 20.6 MWp.

Global solar power solutions provider Photon Energy NV reported substantial growth of the company's project pipeline in Hungary, which increased nearly twofold thanks to the addition of the 13 new projects in different locations in Hungary. All

the newly added projects are expected to reach the ready-to-build stage in 2018 Q2.

The municipality of Fertőd, in the Győr-Moson-Sopron region of Hungary, where the company's fully-owned subsidiary Fertőd Napenergia-Termelő Kft. is in the process of constructing the Group's first photovoltaic power plant in Hungary with an installed capacity of 528 kWp to be completed and connected to the grid before the end of February 2018 (from now on referred to as Fertőd I) saw the addition of five projects (from now on referred to as Fertőd II). The newly added Fertőd II projects are expected to reach the ready-to-build stage in 2018 Q2. 152

Sungrow Turnkey Station powers 1.5MW Floating PV Plant in Japan

Sungrow, the global leading inverter solution supplier for renewables, announced recently that it has successfully installed its 2MW SG2000MV turnkey station and waterproof combiner box for a floating PV plant on the Mitakabe Pond in Sanuki-shi Kagawa Prefecture, Japan.



financed by Kagawa Bank. It is expected to generate 1.87 million kWh of power annually.

The SG2000MV turnkey station deployed at the project features its 20-foot containerised design which integrates four SG500 central inverters, a transformer, and RMU, significantly saving the cost for commissioning and installation, as

Japan, known for its scarcity of open land, has seen the growing use of water ponds for solar plants. The 1.5MW floating PV plant, which provides power for Shikoku Electric Power CO., Inc., costs around 500 million JPY, 85% of which were

well as adding protection to extreme climactic conditions. The combiner box used in the Mitakabe Pond plant, the SunBox PVS-8M/16M-W, is specifically customised for floating solar plants. 153

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Trina Solar reveals its new efficiency record

Trina Solar revealed that its State Key Laboratory (SKL) of PV Science and Technology (PVST) has set a new record of 25.04% total-area efficiency for a large-area (243.18 cm²) n-type mono-crystalline silicon (c-Si) Interdigitated Back Contact (IBC) solar cell, with open-circuit voltage up to 715.6 mV. The result was independently certified by Japan Electric Safety and Environmental Technology Laboratory (JET). The IBC solar cell is the most complicated but with the highest cell efficiency for mass production c-Si solar cell today. The record-breaking n-type mono-crystalline silicon solar cell was fabricated on a large-

sized industrial phosphorous-doped Cz Silicon substrate with a low-cost industrial IBC process, featuring conventional tube doping technologies and fully screen-printed metallisation.

The 6 inch solar cell reached a total-area efficiency of 25.04% as independently measured by JET in Japan. The IBC solar cell has a total measured area of 243.18cm² and was measured without any aperture. The champion cell presents the following characteristics: an open-circuit voltage Voc of 715.6 mV, a short-circuit current density Jsc of 42.27 mA/cm² and a fill factor FF of 82.81%. E

Wärtsilä signs EPC contract in Australia with AGL Energy

The technology group Wärtsilä and AGL Energy Limited, one of Australia's leading integrated energy companies, have signed the contract for a new 211 MW power plant. The deal for the new facility, known as the Barker Inlet Power Station located on Torrens Island near Adelaide, was earlier revealed by Wärtsilä on February 5. The order was booked in March.

begun. Wärtsilä is delivering the plant on an Engineering, Procurement and Construction (EPC) basis. The construction phase is expected to create approximately 200 jobs.

Javier Cavada, President, Wärtsilä, said, "We are pleased that the full go-ahead for this project has been given, and that the project execution work is now underway." The equipment is scheduled to be delivered towards the end of this year &



(R2L) The agreement was signed by Doug Jackson, Executive General Manager – Group Operations, AGL Energy & Suraj Narayan, Sales Director, Wärtsilä

The Notice to Proceed (NTP) has been issued and project execution work has

new plant operational by mid 2019. E

World Bank approves \$486 mn to improve Nigeria Electricity Transmission Network

The World Bank recently approved an International Development Association (IDA) Credit and an IDA Scale Up Facility Credit in the total amount of \$486 million equivalent for rehabilitation and upgrading of electricity transmission substations and lines.

The investments under the Nigeria Electricity Transmission Project will increase the power transfer capacity of the transmission network and enable distribution companies supply consumers with additional power. Together with other investments and policy measures, the project will contribute to ensuring adequate and reliable electricity supply that

is necessary for Nigeria's continued economic development. It will also support private sector participation, capacity development and better governance in Transmission Company of Nigeria and sector institutions.

This project is part of the Power Sector Recovery Program (PSRP) by the Federal Government, which is a comprehensive package of policy, legal, regulatory, operational and financial interventions that will restore the financial viability of power sector. The measures that will be implemented through 2021 are aimed at improving transparency and service delivery and re-establishing investor confidence in the sector. E



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Abhishek Nagarkar of VAC appointed as Director of Sales in India

India's recent economic growth has been bolstered by active investment in research & development (R&D). To meet VAC's end market technological demands, the company has steadily increased its regional team in India and has enhanced this effort with the recent hire of Abhishek Nagarkar, who will serve as the Director of Sales in India beginning in February 2018.

VAC's technological advantage is driven by its differentiated materials and process know-how as well as its close collaboration with customers. The



Abhishek Nagarkar

company has maintained this advantage by establishing a presence in its customers' geographies, allowing VAC to provide critical technical and development support to its customers' R&D efforts.

He joins VAC with over a decade of sales and business development experience across multiple industries within India. He has also held management and technical sales positions at L & T and Schneider Electric. Nagarkar graduated with a BE in electronics from Nagpur University as well as an MBA from the University of Mumbai. E1

Ameren names Senior VP and Chief Digital Information Officer

Bhavani Amirthalingam has joined Ameren Corporation as Senior Vice President (VP) and Chief Digital Information Officer. In this newly created role, she will focus on accelerating Ameren's customer-centric digital innovation.

Amirthalingam has deep experience as a technology leader. She comes to Ameren from Schneider Electric, a Fortune 500 corporation that specialises in global energy management and automation solutions integrating technology, software and services. Previously, she has also served as the chief information officer for



Bhavani Amirthalingam

World Wide Technology Inc., a technology integrator bringing collaborative and innovative approaches to evaluate, architect and implement solutions.

"Bhavani is a proven leader, and we are excited to have her join our Executive Leadership Team," said Warner Baxter, Chairman, President and Chief Executive Officer for Ameren. "She will be instrumental in driving technological innovation that will bring value to the millions of people in Missouri and Illinois who depend on us to power the quality of their lives," he further added. E1

Voiland College appoints Pande, Dutta as school directors

Voiland College of Engineering and Architecture has appointed two new school directors.

Partha Pande has accepted appointment as director of the School of Electrical Engineering and Computer Science. Indranath Dutta has been appointed as director of the School of Mechanical and Materials Engineering (MME).

A WSU faculty member since 2005, Pande is the Boeing Centennial Chair in Computer Engineering



(L2R) Pande, Dutta

and has served as interim school director since last year. He holds a doctoral degree in electrical and computer engineering from University of British Columbia.

Dutta has been at WSU since 2008 serving in a variety of leadership positions, including as director of the Materials Science and Engineering program, associate dean of research, and as interim director of MME. He holds a Ph.D. in materials science and engineering from the University of Texas at Austin. E1



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Mitsubishi Electric receives IEEE Milestone


Mitsubishi Electric Corporation revealed that the company's Diamond Vision series of outdoor large-scale colour display systems has received the prestigious IEEE Milestone award from the Institute of Electrical and Electronics Engineers (IEEE). Diamond Vision is Mitsubishi



IEEE Milestone commemorative plaque

Electric's series of proprietary displays, of which more than 2,000 have been installed globally since the first unit was introduced at Dodger Stadium in

Los Angeles, USA in 1980. The award recognises the prominent role and high esteem of Diamond Vision as the world's first outdoor large-scale colour display systems for creating impressive video images.

Masaki Sakuyama, President and CEO of Mitsubishi Electric, said, "We are deeply honoured to receive the IEEE Milestone for Diamond Vision. This is the first time our company has received this honour exclusively." 


MYSUN's founder, Gagan Vermani honoured

MYSUN, one of India's largest rooftop solar platforms focused on providing end-to-end solar solutions, revealed that their Founder and CEO, Gagan Vermani has been recognised as one of the '50 Most Influential Solar Leaders' in a global listing endorsed by the World Solar Congress. This recognition as a thought leader at the global level in the field of solar power was conferred upon him for his and MY SUN's exceptional work in spreading solar power solutions across India. The award is another feather in the growing cap of MY SUN as it continues the journey of



solarising rooftops across the country.

Gagan was felicitated at the 8th Edition of the World CSR Day event at Taj Lands End, Mumbai. Organised by the World CSR Congress on an annual basis, the event felicitated various corporate contributions towards social and environmental causes. Gagan's inclusion in the prestigious list of influential actors in the solar power space is an acknowledgement of his role in

MY SUN's incredible growth story, scripted by its success in promoting end-to-end solar energy solutions in India. 

TPSDI lauded with Global HR Skill Development Award 2018


Tata Power, revealed that Tata Power Skill Development Institute (TPSDI) has been bestowed with Global HR Skill Development Award 2018 at the 8th World



At the event

Petrocoal Congress, held in New Delhi. The institute was awarded under 'Gold' category for outstanding achievement in adopting innovative strategies for Human Resource Management and Skill Development towards excellence. The event was supported by the Ministry of Petroleum & Natural Gas, Ministry of Coal and Ministry of Power.

Anil Sardana, CEO & MD, Tata Power, said, "The recognition received at the 8th World Petrocoal Congress bears testimony to the efforts of Tata Power's Skill Development

Institute in imparting quality education and training to the young minds of our communities. Tata Power has been successfully following the group's legacy of adopting innovative strategies and TPSDI is one of the key initiatives towards this cause. Skill development is an essential ingredient for India's future economic growth." 



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Smart Lighting Market worth 20.98 Billion USD by 2023

The major factors driving the growth of the smart lighting market include modernization and development of infrastructure to transform cities into smart cities, need for energy-efficient lighting systems...



Picture Credit: Philips Hue

The smart lighting market is estimated to grow from USD 7.93 billion in 2018 to USD 20.98 billion by 2023, at a CAGR of 21.50% between 2018 and 2023. The major factors driving the growth of the smart lighting market include modernization and development of infrastructure to transform cities into smart cities, need for energy-efficient lighting systems, increasing adoption and decreasing cost of LEDs, increased demand for intelligent solutions for street lighting systems, etc.

Services play a major role before and after the installation of smart lighting systems. This segment comprises design and engineering services, installation service, and post-installation services (maintenance, and support and monitoring services). The growth of the smart lighting market for services is mainly attributed to the expected high rate of adoption of smart street lighting systems for energy conservation and ecological safety during the forecast period. Post-installation services consist of maintenance and support for smart lighting systems to ensure long life

of the luminaires and lamps, with minimum energy consumption and maximum efficiency.

Indoor application (residential, commercial, and industrial) is expected to hold a larger size of the smart lighting market during the forecast period. In residential applications, smart lighting can be installed according to the requirement of a particular room or an entire house. The incorporation of wireless technology in smart lightings would help the market for residential indoor application to grow at a high rate. The commercial application of smart lighting includes the implementation of these lightings in offices, retail shops, shopping malls, and hospitality infrastructure. Reducing energy consumption has become a major objective for building owners, governments, utilities, and other stakeholders.

The use of lightings based on wireless technology eliminates the wire usage, thereby, abolishing the need for installation and protection of cables. Therefore, the wireless smart lighting systems have significantly low cost. Also, the wireless system is flexible in nature. Thus, sensors equipped with wireless communication can be organized into an autonomous network, which makes updating, adding, moving, and replacing of sensors easy after the initial installation. The developments in wireless technologies are expected to drive the growth of the smart lighting market for the wireless communication protocols.

The smart lighting market in APAC is expected to grow at the highest CAGR during the forecast period. The increased construction activities in APAC are contributing significantly to the growth of the smart lighting market in the region.

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Substation Thermal Image

Images for illustration purpose only.

Status of Power Generation in India

India has to make sure sustainable growth, not only economically but also from social and environmental factors dependency on thermal sector for power. Our country's potential for hydro-power generation is exponentially increasing, therefore, gradually shifting its base towards renewable energy generation for future plans...



Picture Credit: wikipedia.org

India's energy sector stands-out amongst the most classified power sector in the world. Generation of energy extends from conventional sources, for example, coal, hydro, gaseous petrol, oil, lignite and atomic energy to reasonable non-

conventional sources, for example, wind, sunlight based, and household & agricultural wastages.

In the World Bank's list of electricity accessibility for 2017, India has moved up 73 spots to rank 26th, according to Piyush Goyal, former Minister of State

(Independent Charge) for Power, Coal, Renewable Energy and Mines, Government of India.

Market Capacity

Across all the power stations in India, the total installed capacity is 30,860.58 megawatt (MW) as of December, 2017. The Ministry of Power has put up an objective of 1,229.4 billion units (BU) of power to be produced for the financial year 2017-18, which is 50 BUs more than the objective for 2016-17. For conventional energy, the yearly growth rate in sustainable power generation is calculated to be 27 % and 18%.

