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Publisher's Letter

Global Focus And Our Target

> Whatever decline is observed in fossil fuel pricing, the world has to lean towards renewables to arrest carbon footprints...

There is nothing new in the statement that 'Harnessing Renewable Energy Holds the Key to Bright Future,' however, from the investment point of view how lucrative is it? The latest long-term forecast from Bloomberg New Energy Finance (BNEF), entitled 'New Energy Outlook (NEO) 2016' has some significant indications in this line.

As per BNEF's expectation, there will be $11.4 trillion investment in global power generation capacity over the (2016 to 2040) next 25 years, with electric vehicles boosting electricity demand by 8% in 2040. It also indicates that the low prices for coal and gas are likely to persist, but will fail to prevent a fundamental transformation of the world electricity system over the coming decades towards renewable sources – such as wind and solar, and towards balancing options such as batteries.

Looking at the coal, gas and oil prices that BNEF projects now, I observe, further downward trend compared to their last year's forecast. At the same time, what makes the situation more confusing to guess the future course is a steeper decline of wind and solar costs.

Also, as far as carbon emissions are concerned, the report conveys: weaker GDP growth in China and a rebalancing of its economy will mean emissions there peak as early as 2025. Moreover, rising coal-fired generation in India and other Asian emerging markets indicate that the global emissions figure in 2040 will still be some 700 megatonnes, or 5%, above 2015 levels. Then what's the way out?

Seb Henbest, Head of Europe, Middle East and Africa for BNEF says, "Some $7.8 trillion will be invested globally in renewables between 2016 and 2040, two thirds of the investment in all power generating capacity, but it would require trillions more to bring world emissions onto a track compatible with the United Nations 2°C climate target."

Obviously, whatever decline is observed in fossil fuel pricing, the world has to lean towards renewables to arrest carbon footprints. Contextually, once again our Prime Minister Narendra Modi's prudence is time-tested by the fact that he had set a target of achieving 175 GW of renewable energy by 2022, much before. I plead to all, let us put our all round support to make his great mission successful.

Do send in your comments at miyer@charypublications.in

Mahadevan

Editor-In-Chief

{ The successful publishing house is the one that can guess ahead, not the one that imitates the past. - Helen Jacobs }

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Instrumentation & Controls, Power Electronics & Renewable Energy

INTERVIEW

"We are the gear that meshes seamlessly with our customers' processes..."

Thampy Mathew
Managing Director, ME & India (Process Automation Div)
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FEATURES

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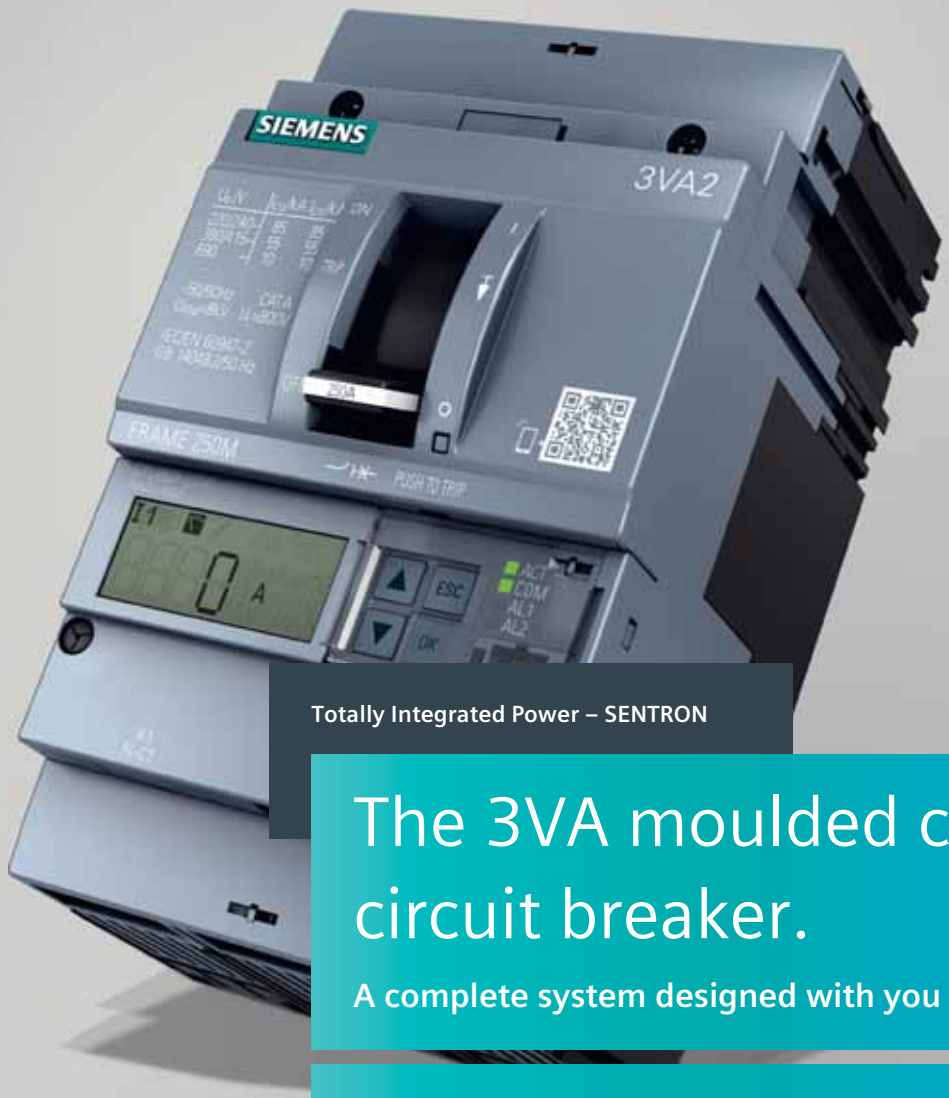

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Going Digital Is The Current Trend

P K Chatterjee (PK)

> The trend of embracing digitalisation will continue in full swing in the power industry to remain competitive...

What's up in the modern industry? On the contrary to the dwindling man to man relationship, device to device connection is intensifying. Yes, the era of Industry 4.0 is not only strengthening communication between devices or components but also playing a remarkable role to integrate the virtual world with the physical one.

The power industry too, being the prime-mover of almost all other industries, is not an exception. Rather here, Industry 4.0 is almost radically transforming the age-old modus operandi. Why do I say so? If we a bit minutely observe, the power industry is the area, which is literally maintaining the largest of the supply chains including all its elements in it. So, this is perhaps the widest area, where Industry 4.0 has the highest potential to boost the overall operational efficiency.

Although the new digital revolution is termed differently by individual vendors, their target is unique, i.e., to create a sound digital network between everything that we see across and (also in some cases) around in the industry. Exactly how will this help the power industry improve? To put an example, let me quote a bit from a Siemens' literature, "Wind turbines, for example, can increase electricity output by comparing operating data with weather data and making necessary adjustments."

The Siemens' literature further explains, "Digital services quickly detect and resolve issues. The intelligent analysis of operational data helps identify patterns and predict potential downtimes. Minimum downtimes boost reliability..."

According to GE's estimation, there is $1.3 trillion in value creation between now and 2025 for companies that are going digital and $90 billion is expected to be invested in the energy industry's digitalisation by 2020. What type of projects are they doing? We all know that recently in Pakistan GE has signed contracts with Halmore Power Generation Company and Orient Power Company to provide its Predix-enabled Digital Power Plant solutions. GE's Digital Power Plant solutions for Pakistan will integrate hardware, software applications with operations optimisation and predictive analytics capabilities to deliver such benefits as improving thermal efficiency and enhancing plant operations.

Digitalisation is the first and firm rung to embrace Industry 4.0. Thus, the trend of embracing digitalisation will continue in full swing in the power industry to remain competitive.

P. K. Chatterjee

> The future of Publishing is about having connections to readers and the knowledge of what those readers want.
>
> - Seth Godin

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Power sector offers huge opportunity for investors

India's power sector is one of the most diversified in the world. Sources of power generation range from conventional sources such as coal, lignite, natural gas, oil, hydro and nuclear power to viable non-conventional sources such as wind, solar and agricultural & domestic waste. Electricity demand in the country has increased rapidly and is expected to rise further in the years to come. In order to meet the increasing demand for electricity in the country, massive addition to the installed generating capacity is required.

India ranks third, just behind US and China, among 40 countries with renewable energy focus, on back of strong focus by the government on promoting renewable energy and implementation of projects in a time bound manner.

According to Union Power Minister Piyush Goyal, the Indian power sector has an investment potential of Rs 15 trillion (US$ 222.36 billion) in the next 4 to 5 years, thereby providing immense opportunities in power generation, distribution, transmission and equipment.

The government's immediate goal is to generate two trillion units (kilowatt hours) of energy by 2019. This means doubling the current production capacity to provide 24x7 electricity for residential, industrial, commercial and agriculture use.

The Government of India is taking a number of steps and initiatives like 10-year tax exemption for solar energy projects, etc., in order to achieve India's ambitious renewable energy targets of adding 175 GW of renewable energy, including addition of 100 GW of solar power, by the year 2022.

The cumulative installed capacity of solar power in India has crossed the 4 Gigawatt mark as of June 30, 2015. The government has also sought to restart the stalled hydro power projects and increase the wind energy production target to 60 GW by 2022 from the current 20 GW.

Letter to the editor

Subject: Feedback related to the article 'Fuel Cell Technology – Clean Energy (Electrical India, July 2016 Issue)

Sir,

This article is innovative and important for revolution in energy sector.

In this article some points like: layers of ceramic on steel base convert natural gas to power supply... I have some doubts regarding how it works.

Please share more information regarding this article.

Yours sincerely,
Gaurav Kumar
Electrical & Electronic Engineering
GIET, Gunupur

Editor's reply:

Dear Gaurav,

First of all thanks for your letter through e-mail.

In the past issues of Electrical India, we have covered many articles on Fuel Cells, and in the future issues also we will continue to do so.

Globally, many companies, institutes and individuals are conducting their research programmes to improve Fuel Cells further to make them more economic and user-friendly.

Although at present mostly the automotive manufacturers (like Toyota, Nissan, Hyundai and others) are showing great interest in Fuel Cells' development, it seems, the time is not very far when Fuel Cells will find place in each and every home as a domestic power supply unit (very much like we see inverters today).

Please read all future issues of Electrical India. We are trying to put more articles on this topic as soon as possible.

Regards,
PK
Editor, ELECTRICAL INDIA

World Bank's President makes important announcements

Recently, World Bank's President Jim Yong Kim, on his two-day visit to India, had a meeting with Prime Minister Narendra Modi – and another meeting with Finance Minister Arun Jaitley. Chiefly, his meeting with the Prime Minister was to ensure support to the government's six priorities and also accelerate the country's renewable energy sources.

Jim Yong Kim

After the visit, President Jim Yong Kim stated, "One of the reasons that I always appreciate my meetings with the Prime Minister is that he always pushes us to move faster and faster – to keep pace with him. We promised that we would do so, and in particular talked about supporting his government's pace on expanding renewable energy sources."

The World Bank's President made two important announcements on solar power during this trip. In his words, "First, we signed an agreement with the International Solar Alliance, consisting of 121 countries led by India, to collaborate on increasing solar energy use around the world, with the goal of mobilising $1 trillion dollars in investments by 2030. This agreement establishes the World Bank Group as a financial partner for the alliance."

"Second, we plan to provide more than $1 billion dollars to support India's ambitious initiatives to expand solar through investments in solar generation. These projects (now under preparation) include solar rooftop technology, infrastructure for solar parks, bringing innovative solar and hybrid technologies to market, and transmission lines for solar-rich states. As part of our $1 billion dollar solar commitment to India, we signed an agreement with the Government of India for a $625 million dollar grid connected rooftop solar program. The project will finance the installation of at least 400 megawatts of solar photovoltaic installations."

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World Bank, India sign deal to boost solar energy globally

The World Bank Group has recently signed an agreement with the International Solar Alliance (ISA), consisting of 121 countries led by India, to collaborate on increasing solar energy use around the world, with the goal of mobilising $1 trillion in investments by 2030.

The agreement signed in the presence of Finance Minister Arun Jaitley, Union Minister of State with Independent charge for Power, Coal, New and Renewable Energy Piyush Goyal and World Bank Group President Jim Yong Kim establishes the World Bank Group as a financial partner for the ISA and sees the institution as using its global development network, global knowledge and financing capacity to promote the use of solar energy.

The World Bank has also announced that it planned to provide more than $1 billion to support India's ambitious initiatives to expand solar through investments in solar generation. The World Bank-supported projects under preparation include solar rooftop technology, infrastructure for solar parks, bringing innovative solar and hybrid technologies to market, and transmission lines for solar-rich states. These solar investments for India combined would be the Bank's largest financing of solar for any country in the world to date.

"India's plans to virtually triple the share of renewable energy by 2030 will both transform the country's energy supply and have far-reaching global implications in the fight against climate change. Prime Minister Modi's personal commitment toward renewable energy, particularly solar, is the driving force behind these investments. The World Bank Group will do all it can to help India meet its ambitious targets, especially around scaling up solar energy," said Kim.

He further added that he also hoped the signing of the agreement with the ISA would help mobilise a global movement toward a climate-friendly future. As part of the agreement, the Bank Group will develop a roadmap to mobilise financing for development and deployment of affordable solar energy, and work with other multilateral development banks and financial institutions to develop financing instruments to support solar energy development.

REC Training Institute gets award

Central Institute for Rural Electrification (CIRE), an apex training institute of Rural Electrification Corporation (REC) Limited, a Government of India Enterprise, under Ministry of Power, has been conferred National Education Award 2016 by ABP News. REC provides loan assistance to SEBs/State Power Utilities for investments in rural electrification schemes.

The award has been given in recognition for its excellent contribution in providing training in power sector. The award was received by G. Shankar, Additional Director, CIRE at a ceremony held in Mumbai attended by representatives from academic and educational institutions.

CIRE was selected by an independent jury and panel of professionals who believe in nurturing Talent and in recognising the best of the best. No nomination was submitted by the institute nor any fee paid towards receiving the award.