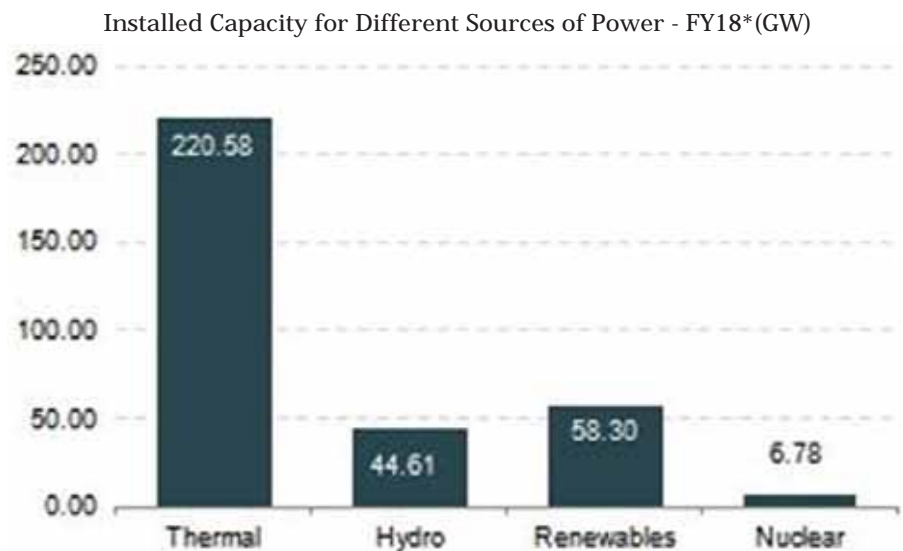
- With power generation of 1,160.1 BU in India in Financial Year 17, our country has seen a growth of around 4.72% over the previous accounting year.
- Between FY10–FY17, electricity generation in India rose a CAGR of 7.03 per cent.
- The aim of the 12th Five Year Plan is to achieve a total domestic energy production of 844 million tonnes of oil equivalent (MTOE) by 2021–22.

Future

The Government of India has set a target of 175 GW for renewable energy generation by 2022, with contribution from solar power (100 GW) & wind power (60 GW). The capacity of power generated by coal is 192 GW and is expected to touch 330-441 GW by the year 2040.

Thermal

Power generation by coal accounts for a total of 60% of country's total installed capacity and this generated energy contributes to 72% of total nation's



Notes: GW - Gigawatt; FY18* Data upto June 2017

source: Ministry of Coal, NHPC Central Electricity Authority (CEA), Corporate Catalyst India

demand. Thermal power plants used a mammoth 530 million tonnes of coal for the year 2014-15, which constitutes to three-fourths of the total coal consumed in the country. The quality of coal in India is very poor and contains 40% ash, indicating that plants burn 0.74 Kg/KWh of coal for power generation, which is 41 % greater than the global average. Poor coal also leads to increased levels of pollution. Therefore, coal-based power plants are major contributors to pollutants like PM, NO_x and SO₂.

The country's coal-fired plants, oil-fired and natural gas-fired thermal power plant mines are inefficient in production and provide a little scope to improve & research on technologies to reduce the emission of greenhouse gases (CO₂) and improve the power generation efficiency of the thermal power plants. Our country's thermal power plants emit 50% - 120% more CO₂ per kWh produced when compared to the average emissions from the countries in

European Union (EU-27).

The Central Government has decided to completely close 11,000 MW of thermal power generation capacity which has been generating energy for the last 25 years and is listed as old and is being replaced with plants of bigger size plants and of super-critical pressure technology which adds up to 20,000 MW with an estimated budget of ₹ 70,000 crore. To implement this plan, 100 old units of power plant capacities ranging between 60 MW-220 MW are being replaced with 30 state-of-the-art high -critical units with capacity between 660 MW-800 MW, hence, saving an amount of ₹ 40,000 crore on land acquisition and infrastructure cost.

CEA (Central Electricity Authority of India) has calculated that coal-fired power plants will be generating 9,58,444 million units of power in the financial year 2017-18 compared to the previous estimation of 9,21,129 million units of power generation in the year 2016-17. It is reported that 89% of

Table 1: Power Generation Capacity with Sector-wise & Type wise

Sector	Thermal (MW)			
	Coal	Gas	Diesel	Total
Central	55,245.00	7,490.83	0.00	62,7375.83
State	65,145.50	7,257.95	363.93	72,767.38
Private	74,012.38	10,580.60	473.70	85,066.68
All India	194,402.88	25,329.38	837.63	220,569.88

the estimated electricity generation from coal power plants which has been achieved between April 1, 2016 and January 2017.

For the year 2017-18, 12,29,400 million units of power is going to be generated from the conventional sources as compared to 11,78,000 million units of power generated in 2016-17.

CEA has also estimated that by the year 2022, most of the thermal plants will be shut down for quite some time and will not be allotted any schedule for generation of energy as India will be shifting its base to Renewable Energy generation. CEA has notified that the total installed capacity from the different types of fuel by the end of the Financial Year 2021-22 which accounts to be 523 GW which includes 50 GW of coal based generation apart from the current construction of thermal power plants which will start its production & benefits can be obtained by Phase III i.e. between 2017-22.

As of 30 April 2017, the breakdown of the total installed

utility power generation capacity with sector wise & type wise is classified in the Table 1.

Hydro

Over the last 20 years, hydro power has emerged as an important contributor for the supply of electricity for the increasing demand for India's huge ambitions to stand as a global power. Nearly three-fourth of the consumable hydro energy potential in India is being utilised in full-swing and has been a constant pillar of support towards India's growth in terms of infrastructure and improvement of the society. India stands at seventh largest producer of hydroelectric power amongst all the countries.

As of 30 April 2017, India's installed consumable hydroelectric capacity is accounted as 44,594 MW, i.e. 13.5% of the total utility power generation capacity. In addition to this, smaller hydro electric generating units with maximum capacity of 4,380 MW (1.3% of its total utility power

generation capacity) has been installed and is successfully operating. Our country's total hydroelectric power worth is estimated to be 148,700 MW at 61% load factor. For the financial year 2016-17, the overall hydro-electric power generated was calculated to be 122.31 TWh (exclusion small hydro units) with an average capacity factor of 33%.

Thus, in total India is enriched with a hydro-potential of minimum 2, 50, 000 MW.

As of 30 April 2017, the breakdown of the total installed utility power generation capacity with sector wise & type wise is classified in Table 3:

Hydro	
Sector	Energy(MW)
Central	11,651.42
State	29,703.00
Private	3,240.00
All India	44,5594.42

The public sector is responsible for 92.5% of country's hydro-electric generation. The National Hydroelectric Power Corporation (NHPC), Sutlej Jal Vidyut Nigam (SJVN), Northeast Electric Power Company (NEEPCO), NTPC-Hydro, and THDC are few of the public sector companies generating hydroelectric power in India. Bhakra Beas Management Board (BBMB), a state-owned enterprise in Northern part of India, is built with an installed capacity of 2.9 GW. After 40 years of continuous

Table 2: Basin-wise Assessed Potential

Basin/Rivers Probable	Installed Capacity (MW)
Indus Basin	33,832
Ganga Basin	20,711
Central Indian River system	4,152
Western Flowing Rivers of southern India	9,430
Eastern Flowing Rivers of southern India	14,511
Brahmaputra Basin	66,065
Total	1,48,701



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generation of power the cost about 27 paise.


Due to deep-rooted risks involved in the development of hydro power plants which are listed as topographical limitations, natural calamities, environmental barriers and rehabilitation and land acquisition issues apart from commercial risks and change of river basin while plant operation, most of the investor & builders are hesitant to step into this energy sector. The crucial commercial risks for private investors is the initial high capital investment and slow Return of Investment because of the high interest rate and long payback period resulting into financial issues.

With the goal of adding energy-potential worth 10,897 MW & 12,000 MW by the end of 12th and 13th five year plan, the contribution of hydro-generation is anticipated to increase by 25.14% with long term aim to expand the total installed capacity from current

level of 20% till 40%.

Conclusion

India has to make sure sustainable growth, not only economically but also from social and environmental factors dependency on thermal sector for power. Our country's potential for hydro-power generation is exponentially increasing, therefore, gradually shifting its base towards renewable energy generation for future plans. Hydro power has been recognized as an efficient and affordable source of power for the sustainable development and also branching out many advantages. Though the private investors are slowly entering the hydro power business because of the risks involved, these developers will fully invest

themselves into hydro-electric generation very soon as nation is slowly redirecting itself into producing clean energy with no harm to surrounding environment and offloading the energy generation from non-renewable sources. Accounting our high population growth and huge demand of industrial and infrastructure growth, the power generation from both renewable (hydro) & non-renewable (thermal) sources will go hand in hand to meet the requirements of the nation. But in no time, Hydro-electric power generation would be a monopoly in the power generation business thus cutting off the dependency on thermal power plants and hence working towards a cleaner environment. 



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S Saravana Balaji

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"Transmission system should be planned ahead of generation"

Sterlite Power Transmission Limited is one of the leading companies which is at the forefront of power transmission industry. Sterlite has four business units namely Solutions, Infrastructure, IndiGrid & Convergence. Government should mandate the planners must evaluate all possibilities to upgrade existing lines, before building any new lines. Besides, benefit span over increased power transfer, faster implementation vis-à-vis creating new parallel corridors conservation of scarce land, RoW and forest resources, etc. So, it is prudent to uprate or upgrade the existing corridor that can serve next 20 years, suggests **Manish Agarwal, CEO – Solutions, Sterlite Power** in an interaction with **Electrical India...**

Please tell us about the major milestones of Sterlite Power

Sterlite Power Transmission Limited, a company that was demerged from Sterlite Technologies in 2016, is India's leading integrated power transmission

developer and solutions provider. Sterlite has oriented all its offerings to address the coinciding challenges of time, space and capital.

Our Global Infrastructure Business has emerged as largest private sector transmission developer in India

and has become first Indian transmission infrastructure developer to enter the global market by winning 03 concessions projects in Brazil.

Our Solutions Business is a leader in uprate and upgrade projects in the country. We provide bespoke solutions to solve complex problems for power utilities, specializing in upgrading, uprating and strengthening power delivery networks. These technology-intensive solutions enable our customers to plan network expansions despite challenges of ROW, environment regulations and urbanization. We recently won our largest MSI project in Kerala. One manufacturing side, globally, we are one of the largest manufacturers of High Performance Conductors, also referred as 'HTLS. Sterlite has distinction of being India's Largest & Fully Integrated OPGW Solution Provider. The company has four state-of-the-art manufacturing facilities producing conductors, OPGW & Underground EHV cables. Our Jharsuguda facility offers upstream integration of molten metal for conductor manufacturing, first of its kind in the country.

What are the current trends in power transmission?

What are the challenges in the transmission segment?

India is running largest RE Expansion Programme in the world. What it means is huge generation capacities added in fraction of a time than evacuation system can be built. Planners should be mindful of 110/1100 days paradigm, it takes 110 days to commission a solar farm, while transmission system may take upto 1100 days to build. Hence, transmission system should be planned ahead of generation.

While the centre has been adding roughly `15,000 crore of transmission lines each year, the states are lagging in adding downstream network in tandem. With advent of the public-private partnership model, states can now attract significant private investment into their transmission network, by adopting the TBCB model.

Besides new lines to connect power-surplus states with those starved of electricity, a large part of the capital expenditure should go into upgrading of existing system. It is possible to augment transfer

capacities of existing system by uprating current or voltage, without using extra land resource. This can usually be done in a third of the time and fraction of cost required to build a new line. Given the challenges of time, space and capital challenges, we feel this is the best solutions for the country. Government should mandate the planners must evaluate all possibilities to upgrade existing lines, before building any new lines.

What is your strategy to plug these loopholes in the sector?

As I said, given the challenges of time, space and capital, government should mandate that the planners must evaluate all possibilities to upgrade existing lines, before building any new lines. We are representing through with multiple forums to have this transmission planning philosophy adopted.

Do you have R&D in India?

Sterlite has been in forefront of technology development and adoption. We extensively leverage technology at every aspect of our business delivery – technology intensive products, design engineering & digital platforms for project planning & execution, simulation tools for power system studies, aerial technologies, smart line project etc.

India is running largest RE Expansion Programme in the world. What it means is huge generation capacities added in fraction of a time than evacuation system can be built. Planners should be mindful of 110/1100 days paradigm, it takes 110 days to commission a solar farm, while transmission system may take upto 1100 days to build. Hence, transmission system should be planned ahead of generation.

We have NABL accredited labs for our products and in-house set-up for new product development. Other model of technology development is partnerships or licensing agreement with technology providers and investment in technology companies.

We are setting-up Center of Excellence for technology solutions that will incubate new products, designs, robotics for transmission line work, system simulation techniques and also, provide test-bed for next generation solutions.

What is your outlook for the sector?

Outlook is strong but it is just that we are going through a phase. Normally, in transmission graph

Interview

investments go down every two three years. Elections are due next year. So, the government may focus on 24x7 village electrification. In next two to three years, there will be a lot of thrust on transmission segment. We have huge plans for next three years. We want to

Besides new lines to connect power-surplus states with those starved of electricity, a large part of the capital expenditure should go into upgrading of existing system. It is possible to augment transfer capacities of existing system by uprating current or voltage, without using extra land resource.

now maximise the bottom-line. So, we are envisaging three times growth in transmission. We are exploring more new markets.

What are the products that launched by the company in ELECRAMA?

At ELECRAMA 2018, Sterlite Power Transmission Limited unveiled three high end products namely STER-AAAC 1120 (Low Loss/High performance conductor), High Ampacity Cable (Low Loss/High

Current Cable) and Smaller Size OPGW suitable for 33KV lines.

High Ampacity Cable: High Ampacity Cable which was launched in ELECRAMA has a unique adaptability of plug and play in the existing distribution network of the same size. The physical diameters are the same for traditionally used XLPE cable and can result in huge savings in terms of both Opex and capex.

STER-AAAC 1120: This low loss/high performance conductor is a typical alloy material consisting of Al with Cu as major alloy element. These conductors are better in mechanical strength, conductivity and less DC resistance.

Smaller Size OPGW: Smaller Size OPGW is suitable for 33KV lines and is developed by Sterlite Power for the first time in India. It has been developed keeping in mind the special guidelines of Ministry of Power to suit specific market needs of India. This special OPGW is suitable for installation on poles also for distribution lines of 33kV line voltage. B1

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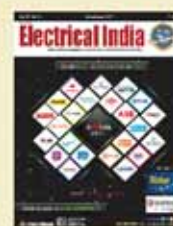
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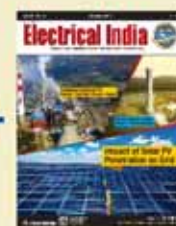
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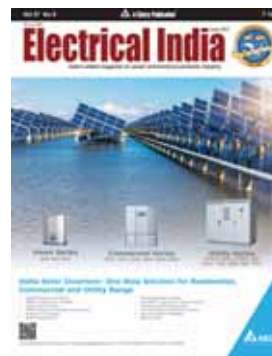
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Underground Cables:

Complete Solution of Urban Distribution Network

The underground cables have several advantages such as less liable to damage through storms, lightning, low maintenance cost, less chances of faults, smaller voltage drop and better general appearance. Voltage drop is also an important factor of cable design...



Picture Credit: www.aicent.af.mil

Electricity plays an important role in the modern society because of its versatility with respect to input energy form. Electricity also offers total environmental, enhancement opportunity as compared to other energy sources used by the consumer. However, the rapid advancement in the field of

electronics and its innumerable applications in residential, commercial, industrial and agricultural sectors, the demands for quality and uninterrupted power supply have increased tremendously. The primary requirement of distribution companies is to give power supply to the consumer in a reliable manner at a minimum cost, taking into consideration the constraints and the criteria such as reliability, economics, environment, society impacts and value of electricity.

The main hindrance in ensuring uninterrupted power supply in the overhead distribution system is the unavailability of space in developed urban areas. Falling of tree branches on the overhead distribution lines and short circuiting of conductors due to heavy winds and gales, rains, accidents due to bare conductors, failure of supporting structures, etc. Underground cable system is very useful in low voltage distribution network in urban areas to mitigate the problem of space availability and minimize frequent breakdown in the lines.

Underground cables offer an affordable and justifiable solution for critical parts and in some cases the entire length of overhead high voltage power lines. With appropriate technology used in appropriate places, the environmental impact of underground cables can be minimized. Underground cables help in ensuring uninterrupted power supply that is hitherto uncommon in overhead systems. The main hindrance in ensuring uninterrupted power supply

through overhead systems is the non-availability of space in developed urban areas. Underground cables can transmit power across densely populated areas where land is costly or environmentally or aesthetically sensitive

A cable is basically an insulated conductor and is used for underground distribution of electricity. Insulation is used to cover the conductor and provides isolation from the surroundings. It should possess high resistance, high dielectric strength, high mechanical strength and long durability. Underground cables are generally used in densely populated areas such as cities and metros, where there is high density of automobiles; high raised commercial, residential buildings and places; where vital installations of uninterrupted power supply such as water supply system, hospitals and IT services, etc. Underground cables are also preferred in industries, sub-stations, railways and road crossings, servicing of residential installations and other similar locations. Underground cables system provides high reliability, least interruptions due to line faults and good safety. In addition to this, the I²R losses are quite low compared to overhead system due to the absence of steel wires. Its advantages such external protection is provided against mechanical injury, moisture entry and chemical reactions.

Cable Design

A power cable commonly consists of conductor, bedding, armouring, outer sheath and

insulation. Underground cables consist of one central core or a number of cores of tinned stranded copper or aluminium conductor's insulation from each other. A metallic sheath of lead or alloy or of aluminium is provided around the insulation to protect it against ingress of moisture. The initial heavy cost is the only factor which discouraged the use of underground cables for the purpose of transmission and distribution of electric power.

For mining, extra mechanical strength is provided to cable with double armouring. For wind power plant, customers generally require flexible and UV protected cable with mechanical tough sheath. The underground cables have several advantages such as less liable to damage through storms, lightning, low maintenance cost, less chances of faults, smaller voltage drop and better general appearance. Voltage drop is also an important factor of cable design.

The type of cable to be used at a particular location is determined by the mechanical considerations and the voltage at which it is required to operate. According to voltage, these are classified as low-voltage cables for operating voltage upto 1 kV, high-voltage cables for operating voltage upto 11 kV, super tension cables for operating voltage upto 33 kV, extra high tension cables for operating voltage upto 66 kV and extra super voltage power cables for operating voltage beyond 132 kV. The current rating of the cables apart from the above factors also depends on a large number of other factors such as method of cable laying employed, spacing

between the cables, number of cores and the thermal conductivity of the soil. An approximate indication of the current carrying capacity for Indian conditions, which is based on a maximum conductor temperature of 80°C for 11kV cables and above. The ground ambient temperature of 30°C applies to most places in India.

Selection of Cables

Electrical cables are the nerves of any electrical network. Cables consist of a huge percentage of capital investment in any electrification project. And, they are the most vulnerable to failures too. Most of the cable failures could be attributed to improper selection. Right selection of cables is not only very important for reliability of power supply and safety of devices as well as human beings present around them, it also prevents loss of assets and saves costly business hours. The type of cable used at a specific location is determined by the mechanical considerations and the voltage at which it is required to operate. The grade of insulation of the underground cable depends on the voltage levels. For selection of cable of correct size and type for a particular application, the following factors/ parameters need to be considered are:

i. Voltage Rating: This is the rated voltage of the system, in which the cable is to be installed & used. The type of operating system such as dc (2-wire or 3-wire) or ac (Single-phase, three phase), earthed or unearthed and operating voltage such as 415/240 V, 11, 33, 66, 132 KV etc.

- ii. Type of Conductor: The most generally used conductor in a cable is either Copper or Aluminium. As is known, for the same voltage rating, type, insulation, cross sectional area and method of installation, the continuous current rating, the short time current rating and the per unit length cost of a Copper cable is considerably higher than that of an Aluminium cable.
- iii. Type of Insulation: Most of today's cables are insulated either with PVC or with XLPE. Obviously, for the same conductor material, voltage rating, type, insulation, and other parameters, the per unit length cost of an XLPE insulated cable is considerably higher than that of a PVC insulated cable.
- iv. Type of Cables: Unarmoured cables are used in indoor installations and on above ground installations, such as in cable trays, in pre-built concrete cable trenches, etc., Armoured cables are mandatory for any underground cable installation. The armour can be a wire or strip made of Galvanised Iron or Aluminium. In many cases, this armour is connected to the earthing system, preferably at one end only, generally, the sending end.
- v. Continuous Current Rating: The continuous current rating of cables with Aluminium / Copper conductor is made available by the manufacturers. But, it should be noted that the continuous current ratings are given by the manufacturers for

certain standard conditions of laying. In practice, it is not possible to get or to maintain these standard conditions. Thus, certain rating factors are applied to arrive at the practical continuous current rating.

- vi. Rating Factors: The Rating factor for variation in ground temperature or in duct temperature, variation in ambient temperature, variation in thermal resistivity of soil and Group Rating Factor – Vertical Spacing & Horizontal Spacing should be considered appropriately.
- vii. Voltage Drop: Cables consist of resistance & reactance. And, thus the current flowing through such an impedance will cause a voltage drop. This drop should not affect the loads connected by the cable.
- viii. Short Circuit Values: The "short-circuit current rating" is the maximum short-circuit current that a component can withstand. Failure to provide adequate protection may result in component destruction under short circuit conditions. Short circuits and their effects must be considered in selecting cables. These cables should have a short circuit rating which is the highest temperature the cable can withstand during an electrical short circuit lasting up to about half a second.
- ix. No of Core: No of core selection depends upon power system. For Single Phase Power Supply, we can use 2 core cables for three phase supply we can use 3.5 core or 4 core cables for HV supply.

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- x. Economics: It is also an important factor for selecting the type of cable. It is to be kept in mind that the cost of cable should not be such large that it causes loss and another cable may fetch the same results in low cost and loss.
- xi. Environmental Conditions: Cable operates at its best when it is installed in its optimum environmental conditions. For example, XLPE cables work well in areas where moisture content is good. Thus, proper cable should be selected so that the system becomes more efficient.

Cross Linked Polyethylene Cable (XLPE)

XLPE cable is most commonly used in transmission and distribution network due to its characteristics. Specially, treated low density polyethylene results in cross linking of carbon atoms and the compound is a new material having extremely high melting point with light weight, small dimension, low dielectric constant, higher current carrying capacity, high overload capacity, higher short circuit rating and high mechanical strength due to high thermal resistance and very low moisture absorption. These cables can be directly laid on the soil bed and easily worth for voltages upto 33 kV. Depending on the type of cores, the cable is further classified as 1 core, 3 core, and 3 ½ core. Commonly used conductor materials are aluminium and copper. However, aluminium cables are more common because of expensiveness of copper.

Advantages of Underground Cables

- i. Less subjected to damage from severe weather conditions (mainly lightning, wind, freezing).
- ii. Underground cables need a narrower surrounding strip than overhead line to be kept permanently clear for safety, maintenance and repair.
- iii. Reduced range of electromagnetic fields (EMF) emission, into the surrounding area. The electric current in the cable conductor produces a magnetic field, but the closer grouping of underground power cables reduces the resultant external magnetic field and further magnetic shielding may be provided.
- iv. Underground cables pose no hazard to low flying aircraft or to wildlife.
- v. Underground cables have much less danger of conductor theft, illegal connections, sabotage, and damage from armed conflict.
- vi. UG cables have greater safety and less interference with communication lines, with better outlook.
- vii. Burying utility lines makes room for more large trees on sidewalks, the trees conveying environmental benefits and increase of property values.
- viii. Apart from creating less visual and environmental impact that generates large opposition from local communities, underground cables have several other unique benefits, in particular, they:
 - have lower transmission and

distribution losses;

- can absorb emergency power loads;
- have lower maintenance costs;
- require a narrower band of land to install, and;
- are less susceptible to the impacts of severe weather.

Operating Limitations with Cables

- i. Cables required high charging current and reactive power for operation. The reactive power is capacity in nature and can affect at lightly loaded conditions due to Ferranti effects of rising of sending end voltage of the cable.
- ii. Flow of charging current causes heating of cables and reduces the lower current capability. Sometimes, higher dielectric loss may further rise in the temperature.
- iii. Switching of cable capacitive current may give rise to over voltages.
- iv. The main limitations of underground cable are expensive compared to OH lines, difficulty in fault detection, restoration of power supply takes longer time during break down and more expensive maintenance and management.
- v. For ensuring longer life of the cable, UG cable should never be overloaded for longer duration and always advisable to restrict the loading to about 75% of the rated capacity.
- vi. Before carrying out maintenance of the UG cable, care should always be taken to discharge the static charges stored in the cable.

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- vii. Underground system cannot be operated above 66 KV because of insulation difficulties but overhead system can be designed for operation up to 400 KV or higher even.
- viii. Underground cables are more subjected to damage by ground movement.
- ix. Whereas overhead lines can easily be uprated by modifying line clearances and power poles to carry more power, underground cables cannot be uprated and must be supplemented or replaced to increase capacity. Transmission

and distribution companies generally future-proof underground lines by installing the highest-rated cables while being still cost-effective.

Conclusion

Underground cables offer an affordable and justifiable solution for critical parts and in some cases the entire length, of overhead high voltage power lines. Underground cables at installation is more expensive than overhead lines. However, the maintenance cost of underground system is very low in comparison with that of overhead

system. Underground system is free from interruption of service on account of thunderstorm, lightning and objects falling across the wires. In underground system, there is no interference to communication circuits. It may be beneficial to place 11kV and 420 V distribution systems in densely populated urban areas through underground cable. 



Ashok Upadhyay


Dy. Director (Generation)
M.P. Electricity
Regulatory Commission
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Sterlite Power Wins `1500 cr Goa Power Transmission Project

Sterlite Power has successfully acquired the Goa-Tamnar Transmission Project Limited. The project will deliver an incremental 400kV feed to Goa and scale up the transmission network for power evacuation from generation projects pooled at Raigarh (Chhattisgarh). With fifteen power transmission projects including three in Brazil, Sterlite Power is poised to significantly increase its current market share of 30% of the PPP market. The Raigarh pool in Chhattisgarh had been facing high-fault levels and this project aims at creating an alternative path of evacuation. The project will help address the quality of power transfer from generating stations connected to the Raigarh pool.