TERI to hold global conclave

The Energy and Resources Institute (TERI), ranked globally as one of the five most impactful think tanks by the International Center for Climate Governance Ranking 2016, has announced the 2016 edition of its flagship event, World Sustainable Development Summit (WSDS).

Themed 'Beyond 2015: People, Planet & Progress,' the Summit assumes critical significance in the background of the adoption of Sustainable Development Goals and signing of the landmark Paris Agreement last year. The Summit will be held from October 5 to 8 in New Delhi.

WSDS has evolved from the 15-year legacy of the Delhi Sustainable Development Summit (DSDS), which was initiated by TERI in 2001. It is among the first international summits to discuss the new agenda post the adoption of the Sustainable Development Goals and COP 21.

Union Minister launches Solar Power Tree

Recently, Union Minister for Science & Technology and Earth Sciences, Dr Harsh Vardhan launched the 'Solar Power Tree' in New Delhi. It has been developed by the CSIR-Central Mechanical Engineering Research Institute (CSIR-CMERI), a constituent laboratory of Council of Scientific and Industrial Research (CSIR).

The Solar Power Tree harnesses solar energy for producing electricity with an innovative vertical arrangement of solar cells. It thus reduces the requirement of land as compared to any conventional Solar Photovoltaic layout, on one hand, while keeping the land character intact on the other. Even the cultivable land can be utilised for solar energy harnessing along with farming at the same time. The innovation finds its viability both in rural and urban areas.

Dr Harsh Vardhan launches the Solar Power Tree...

Dr Vardhan, while appreciating the efforts of the scientists of the CSIR-CMERI, said that the Solar Power Tree innovatively addresses the challenge of increasing demand for Green Energy by gainfully utilising scarce land resources in the country. Further, he noted that in order to produce 1 MW of solar power it needs about 3.5 acres of land in the conventional layout of solar panels. Thus, for any state in the country to survive on green energy, there will be requirement of thousands of acres of land, which itself is a major issue.

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Tata Power celebrates its Club Enerji Carnival

The 'Club Enerji Carnival' of Tata Power was held on July 12, 2016 in Mumbai. The main objective of the carnival was to honour Tata Power's 100 years' contribution to the nation. A total of 500 students across six cities namely, Mumbai, Delhi, Pune, Kolkata, Bengaluru and Ahmedabad participated in the Carnival. The event was graced by the presence of Tata Group Chairman, Cyrus Mistry and Tata Power CEO and MD, Anil Sardana along with other Tata Power leadership officials.

The highlight of the event was 'Energy Q'- a quiz competition. The participating students captivated the audience with their grasp on science, energy conservation and general knowledge. The quiz competition had five rounds to enter the grand finale. Out of 200 participating schools, four schools were shortlisted. NL Dalmia High School, Mumbai was the winner and was entitled as Tata Power Enerji Q Champion. Nalanda Public School, Mumbai was the second runner up and Delhi Public School, New Delhi was the third runner up.

A view of the Club Enerji Carnival...

Furthermore, six talented students from the participating cities showcased their ideas to the jury panel through innovative projects themed on resource and energy conservation. In order to encourage these students the jury selected and awarded three winners.

On the other hand there was a painting competition organised, which followed the same pattern of recognisation. The event also included dance performances and plays on energy conservation.

Cyrus Mistry said, "It's a pleasure to be here with Tata Power Club Enerji participants and witness the enthusiasm of young champions, teachers and schools in making a positive difference to the environment & society at large."

Anil Sardana said, "Club Enerji Carnival brings together students across India and provides them with a platform to showcase their zeal in the area of energy conservation and resource conservation."

BHEL commissions another unit of Teesta Low Dam HEP

The third unit of the 4x40 MW Teesta Low Dam Hydro Electric Project (HEP) Stage-IV has been successfully commissioned by Bharat Heavy Electricals Limited (BHEL) in West Bengal. A run-of-the-river greenfield project located in Darjeeling district of West Bengal, Teesta HEP is being set up by National Hydroelectric Power Corporation (NHPC), on the River Teesta.

The fourth and final unit of the project is also in advanced stages of execution. Power generation from the Teesta project will result in reduction of Green-House Gas (GHG) emissions and will help in achieving a low carbon development path for the state as well as the nation.

The order for Electrical & Mechanical (E&M) works for all four units of 40 MW each was placed on BHEL by National Hydroelectric Power Corporation (NHPC).

BHEL's scope of work in the project comprised design, manufacture, supply, installation and commissioning of complete E&M works including vertical shaft Kaplan Turbines and matching generators. The equipment has been supplied by BHEL units at Bhopal, Jhansi, Rudrapur and Bengaluru, and the execution of work on site is being carried out by the company's Power Sector Eastern Region.

BHEL is presently executing HEPs of around 3,300 MW in the country, which are under various stages of implementation. Other projects of NHPC currently under execution by BHEL are the 4x200 MW Parbati HEP Stage – II and 3x110 MW Kishanganga HEP.

L&T Power bags 71.3 mn USD worth orders from Mitsubishi Hitachi Power Systems

L&T-MHPS Boilers Private Limited (LMB) and L&T-MHPS Turbine Generators Private Limited (LMTG), joint venture companies of Larsen & Toubro Limited (L&T) have secured export orders worth 71.3 million USD from Mitsubishi Hitachi Power Systems Limited (MHPS).

LMB contract comprises supply of pressure parts for 2 x 1000 MW power plant in Indonesia and contains furnace header, panel, coils and piping. This company is currently executing nine export orders for the supply of pulverisers and pressure parts for a range of MHPS projects in Japan and Indonesia. It has already executed eight MHPS export orders for the supply of pressure parts, pulverisers and engineering services to Middle East, Africa and South East Asia.

LMTG contract comprises supply of turbines for the 2 x 1,000 MW plant. This company has the opportunity to execute 1,000 MW supercritical steam turbines' order, after having manufactured the first 800 MW steam turbine in India. This order takes the company's tally of export orders to 22 units, out of which 11 are presently being executed, thus increasing its global footprint of subcritical to ultra supercritical steam turbines and components to the Americas, Middle East and the Far East.

Conference on
Smart Automation for SMEs

23 September 2016, Bangalore International Exhibition Centre, Bengaluru

Smart Automation aims to raise awareness among the SMEs about the definite competitive advantage that can be gained by adopting innovative technologies and solutions. Government of India with its initiative "Make-in-India" is infusing vigor into this sector to ensure progression in technology and manufacturing processes.

The co-located conference on "Smart Automation for SMEs" will showcase how SMEs can bridge quality gaps, sustain long lived performance, master the skills needed to absorb required levels of Industrial Automation and become partners in global supply chains.

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Suzlon's first wind farm site completes 20 years

Suzlon Group has completed an operational milestone of 20 years of its first wind farm at Dhank, Gujarat. It was initially built for Indian Petrochemical Corporation Ltd. (IPCL). Currently it's being utilised by Reliance Industries Ltd.

The site has a total of 14 Wind Turbine Generators (WTGs) commissioned and erected for IPCL and other SMEs.

Ten of the WTGs have completed 20 years, with the remaining 4 scheduled to do so in December, this year.

The 10 units consist of 2 units of 270kW and 8 units of 350kW. Since March 1996, the site has successfully powered 70,000 households in Gujarat.

The company has played an essential part in the growth of wind energy in the state since its inception. As of March 2016, the total wind installations in Gujarat stood at 4,037 MW, out of which 1,842 MW or around 46% has been contributed by Suzlon.

Supporting the transition of the state to a sustainable energy mix, the company's wind energy installations power over one million homes in Gujarat and offset 3.9 million tonnes of CO_2 emissions yearly. The company also adds to the economic and social development of the state and has provided employment to around 1,000 people.

ReNew Power signs PPA with Delhi Metro Rail Corporation

ReNew Power Ventures Private Limited, an Independent Power Producer (IPP) company, has signed a PPA for 6 MW solar installations with Delhi Metro Rail Corporation (DMRC) for various metro stations in Delhi for a term of 25 years.

The major lines allocated under this PPA are Dwarka Sector 21 to Rajiv Chowk; Badarpur to Central Secretariat and a few others are expected in the future.

The major stations that will be covered within these lines include Badarpur, Tughlakabad, Dwarka Sec 21, Airport Depot, Govindpuri, Sarita Vihar, Kaushambi, Karkarduma, Yamuna Bank, Kirti Nagar amongst others, which are estimated to be completed by February 2017.

In total, the project will generate more than 8 million units of power annually and offset over 7,000 tons of carbon emissions every year.

With nearly 5 MW capacity planned to be executed in parking lots, this project is India's largest solar system installation in parking lots till date. Solar PV Carports shall cater energy to metro stations and will also facilitate parking space for two and four wheelers.

Speaking of this new undertaking, Sumant Sinha, Chairman and CEO, ReNew Power said, "ReNew Power is proud to be instrumental in accomplishing DMRC's initiative of going solar. As we look forward to the implementation of this project, we also hope to be a part of many such ventures in future."

ReNew Power, which recently achieved one GW of commissioned solar and wind energy capacity in March 2016, is installing many similar rooftop projects with reputed off-takers pan India. The company has several commissioned projects in MP, AP and Telangana.

Essar Power Gujarat shows turnaround performance

Essar Power Gujarat Ltd (EPGL), which owns and operates a 1,200 MW imported coal-fired thermal power plant at Salaya in Gujarat's Devbhumi Dwarka district, has recorded a 168% growth in EBITDA in the financial year ending 31st March 2016 – three years after commissioning. The PAT is around Rs 39 crore, compared to a loss of Rs 684 crore in FY15.

This turnaround in performance can be attributed to higher operational efficiency, a reduction in coal prices through e-auction based procurement, and normative plant availability. EPGL's EBITDA in FY16 stood at Rs 533 crore, compared to Rs 199 crore in FY15. The FY16 EBITDA margin is 28% compared to 11% in FY15.

A key factor driving financial performance, the reverse e-auction platform set up by EPGL helped widen the company's coal supplier base. Coal miners / suppliers from the US, Russia, Colombia and other countries placed competitive bids in a transparent manner. Global competition helped EPGL source coal at prices lower than those prevailing in the market.

Ramesh Kumar, Managing Director, EPGL, said, "We have worked relentlessly despite the challenging business environment to deliver a significant improvement in our performance. We are on course to harness greater efficiencies in the current financial year once with the imminent commissioning of a sea water intake system and coal conveyor corridor. These are expected to add Rs 150 crore to the margins. With sustained performance in the first quarter of the current financial year and better operational efficiency, we are confident of further improving our earnings in the current fiscal."

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Mississippi Power starts production of syngas

Mississippi Power, a subsidiary of Southern Company, has started producing syngas using lignite at the Kemper County energy facility. The successful production of syngas demonstrates the viability of the Transport Integrated Gasification (TRIG) technology, which is being used for the first time at commercial scale at the state-of-the-art facility, and will be combined with the other major systems to eventually produce power.

"This is a major achievement for the Kemper project, and I am very proud of everyone who has worked safely and tirelessly to overcome challenges and reach this important point," said Mississippi Power President and CEO Anthony Wilson.

"Producing syngas from Mississippi's own abundant natural resource – lignite – should be encouraging to our customers, communities and energy companies around the world. This proves that Kemper's technology can provide a way forward for coal and puts us a step closer to full plant operation," he added.

An integral aspect of the plant's operations, syngas is created when locally mined lignite is heated at high temperatures in the plant's gasifiers, converting the coal to gas. To produce electricity, the plant is designed to use syngas similarly to natural gas to power a turbine. The facility is designed to capture at least 65% of CO_2, with resulting emissions better than a similarly sized natural gas plant.The TRIG coal gasification technology deployed was jointly developed by Southern Company, KBR and the U.S. Department of Energy over the past two decades at the Power Systems Development Facility, an Alabama-based research facility operated by Southern Company.

Hybrid-electric aircraft with more seats will soon be possible: Siemens

Researchers in Siemens have developed a new type of electric motor. With a weight of just 50 kilograms, this delivers a continuous output of about 260 kilowatts – five times more than comparable drive systems. This record-setting propulsion system successfully completed its first public flight recently, at Schwarze Heide Airport near Dinslaken, Germany; where it – almost silently – powered an Extra 330LE aerobatic airplane. The new drive system had already made its maiden flight on June 24, 2016. This advance means that hybrid-electric aircraft with four or more seats will now be possible.

"This day will change aviation. This is the first time that an electric aircraft in the quarter-megawatt performance class has flown," said Frank Anton, Head of eAircraft at Siemens' central research unit Corporate Technology.

Aircraft with Siemens' electric motor...

The Extra 330LE, which weighs nearly 1,000 kilograms, serves as a flying test bed for the new propulsion system. As an aerobatic airplane, it's particularly well suited for taking the components to their limits, testing them and enhancing their design.

In addition, the company will be contributing this technology to the cooperative project that Siemens and Airbus agreed to in April 2016 for driving the development of electrically powered flight. Electric drives are scalable, and Siemens and Airbus will be using the record-setting motor as a basis for developing regional airliners powered by hybrid-electric propulsion systems. "By 2030, we expect to see initial aircraft with up to 100 passengers and a range of around 1,000 kilometers," explained Anton.

"The first flight of our propulsion system is a milestone on the road to electrification of aviation. To continue this journey successfully, we need disruptive ideas and the courage to take risks," said Siegfried Russwurm, CTO, Siemens.

Gamesa receives orders for supply of wind turbines at seven projects in India

Gamesa continues to make solid inroads into the Indian market, reinforcing its leadership position with seven new orders for the supply of 460 MW in total to several customers. All these contracts have been signed during the second quarter of 2016.

The company will handle the turnkey construction of most of the developments, as well as the supply, installation, commissioning and management of the operations and maintenance services of the facilities.

In all, Gamesa will supply 170 of its G114-2.0 class S turbines (340 MW) and 60 of its G97-2.0 MW class S (120 MW) turbines, both of which were specifically configured for the Indian market with the aim of maximising turbine performance at low wind speed sites. These projects are slated for commissioning during the first quarter of 2017.

Gamesa's turbine...

Gamesa is present in India since 2009, and it has installed over 3,000 MW here. In the first quarter of 2016, India accounted for 26% of the company's total sales volume (in MW). As per the company, These seven new projects reinforce Gamesa's positioning in India, where the company ranked as the number-one OEM in 2015 for the third year in a row. According to the most recent ranking compiled by specialist consultancy MAKE, Gamesa increased its share of the Indian market from 25% in 2014 to 34% in 2015, further widening the gap with respect to the number two player. As for the market's potential, MAKE is forecasting 30 GW of new wind power capacity additions in this market by 2025, driven the country's growing energy requirement.

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Valmet bags order for modernisation of turbine automation

To modernise the turbine automation and to deliver a new turbine controller to the Hovinsaari biomass-fired power plant in Kotka, Finland, Valmet received an order from Kotkan Energia Oy. This order was included in Valmet's first quarter but the value was not disclosed. In turn to improve turbine reliability and availability, the new automation will be commencing in September 2016.

Sooner or later, the plant's turbine will be controlled through the main automation system instead of separate automation systems and link applications that will improve process transparency.

Antti Roponen, Control and Instrumentation Specialist at Kotkan Energia, said, "Valmet was able to offer us a modern turbine controller complemented by a condition monitoring solution as a turnkey delivery. Both of them can be integrated within our existing Valmet DNA automation system."

Hovinsaari Biomass-fired plant...

Tom Bäckman, Turbine Control Product Manager, Valmet, said, "The new automation will make the operators' work simpler and easier because it includes features such as start-up sequences. Automation maintenance will be easier since the same engineering tools will be used in the automation system and the turbine controller. If necessary, the operators and maintenance staff have fast access to Valmet's expert support via a remote connection."

As the plant's existing turbine control system has reached the end of its life cycle and for which spare parts are no longer available, Valmet's automation will soon replace that.

Ballard to locally produce Fuel Cell Stacks in China

Ballard Power Systems has signed definitive agreements with Guangdong Nation Synergy Hydrogen Power Technology Co. Ltd. ('Synergy') in Foshan, China – for the establishment of an FCvelocity-9SSL fuel cell stack production operation in the City of Yunfu, in Guangdong Province. The fuel cell stacks will be packaged into locally-assembled fuel cell engines and integrated into zero-emission buses and commercial vehicles in China.

Subject to closing, the transaction has a contemplated minimum value of $168 million to Ballard over five years – and includes the following key elements.

Ballard will receive $18.4 million in Technology Solutions revenue for technology transfer services, production equipment specification and procurement services, training and commissioning support in relation to the establishment of a production line in Yunfu for the manufacture and assembly of FCvelocity-9SSL fuel cell stacks, with most of this revenue expected to be recognised in 2017.

On closing of the transaction, expected in late-2016, a joint venture will be created to undertake the stack manufacturing operations and will be owned 90% by Synergy and 10% by Ballard.

On commissioning of the operation, expected in 2017, Ballard will be the exclusive supplier of Membrane Electrode Assemblies (MEAs) for each fuel cell stack manufactured by the joint venture, with minimum annual MEA volume commitments on a 'take or pay' basis totaling in excess of $150 million over the initial 5-year term from 2017 to 2021.

Wärtsilä supplies 67 MW Smart Power Generation power plant to Mauritius

Wärtsilä will supply a 67 MW Smart Power Generation plant to Mauritius. The order consists of four Wärtsilä 46 engines running on heavy fuel oil. The equipment will be delivered in late 2016, and the plant is scheduled to be functioning by September 2017.

"Wärtsilä has been our trustworthy and professional partner for over 10 years. Their solutions are among the best in the market for producing reliable and highly efficient electricity with low emissions and low noise levels," says Martin Kok Jensen, Sales and Marketing Director at Burmeister & Wain Scandinavian Contractor A/S (BWSC). The company is the EPC contractor for this project for which Wärtsilä will deliver the engines, equipment and engineering.

Economic growth and a growing tourism industry have caused an increase in energy consumption in Mauritius. To meet the rising demand, the retired diesel generating sets at the St Louis Power Station will be replaced with Wärtsilä engines.

St Louis Power Station 67 MW. Photo courtesy of BWSC...

The reliability of the grid is extremely important for an insular country like Mauritius. The modernised power station will provide semi-baseload power, including daily starts and stops, to the local residents and industries.

According to Bloomberg New Energy Finance, the country has set a target of having renewable energy comprise 35% of the total power generated by 2025. "By compensating for the gaps in the intermittent output of renewable sources, this fast-reacting plant will be able to support in renewable energy integration," says Joost Bos, Business Development Manager at Wärtsilä.

Upon completion of this project, Wärtsilä and BWSC's joint track record in Mauritius will be a significant 200 MW, which represents some 25% of the country's total capacity. In Africa, Wärtsilä's total installed base is 6500 MW in 46 countries. Wärtsilä's Smart Power Generation power plants are based on multiple internal combustion engines.

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Westinghouse hierarchy undergoes transition

D Roderick and José E Gutiérrez

They witness a change in their designations and duties...

Westinghouse Electric Company has a series of transitions in its hierarchy. Danny Roderick has been appointed as President and CEO of Toshiba Corporation's Energy Systems and Solutions Company (ESS). He will fulfil this role in addition to his role as Chairman of the Board of Westinghouse Electric Company.

José Emeterio Gutiérrez has been named acting President and CEO. He provided leadership to the company's nuclear fuel fabrication, components and services to Westinghouse's customers globally. He also has had responsibility for the company's global nuclear supply chain organisation. Previously, he served as Managing Director and Vice President for Southern Europe in Westinghouse's Europe, Middle East and Africa (EMEA) region.

David Precht assumes the position of acting Senior Vice President, Nuclear Fuel and Components Manufacturing. Prior to this he served as Vice President of Columbia Fuel Operations in Columbia, South Carolina, a position he has held since 2014. In his most recent capacity, he had oversight for Westinghouse's Columbia Fuel Fabrication Facility, as well as leadership responsibility over Fuel Delivery Operations and International Fuel Delivery teams for the company's largest U.S. manufacturing organisation.

Paul Romer becomes Chief Economist of the World Bank Group

Paul Romer

He'll support the president and the senior management of the institution...

World Bank Group President Jim Yong Kim has declared the appointment of Paul Romer as the Chief Economist of World Bank. Romer is a widely respected economist – and a successful entrepreneur who joins the bank at a critical time when the field of development is changing under the forces of rapid technological change, globalisation and demography.

He is currently a professor at New York University (NYU), Director of NYU's Marron Institute of Urban Management, and a Professor of Economics in NYU's Stern School of Business. Early in his career, his research brought the economics of ideas into the analysis of economic growth. His subsequent start-up company Aplia, which focused on educational technology, and his more recent exploration of urbanisation as a driver of economic development both signal the breadth of his intellectual and practical interests.

As Chief Economist, Romer will support the president and the senior management in leading the institution and inspiring the development profession during this time of transformative change. As leader of the Development Economics Vice-Presidential Unit, his intellectual and strategic leadership will ensure the World Bank Group remains at the forefront of international development knowledge.

Jean-Francois Beaudoin takes over as SVP, Alstom, AP region

Jean-Francois Beaudoin

He will lead the Asia-Pacific region, which includes 12 active markets...

Alstom has appointed Jean-Francois Beaudoin as the Senior Vice President (SVP) of its Asia Pacific region. He will lead the Asia-Pacific region, which includes 12 active markets covering India, Australia, China, Singapore, Indonesia, Malaysia, Thailand, Hong Kong, Vietnam, Taiwan, Korea and the Philippines. In this role, he will also become a member of Alstom's Executive Committee.

Born in 1977, he is a graduate from Ecole Polytechnique in 1998, and holds a PhD in Mathematics & Automatics from Mines ParisTech. He also attended the executive education programme at INSEAD, Paris.

Jean-Francois joined the Alstom Group in Paris, France in 2007. Prior to his current appointment, he was the Managing Director of the Rolling Stock (RS) business for Alstom Transport Asia-Pacific. In this role, he has significantly contributed to the order backlog increase through key breakthroughs in the Australian, Indian and Chinese market, and has significantly localised the footprint in the region. Before moving to Asia-Pacific, he was acting as SVP Finance for the Alstom Transport sector.

"The Asia-Pacific transport market is witnessing enormous growth spurred by the stable economic outlook of the region and its growing urban population. It is an extremely interesting time to spearhead the growth that the group expects from this region. With our expanding presence and footprint in India, the prestigious projects that we are executing in Australia, India, and East Asia, Alstom in Asia-Pacific is well placed to continue successfully delivering for our customers", said Jean-Francois.

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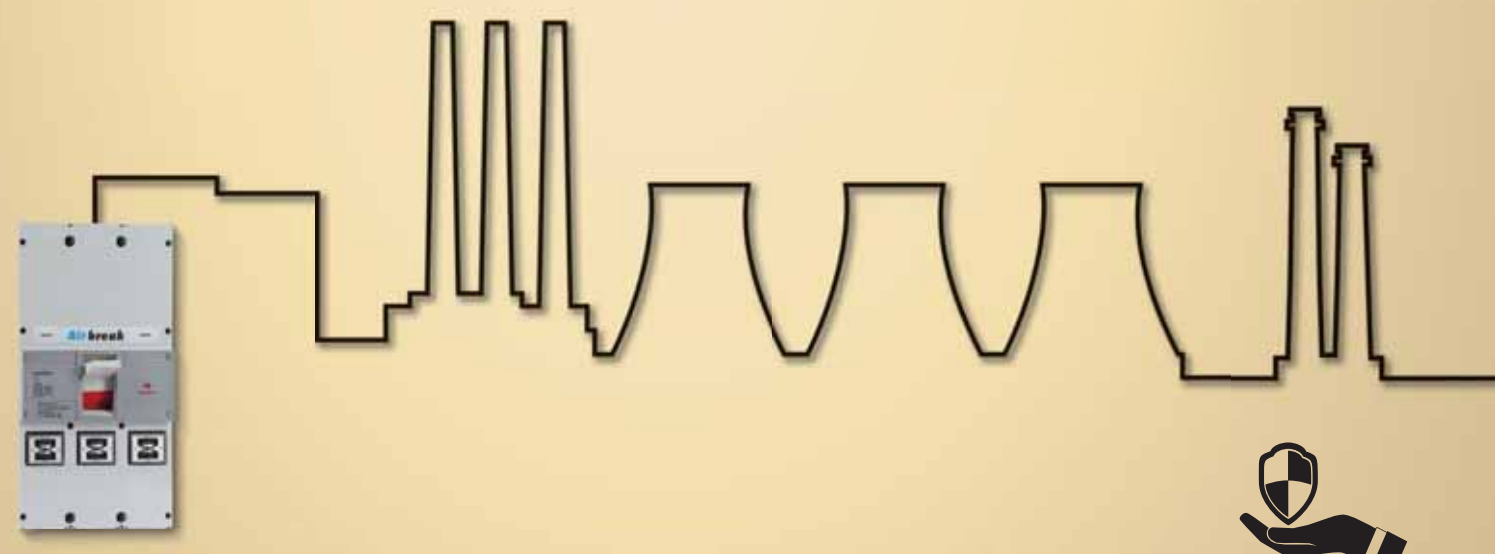

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A Look At The Game Changers

Energy system flexibility, supportive policies, and smart initiatives create irreversible market momentum, finds Frost & Sullivan's Energy Team...

Image Courtesy: PK Chatterjee

A view of the solar cells installed at Hotel Langham Place, Guangzhou, China...

Solar power is finally maturing as a key energy source on the global stage. In addition to green targets, energy independence, and distributed energy, a crucial market accelerator has been the defining of the structure of Feed-in Tariff (FiT) for solar PhotoVoltaic (PV)-generated power. Along with regulatory dynamics and incentives, this has lowered the Levelised Cost Of Electricity (LCOE) of solar power. With higher economies of scale, the cost of solar power systems for both residential and utility-scale PV will reach grid parity by 2020 – and increase uptake of decentralised solar energy. As a result, stakeholders from raw material suppliers, solar cell manufacturers, solar module manufacturers, and balance of system equipment suppliers to system integrators and installers are positioned for robust growth.

A new analysis from Frost & Sullivan, titled Global Solar Power Market – 2016 Update, finds that market revenues stood at $113.75 billion in 2015 and will grow at a Compound Annual Growth Rate (CAGR) of 9.5% to reach $179.13 billion in 2020. Installed capacity with grow from 50,780 to 76,600 MW at a CAGR of 8.6% for the same period.

"Pro-solar incentives and the recently made pledges at the COP 21 summit will ensure that the market for solar PV continues to grow exponentially over the next five years. Grid integration of renewables and investment in energy storage initiatives are other market enablers," said an Analyst from Frost & Sullivan's Energy & Environment wing.

Geographically, Asia will see aggressive expansion of solar PV fuelled by economic growth, urbanisation and greater electrification:

- Asia's market share will rise to 64.1% by 2020 with China, India and Japan together accounting for more than 80% of all solar installations planned over the next 5 years. China and Japan will lead with compelling FiT rates and capacity based rebate programs.
- North America will witness a robust growth with the extension of investment tax credit eligibility for solar generators until 2019. By 2020, the region will have about 20 million residential prosumers. Fiscal incentives, technological advancements, and new solar leasing models will be strong drivers.
- Europe, however, will suffer a setback due to withdrawal of subsidies and incentives. Huge overcapacity, coupled with price decline of solar modules, will see suppliers struggling to make profits.
- Investments in grid infrastructure, especially in remote off grid locations, will energise demand in the emerging markets of Latin America and Africa.

"Extreme weather variations, declining energy reserves, and increase of distributed generation technologies will compel utilities to seek newer models supporting energy efficiency and energy management initiatives. The solar PV supply chain participants are expected to develop new technologies that will lower costs and integrate PVs with flexible infrastructure grids. Innovative business models to integrate solar power will also open opportunities in smart metering, demand response and net metering," noted the analyst.

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Energy meters are user-friendly and guide customers about their energy usage and requirements. Information provided by Smart Meters is a big tool to empower the user...