Commenting on the development, the Group CEO of Sterlite Power, Pratik Agarwal said, "We are excited



to win this prestigious project that will create higher quality of power supply across the two states. With this acquisition, we have increased our footprint of inter-state transmission projects to 21 states. Significantly, we are committed to delivering this project also ahead-of-schedule as has been our track record.' 

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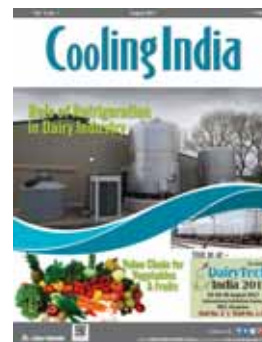
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Renewable Integrated Microgrids

It is essential to ensure that the available renewable sources are utilized in the best possible manner. In order to maintain uninterrupted power supply, the authors propose that a pump hydro storage unit is used to manage the intermittencies associated with renewable energy sources...



Microgrids integrated with renewable energy sources are a promising step towards the accomplishment of goal of power to all. It is essential to ensure that the available renewable sources are utilized in the best possible manner. In order to maintain uninterrupted power

supply, the authors propose that a pump hydro storage unit is used to manage the intermittencies associated with renewable energy sources.

The microgrid concept refers to a single controllable system designed to meet special requirements such as enhancing

local reliability, supporting local voltages and reducing feeder losses. The accomplishment of the mission to provide power to one and all, makes microgrid an inevitable option. The mode of operation of a microgrid can broadly be categorized as grid connected and island mode. The former mode allows the microgrid to either cater to its entire load all by itself or export/import power to/from the main grid, whereas the latter supports the isolated grid operation without any power sharing with the main grid. As per Ministry of New and Renewable Energy (MNRE), India has a huge potential of electricity generation through renewables. It is, thus, realized that RES integration in microgrids could be a promising solution to tackle ever increasing energy demand. The nineties decade saw many power network companies changing their way of operation from vertically integrated units to open market systems. The major driving force behind deregulation was to encourage competition amongst utilities and marketers to reduce energy prices.

Out of the many energy pricing methods available, spot pricing or locational marginal pricing (LMP) is one of the most popular one. In LMP, determination at different buses with optimization of social benefit has been carried out where social benefit refers to the difference between the benefit of energy to society i.e. society's willingness to pay for its demand and the cost of energy. Renewable energy based μg is aimed at minimizing lifecycle cost and highlights the uncertainties



Figure 1: Renewable Microgrid
(Source: Tatung Smart Energy-Micro Grid Solution, Taiwan)

involved in storage devices in μg .

Energy storage with newer battery technologies are descriptively outlined with several types of storage technologies described. Despite all the merits, the battery storage suffers an obvious drawback of being bulky. Therefore, authors propose pump hydro storage, which is not only robust, but also cost effective as compared to battery storage. Keeping in view the reliability of supply, the authors encourages bidirectional power sharing between the microgrid and the main grid carried out in accordance with the locational marginal price (LMP) fixed by the main grid whereas the intermittencies in RES are managed by pump hydro storage unit installed within the microgrid.

Microgrid

A microgrid is a group of interconnected loads and distributed energy resources

within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode. (US Department of Energy Microgrid Exchange Group).

Microgrids are electricity distribution systems containing loads and distributed energy resources, (such as distributed generators, storage devices, or controllable loads) that can be operated in a controlled, coordinated way either while connected to the main power network or while is landed (CIGRÉ C6.22 Working Group, Microgrid Evolution Roadmap).

Typical Microgrid Requirements

1. Grid Connected Capabilities
 - Optimization of Economic Operation
 - Support Integration of

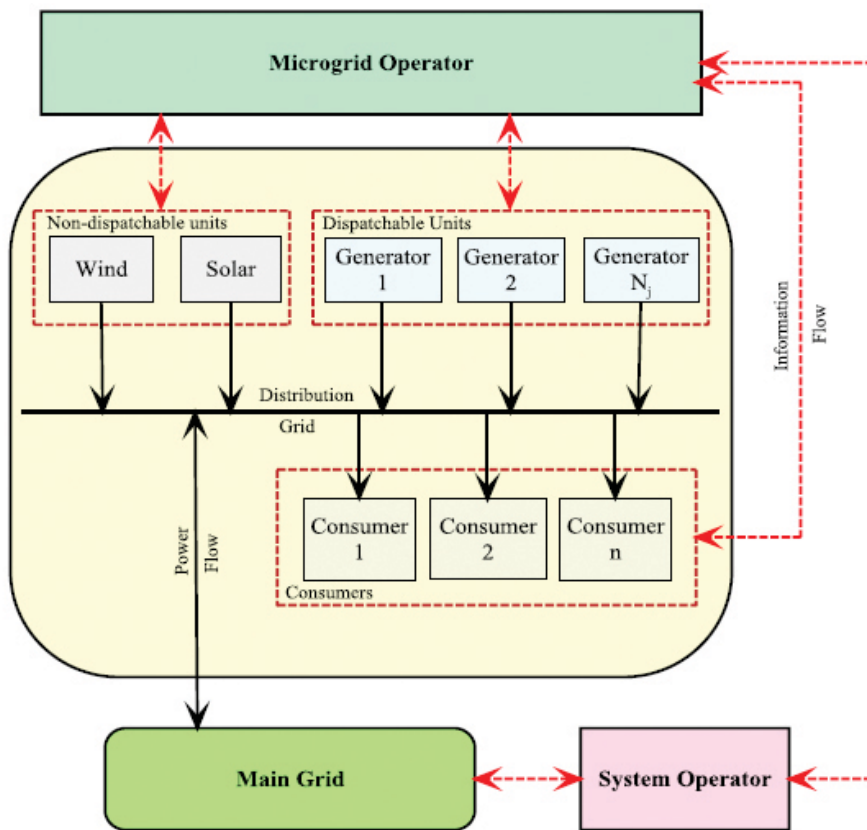


Figure 2: Microgrid Architecture

generating sources. RES, such as photovoltaic or wind power generators are popularly being integrated in a microgrid to curtail greenhouse gas emissions. The performance of a renewable microgrid system is analyzed for various situations considering both grid-connected and grid-isolated mode. The key issues suffered by any renewable microgrid are due to the intermittencies in RES availability.

A broad layout showing the components of a renewable microgrid is outlined in Fig. 1 where varied, generating sources, including wind, solar PV are incorporated. The energy storage system smoothes out the irregularities in power supply due to renewable energy sources. Microgrid could either be connected to the main grid or work in isolated mode.

I. Microgrid Architecture

A typical architecture of μg is shown in Fig. 2 comprising of dispatchable, non-dispatchable generating sources.

In order to ensure a systematic bilateral power exchange, Microgrid Operator can export or import power to/from the System Operator (controller of main grid) after assessing the excess or deficiency of power. Generating sources include both dispatchable and non-dispatchable units. Dispatchable sources have a controlled output, i.e. can be switched on/off as and when required, whereas the output from a non-dispatchable unit is utilized as and when available, i.e. it is not controlled, renewable sources which includes solar, wind etc. are

- Renewables
 - Support for DER Market Participation
- 2. Islanding Capabilities
 - Emergency Islanding Support
 - Managing Critical/Non critical Loads to Available Generation
 - Island Operations with High Penetrations of Renewables
 - Optimized Island Operation for Longevity
- 3. Secure Operations
 - CyberSecure Communications Network
 - Distributed and Resilient Architecture

A microgrid connects to the grid at a point of common coupling that maintains voltage at the same level as the main grid unless there

is some sort of problem on the grid or other reason to disconnect. A switch can separate the microgrid from the main grid automatically or manually, and it then functions as an island. A microgrid not only provides backup for the grid in case of emergencies, but can also be used to cut costs, or connect to a local resource that is too small or unreliable for traditional grid use. A microgrid allows communities to be more energy independent and, in some cases, more environmentally friendly.

A microgrid could comprise a variety of generating sources, including both renewable and non-renewable sources. The dire need to cut down pollutant gas emissions has led to the development of distributed renewable energy



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Pumped Hydro Storage

either completely put to use or are stored. This varied generation is the beauty of microgrid concept, i.e. hybrid generation is possible in the microgrid system setup. As can be seen in Fig 2, a cluster of consumers can be fed through this setup. Microgrid operator and system operator play a crucial role in the power exchange process. Microgrid operator controls the optimal operation of the microgrid, i.e. it assures the reliability of supply during all intervals of demand. The system operator is the controller of the main grid and coordinates the bilateral power exchange between the main grid and the microgrid.

II. Pump Hydro Storage System

Pumped hydroelectric energy storage (PHES), is a type of storage used by power systems for load balancing. It stores energy in the form of gravitational potential energy of water, which is pumped from a lower elevation reservoir to a higher elevation. The surplus off-peak electric power is used to run the pumps. During periods of high power demand, the stored water is released through turbines. Although the losses of the pumping process make the power plant a net consumer of energy overall, the system increases revenue by selling more electricity during periods of high demand.

A pumped hydro storage plant operates with an upper and a lower reservoir. In the generating mode, the water flows from upper to lower reservoir whereas during pumping mode, i.e. a period of low demand, the generated power is used to pump water from the

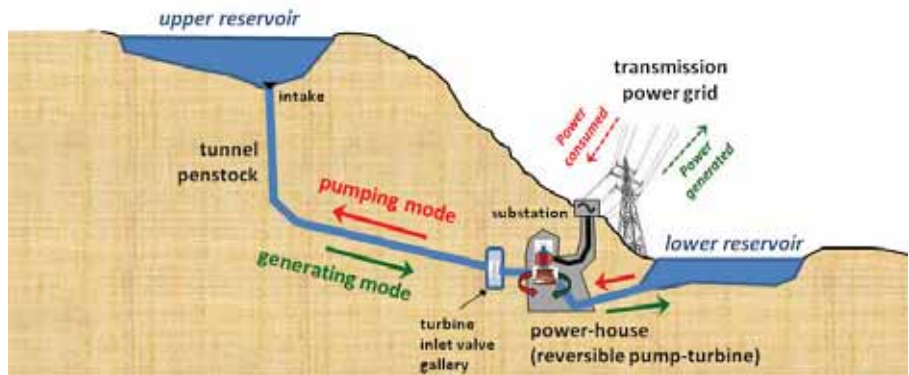


Figure 3: Pump hydro storage system
(Source: Our world of energy)

lower to the upper reservoir as can be seen in Fig.3. Though some losses are reported in this kind of storage system (approx. 15-30%), this, however, is still better than a battery storage system. Figure 3 illustrates the process of electricity generation and demand by such plants.

Pumped - storage hydroelectricity allows energy from intermittent sources (such as solar, wind) and other renewables, or excess electricity from continuous base-load sources (such as coal or nuclear) to be saved for periods of higher demand. The reservoirs used with pumped storage are quite small when compared to conventional hydroelectric dams of similar power capacity, and generating periods are often less than half a day.

Pumped storage is the largest-capacity form of grid energy storage available. The round-trip energy efficiency of PSH varies between 70%-80%. The main disadvantage of PSH is the specialist nature of the site required. It needs both geographical height and water availability. Thus, the suitable sites are either in hilly or mountainous

regions and potentially in the areas of outstanding natural beauty. Therefore, there are many social and ecological issues to overcome.

The idea behind a renewable microgrid is to accomplish the goal of power to all in an environment friendly manner. The microgrid self-sustains its demand unless there is a shortage of power in which case, power is bought from the main grid. Likewise, power is sold when surplus amount is available with the microgrid.



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Safe Cable Guidance with Small e-chains from igus



Low noise and secure cable guidance, in a small space with the low profile E2.10 e-chain. (Source: igus GmbH)

Energy chain E2.10 offers cable-friendly design and a quick and easy assembly, thanks to the simple e-chain opener. Space-saving, strong and easy to assemble - these are the requirements for many machine components. This is true everywhere from general mechanical engineering to medical technology. To meet these requirements, igus offers the low profile E2.10 e-chain with an inner height of 10 millimetres and the smallest bend radii especially, for very small installation spaces. The links of the series consist of only two parts: the bottom / side part and a crossbar. They have a quiet operation, a cable-friendly design and are easy to assemble.


In confined spaces on machines, a safe energy supply with highly dynamic travel of the cables is especially important. To ensure this, the motion plastics specialist igus introduces low profile e-chains in its product range. The E2.10 e-chain from the E2.1 series has an inner height of only 10 millimetres and an outer height of 15 millimetres. Therefore its use is ideal for the smallest spaces. The chain links consist of, like all links of the E2.1 family, only one bottom / side part and one crossbar. This can be opened from the top and from the side easily with a screw driver. With each first order, a simple e-chain opener tool for

opening the chain quickly is also included. Thus, the chain can be opened within a few seconds and, after fitting the cables, easily closed again by hand. The E2.1 series has a robust stop-dog for up to 25 percent more unsupported length, 100 percent higher fill weights and at the same time 10 percent less weight than identical igus e-chain types. The "brake" on the stop-dog of the links provides very quiet chain running. This means they are great in automatic doors, vehicles or in medical furniture, for example.

Cable-friendly Design & Easy Assembly

Lightweight, yet sturdy and strong, the E2.1 series is suitable for a wide range of demanding application scenarios. Therefore, igus has now further expanded the E2.1 product range with three new sizes with 26, 38 and 48 millimetres inner height. Thanks to the smooth contours, the series has a very cable-friendly interior, offering up to three millimetres more inner height with the same outer height compared to the previous series. In keeping with the design of the interior of the chain igus offers separators with rounded edges for a long service life of hoses and cables. For a precise mounting of the separators, an integrated grid marking is provided on the crossbars.

For Compact Installation Space

In order for the energy chain and the cable to form a perfect unit, igus develops highly flexible chainflex cables, which are specifically designed for use in energy chains. With the chainflex CFBUS.LB.060 Profinet cable, for example, data can be transmitted in the tightest of spaces with a bend radius of just $7.5 \times d$. All chainflex cables are tested in the in-house test laboratory spread over an area of 2,750 square metres. This makes igus the only manufacturer on the market to offer a 36-month guarantee on its cable product line. As a ready-to-use readychain, which is a complete system consisting of cables and e-chain, the customer can immediately start using his application. 

Credit: igus India

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SYSKA to Set Up Manufacturing Units in India

SYSKA Group, a home grown brand specializing in lighting solutions with its LED lights has invested approximately ₹ 170 crore in India. With an aim to support government's initiative of 'Make in India', SYSKA has set up over three manufacturing plants for its lighting products in the country. Headquartered in Pune, SYSKA is one of the few companies in its sector to invest heavily to start manufacturing plants in Shirwal, Rabale and Chakan.

SYSKA LED lights promote the creation of sustainable environment and also adoption of energy efficient lights. SYSKA is in line with government's mission of 'Make in India' for providing efficient lighting solutions. The manufacturing plants will have a humongous production of lightings varying from bulbs, tube lights, panel lights, industrial lights etc. This investment by the SYSKA group will also facilitate huge employment opportunities in the country.

Talking about the investment, Rajesh Uttamchandani, Director, SYSKA Group, said, "We at SYSKA believe and support government's marquee initiative 'Make in India'. For more than 30 years now, we have been bringing, wide range of energy efficient lighting solutions and innovative products of international quality for India market."

SYSKA currently has three manufacturing units in the country and is planning to invest in a few more plants in the near future. SYSKA has invested about ₹ 150 crore in Shirwal plant, which is mega project under the 'Make in India' initiative of Government of India. The production capacity of the plant would be 30 lakh units per month and it will employ around 1000 employees. The company has invested of about INR 10 crore on a plant size of 40,000 sq ft at Chakan. The plant is currently running and producing around 700-1000 units of industrial lights per day of 12 hours shift, which we are planning to increase to 3000 units per day. 




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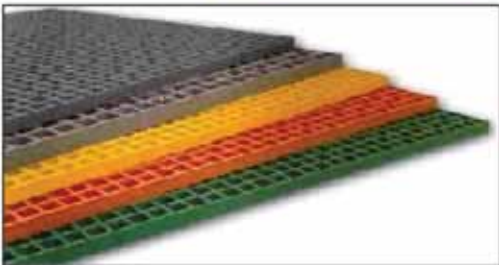
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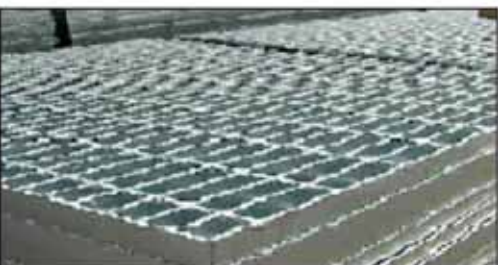
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Light Emitting Diodes with Plasmonics

Metallic nanostructures supporting plasmonic resonances are an interesting alternative to this approach due to their strong light-matter interaction, which facilitates control over light emission without requiring external secondary optical components...



Picture Credit: <http://antekel.blogspot.in>

Solid-state lighting (SSL) is an illumination technology that has emerged in the past decade due to the development of white light-emitting diodes (LEDs). Currently, LEDs use a mature technology that can outperform traditional light sources due to their higher efficiencies, longer lifetimes, fast switching, robustness

and compact size. The working principle of LEDs is based on electroluminescence, that is, the radiative recombination of injected electron-hole pairs in a material. We expect to see widespread replacement of traditional light sources with LEDs within the next two decades, leading to a considerable reduction in

worldwide electricity consumption. To facilitate this transition, we must integrate LEDs into many different applications. To do this, we must be able to accurately and specifically control brightness, color and directionality of light emitted from LEDs. It appears that this control may be achieved using nanostructures.

Light-emitting diodes (LEDs) are driving a shift towards energy-efficient illumination. Nonetheless, modifying the emission intensities, colors and directionalities of LEDs in specific ways remains a challenge often tackled by incorporating secondary optical components. Metallic nanostructures supporting plasmonic resonances are an interesting alternative to this

approach due to their strong light-matter interaction, which facilitates control over light emission without requiring external secondary optical components. An efficient light source is characterized by the three following aspects:

- the generation of photons from electrical power with minimal losses
 - a maximum of the generated photons illuminates the desired object, which can be for example a secondary optical element, or an open space
 - the emission spectrum is optimized for the sensitivity of the detector, which in case of general lighting is the human eye.
- A lot of progress has been made to improve the electrical LED

efficiency mentioned above in a) since the first LED has been introduced. Furthermore, over the past few years, a lot of attention has also been paid to point c), the optimization of the white light emission spectrum with respect to the human eye sensitivity curve. However, the latter has to be done with the boundary condition of still representing all the colors visible to the human eye, which is typically characterized by the color rendering index (CRI). Several ways on how to achieve highly efficient systems while maintaining an acceptable CRI have been proposed and realized.

Plasmonic LED

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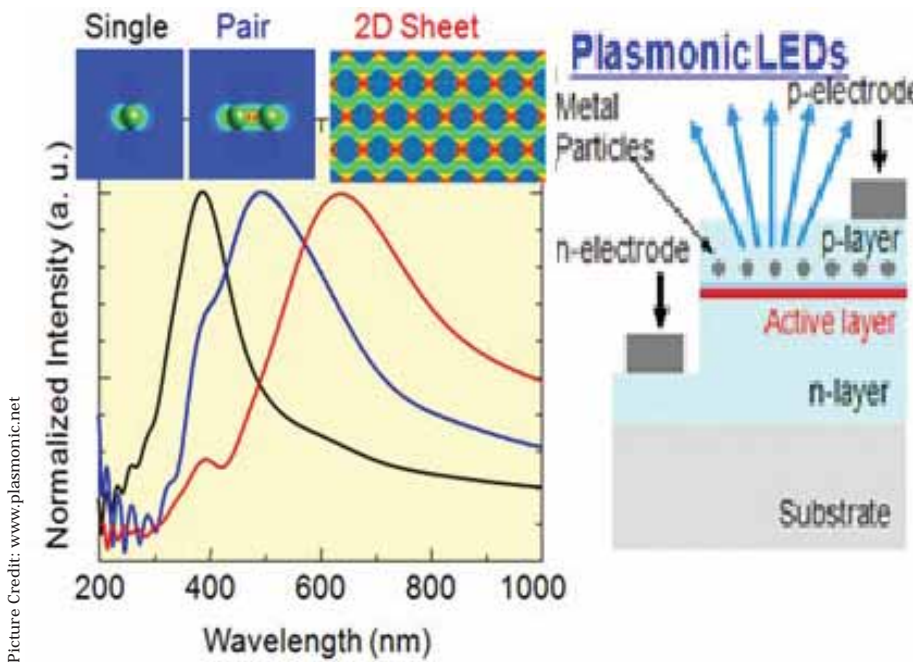
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a certain narrow wavelength range. This enhancement corresponds, on the one hand, to a modification of the angular emission profile, as more light is emitted in a specific direction than in others at a particular wavelength. On the other hand, it also corresponds to a modification of the spectrum in a particular direction or small solid angle, as in this angular range more emission occurs at certain wavelengths than at others. Therefore, using periodic plasmonic arrays in combination with LED phosphors can address both points b) and c) mentioned above simultaneously. Using such a plasmonic LED device could therefore, show the following advantages over a regular phosphor-converted LED:

- Modification of the angular emission profile such that the periodic plasmonic NP array could replace (partly) bulky secondary optical structures for focusing and collimating light in lighting applications.
- Shaping of the emission to better fit the eye sensitivity, especially in the red part of the visible spectrum.

Developmental Status

- Confinement—which occurs due to the large difference in refractive index between the semiconductor and the ambient media—leads to severe total internal reflection at the interface, lowering the light extraction efficiency (LEE) of III-nitride LEDs. The light trapped inside of the LED device is eventually reabsorbed, thereby, decreasing its efficiency. To achieve high light excitation and

wavelength of light, are especially, suited to enhancing light-matter interactions. Metallic surfaces and nanostructures supporting surface plasmon polariton (SPP) resonances are of particular interest in this regard. These resonances have their origin in the coherent oscillation of charge carriers in the metal. The spontaneous emission from sources in the proximity of metals can be modified by SPPs, thereby, influencing the emission rate and directionality. These modifications are analogous to the resonant amplification and directional radiation of antennas. Therefore, metallic nano-particles supporting SPPs have been referred to as optical antennas or nano-antennas. However, integrating such resonant nanostructures into state-of-the-art lighting applications remains challenging. The vast majority of studies has focused on modification of the emission properties of single and low-efficiency emitters, while real

applications in SSL require modification of emission over macroscopic areas, typically, in the mm² range, of highly efficient emitters for which the typical photoluminescence quantum yield (QY) exceeds 90%. Until recently, these stringent requirements have limited the use of plasmonic structures for SSL. This situation is quickly changing due to the introduction of cost-effective nanofabrication techniques for use in light extraction, spectral shaping of emissions and strong beaming, without requiring additional external optical components.

Plasmonic nanostructures are known to influence the emission of near-by emitters. They can enhance the absorption and modify the external quantum efficiency of the coupled system. It has been shown that periodic plasmonic metal nanoparticle (NP) arrays can largely enhance the photoluminescence of nearby emitters in particular directions for

output performance, LEE enhancement is crucial. By modifying the chip shape or its surface morphology, the LEE can be improved. Several approaches have been proposed for the fabrication of different structures, either inside of the substrate or on its surface (e.g., photonic crystals, nanopillars, a patterned substrate, surface roughness, and reflectors). The typical scale of these structures ranges from a few hundred nanometers to a few micrometers, depending on the resolution limit of the optical lithographic technology used.

- New methods that enhance the efficiencies of LEDs using

nanostructured metals are being investigated. This is an emerging field that incorporates physics, materials science, device technology and industry. To evaluate the possibility of using plasmonics to enhance the light emission of a phosphor-converted LED device and create an efficient directional light source, regular arrays of aluminium nanoparticles covered with a red dye layer are under investigation. In arrays of aluminum nanocylinders with a diameter of ca 140 nm combined with a thin (650 nm) layer of luminescent material, very narrow resonances have

been observed, which lead to large enhancement factors of up to 70 and 20 for excitation with a directional blue laser source and a lambertian LED respectively, in a small spectral range for particular angles. These changes in the angular emission profile of the red dye as well as the spectral shape of its emission can help to optimize the efficacy of phosphor-converted LED modules and increase the amount of useable light in a certain angular cone. Using Fourier microscopy, large modifications of the angular emission profile as well as spectral shaping are observed for these plasmonic LED devices

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if compared to reference samples without plasmonic nanostructures.

- Inorganic blue LEDs that are based on InGaN/GaN multi-quantum-well heterostructures are currently used in advanced architectures to obtain white-light emission. However, light generated in the active region of the multi-quantum-well structure can be reflected at the interfaces and trapped in the layered structure before it reaches the phosphor. To remedy this and maximize light extraction, metallic surfaces and nanostructures have been used. The metallic thin films used with SPPs have been applied directly to LEDs to enhance the spontaneous emission rate of excitons in quantum wells. The process can be explained as follows. Electron-hole pairs are injected in the active region of the LED. When a metal layer is grown at a distance smaller than the evanescent decay length of the SPPs, the electron-hole pairs recombine, giving their energy to the SPPs. Thus, the metal provides additional states for exciton recombination. This

enhanced density of states for exciton recombination can significantly increase the recombination rate. Because SPPs are evanescent surface waves, they cannot radiate to free space. The metallic surface can be made rough to efficiently couple SPPs to free space radiation and enhance the emission intensity. Enhancement of the visible light emission originates from a combined higher recombination rate and a higher quantum-well extraction efficiency enabled by the nanometer-sized roughness in the metal layer. Although such random textures result in improved extraction efficiencies, they provide little control over the directionality of the emitted light, which typically displays a Lambertian profile.

- Accurate control over the angular distribution of the emission can be achieved using metallic nanostructures, which are directly fabricated, with predetermined geometries and dimensions, on the emissive semiconductor surface. A periodic designs may also be used to avoid undesirable angular and/or spectral dependencies. Unidirectional beaming of the LED emission has been recently demonstrated using a periodic array of optical antennas with specifically designed geometries. The silver flat film causes a substantial reduction in the intensity of the emitted light for both

polarizations because no mechanism is provided to scatter the excited SPPs into radiation. In contrast, in the direction of the maximum intensity for one polarization, the output intensity of the LED with metallic nanostructures is enhanced compared with that of the flat sample. This polarization dependence can be attributed to the asymmetric shape of the nanostructures. Emission enhancements with a preferential light polarization can be beneficial for applications where light impinges upon smooth surfaces at nearly grazing angles, for example, automotive lighting. In these cases, it may be desirable to selectively enhance the emission obtained for one polarization only, because the other polarization may lead to unwanted effects, such as glare from incoming drivers.