India is currently one of the biggest energy consumers in the world and demand for energy is only expected to grow in future. The country also has one of the biggest power transmission networks in the world. However, high Transmission and Distribution losses and high incidence of power theft have been a major area of concern. All these challenges present a huge market and opportunity for energy meters in India.

Energy meters have the potential to lay the groundwork to enable an era of smarter, connected-homes. Energy meters provide utilities with the infrastructure to deliver new services to customers, like home energy management and demand response programs, in ways that previously weren't possible. Energy meters can inform consumers how much electricity they are using at every hour of the day. And as utilities move toward time of use pricing, this gives consumers real power over the cost of their bill at the end of each month. With energy meters consumers can now make decisions about their electricity use. Energy meters present a great opportunity for utilities to change customer behaviour with regard to their energy use. But it will require guidance from utilities to show consumers how the information smart meters provide can be empowering.

Introduction of these energy meters will be the lifeline of metering industry and would give strong support to the government's initiatives to create smart cities. Therefore, they will witness lot of developments and technological advancements owing to growing demand of electricity in the forthcoming year. We are expecting that policy makers will give lot of emphasis on the issues such as depletion of AT&C (Aggregate Technical & Commercial) losses. Reduction in commercial losses is the biggest advantage of having energy meter and this will be a major growth driver of the sector. Smart meters will reach both commercial and residential segments owing to multiple benefits like saving the cost of manual meter reading; conquering the problems related to electricity theft, collection inefficiencies and poor billing. The government is showing lot of interest in acquisition of smart metering technologies and lot of schemes and announcements are expected. Net metering could be one of the major step in this direction in order to achieve energy security by 2022. Net metering for rooftop installations allows users to 'net off' their energy bill for every unit sent back to the grid after one's own consumption. This is advantageous because it promotes solar energy installations and generation; it takes pressure off the grid especially when the demand is high; it saves money for utility companies on meter installation, billing, etc.; and, last but not the least, it helps our state achieve its solar energy target.

Energy meters are user-friendly and guide customers about their energy usage and requirements. Information provided by smart meters is a big tool to empower the users. Smart metering helps customers in saving energy and money, which can help them to better manage their budgets. Budgets can also be aided through more accurate invoices that reflect actual consumption and can support prepayment programs. Through greater accuracy and communication, as well as simplifying actions like switching procedures and making meter reading non-intrusive, customer satisfaction can be enhanced.

Metering industry has witnessed unprecedented development in terms of technology. Many advanced features such as time of day metering, automatic meter reading and prepaid metering emerged as a result. The government is taking lot of initiatives for the growth of the sector. There have been announcements for schemes like Integrated Power Development Scheme and Deendayal Upadhyay Gram Jyoti Yojana. This resulted into increased demand for the meters.

Initiatives of the government like 100 smart cities will give further impetus to the growth of this sector as efficient energy storage and distribution is the lifeline for any smart city. Metering at all levels (incomers, feeders & distribution transformers) drive the growth for metering industry.

Schneider Electric continues to grow in Panel Metering space while retaining its leadership position in the market. With enhanced emphasis on organisation wide 'Smart Power' initiative, it is expected to grow further. Through Smart Power, customers can expect complete integration of Powergear, Controlgear, Metering & WAGES on a common platform called PME (Power Monitoring Expert). It comes fully loaded with Billing (for tenant billing & cost allocation), Energy Analysis, Energy Awareness, Power Quality & UPS performance modules for achieving overall objective of Smart Enterprise.

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Managing Coal Fired Thermal Power Plants Efficiently

This article identifies areas where installation of instrumentation and controls can bring about energy efficiency, safety and cost reduction in the primary cost components of a coal fired thermal station, viz., coal, fuel oil, water and auxiliary power...

There are two major focus areas for Instrumentation And Control Systems (ICS) for Thermal Power Plants (TPS): Power block [boiler, turbine, generator (BTG) and associated auxiliaries] ICS for achieving generation and ICS for BOP (Balance Of Plant-the outlying auxiliaries) for providing the support. Traditionally, the focus of instrumentation and controls has been on the power block with the primary aim of achieving good generation. In the BOP areas, there is alow level of automation and instrumentation. This article identifies areas where installation of instrumentation and controls can bring about energy efficiency, safety and cost reduction in the primary cost components of a coal fired thermal station, viz., coal, fuel oil, water and auxiliary power.

Primary sensing, data acquisition and storage systems, data highways, data base creation and software for totalization, secondary computations based on primary data, flexible report generation functions are essential for efficient plant operation in the following areas:

i. Coal measurement and management systems
ii. Oil measurement and monitoring systems
iii. DM water measurement and monitoring system
iv. Auxiliary power
v. Station heat rate

Linking of the above to the plant operating parameters to calculate online indices or porting of plant operating parameters to these software is essential for efficient operation of the plant and cost control. There are technology gap in the above areas. ERP (enterprise resource planning) packages normally address inventory, knowledge, procurement, spares, maintenance and operational management and do not cover primary input tracking. Continuous and constant monitoring and control of fuel consumption, water consumption and auxiliary is essential for achieving cost effective power generation.

Introduction

The major investment into coal plant ICS and condition monitoring is for the power block and electrical controls and their associated auxiliaries with an aim of achieving good energy generation (units generated in a given time slot and the unit loadability). Generation has always had precedence over energy efficiency, safety and cost considerations. The areas of outlying auxiliaries and inputs that go into the thermal power plants are audited through instrumentation of the analog type with human intervention. This was because the primary sensing technologies were not available and technology of data acquisition and data transfer were not cost economical for either on-line or off-line monitoring. The technology developments in the areas of sensors, computing and communication now enable cost effective solutions. The existing scenario therefore needs intervention through improvements in monitoring and controls of primary inputs that go into a coal fired plant.

The concept of stand alone measurement grids/hubs through DAS (data acquisition systems) need to be implemented for the primary inputs, coal, fuel oil, water and auxiliary power. The stations must prefer Intelligent Electronic Devices (IEDs) over analog stand alone measuring equipment, which cannot be seamlessly integrated into a central server and which have provision for downloading data into a data base.

Also, the concept of separate and independent receipt and consumption measurements would help in tracking of losses in the system. In most cases a single measurement represents both the receipt and consumption.

Presently the station coal measurement at the TPS is mainly at the coal handling plant and the station as a whole is responsible for the overall coal receipt and consumption. The responsibility for accounting and tracking of coal consumption is not vested with any particular group such as Coal Plant Group, Fuel Logistics Group or Operations Group. For more effective management, the sharing of responsibility of coal consumption in the plant could be based on the jurisdiction of the various technical groups and can be as follows:

Coal weight and coal GCV between the coal mine and the entrance of the CHP of the TPS: Fuel Logistics Group which liaisons with the mines and the railways, etc.

Coal weight and coal GCV drop between Coal Handling Plant and the bunker: Coal handling Plant Group which receives handles and conveys the coal to the bunkers. It will be the responsibility of the coal handling plant to account for coal weight and coal GCV drop between receipt point and the bunkers.

Beyond the bunker: Once the coal enters the bunkers and the mills, the Operations Group must take the responsibility to control and minimise the coal consumption.

To implement the above, the instrumentation and control set up is to be developed to get a break up of the quantities at each level of the plant.

Technologies for determination and control of transit losses for operating cost reduction

The technology of computing transit loss in many of the stations is obsolete and involves analog outdated machinery and manual recording at several places and also double recording resulting in wastage of manpower for recording purposes when it can easily be automated. Manual intervention increases chances of errors which are difficult to track and reconcile. Presently, the time constant to compute and realise the magnitude of the transit loss takes around 3-5 days.

The technology of the pit type weigh bridges is obsolete and involves manual recording of analog signals. Printout in the form a dot matrix printer is also obsolete. Human intervention is inevitable in the measurement process. Though the accuracy is adequate the overall uncertainty is depending on the reliability indices of average interruption frequency and duration indices on an annual basis. Since the disposal rate of a rake is 4-8 hours, an outage of the weigh bridge for 1 day will lead to an uncertainty of 3 rakes.

The power stations would benefit by going in for technology up gradation in this critical area of their operation. Global positioning system technology for precisely mapping and tracking the movement of the trains for effective tracing the origin and location of the transit loss is an appropriate solution. ***Rail tracking system*** through GPS or alternative technologies needs to be adopted.

Rail signature system at the sending end and receiving end are also essential to ensure that there is no tampering. Rail signature systems are usually installed at the entrance to the coal yard at the tippler hopper area.

The ***Wheel Impact Load Detector (WILD)*** developed under RDSO research initiative can integrate rail signature as well as wagon weighment at speeds in the range of 0-150 km/h in one system. Besides weighing of primary resources, viz., coal, accurately, the

Figure 1: View of location of in motion weigh bridge on railway tracks...

transit losses can be reduced by effective tracking of wagons from their source mine to their destination (power house coal yard). It is recommended to go in for ***fully automatic pitless in-motion weigh bridges*** (where the entire rake is measured at a speed of 10-150 km/h). Figure 1 & 2 show view of in-motion weigh bridge.

The high speed in-motion weigh bridge should have an electronic digital interface to digital data transfer to a central server/data highway through communication media both at the sending and receiving end. The in-motion bridges would be required for gross weight and for tare weight at both sending and receiving ends. At a central server the data from the motion bridges can be downloaded into a data base – from which it can be used to calculate a variety of information automatically without any human requirements of feeding in data.

Technologies and models for station & unit coal measurement (coal receipt & consumption measurement)

Since the weigh bridges are analog in design with open loop communication, human intervention is required and hence fully automated pitless in motion weigh bridges with digital interface and provision for data communication to a central server or receiver control room is recommended. These must act as Intelligent Electronic Devices (IEDs) and seamlessly communicate with the overall plant automation. Besides, fully automatic rail signature at the receiving end is also recommended with provision for acting as IEDs to communicate with the plant automation.

The periodicity of coal inventory measurement is once in 10-30 days depending on the station practices. The inventory accounts for coal present in the coal yard and is used as a basis for working out the coal consumption in the units and in the station.

Traditionally, the coal consumption was estimated by apportioning on the basis of units generated and specific coal consumption (kg of coal per kWh generated). Unit bunkers were filled based on the need – and the coal consumption was not being measured because of non availability of instrumentation for both coal quantity as well as bunker level indication. Many of the stations are not having complete gravimetric feeder set up on any Unit with provision for coal flow measurement. The quantum of consumption is not known accurately.

In the absence of coal measurements to individual units, it is not possible to know the specific fuel consumption which is the basis for the heat consumption of the unit. The presently used system in many of the stations is highly inadequate and not sufficiently sensitive to unit performance. Hence, the estimated specific coal consumption does not reflect on the realistic coal consumption of any particular unit in question. The coal entry into the boilers of each unit needs to be measured. At present technologies for on-line or off-line coal monitoring of unit coal consumption are available and are also in use in a few of the stations.

An online process (without any human intervention) which would give the on-line coal consumption with uncertainties of 1.0% is feasible and the technology for the same is well proven and established. The conventional stacking method can be used for reconciliation of data/cross verification only and not for coal consumption measurement.

The use of fully automated, tamper proof modern instrumentation free of human intervention for ***on-line coal inflow and consumption*** needs to be used. Based on an assessment of the different technologies the following are recommended in the Indian scenario:

i. ***Installation of belt weighers*** for all coal conveyors. The belt weighers alone do not give unit specific coal measurement

Figure 2: View of recorder of in-motion weigh bridge...

which is essential for accounting purposes. The belt weighers give weight of coal moving through it between any two time intervals. The arrangement for unit wise coal consumption is essential. This is possible by providing a system of monitoring the time elapsed by a belt over a given bunker and which involves integration of the output of the belt weighers over the total bunkers of a given unit in a given period of time. A viable and innovative scheme for monitoring the bunker wise coal from the belt weigher data is possible through time wise integration of belt weigher data and totalization in separate data bases assigned for each of the bunkers.

ii. Coal level in the bunker is presently recorded manually which is obsolete and does not give quantitative data on the bunker level. Further it gives data only when the persons inspect it and does not give the exact height of the coal stack. The height of the coal stack is generally not uniform and is measured through a string. ***Microwave or Ultrasonic bunker level monitoring system*** with digital data output, communication of data to central server or control room is required.

iii. In addition to belt weighers, coal flow into the units needs to be monitored by **gravimetric feeders (in each mill) which provide accurate and authentic coal flow measurements**. This is to provide a redundancy in the measurement. The differences in the two are to be reconciled to be within 0.5%. At present, there are several types of reliable gravimetric feeders available and any reliable feeder can be installed.

iv. ***DAS &Software is to be in place for integrated online coal energy management*** in the plant. The software inputs data from the various field instruments for coal receipt into the station from various sources (such as wagon tippler, track hoppers, ropeways, trucks, conveyors, bucket elevators etc.) and coal consumption at various bunkers. This software must also compute the coal consumption, heat consumption, heat rate, etc., at various points, on line. The DAS software and hardware are to form a self centered grid/hub for coal management with open architecture and seamless interface with other DAS/DCS.

v. ***Computation of unit coal consumption.*** This is purely from the reading of the belt weighers and bunker monitoring system. This coal consumption is to be used for computation of unit and station heat rate for normal and cycling operations as per international practices.

vi. ***Computation of stacking loss.*** This is the difference between the total online receiving end coal consumption and the total on line bunker wise coal consumption of each unit. If all weighing instruments are fully automated IEDs, the on line stacking loss can be computed.

vii. Computation of coal inventory over a time period of month, quarter and year is through stockpile contour profiling software based solution such as **Total Station, etc.** for more accurate stock pile measurement. The bulk density of coal (kg/m^3) needs to be physically determined for crushed and uncrushed coals as well as coals of different varieties and weighted average needs to be taken rather than one single value for the entire stockpile.

In all above instruments to be fixed the following must be observed:

- The instruments must function as Intelligent Electronic Devices (IEDs) by digitally communicating with a central server or control room through downloading of data continuously. The data from each of the sensors must be downloadable into a data base format from which it must be compatible with other data for on-line calculations.
- The instruments must have provisions for communication of digital data.
- The instruments and the digital conversion systems must have a very high reliability in terms of 0.5 interruptions per year and 4 hours per year.
- The integrated coal DAS must be of open architecture.