- At the LSPR wavelength (~650 nm), the nanopillar array beams more light toward the bottom of the pillars. The opposite occurs at the SLR wavelength (~585 nm). These effects are due to the enhanced magnetoelectric response of the nanopillar array (magnetic dipole moments are excited via the electric field of light), which originates from the pyramidal shape and height of the nanostructures. Future research should further investigate these phenomena in order to increase emission asymmetry and maximize the fraction of the emitted intensity that can be efficiently used in SSL.

Unlimited Advantages

LEDs constitute a new technology that is currently driving substantial changes in the way artificial light is generated. Several applications, for example, screen or automotive lighting, require light to be directed in only one direction. For planar structures, such as shallow nano-antenna arrays, light beaming into small angles is enhanced with roughly equal strengths in the forward and backward directions. The light emitted backward must be recycled using secondary optics, resulting in losses. To address this issue, the forward-backward light emission symmetry of planar structures can be broken by integrating an array of nanostructures with a pyramidal shape into the fluorescent layer. The inclusion of metallic nanoparticles minimizes the need for optical components in LEDs, such as parabolic mirrors or condenser lenses that are used for beaming the emission. These optical elements are often bulky, increasing the total size of the LEDs and limiting their integration. Therefore, the performance of metallic nanoparticle arrays in SSL applications must be assessed in terms of overall system efficiency with and without the presence of the metallic nanoparticle arrays. From a device perspective, the enhancement of phosphor-layer emissions enabled by the use of nanoparticles must not only be compared with emissions obtained from the same layer when no nanoparticles are used. We must also compare the results obtained with the same phosphor layer under conditions in which the usual secondary optical elements are in place. An additional advantage of nanoantenna-enhanced emission is that it also reduces the phosphor-layer thickness, which is important with regard to heat dissipation. Heat reduces emission efficiency, limiting the performance of LEDs. So far, it has not been easy to use thin layers in pc LEDs owing to their low blue absorption; the conversion efficiencies of these layers have not been sufficient to generate the desired emission spectrum.

Hurdles to Overcome

The texturing process still has several disadvantages, however, including non-uniformity, high cost, material degradation, and limited efficiency enhancement. Due to its high optical transparency and low resistivity, a transparent conductive oxide layer (TCL) can be employed on the LED surface as an effective current-

spreading layer and graded refractive index material. Although the physics of strongly coupled plasmon-emitter systems is very rich, and the prospect of strongly interacting emitters is exciting, the potential of these systems for use in light-emitting devices has rarely been discussed. One of the challenges in this regard is related to the poor QY that phosphor layers with high densities of organic molecules display. Although it is required to access the strong coupling regime, a high molecular density degrades the photoluminescence quantum yield QY of the ensemble via an effect known as 'concentration quenching'. Therefore, challenges remain with regard to improving high-QY light-emitting devices via strong emitter-plasmon coupling. BT



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- Contains a full suite of generator and motor protection for fault detection & clearing, eliminating damaging conditions to the generator or motor.
- Contains an extensive array of communication options which allows for easy integration into a wide variety of control systems.
- Network Load Sharing provides easy implementation in complex paralleled systems.

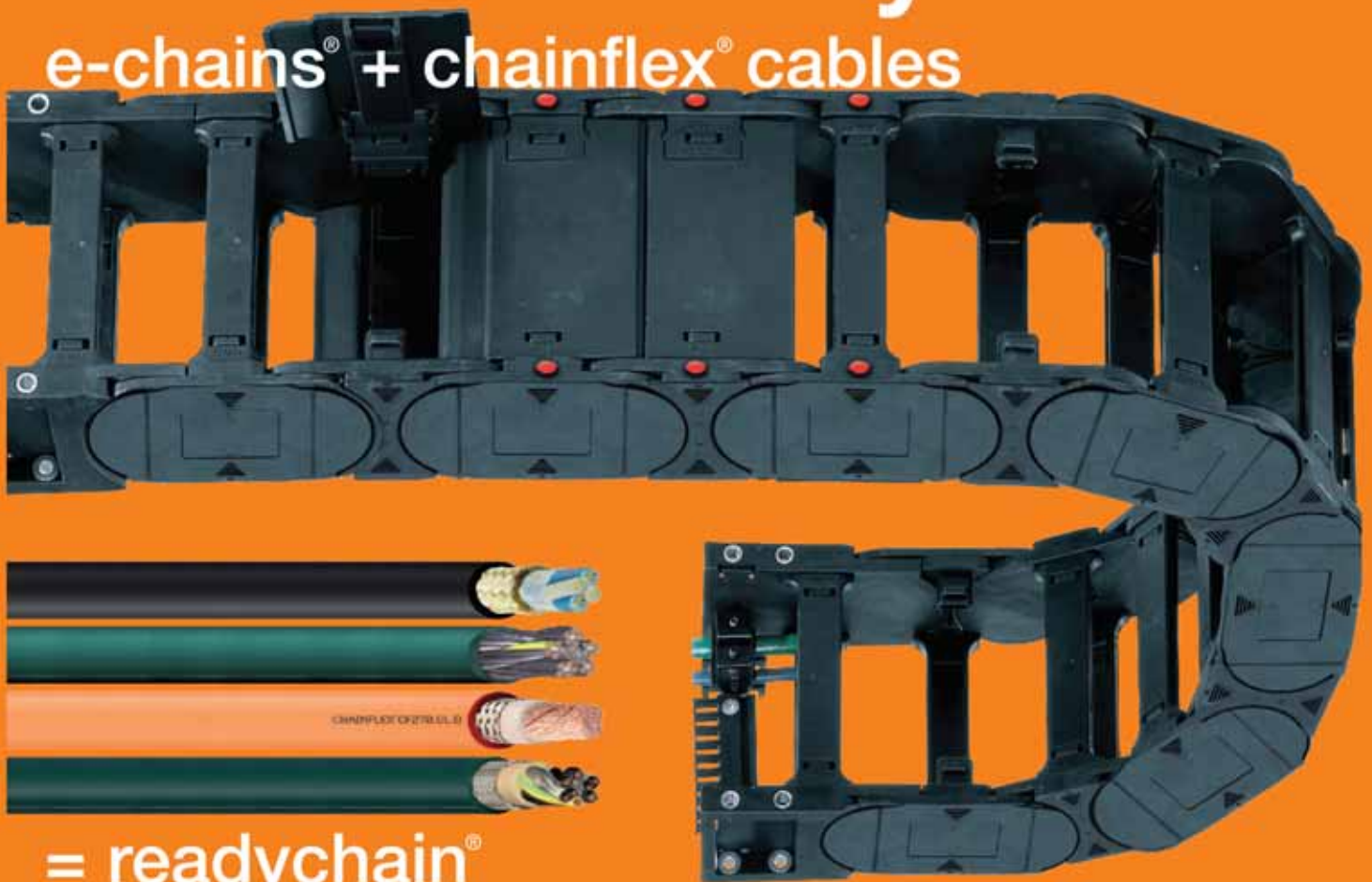
Features

- Outstanding voltage regulation accuracy.
- Precise excitation control for synchronous generator or synchronous motor applications.
- Full generator metering capabilities.
- Automatic Voltage Regulation or Field Current Regulation / Field Voltage Regulation, Power Factor and VAR modes of operation.
- Integrated Generator Protection with detection of - Loss of PMG, Field Short Circuit and Sync Check.
- Load sharing over Ethernet.
- Auto tuning feature with two PID stability groups.
- Optional integrated power system stabilizer (PSS).
- Configurable Protection.
- Over-excitation Limiting (with temperature compensation).
- Under-excitation Limiting.
- Stator Current Limiting (with temperature compensation).
- Var Limiting.
- Under-frequency Limiting or V/Hz Limiting.
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Overall, it makes sense to invest in latest technology and reap its benefits for better returns on investments. 

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Changing Landscape of Energy Sector

Solar energy has gained the highest growth rate worldwide due to potential availability, good visibility & safe use for small and large scales by commercial, residential & utility scale users...



Renewable energy could generate 50% of electricity in India by 2040. India is the world's largest democracy and the second most populous country with more than 1.3 billion individuals on the earth. World's third largest producer & fourth largest consumer of electricity is India. Being a strategic commodity, energy plays an important role in

economic development of the country. Availability of energy, land and water are some of the most important resources of India. India heavily depends on coal & holds third rank after China and USA in terms of coal fired power generation. As on 31st August 2017, India has an installed generation capacity of 329.2 GW & peak demand is about 163.2 GW. India's



Figure 1: Month wise power supply position of India during FY 2016-17

energy landscape is changing promptly. Meanwhile, India has targeted a 275 GW of renewable energy by 2027.

NTPC is the largest thermal power generation company in India with power generating capacity of 51,708 MW at present and with a long-term plan to become 128 GW company by the year 2032. Power Grid Corporation of India Limited is the India's largest electric power transmission utility and the central transmission utility of India. As on 31st March 2017, the total transmission capacity is 75,050 MW of the inter-regional links.

To reduce energy intensity in Indian economy, the Government of India under the provision of Energy Conservation Act 2001, has set up Bureau of Energy Efficiency (BEE) on 1st March 2002. In 2003, Central Electricity Regulatory Commission armed with the provisions in Electricity Act came out with the action plan of regulating the central power generation utilities and to transform Indian power sector. Now, consumer and distribution companies have the freedom to buy electricity directly from the generating companies.

In Indian Context

Fossil fuel based power systems directly emit greenhouse gases to the environment, leading to serious environmental and health impacts. Renewable energy sources are clean & environment friendly, improves quality of human life by providing inexhaustible and enormous supply of energy. Solar

energy has gained the highest growth rate worldwide due to potential availability, good visibility and safe use for small and large scales by commercial, residential & utility scale users. Most parts of tropical country India, experience 250-300 clear sunny days in

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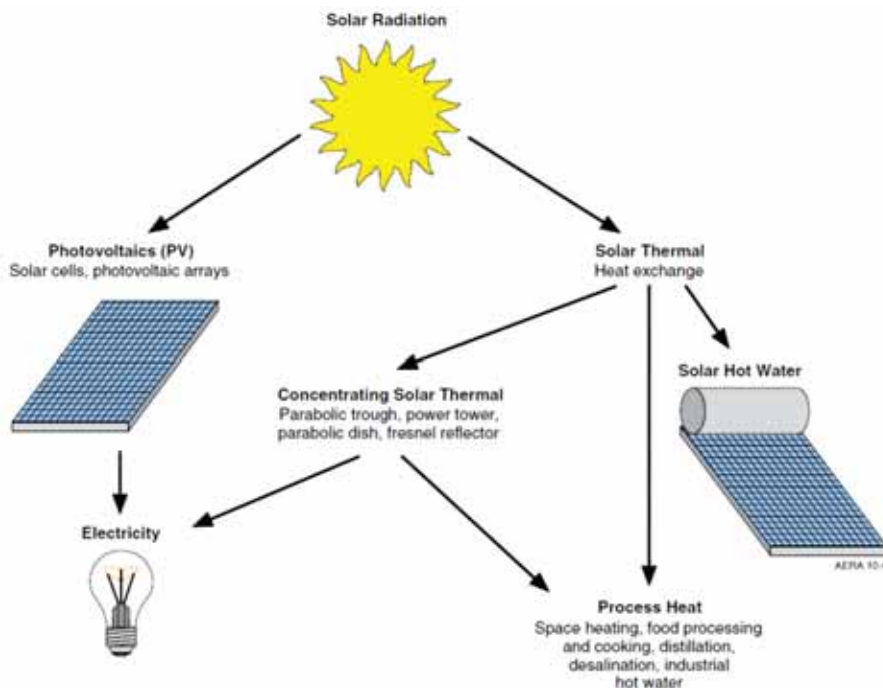


Figure 2: Solar Energy Flows

mirrors or lenses for large scale centralised power. Solar thermal & photovoltaic technology can also be combined into a single system generating both electricity & heat.

As on 31st July 2017, the cumulative installed capacity of solar energy is 13.6 GW. The Government has revised the Jawaharlal Nehru National Solar Mission target of grid connected solar power projects from 20 GW to 100 GW by 2022 to be achieved through rooftop solar power plant (40 GW) and ground mounted solar power plant (60 GW).

Major Govt Initiatives

- Solar park scheme for setting up of over 50 solar parks & ultra mega solar power projects.
- Scheme for setting up 1000 MW of Grid-Connected Solar PV Power Projects by Central Public Sector Undertakings (CPSUs) and Government of India organisations with Viability Gap Funding (VGF).
- Scheme for setting up 300 MW of Grid-Connected Solar PV Power Projects by Defence Establishments and Para Military Forces with VGF.
- Pilot-cum-demo projects for development of grid connected solar PV power plants on canal banks and canal tops.
- Bundling Scheme - 15000 MW grid-connected solar PV power plants through NTPC Ltd/ NVVN.
- VGF scheme for setting up of 2000 MW of Grid Connected Solar PV Power Projects.
- VGF Scheme for setting up of 5000 MW of Grid Connected Solar PV Power Projects.
- Installation of Grid Connected Solar Rooftop Power Plants.

a year. The annual global radiation varies from 1600-2200 kWh/m². Solar power is generated when energy from the Sun is converted into electricity or used to heat water, air or other fluids. Energy can be generated by two technologies namely solar photovoltaic (convert sunlight directly into electricity) and solar thermal (convert solar radiation

into heat). Photovoltaic system can be installed on rooftop, integrated into building design and vehicles or scaled up to megawatt scale power plants. Solar thermal is commonly used for hot water systems. Solar thermal electricity is typically designed for large scale power generation. Photovoltaic system can also be used in conjunction with concentrating



Figure 3: Global Horizontal Irradiation across India

State	Total Cumulative Capacity Till 31st July 2017 (GW)
Andhra Pradesh	2.04
Gujrat	1.26
Karnataka	1.26
Madhya Pradesh	1.11
Rajasthan	2.02
Tamil nadu	1.69
Telangana	1.60

and this process change depends upon the time and day of the year. Usually, solar power plants are located in remote areas characterized by higher solar radiation, which can be very far from the load centre that accounts for very high transmission losses. Net power generation by solar power plant can be enhanced as dependent on radiation. Optimal use of existing distribution network and geographic information system enhances the system efficiency and reliability. Large scale power plants require approximately two hectare of land per MW of power. Small scale photovoltaic and concentrated solar power plants can be installed on existing structure such as rooftops.

Conclusion

With declining photovoltaic cost and downward trend in solar tariffs, solar power has come out as cheapest source of power. State sector and national solar mission has favorable policies for high yield solar

market and local employment opportunities. In addition, there is a requirement of innovative solution for typical existing Indian rooftop challenge. The need of the day is to address the future issues and challenges for the increase volume of solar photo-voltaic waste over the next decade. E1



Anupam Sharma

Senior Project Associate,
IIT Kanpur



Dr. Madhu Sharma

Associate Professor,
UPES Dehradun

Numeric, First UPS Manufacturer to Get BIS Registration

Numeric, the leading UPS manufacturer and power quality solution provider in India becomes the first UPS manufacturer in the country to comply with Bureau of Indian Standards (BIS) registration for 6 - 10 KVA range. The UPS product offerings by Numeric already conform to the international standard-CE.

According to the order issued on November 7, 2014, Electronics and Information Technology Goods (Requirements for Compulsory Registration), it is now mandatory for registration of lesser than equal to 10 kVA rating UPS systems as per phase 3 order. As per a government order dated- August 17, 2017, Numeric UPS rating 6-10kVA were covered in the BIS compulsory registration scheme.

Palash Nandy, Chief Executive Officer, Numeric said, "We are extremely happy to announce that Numeric is the first UPS manufacturer in India to register with the Bureau of Indian Standards (BIS) in the 6-10KVA of UPS range. UPS has remained a key element in any electrical infrastructure-be it SOHO, retail, manufacturing, healthcare, datacenters, IT/ITES, BFSI, hotels etc and our endeavor is to ensure that our customers get best in class products and services that are compliant with the highest quality standards." He further added, "The key consideration in choosing the backup solution like UPS is reliability and efficiency and we at Numeric ensure both of these to our customers." E1





Input:

- Solar Panel Voltage : Max 24 V DC, 60 W
- Auxiliary Supply Input : 18 V - 24 V DC

Battery:

- 12 V DC Lead-Acid Max 40 Ah
- Charging Current: 0.1 to 6 A

Environmental:

- 45 Degrees Ambient with upto 95% non-condensing relative humidity

Features:

- MPPT Algorithm for Solar Panel Power Conversions
- 32 Bit Micro-processor Based Design for Reliable Operation
- Input Over Voltage, Output Over Load Protection
- Precise Three Stage Battery Charging for Extended Battery Life
- Battery Over Charge and Deep Discharge Protection
- Easy Fault Diagnosis with Status LEDs
- Automatic Internal Cooling for Extended Operation in Extreme Environments
- Pure Sine Wave Output For Trouble Free Operation of Connected Appliances
- Output Short Circuit Protection
- Battery Low Indication, Battery Full Charge Indications
- Low Power Consumption

150W Sine-wave Inverter

Output:

- 230 V AC, 50 Hz, $\pm 5\%$
- Rated Wattage: 150 W Internally Limited
- 12V DC Output



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AGC-4: Hot Standby

In a fast changing world of ever-increasing energy demands, you need a power controller that can dependably and efficiently ensure the continuous flow of power. DEIF's AGC-4 features proven technology for a wide range of generation systems in critical power applications.

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

For critical applications, power outage is simply not an option. To provide continuous availability of power, you need DEIF who has proven technical expertise and problem solving capabilities. A single source of solution for mission critical power needs, DEIF guarantees continuous flow of power with highly dependable solutions.

DEIF's advanced technologies combined with customer centric focus secures genset and grid protection, reliable efficient power to maintain uptime, lowering operating costs through fuel optimisation, for all sectors especially, so for healthcare, datacentres, telecommunications, industrial process control systems and television & radio broadcast systems. DEIF's Automatic Genset Controller, AGC-4 offers complete and dependable engineered solutions for mission critical processes.

Critical Power Applications

- **Healthcare:** DEIF offers state of the art critical power management solutions, in line with global standards, that demands restoration of emergency power supplies in less than 10 seconds. Installing

DEIF solutions will give you peace of mind and keep you assured that the patient laying on bed is safe.

- **Datacentres & Telecommunication:** Datacentres are critical to many companies and downtime can cost millions of dollars through data loss and dissatisfied clients, resulting in lost business. DEIF product's hot standby and redundancy features help the customers to solve their power challenges by keeping electricity flowing at mission critical datacentres so that customers serve their clients, solve problems and access data without any interruption.

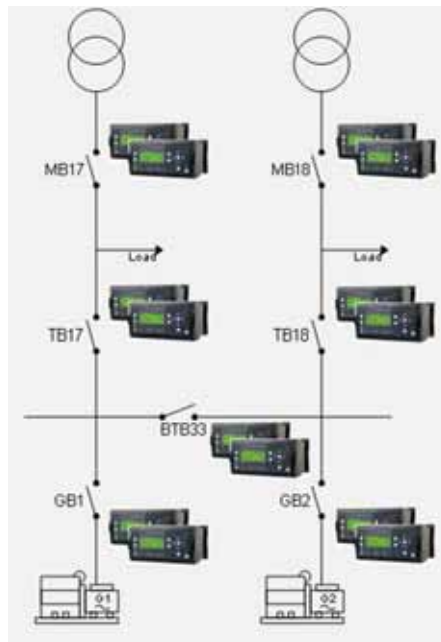
- **Industry:** DEIF delivers extensive product and service solutions to meet your unique industry challenges. Manufacturing facilities have a high continuous energy demand created by their production processes. Whether it's chemical, pharmaceutical, glass making, metallurgy or automated production lines or any other manufacturing processes, DEIF has designed, installed and serviced critical power control solutions that keep industrial operations

powered and productive.

DEIF offers products with wide range of features that give you plenty to play with.

- Hot Standby – Change to backup genset controller on the fly.
- Close Before Excitation – Fast online energy backup by closing genset breakers before activating the alternator excitation system.
- Digital AVR Communication – Dynamic response.
- Redundancy – Increased performance through dual CAN lines, analogue and droop.
- Multiple Master – Extra security with master backup.
- DEIF Emulation – Safe and complete solution test for fast onsite installation and commissioning.
- Remote HMI Interface – To optimise daily operations of widely scattered genet.
- Lifetime Event Log – For close analysis and monitoring.

19





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ABB's Smart Factories in Bangalore


In line with ABB's sustainability commitments and the 'Make in India' push for best in class global technology, the factory will be key in ensuring electrical protection, energy efficiency and boosting the productivity of data and power-hungry facilities across the country.



ABB India has inaugurated one of the first smart factories in Bangalore for the production of electrical protection and connection solutions. The facility will be located on the existing factory premises of Nelamangala in Bangalore, the start-up and IT capital of India. The smart factory enables continuous monitoring of the production process through visualisation of operational data, to increase efficiency and flexibility of the manufacturing process. The smart production line can track and display operational performance parameters across the entire manufacturing chain in real time. The factory also has digital lifecycle management with interconnected automation components, machines as well as data about processes and products. Real-time feeds monitor the entire manufacturing process.

Remote access and wireless communication with Radio Frequency Identification Devices (RFID) manage the production process, work orders and testing parameters. Taking the 'Make in India' initiative to the next level of precision and smart technology, the newest member of the portfolio, Emax 2, includes product line features such as product assembly on track guided vehicles (TGV) powered by electric motors on a closed loop track.

The smart factory, which is part of ABB's

manufacturing 19-acre Nelamangala campus, will house the production line for the entire range of ABB's protection and connection business, which helps to protect power systems from surges and enables a reliable power supply for various installations. The Bangalore facility will manufacture ABB's range of air and molded case circuit breakers, electronic and thermal relays, contactors, pilot devices and ABB's latest range of plug-and-play low-voltage circuit breaker, Emax 2. 

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Vice President M Venkaiah Naidu & Minister of Commerce and Industry Suresh Prabhu during inauguration ceremony of ELECRAMA 2018.

Overwhelming Response at ELECRAMA 2018

Business queries worth ₹ 6,500 crore generated during Buyer Seller Meeting. The mega show witnessed footfall of over 2,98,000 ...

The 13th edition of ELECRAMA – the biggest showcase of the world of electricity organised by Indian Electrical and Electronics Manufacturers' Association (IEEMA) at India Expo Mart in Greater Noida from March 10 to 14. The five-day ELECRAMA 2018 recorded more than 2,98,000 footfalls from more than 120 countries. Over 1,200 exhibitors showcased their products and services.

While inaugurating ELECRAMA 2018, Vice President M Venkaiah Naidu said the government should support manufacturers of electrical and electronics equipment and protect the industry from cheap imports. At the same time, industry leaders must embrace digital technologies and come up with futurist solutions to meet India's growing need for sustainable power.

Minister of Commerce and Industry Suresh Prabhu also called for adopting new technologies to improve energy efficiencies. "The Indian electrical and electronics industry has the skills and capacity to even explore global markets." Organisers said business queries or more than 1 billion USD were estimated at the event. "We had a lot of visitors from 120-plus countries who experienced transformational developments taking place in India and globally," said ELECRAMA Chairman Vijay Karia.

In addition, market forces such as customers turning producers, rise of renewable sources of energy and industry convergence are pushing utilities to think out-of-the-box, experts said at the 2nd edition

of three-day World Utility Summit 2018 held concurrently with ELECRAMA – the world's largest confluence of everything electric. Over 300 delegates were present at the inaugural session presided over by Arvind Singh, Principal Secretary (Energy) at the Maharashtra Government.

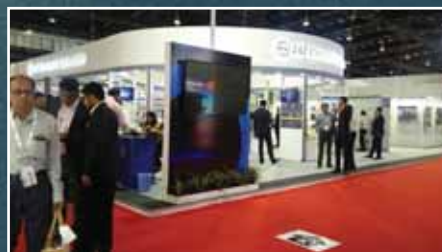
eTechNxt as a concept is introduced for the first time at ELECRAMA. The purpose of eTechNxt is to showcase new technologies which are going to impact the electricity and power sector in a big way. These technologies are already brewing up and going to be the next big thing.

There are four major tracks at eTechNxt: digital delivery of power, industrial internet of things (IIoT), energy storage and electric vehicles. Various stakeholders have demonstrated what they have in these areas, and engage with users and influencers to explore the demand and what are those demand drivers. Apart from that, there were various start-ups showcasing some of these upcoming technologies.

Jye Ying Lu, Director of Malaysia-based Powerpoint Electrical, said, "We have had good opportunity to meet Indian manufacturers. The Indian industry has matured and improved a lot over the past 10 years. The products are well received in Malaysian and other markets as well."

Ornousa Sok Pona, Director at Thailand's government-owned Provincial Electricity Authority, said, "In terms knowledge-sharing, ELECRAMA is of immense value."

EI



FLIR E53: Thermal Imaging Camera for Electrical/Mechanical Applications

The entry-level E53 Advanced Thermal Imaging Cameras offer the superior resolution and range performance needed to quickly identify hot spots and discover potential points of failure in electrical distribution and mechanical systems. With 43,200 pixels resolution and a more vibrant LCD screen than any other pistol-grip camera, the E53 makes it easier than ever to diagnose problems—even



at a distance. Avoid costly shutdowns and lost production time through regular predictive maintenance routines with these rugged, intuitive cameras and improve plant reliability & safety and make your work easier.

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Rish Insu 5Dx

Considering the ever increasing demand of electricity, there is always a need of newer ways to satisfy the same with an increase in number of generating stations & to facilitate an uninterrupted power supply. The prior is a long-term activity but the latter can be achieved by various ways that includes one of the major methods - the periodic maintenance. In order to enable & empower government & private utilities, to have a complete diagnostic sculpture of all the constituents in the power system, Rishabh Instruments Pvt. Ltd. is here with a perfect solution – the Rish Insu 5Dx.