By this process the coal consumption will depend on the unit performance and not vice versa. The other advantages are:

- The process is fully automatic and does not involve human intervention
- The process is closed loop without scope for errors from extraneous sources.
- Stone picking, tippling and weighment need not be coupled and these can be independent activities.
- The measurement will be available on line to all concerned and avoids 10 days time delays for each settlement slot of coal consumption.
- Wireless data communication can be adopted.

All the above technologies are proven and in use in many power stations across the country.

Technologies for measurement and computation of average heating value of coal

The heating value determines the coal consumption. The measurement of GCV is as important as the coal quantity measurement as it directly affects the coal consumption and generation cost on account of coal.

In the TPS context three heating values are of importance:

i. GCV (dispatch end): Gross heating value -a commercial heating value for payment purposes.

ii. GCV: Gross heating value of the received coal sampled at the point of unloading.

iii. GCV: Gross heating value of the coal fed into the boiler and sampled either at the conveyor belt to the bunker or at the coal feeder.

Accordingly, the heating value of coal is determined for the following three cases:

i. ***GCV (sending end coal) (kcal/kg) of Coal dispatched from collieries:*** rake wise, colliery wise, weekly and month wise data.

ii. ***GCV (receipt coal) (kcal/kg) of Coal received from collieries:*** rake wise, colliery wise, weekly and month wise data.

iii. ***GCV (fired coal) (kcal/kg) of Coal being used in the units:*** shift wise, unit wise, stage wise and month wise data

While receipt coal is sampled on the basis of mine, rake, truck, ropeway, etc., the fired coal is sampled on the unit wise basis. Earlier practice was to determine only sending end GCV and bunkered coal GCV as the receipt GCV data was not directly used in any calculation. Presently, the stations are determining the GCV of receipt coal as well as GCV of fired coal, in addition to the sending end GCV.

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Figure 3: View of a bomb calorimeter...

Heating value determination: In many cases, the GCV is determined by proximate analysis. The GCV of sending end, receipt coal as well as bunkered coal is being determined by proximate analysis or by a bomb calorimeter. All GCVs need to be determined only by a bomb calorimeter and never through proximate analysis (Figure 3).

For further refinement in the heat value determination, ***sample to sample variation*** in a rake (for receiving end coal) for each rake and to measure ***in-sample variation*** to select the minimum sample size. This data can be used to authenticate the GCV values determined.

Averaging schemes for monthly GCV (dispatch coal and receipt coal): The averaging of the GHV (dispatch) and GCV (receipt) is based on weighted average of each independent consignment received at the TPS through EXCEL. The software for auditing of the quantities and individual heating values calls for a data base for compilation of the monthly average values between pre-defined points of time. The data base is required for establishing the correctness of the monthly average values as well as archiving of the data over a period of time.

Averaging schemes for monthly GCV (bunkered coal): The monthly value of GCV which is a single point GCV is obtained from mixing all monthly samples and determining the GCV through a bomb calorimeter. In addition to the above, the GCV of daily sample is also determined and the weighted average value of the daily GCV is taken to determine the monthly GCV. The GCV of the average value is reported and the mix sample is used for tallying. The monthly average bunkered coal GCV is the basis for declaring the GCV, which goes for cost calculations and which is used for computing the SHR (Station Heat Rate).

Receipt coal sampling: Manual sampling is being resorted to in many stations where there is no automatic sampling. Change over to mechanised auger sampling must be done at the earliest. The automatic vehicle mounted auger may be used extensively in all stations for all receipt coal as it will help in taking out coal samples up to a depth of nearly 2m from the top of the wagon. In manual sampling, only top coal is removed and the internal coal is not sampled.

Bunkered coal sampling: To minimise sample to sample variations in coal quality, use of automatic samplers is suggested for bunkered coal. Further it is quite cost effective in comparison to manual sampling which is a time consuming process.

Automatic samplers for collection of bunkered coal samples are as follows:

Sampling from static heaps such as bunkers:

- Auger
- Sampling shovel
- Automatically operated bucket moving with uniform speed into the falling coal stream at adjustable intervals of time

Sampling from falling stream such as feeders:

- Breeches chute type sampler
- Swinging arm type sampler
- Chain bucket type sampler

Sampling from moving conveyor belts:

- Sweeping scrapper arm

Automatic buckets and swing arms are good for coals with wide ranging size distribution.

Sample preparation: For the sample preparation process, primary & secondary sample crushers and sample pulverizes are required to be constantly repaired to ensure that the grinding surfaces are intact and not eroded to provide the sizes stipulated in the standards.

GCV data management: The GCV values are being recorded into a register without back up of computer print out to authenticate the recorded data. The GCV values are being recorded into the register with human control loop leaving scope for errors. The process needs to be made more transparent and authentic. The process of entry of the data from the bomb calorimeter into the register needs to be automated and authenticated by back up data either from a print out of the memory of the bomb calorimeter or print out of each value.

Coal characteristics as operational aids: Equipment for TGA analysis of the coal may be introduced. The equipment must be fully automatic with provision for transmission of the results (TGA traces) to a central server or control room from where the different groups can view it. The combustion characteristics are not dependent on the GCV alone but on the percentage of volatiles. If the volatiles are too low in the coal then even though GCV is high its combustion characteristics are affected. This information can also be used to ascertain that the flame temperature is appropriate for a given coal. This analysis must be done before the coal goes to the bunker so that the operator is well aware of the combustion characteristic during the shift. It is clarified here that obtaining a TGA after the combustion is over is only of academic interest

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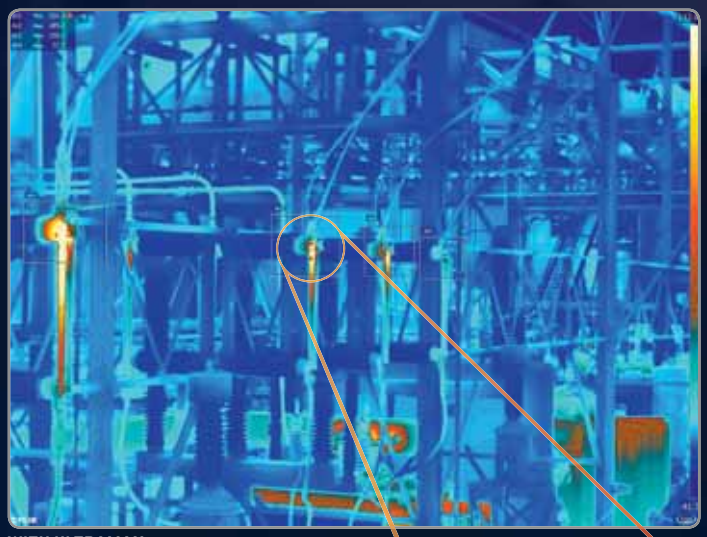

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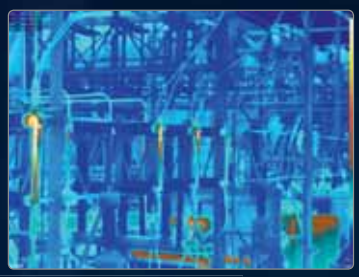

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and does not provide the operator with any inputs for operational optimisation. This will be useful when there is over 3 days coal stocks.

Ultimate analysis (elemental analysis) mapping of coal from different mines and sources is essential at least once a month instead of biannually or annually in many stations through a carbon, hydrogen, nitrogen (CHN) apparatus. This is useful for process optimization of boiler efficiency. At present ultimate analysis is not finding much use in operational optimisation in many stations. This is an essential requirement for optimisation of heat rate as it is used for computing the flows and losses in the boiler.

Technologies and models for measurement of fuel oil (receipt and consumption monitoring)

Fuel oil refers to basically Furnace Oil (FO) and Light Diesel Oil (LDO). In the present energy context considering that oil is a scarce resource, the instrumentation for measurement of oil receipt and consumption is inadequate in many of the stations. Oil consumption in individual units is not available to a pre-designed accuracy level based on individual gun hours. Though the total consumption of oil is known reasonable, the individual unit wise consumption required for energy control is not known accurately as this is apportioned based on gun hours considering equal flow of oil in each gun. Moreover, the oil measurement involves human intervention through manual recording of levels.

Oil receipt measurement: Pitless in-motion weighbridge is recommended for measurement of oil in tankers. Fully automatic ultrasonic level indicators with provision for conversion of signals into digital signals and communication through a media to central server or processor could be considered for installation for all oil tanks. The digital signals must be downloadable into a data base on a continuous basis. A fueloil monitoring software package with DAS hardware is to be in place for on line calculation and logging of the oil receipts, etc.

Oil consumption measurement: The present method of oil measurement in many of the stations is based on manual log reading of the on-off timing of the oil guns multiplied by a constant gun oil consumption.

Figure 4: View of level indicator for fuel oil...

Alternatively pump hours are also taken as a basis for measuring oil consumption between two time intervals. ***Fully automatic differential pressure orifice plate or nozzle type or mass based oil flow meters*** with provision for continuous digital data transfer would be useful for all units for monitoring oil consumption. Continuous logging of oil indicator levels can also be used for oil consumption monitoring (Figure 4).

Figure 4: View of an oil level indicator for monitoring fuel oil.

The ***oil gun on-off operation data*** must be recorded through a time based system automatically to give a time trace of when the guns are on and when the guns are not in service. This will be useful for performance optimization group to study the operator to operator variations, coal to coal variations, variation in different seasons, etc. Solenoid valve based on-off monitoring of gun time may be introduced. This is not much useful for oil consumption monitoring.

Integrated fuel oil receipt and consumption monitoring: A ***fueloil monitoring DAS & software package*** is to be in place. When digital ultrasonic level data of tanks, digital individual unit wise oil flow data, individual gun hours data, GCV of oil, etc., are available on line, the software package must calculate the oil receipts, oil consumption, shift wise, unit wise oil consumption, specific oil consumption, time trace of guns, oil consumption during cycling operations, heat consumption due to oil usage, contribution to heat rate, etc.

Technologies and models for measurement of DM water and associated water systems

The power generation process involves production, storage, transfer and measurement of DM (De-Mineralized) water, soft water, raw water and drinking water- production, consumption and flow. DM, Soft water, raw water and drinking water all need to be measured and audited for overall water balance on line and in real time and must not be assumed values.

In many of the stations, the flow instrumentation in the entire DM plant is not adequate. Separate consumption and production measurements are not available. Online monitoring of DM water flow is available and unit make-up with integrators are essential to control the energy efficiency as the make-up is directly proportional to the steam lost from the system and affects the unit heat consumption and heat rate. Fully automatic on-line measurement of water consumption for both production and consumption measurement of

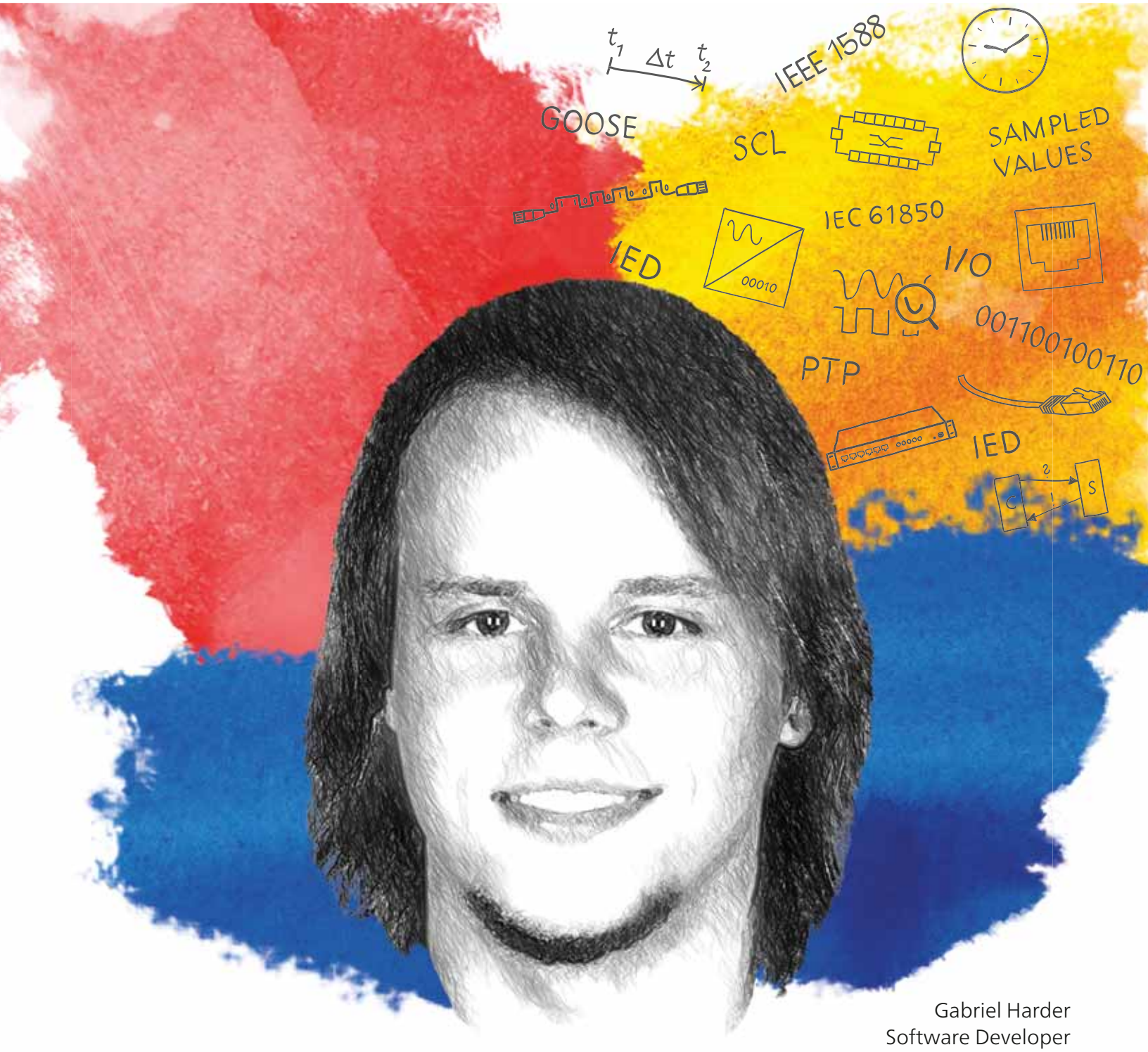

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Figure 5: View of console a typical control panel in a coal power plant...