The Digital Insulation tester 'Rish Insu 5Dx' designed to perform professional insulation resistance measurements with test voltage programmable upto 5kVDC and wide measurement range upto 10Tohm which permits a large application for each industrial LV environment (test on electrical machines, power transformers, electrical cables,

switchboard panels, generic devices, etc). Three different function modes are available on meter: FIX mode (fixed test voltage), ADJUST mode (programmable test voltage) and RAMP mode (programmable test voltage and duration time with upto 3 kind of selectable ramps) which permits to reach correct results in each situation. The Polarization Index (PI) and Dielectric Absorption Ratio (DAR) available features are duration tests which permit to define a good behaviour of the global insulation. The Insulation tester Rish Insu 5Dx is powered by a NiMH rechargeable

battery with integrated adapter that permits to reach great performances during the measurements, it has an internal memory for saving results and a RS-232 interface for connection to PC and transfer saved measurements. All structure is fitted in a portable hard carrying case which assures safety typical of an 'on field' Digital Insulation Tester.

For further information: <http://rishabh.co.in>

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Intrinsically Safe True RMS Digital Multimeter – KM 822sEX

Kusam-Meco, pioneers of digital multimeters & clampmeters in India have introduced for first time a new intrinsically safe true RMS Digital Multimeter with PC interface model KM 822sEX. It has high transient protection of 12 KV (1.2/50mS) lightning surge. It has a four digit 10,000 counts large easy to read, backlight dual display. EX marking on meter i.e. Ex ib I Mb, Ex ib IIC Gb, SAEx MS/09-291X, Ex ib falls under Zone 1 which is an area where flammable gas can occur in normal operating conditions.

The measuring functions include:

- DC/AC Voltage: 60mV ~ 1000V;
- DC/AC Current: 600micro A ~ 10A;
- Resistance: 0.1 Ohm ~ 60MOhms;
- Frequency: 5Hz ~ 1MHz
- Capacitance: 60nF ~ 20mF. It also has diode, continuity, duty cycle function.

In addition, it features splash/drop proof, intrinsically safe, beep-jack audible & visible input warning, relative zero mode, data hold, ex rating-EX IB i/IIC t6. It has (optional) PC interface for downloading the data in computer via USB cable & software.

These meters comply to IEC SANS 600790:2000 & IEC SANS 60079-11:1999, which is for electrical



apparatus for explosive gas atmospheres. Part 0 (general requirements) & part 1 (intrinsic). The approved explosive protection rating of this equipment is suitable for use in Zone1 hazardous area. Group I (coal mines) underground & Group II (surface).

Safety: It has double insulation per IEC61010-1 2nd Ed, EN61010-1 2nd Ed, UL61010-1 2nd Ed. & CAN/CSA C22.2 No. 61010.1-0.92 to Category IV 1000Vac & Vdc. For voltage, Ampere, Milli Ampere Micro Ampere ranges, the safety category is IV1000 Vac & Vdc. It has fuse protection for micro Ampere & milli Ampere 0.44A/1000Vac & Vdc, 1R10kA or better, F Fuse. For Ampere ranges, the fuse protection is 11A/1000Vac & Vdc,

IR20kA or better, F Fuse. For Voltage range fuse protection is 1050Vrms, 1450Vpeak. Milli Volts, Ohms & others fuse protection is 600Vdc & Vac rms.

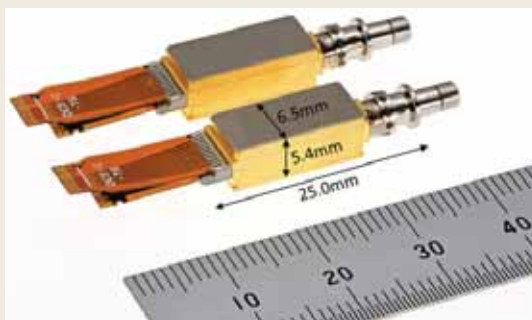
It features a rugged fire retardant casing, protective holster with probe holder & tilt stand. It is powered by one 9V battery no. NEDA 1604G, IEC6F22. Standard accessories supplied are user manual, battery, test lead & carrying case. PC software is optional.

For further information: www.kusamelectrical.com

Mitsubishi Electric to launch Compact Integrated 400Gbps EML-TOSA

Mitsubishi Electric Corporation revealed that it will begin shipping a laser-diode transmitter optical subassembly (TOSA) capable of supporting 400Gbps optical transmissions on April 1. The new TOSA, when used in a set of two, can be used in the industry's first electro-absorption modulated laser diode (EML)-TOSA solution for IEEE 400GBASE-LR8 applications. The device will be displayed at the Optical Fiber Communication Conference and Exhibition 2018 (OFC) in San Diego, California from March 13 to 15.

In response to the demand for increasing data capacity, Mitsubishi Electric's new laser-diode TOSA offers 400Gbps transmission capability for large-capacity communication facilities (data centres, etc.)



and high-speed optical transmission networks.

Product Features

Large-capacity, high-speed 400Gbps communication

- Multiple transmission of eight wavelengths by two TOSAs
- 50 Gbps / wavelength (400Gbps in eight wavelengths) achieved with 4-level pulse-amplitude modulation (PAM4) method
- Capable of 10km transmission thanks to EML chip featuring high extinction ratio and high power
- Package size complies with common specifications for CFP8 optical transceivers (when using two TOSAs)

For further information: www.mitsubishielectric.com

STELPRO launches MAESTRO

STELPRO, a well known Canadian manufacturer of integrated heating solutions, extends its commitment to smart home automation by launching MAESTRO, the smart thermostat compatible with zoned electrical equipment. Simple and intuitive, MAESTRO is designed to fit the lifestyle of consumers, thanks to a variety of custom features such as geo-fencing, anticipated start, personalised activities and grouping of rooms into zones. In addition to easily managed and personalised home heating, MAESTRO allows consumers to significantly reduce energy costs and save on their electricity bill.

Orchestrating comfort at home, MAESTRO controls the thermostats of the house that are connected and compatible with all electric heaters, such as baseboards, convectors and fan heaters. The smart thermostat gives households full control over their comfort according to their lifestyle, allowing to adjust the temperature of each room depending on their activity for a given period of



time. With its unique geo-fencing feature, MAESTRO detects when an occupant arrives or leaves the home within two kilometers and adjusts the temperature accordingly, maximising energy consumption.

For further information: stelpro.com

GE reveals Innovative Energy Storage Platform

With a commitment to deliver cleaner, more reliable power where and when it's needed most, GE launched the GE Reservoir - a comprehensive energy storage platform that delivers a suite of customised storage solutions to help customers address new challenges and seek new opportunities in a rapidly transforming power grid that is becoming more highly diversified and distributed.

The Reservoir, which already has a 20 MW, 80 MWh pre-launch commitment, expands GE's 10-year footprint in the energy storage space and builds upon recent successes and milestones. Last year, GE introduced the world's first hybrid-electric gas turbine to multiple accolades across the industry. GE was the first-to-market with advanced applications for hybrid electric-gas turbines, wind hybrids and 'Black Start' capabilities. And just last month, GE announced a new project with the Arenco Group to build one of the world's largest energy storage systems in the UK.



Eric Gebhardt, Vice President and Strategic Technology Officer of GE Power, said, "GE's Reservoir platform enables cost-effective distribution, storage, and utilisation of cleaner, more reliable power where and when it is needed most. It can fit into most any setting, from centralised grid systems to the most remote villages and communities. The Reservoir also allows energy providers new degrees of flexibility for more intelligently managing and getting the most out of all their power assets."

For further information: www.ge.com



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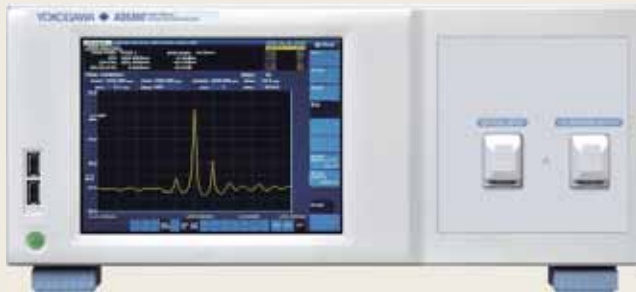
Growth in Transmission Sector

1. Transmission Lines (All Figures in CKM)									
At the end of	6th plan	7th plan	8th plan	9th plan	10th plan	11th plan	12th plan	During 2017-18 Upto November 2017	Capacity as on November 2017
+500 kV HVDC									
Central	0	0	1634	3234	4368	5948	12,072	0	12,072
State	0	0	0	1504	1504	1504	1,504	0	1,504
JV/Private	0	0	0	0	0	1980	1,980	0	1,980
Total	0	0	1634	4738	5872	9432	15,556	0	15,556
765 kV									
Central	0	0	0	751	1775	4839	25,465	1,428	26,893
State	0	0	0	409	409	411	1,177	335	1,512
JV/Private	0	0	0	0	0	0	4,598	283	4,881
Total	0	0	0	1160	2184	5250	31240	2,046	33,286
400 kV									
Central	1831	13068	23001	29345	48708	71023	92,482	3,482	95,964
State	4198	6756	13141	20033	24730	30191	48,240	4,065	52,305
JV/Private	0	0	0	0	2284	5605	17,065	1,613	18,678
Total	6029	19824	36142	49378	75722	106819	157787	9,160	166,947
220 kV									
Central	1641	4560	6564	8687	9444	10140	11,014	62	11,076
State	44364	55071	73036	88306	105185	125010	151,276	2,547	153,823
JV/Private	0	0	0	0	0	830	978	5	983
Total	46005	59631	79600	96993	114629	135980	163,268	2,614	165,882
Grand Total	52034	79455	117376	152269	198407	257481	367,851	13,820	381,671
2. Sub-Station (All Figures in MVA/MW)									
At the end	6th plan	7th plan	8th plan	9th plan	10th plan	11th plan	12th plan	During 2017-18 Upto November 2017	Capacity as on November 2017
+500 kV HVDC Converter/BTB Station									
Central	0	0	0	3500	6500	8250	15,500	3,000	18,500
State	0	0	0	1700	1700	1500	1,500	0	1,500
JV/Private	0	0	0	0	0	0	2,500	0	2,500
Total	0	0	0	5200	8200	9750	19500	3,000	22,500
765 kV									
Central	0	0	0	0	0	24000	138,000	6,000	144,000
State	0	0	0	0	0	1000	15,000	2,500	17,500
JV/Private	0	0	0	0	0	0	14,500	1,500	16,000
Total	0	0	0	0	0	25000	167500	10,000	177,500
400 kV									
Central	715	6760	17340	23575	40455	77225	116,170	6,445	122,615
State	8615	14820	23525	36805	52487	73172	117,782	15,820	133,602
JV/Private	0	0	0	0	0	630	5,520	4,860	10,380
Total	9330	21580	40865	60380	92942	151027	239472	27,125	266,597
220 kV									
Central	500	1881	2566	2866	4276	6436	9,046	385	9,431
State	36791	51861	81611	113497	152221	215771	303,480	10,115	313,595
JV/Private	0	0	0	0	0	1567	1,767	180	1,947
Total	37291	53742	84177	116363	156497	223774	314293	10,680	324,973
Grand Total	46621	75322	125042	181943	257639	409551	740765	50,805	791,570

Source: powermin.nic.in

Yokogawa Test & Measurement releases AQ6360 Optical Spectrum Analyzer

Yokogawa Test & Measurement Corporation reveals the release of the AQ6360, an optical spectrum analyzer for production line applications that employs the dispersive spectroscopy technique (A technique for the extraction of a narrow range of wavelengths by passing light through a diffraction grating and a narrow slit) and covers optical communication wavelengths in the 1200–1650 nm range. With its compact, lightweight design and optimal performance specifications for production line applications, the AQ6360 is an ideal instrument for the production line testing and inspection of the semiconductor lasers used in optical transceivers, optical amplifiers, and other types of optical communications devices.



Product Features

1. The right specifications at a low price

As its performance specifications have been optimised for the production line testing and inspection of semiconductor lasers, the AQ6360 costs approximately 30% less than our high-performance AQ6370D model.

Major specifications:

- Wavelength resolution: 0.1 to 2 nm
- Level sensitivity: +20 to -80 dBm (dBm: decibel per mW)
- Dynamic range: 55 dB

2. Stable measurement independent of optical fiber type

The AQ6360 features a unique free-space optical input. As no fiber is mounted inside the instrument, the AQ6360 can accept light signal inputs from both single-mode and multimode fibers, ensuring stable measurement independent of the optical fiber type.

3. High-speed measurement

The AQ6360 can measure optical signals approximately two times faster than the AQ6370D.

4. Compact

The AQ6360 is compact, measuring just 426 mm (W) × 459 mm (D) × 177 mm (H), and it weighs only 15.5 kg. It is approximately 20% shorter and lighter than the AQ6370D.

For further information: www.yokogawa.com

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Battery Analyzer

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Current Transformer Tester

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- RD helical gearboxes: 50 to 2300 Nm. Two and three stages.
- RN parallel shaft gearboxes: 180 to 3300 Nm. Two and three stages.
- RO-RV bevel/helical gearboxes: 180 to 3300 Nm. Three stages.
- RG precision planetary gearboxes: 10 to 230 Nm.
One and two stages.
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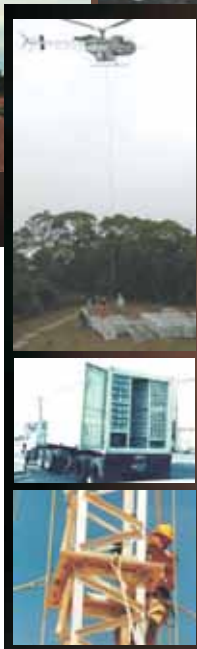
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