Figure 6: Older design of control panel of a coal handling plant in a power station...

raw water, DM water, soft water and drinking water is required for auditing and conserving the water consumption and reducing the water related costs of generation.

Both DM water production and consumption must be separately measured and audited. In the absence of separate measurements, it is normally construed that all production is utilized and hidden losses are not identified.

Installation of fully automatic differential pressure orifice plate or nozzle type flow meters with digital output, communication media to relay the data to a central server or the DM control room computer and provision for downloading the data into a data base for on line monitoring of make up especially during cycling operations is essential for auditing water consumption. During cycling operations such as warm, hot or cold starts considerable amounts of steam is lost and has to be replenished. On line monitoring of DM water would help in control of unit heat rate as well as give an accurate account of the chemicals consumed for DM water production.

Integrated water monitoring DAS & software package: The package must have capability to draw inputs from the various field instruments (which will act like IEDs) and make an on-line continuous data base grid of the information for generation various types of information such as consumption per unit per shift, consumption during cycling operations, operator wise consumption, etc., to enable the performance optimisation group to take control action on the areas of wastage and excessive consumption. Consumption and production should be separately monitored. At present only gross data is being recorded and is not useful for energy control.

Technologies and models for measurement of auxiliary power

The auxiliary power is computed off-line at many of the power plants by collecting energy meter readings by 24 hours interval at control room. At present the power stations are computing the auxiliary power by the following procedure:

i. The gross energy generation is computed by taking the generator energy meter readings.
ii. The in-house auxiliary power is computed by taking the energy meter readings of UAT (Unit Auxiliary Transformer) bus.
iii. The station auxiliary power is computed by taking the summation of energy consumption of station transformers and proportioned for individual units based on its gross energy generation.

In many stations, the CTs and PTs are of low accuracy class even though metering is of 0.2 class. Hence, all the CTs and PTs at plant and Generation Control Room (GCR) must be of 0.2% accuracy class for energy billing. For all HT auxiliaries their power output should be recorded through sensors (3 voltages, 3 currents and 3 phase angles) and specific energy consumption should be indicated for process optimisation. Adoption of single phase data is neither accurate nor diagnostic.

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Integrated DAS & Software for auxiliary power: Automatic data logging of generated and auxiliary power is required for evaluation of energy consumption and its use pattern. Typically energy management systems are useful. Figure 5 shows the console of a typical control panel as compared to older control panels (Figure 6).

Technologies and models for measuring station heat rate

Many individual units in stations (almost 60-70%) are not having an up to date heat rate evaluation package or a performance evaluation modules. OEM (Original Equipment Manufacturer) supplied package is in use for some units but not adequate if these packages are supplied long back.

Installation of on line heat rate monitoring packages is essential for each and every unit of the TPS. These packages need to be utilised for heat rate computation for turbine heat rate computation while boiler efficiency is calculated from indirect method. On-line unit heat rate packages may be installed for units that do not have it. From the combined output of the online heat rate of individual units, the on-line capacity weighted average Station Heat Rate (SHR) may be computed. Offline standard heat rate package may be procured for SHR.

It is essential to go in for actual measurement of heat rate based on instrumented on line monitoring of coal and oil, which enter the unit and the energy generated from these. It is essential to link the units generated to measured quantities of coal and oil within accuracy bands which are pre-fixed and maintained. The reliability of instruments is required in the order of 0.5 interruptions per year and of 4 hours per year.

Plant instrumentation & controls

Some of the areas for improvement are as follows:

i.Many units do not have a Distributed Control System (DCS) and rely on analog control systems with no data storage and no data transfer capability. Introduction/up gradation of data highway and data storage to modernise the C&I system is essential. Upgradation of the data acquisition, storage and data high ways along with specialised or customised software is essential for transparent, efficient operation and maintenance of the power plants to meet its objectives through network and internal integration of data.

ii.O_2 measurement may be introduced after APH at the ID fan discharge. This will give the APH in-leakage. The O_2 measurement may be on the basis of forming a grid of a minimum of 3 sensors in one duct. This will help in providing the representative O_2 levels.

iii.On-line CO measurement is presently not reliable. Off line CO measurement is now need based. Continuous monitoring of CO before APH may be introduced for combustion optimisation.

iv.Introduction of fire ball visualisation through infrared/acoustic/optical pyrometry or Visual systems through CCTVs with filters.

v.Furnace Exit Gas Temperature monitoring system (FEGT) with HVT (High Velocity Traversing air cooled probes) using acoustic pyrometry/infrared thermometery/radiation pyrometry/visible CCTV with filters.

vi.On-line condition monitoring through on-line vibration measurement of major HT auxiliaries like ID fan, etc.

vii.Variable pressure operation and sliding pressure operation to be used.

viii.Replacement of AVR (Automatic Voltage Regulator) by digital voltage regulator (DVR) for units which do not have these.

ix.Electromechanical relays for generator protection may be replaced by group solid state numerical relays.

Conclusions

The main conclusions of the study are as follows:

i. Cost control of components affecting generating cost like fuel, water and auxiliary power is possible through auditing, monitoring and constant control which is possible only through a strong instrumentation and control system.

ii. Measurement of important parameters which affect the input costs like coal, oil, water need to measured and not estimated.

iii. Both receipt and consumption need to be separately monitored, reported and reconciled through computerised Data Acquisition System (DAS) in respect of coal, fuel oil, water flows through the plant.

iv. There must not be human intervention in the measurement, recording, averaging and compiling quantities of coal, fuel oil and water resources which affect the station input costs.

v. Transit loss, specific fuel consumption and GCV are interlinked and realistic quantification of these will only be possible if an integrated automatic fuel monitoring DAS hub is in place.

vi. Measurements and data grids are required for the following areas:

→ **Coal (imported, raw & washed):** Measuring of in-motion railway wagons, ropeways, conveyors, bunker levels and coal fed into each unit.

→ **Fuel Oil (LDO & FO):** Overall of each unit and station.

→ **DM water:** DM water production and consumption in each unit.

→ **Raw water, soft water and drinking water:** Consumption in various locations including intake.

→ **Auxiliary power (UAT & ST):** The measurement of individual equipment power is required.

→ The measurements of these parameters are not enough. Totalisation and data handling to compute receipts and unit consumption on-line, daily and monthly and yearly are required. Mere installation of instruments at the key points will only give stage-wise consumption but not unit wise consumption. **For energy monitoring, unit wise consumption is essential.** The instruments must have features for recording unit wise consumption by time totalisation into multiple data bases. Also, these equipment must be of the **continuous recording type with digital interface and provision for totalisation** over the year. Further these instruments must have high reliability.

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Director
Central Power Research Institute, Bangalore

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Implementation Of Carrier Based SVPWM For Grid Connected PV System

This article describes through block diagram and simulink model – the integration of Grid-connectred PV system...

Energy plays a pivotal role in our daily activities. The degree of development and civilization of a country is measured by the utilisation of energy by human beings. Energy demand is increasing day by day due to increase in population, urbanization and industrialisation. The world's fossil fuel supply via coal, petroleum and natural gas will thus be depleted in a few hundred years. The rate of energy consumption increasing, supply is depleting in inflation and energy shortage. This is called energy crisis. Hence, alternative or renewable sources of energy have to be developed to meet future energy requirement.

Due to this reason usage of non conventional energy resources such as hydropower, wind is rapidly increasing. Countries having hydro potential are implementing different turbines technologies for generating electricity and to help utility. Similarly, Wind energy sector is also achieving the progress in wind turbines. In addition to this, the most promising source of renewable power today, is photovoltaic system.

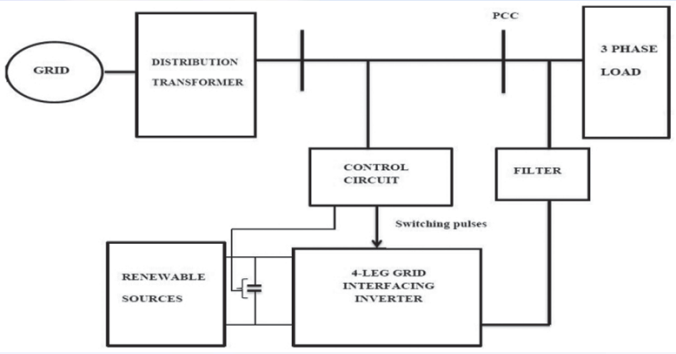

Figure 1: Block diagram...

Though Renewable Energy Sources (RES) are promising solution for current power scenario but these sources are intermittent in nature. Thus, a strong research is going on the techniques for improving efficiency and the performance of RES. Here, we are considering Photovoltaic system (PV) as a RES. Output of PV is DC and it needs to be converted to AC before injecting to grid. In order to have satisfactory output; it is of prime importance to develop control schemes for the grid coupled inverters which are used for DC to AC conversion. In this article, we explain the block diagram and simulink model. Carrier based control scheme is mentioned in it. Simulation results and conclusion are also elaborated in detail.

Table 1: System parameters...

S. No.	Parameters	Value
1	3 Phase Supply from Grid	11kV
2	Supply Frequency	50Hz
3	Step Down T/F	1MVA,11kV/415V
4	Y grounded, Linear load (3 Phase to neutral)	P = 60kW Q = 20kVAR
5	Nonlinear Load	R = 20 ohm L = 5mH
6	Filter	C = 810 µF L = 5000H
7	DC-Link Capacitance and Voltage	20000 µF,585V

System Model And Assumptions

A. System Configuration

Different blocks for the system under consideration are mentioned in Fig.1. Here we are using 11kV, 50Hz grid. For injecting output of PV at distribution point, we are using 3phase 4 wire transmission network. A voltage source inverter is used for converting DC output of PV system to AC. In addition to this, DC link capacitor is used for having control on 2 sides of the inverter namely; grid side and load side. Control circuit is having logic implemented for carrier based SVPWM. Here, we are analysing the carrier based SVPWM results for both linear as well as non linear load. Lastly, LC filter is also used to minimise harmonics arising due to non linear load switching.

B. Overall Model of the System

By following the above block diagram we have prepared simulink model as shown in Fig. 2. System parameters are mentioned in Table I.

C. Solar Photovoltaic Model

Inverter block shown in above model consists of subsystem of solar panel as well as SVPWM control scheme for inverter. It is as shown in Figure 2.

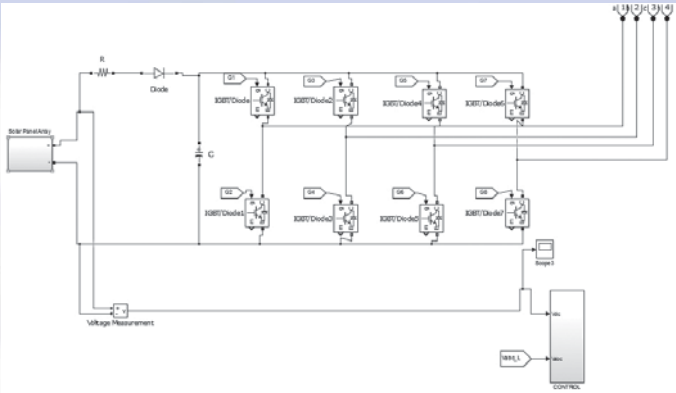

Figure 2: Subsystem of Inverter Block...

Solar panel array is composed of PVA model as shown in Figure 3. Here, Subsystem 1 is representing the model as revealed in Figure 4. In this model, there is subsystem 2 which includes the mathematical model of PV cell.

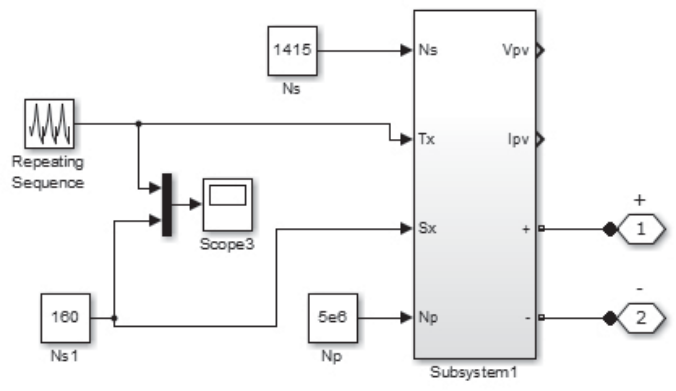

Figure 3: PVA Model...

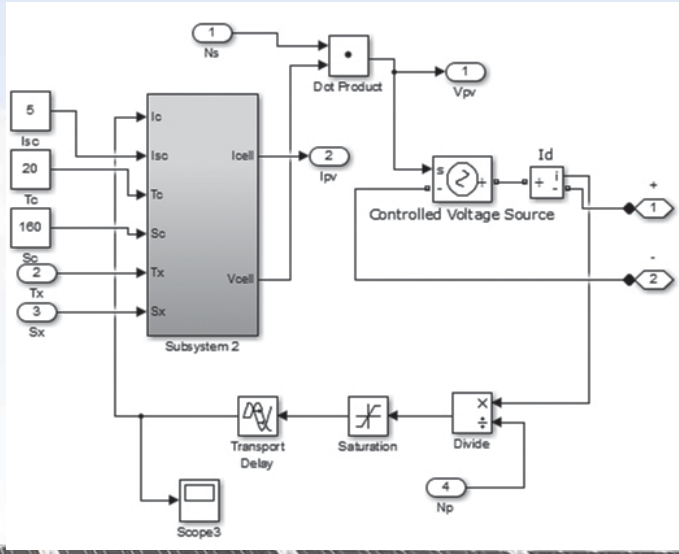

Figure 4: Subsystem 1...

Control Scheme

Grid Synchronisation

Output of inverter must be synchronised with the grid. This can be achieved using Phase Lock Loop (PLL). Unit vector templates derived from data extracted by PLL through grid are stated as in (4), (5) and (6).

$$U_a = \sin \theta \quad (4)$$

$$U_b = \sin (\theta - 2\Pi/3) \quad (5)$$

$$U_c = \sin (\theta + 2\Pi/3) \quad (6)$$

Instantaneous values of voltages can be derived using above unit vectors. These are given by (7), (8) and (9).

$$V^*_a = V_m \times U_a \quad (7)$$

$$V^*_b = V_m \times U_b \quad (8)$$

$$V^*_c = V_m \times U_c \quad (9)$$

Where, V_m is the output of PI controller. Error between the reference voltage V^*_{dc} and the DC output of PV which are given as inputs for the PI controller generates the active voltage component V_m. Here, we are considering the balanced 3 phase system and thus maintaining neutral current as zero using 4_{th} leg of inverter and hysteresis current controller.

Carrier Based SVPWM

In this article, we have proposed a carrier based SVM whose simulink model is as shown in Figure 5. Modulating signals obtained after grid synchronisation are added to offset voltage. The modified signals are compared with the high frequency triangular carrier to produce gating signals for inverter switches.

$$V_{offset} = -(V_{maximum} + V_{minimum} / 2) \quad (10)$$

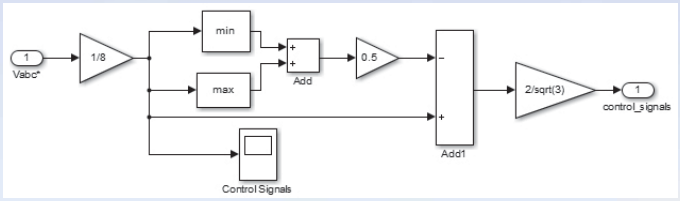

Figure 5: Carrier based SVPWM...

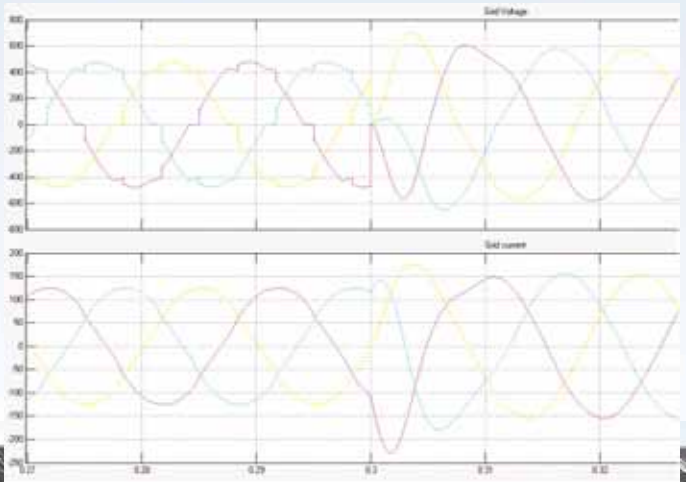

Figure 6: Grid voltage & current...

Simulation Results

Power obtained from photovoltaic system is injected into the grid at t = 0.3 sec. Waveforms for grid, inverter and load are as shown below Fig. 6, 7 & 8. We can clearly observe that after injection of renewable energy via inverter, we are getting smooth sinusoidal output along with the improvement of voltage profile. As PV power drives the load, we can also get the reactive power compensation for load. It is shown in Figure 9.

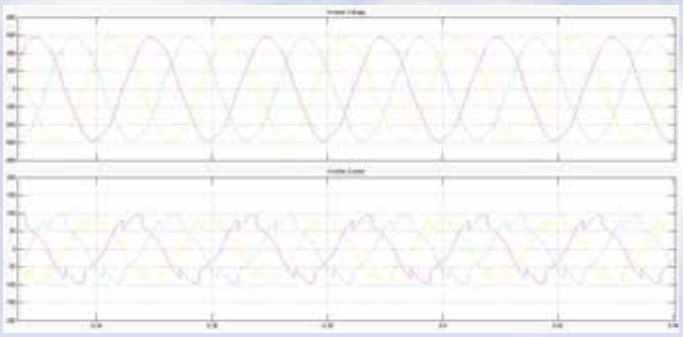

Figure 7: Inverter voltage & current...

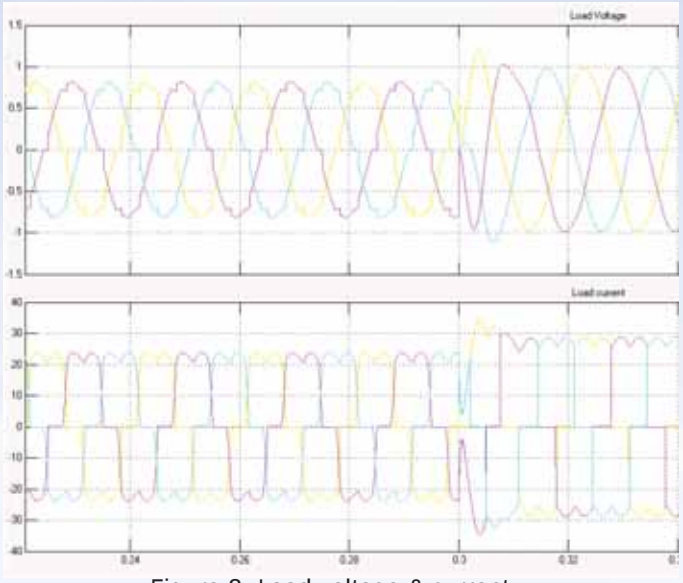

Figure 8: Load voltage & current...

Fast fourier analysis for calculating the parentage of total harmonic distortion is performed which revealed that harmonic distortion gets reduced from 7.38% to 2.45%.Refer Figures 10 & 11.

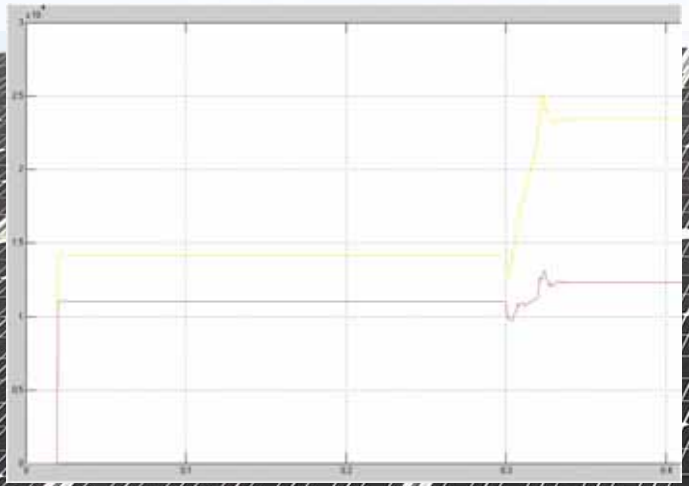

Figure 9: Active and reactive power of load...

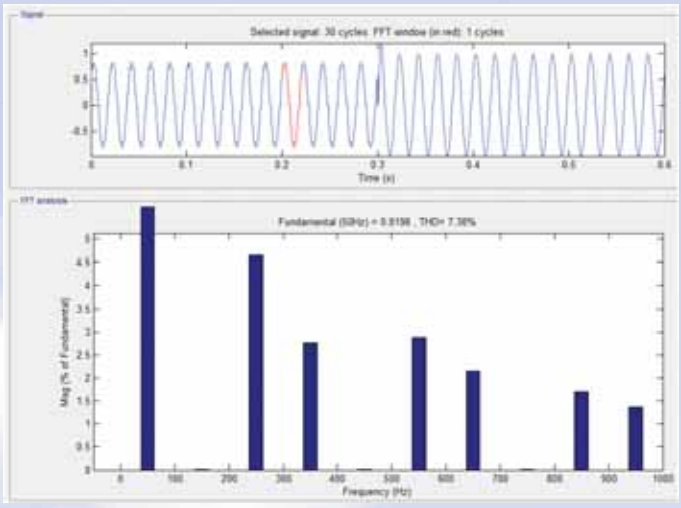

Figure 10: Before injecting PV power...

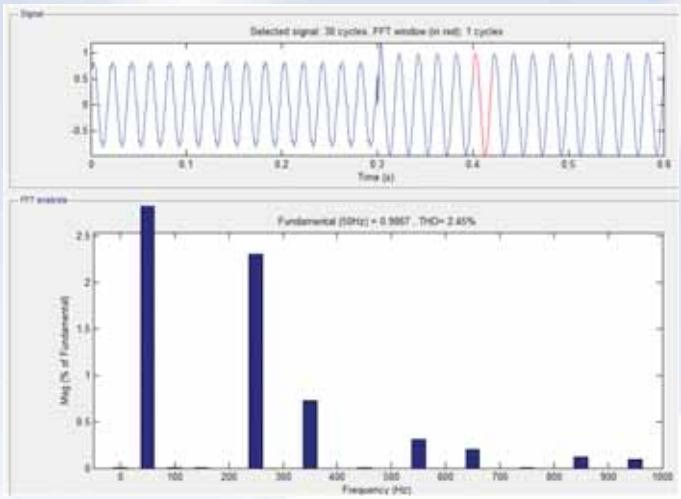

Figure 11: After injecting PV power...

Conclusion

Space vector method used in this project helps in improving voltage profile of the system. Also, we can compensate for reactive power. Total harmonic distortion of the voltage can be reduced to the acceptable value as DC utilisation is maximum in this method. As compare to sine triangle PWM method, this method is very simple in application. We can easily have its implementation for multilevel inverters also.

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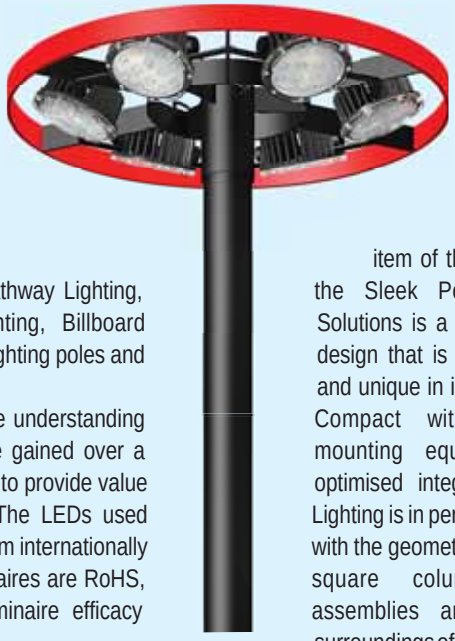

The application includes Facade Lighting, Pathway Lighting, In-ground Luminaire, Uplighter, Up-down Lighting, Billboard Lighting, Vertical Light Bars, Wall Washers, Area Lighting poles and above all popular sleek polar lighting solutions.

The solutions offered are backed by extensive understanding of illumination in urban spaces and the expertise gained over a period of three decades. The fixtures are designed to provide value technology, ideally suited to Indian Conditions. The LEDs used comply with LM 80 testing requirements and are from internationally reputed makes such as Nichia / CREE. The luminaires are RoHS, LM 79 and CE certification compliant. The luminaire efficacy (lumens/per watt) is much above 100 for all luminaires. Varied optical options for lighting distribution and Correlated Colour Temperature (CCT) for cool white, neutral white or warm white are available to suit specific requirements.

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Testing For Renewable Energy Installations

This article principally deals with PV (PhotoVoltaic) solar installations and to some extent, small wind turbines – as these are without doubt the most popular renewable energy options...

For the most part, testing electrical installations that include renewable energy sources covers familiar ground. There are, however, some specific requirements associated with these installations that are likely to be rather less familiar, as Simon Wood of Megger explains.

Renewable energy installations take many forms. Small-scale hydro, solar thermal hot water and ground source heat pumps are just a few examples, all of which have their own testing requirements.

Let's start with a potentially costly myth. Some suppliers say that it's necessary to purchase expensive 'dedicated' test equipment for use on renewables installations, but that's not true. Like all UK electrical installations, renewable energy installations are tested according to the 17th Edition of the IET Wiring Regulations. It means that anyone who tests conventional installations will already have almost all of the test equipment they need for renewables. Why to buy it again?

Note, however, that the last sentence said 'almost all' of the test equipment needed. A small amount of additional test equipment is required, but buying this separately costs far less than buying a dedicated renewables test set.

What is this additional test equipment, and why is it needed? Conventional domestic and commercial electrical installations are concerned only with AC voltages and currents, whereas PV panels produce a DC output. So for testing purposes, an instrument capable of reading DC voltage up to 600 V and DC current up to around 10 A is needed.

A good quality digital multimeter will easily meet these requirements. When choosing an instrument, however, look for one with a CAT IV 600 V safety rating. This means you are well protected against the potentially dangerous effects of voltage transients, whether from the renewable energy source or the supply network.

Those who work frequently on PV installations may also consider buying a clamp meter with AC and DC capabilities, as this will allow current measurements to be made without the need to break into the circuit. A clamp meter is, however, by no means essential.

For work on PV installations, the next additional instrument needed is an irradiance meter. Essentially, this is a special form of light meter that measures the amount of sunlight falling on its sensor, and it is used to ensure that the PV panels operate to the manufacturers published specification are fitted in the best possible location and are oriented to maximise their energy output.

Irradiance meters are not particularly expensive, but it is advantageous to select one that has the sensor built in to the instrument body. These meters are often used on a roof or at the top of a ladder, and juggling with a meter in one hand and a sensor in the other is neither convenient nor safe when working at height.

For similar reasons, a reading hold facility is also highly desirable, as it means the user doesn't have to struggle to see the display while the actual reading is being taken. Instead, they can simply press the hold button and read the result later in a more convenient position.

Moving on now to wind turbine applications, it's clear that the solar irradiance meter would need to be substituted for an anenometer, although the digital multimeter will still be very useful. Many wind turbine installations, however, have their own earthing electrode to ensure safe operation and some means will be needed of measuring the earth resistance of this electrode.

Electricians who have worked on installations for caravan parks and temporary outdoor installations may well have already met this requirement, and be in possession of the test equipment needed for earth resistance measurement. For those that don't have this equipment, however, there are two options available.

The first is simply to buy a standalone earth resistance test set, and this is likely to be the right option for those who already have up-to-date instruments for testing standard electrical installations. Those who may be considering buying a complete set of new installation test equipment may, however, prefer considering the second option – the purchase of a Multifunction Installation Tester (MFT) with built-in facilities for earth resistance testing.

MFTs of this type have only recently appeared on the market and, for those purchasing new installation test equipment, they offer a considerable cost saving compared to buying a standard MFT plus a separate earth resistance test set.

Testing renewable energy installations is nothing more than an extension of the testing work needed for conventional electrical installations. As we've seen, very little extra equipment is needed and, provided that equipment is chosen carefully, testing renewable installations conveniently and safely is a straightforward task for competent persons.

For further information: Pratyush.Sinha@megger.com

Enabling Low Priced 6-axis Robot

igus expands the robolink modular kit for industrial low-cost automation...

The robolink D modular kit from the motion plastics specialist igus offers users the ability to assemble cost-effective custom robotic systems. The separate joints, which are driven by a motor directly on the axis, are available in various installation sizes.

Now igus has further expanded its range. It presented at Hannover more components that offer still more scope for design. This gives the ability to combine motors and joints in several sizes with the standard controls to make a complete 6-axis low-cost robot made of plastic and aluminium.

In Hall 17 igus exemplarily displayed an application that can move up to 3 kg load, with Beckhoff control.

New strain wave gearing for lighter arms

A special feature is the new robolink strain wave gearing, which can be, for example, very easy to use as the sixth axis of the robot arm, that is, as a radial connection between arm and gripper.

It is very lightweight and efficient and is offered by igus in two installaiton sizes as a single component, or with a Nema17 or NEMA23 stepper motor.

"The strain wave gearing has the advantage that it has minimal backlash and thus ensures a precise adjustment with incredible smoothness," explains Martin Raak, Robolink Product Manager at igus. "It is very compact and has a high transmission ratio," he adds.

The gearbox consists of an outer ring gear and a flexible wear-resistant inner ring gear made of iglidur high-performance plastic.

Quick and easy to configure with new online tool

In Hannover, igus displayed a complete 6-axis arm with strain wave gearing. The worm wheels for the new transmission ratios 1:30 and 1:70 of the robolink D worm gear also utilise iglidur materials.

For these, igus now also offers a decoupled option of motor and joint. The two components are connected to each other by an aluminium profile – the result is a better weight distribution on the axis, whereby more load can be lifted.

The new universal gripper adapter allows the attachment of different grippers on the robolink D joints. The robolink D modular kit is rounded off with a new online configurator, by which users can assemble their robolink D joints, and thus can configure their low priced robotic arms.

From € 243 per axis

The system is modular and therefore cost effective through the use of iglidur plastics. A robolink joint without a motor is already available from Euro 243, when ordering one piece. Motors, encoders, cablings and other accessories are available as options. igus also supplies mounted arms; all gears are offered to robot manufacturers in series production.

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Uniquely Different Solutions

Testo now offers portable and stationary measurement solutions for almost all areas of application from one provider for HVAC/R...

After intensive research and development work, Testo AG has now reached its target to provide an all round solution to the HVAC/R sector by introducing first of its own set of electrical measuring instruments, backed by latest German technology. With them, the company tries to provide uniquely different solutions with advanced features to their customers. These intelligent electrical measuring instruments from Testo makes it possible for the users to carry out their daily measurement tasks more easily, safely and efficiently than ever before. In contrast to many products in the market, the measuring instruments from Testo show many differentiating benefits and an excellent price-performance ratio. Added to this is the advantage, that with 12 products, Testo India completes its basket of necessary tools for measuring needs of HVAC/R.

The objective is to make HVAC/R measurements easier

The market for electrical measuring instruments today already offers a multitude of solutions for many different measurement parameters. This is the reason why Testo did not want to simply launch yet another measuring instrument on to the market, but to provide a real added value for the target group. In particular, Testo wants to provide innovative technology to enable efficient working of HVAC/R sector than with existing measurement solutions. The new instruments are extremely user-friendly: they are easy and intuitive to use, save many work steps, offer the highest level of safety, and are suitable for various applications.

Five product families for all important measurement tasks

Testo is launching a total of five product families for all important measurements on electrical appliances and systems. These include a digital multimeter in three versions, which automatically recognizes the measurement parameters by socket use, and which can be more safely operated using function buttons than with the usual rotary dial. Three clamp meter models with a unique clamp mechanism for measuring tight-fitting cables. This allows current cables to be grabbed precisely. It is available with two current-voltage testers which fulfil the newest voltage tester standard, and allows selection of measurement parameters automatically and without the danger of confusion. Completing the range are three voltage testers – all equipped with an all-round LED display which can be read from any position – and a non-contact voltage tester with a filter for high-frequency interference.

Testo 760 – the first automatic multimeter

The Testo 760 digital multimeter family comprises three models for all important electrical measuring tasks. Function keys replace the traditional dial on all three instruments, which means easier operation and greater reliability. Incorrect settings are now impossible, because the measurement parameters are detected automatically via the assignment of the measuring sockets and also shown by the illumination of the appropriate function keys. The Testo 760-1 model is the standard version for almost all daily measuring tasks. The Testo 760-2 is differentiated by a larger current measurement range, the true root mean square measurement - TRMS - and a low-pass filter – for VFD output voltage measurements accurately. The Testo 760-3 is the model with the highest specification and, in addition to the features of the other two models; it has a voltage range of up to 1,000 V, along with higher measuring ranges for frequency and capacitance. In addition, µA current measuring range is also available.

Testo 770 – grab cables without touching

The three instruments in the Testo 770 clamp meter family are ideally suited for non-contact current measurement in switching cabinets with a

unique feature of inrush current measurement as well. One of the two pincer arms can be fully retracted into the instrument. This unique grab mechanism means that cables in tight switching cabinets can be easily grabbed. The automatic measurement parameter detection also ensures reliable work: in the current and voltage area, all three instruments detect direct and alternating current and select other parameters such as resistance, continuity, diode and capacitance automatically. The Testo 770-1 model is the standard version for daily measuring tasks, including starting current measurement. The Testo 770-2 also has a µA range as well as an integrated temperature adapter for all type K thermocouples. In addition, the Testo 770-3 offers a power measurement function, along with Bluetooth.

Testo 755 – the first voltage tester measuring current

Both instruments in the Testo 755 current/voltage tester family are the first of their kind: voltage testers which meet the latest standard and which can also measure current. This means they are suitable for virtually all daily electrical measuring tasks. Each time they are used they automatically select the right settings and therefore prevent dangerous incorrect settings. Both instruments have all the important functions for determining voltage/de-energization, for measuring current and resistance, as well as for continuity tests. In addition, the integrated flashlight enables dark spots to be illuminated. The measuring tips can be changed easily, so that the whole instrument does not need to be replaced in the event of damage. The Testo 755-2 model is differentiated by the larger current range of up to 1,000 V and special functions, such as the single pole phase testing and rotating magnetic field measurement. In addition, it is also certified according to voltage tester standard DIN EN 61243-3:2010.

Testo 750 – the voltage tester with all-round LED display

The three models in the Testo 750 voltage tester family are the first instruments with an all-round LED display. The display can be seen from any position and guarantees an ideal voltage indication thanks to its unique fibre optics. All three models meet the latest voltage tester standard EN 61243-3:2010 and have a safety specification according to CAT4. They have the most important functions for voltage testing, continuity testing and rotating magnetic field measurement. The Testo 750-2 is also suitable for single pole voltage testing and has a flashlight along with an RC trigger function. Vibrating load buttons ensure that trigger tests cannot be carried out accidentally. In addition, the Testo 750-3 is fitted with an LC display to show the current reading.

Testo 745 – the non-contact voltage tester

The Testo 745 non-contact voltage tester with a voltage range of up to 1,000V is particularly well-suited to fast initial checking of any suspected fault sources.

When the presence of voltage is determined, the Testo 745 gives a warning via a clear visual and acoustic signal.

In order to increase reliability, the voltage tester has a filter for high-frequency interference signals and is also waterproof and dustproof according to IP 67.

With the introduction of the electrical measuring instruments, Testo now offers portable and stationary measurement solutions for almost all areas of application from one provider for HVAC/R.

For further information: E-mail: info@testoindia.com

"We are the gear that meshes seamlessly with our customers' processes..."

Pepperl+Fuchs (India) Pvt. Ltd. is a wholly owned subsidiary of Pepperl+Fuchs GmbH, which is a well known developer and manufacturer of electronic sensors and interface components for the global automation market. In an e-interview with the team of Electrical India, Thampy Mathew, Managing Director (Process Automation Division) of the company (Middle East & India) is talking on electrical safety awareness in India, the immediate necessities thereon and his company's offerings to enhance the same. Excerpts...

Q **How is the awareness for electrical safety increasing in the Indian sub-continent?**

A There has been established and good Electrical Safety Standards in India. However, concerning awareness towards this and more than that, effective implementation and regular audit of facilities to ensure safety are yet to be considered with due diligence by Authorities. As a result, the country still experiences high loss of lives and properties in the event of electrical hazard.

There are several initiatives to create awareness of Electrical Safety Practices and National Standards by the Government and Independent bodies. The regulations should insist on periodic inspection / re-assessing of electrical installations in plants & buildings and encourage skill upgradation through enhanced scope under the framework of certification itself. The culture of 'safety' need to be inculcated by law, which will definitely solve the root-cause of majority of the problems connected with Electrical Safety.

Q **Please give us a brief account of the products offered by Pepperl+Fuchs in India?**

A Pepperl+Fuchs is known by customers around the world as a pioneer and an innovator in electrical explosion protection technology in Process Industries.

We are Global Leaders in Conventional & Field bus Interface

Solutions and a brief range of our products. Our solutions are listed below. More details are available in www.pepperl-fuchs.com

Electrical Explosion Protection Equipment / solutions:

- Flame Proof (Exd) Distribution Panels, Lighting Panels & Control Panels
- Flame Proof (Exd) Switch Racks
- Flame Proof (Exd) Motor Starter Panel & Local Starter Panels
- Flame Proof (Exd) Local Control Stations & MOV Isolators
- Flame Proof (Exd) Cast Aluminum Enclosures ,Terminal Boxes & Fuse boxes
- Increased Safety (Exe) Stainless Steel Enclosures and Terminal Boxes
- Increased Safety (Exe) Stainless Steel/GRP Local Control Stations
- Increased Safety (Exe) or General Purpose Fieldbus Junction Boxes

The above products are available in Stainless Steel, Cast Aluminium (LM4 & LM6) & FRP/ GRP




Q What's your observation on the changing demand of the Indian customers?

A The Indian customers are noted for their high degree of value orientation. India is a huge market even for costly products, however, the customers are discerning and look for value for money.

Due to this, engineered solutions for critical applications cannot find its right commercial proposition and most of the time compared with normal products, which can de-rail the very purpose of safety related to highly dangerous electrical installations!

In the past, there existed a collaborated approach between solution providers and customers to arrive at the right mix of technology and safety as outlined for various applications in industries, which unfortunately got diluted by e-bidding or consumer-driven psychology.

Q What makes Pepperl+Fuchs' products different from those of its competitors?

A We are the gear that meshes seamlessly with our customers' processes, providing creative ideas and accompanying them into the future. Our products and solutions are innovative. They are centered on the customer's current & future requirements. Pepperl+Fuchs brand always stands as a differentiator from competitors.

The German engineering and quality consciousness added with Indian skilled labour created the perfect taste of products & solutions required for all Electrical & Automation applications for Industries in India.

Pepperl+Fuchs GmbH had established its wholly owned subsidiary here in 1997, and proved this fact to become No.1 supplier in our area of expertise.

Q Where do you manufacture your products? Do you have localised manufacturing facility in India?

A Pepperl+Fuchs has several manufacturing facilities worldwide including Germany, Singapore, USA, UK and in India. P+F India had been doing value- added solutions like Control Panels, Fieldbus Junction Boxes, Ex-certified Terminal Junction Boxes / Control Stations etc., in their Bangalore facility from 1999.

Last year (2015), Pepperl+Fuchs acquired an exclusive Electrical Explosion Equipment manufacturing company (part of GOVAN – Australia group) in Chennai. There we do Casting & Fabrication of Explosion protection enclosures, and assembly of Electrical Solutions based on Customer requirements.

With all required Global accreditation, this facility also caters to global Pepperl+Fuchs requirements of such Explosion-proof enclosures for Industrial Customers around the world.

Q How much customisation do you offer to cater to the exact need of a customer?

A

- Pepperl+Fuchs offers a broad portfolio of Electrical Equipment and Solutions for installation & control of machinery as well as electrical networks in harsh environments and explosion hazardous areas.
- Pepperl+Fuchs India houses a team of 15 design Engineers

P+F's Indian headquarters and manufacturing unit in Bengaluru...

for customising solutions required as per specific needs. Facilities in India also housed certified Norm-Experts in Hazardous areas, authorised to Audit and Certify Electrical Circuits and Engineering Drawings as per approved standards.

- Various types of protections and enclosures along with a high level of flexibility allow the design of the most efficient control and distribution solutions for any application in industrial environment.
- Experienced project engineers at the Pepperl+Fuchs Solution Engineering Centers – located worldwide – supports the users to find out their specific requirements – and team India converts that to certified electrical solutions ready for installation at their sites.

Q What are the industries or sectors that can benefit maximum from your product offerings?

A Oil+Gas& Refineries, Chemical Industries, Pharmaceutical Plants, Power Industries, Water+Waste Water & Other Process Industries.

Q What kind of after-sales service do you offer? How do you do that?

A Pepperl+Fuchs maintains a global network of After-Sales Support, since for Pepperl+Fuchs, field support & service are on top of the agenda. Hence, customers can purchase the most innovative, high-quality products and solutions all over the world with ease for their life cycle performance. Furthermore, comprehensive technical documentation is made available besides expert insights and regular trainings and seminars in :

- Control Systems Solutions
- Literature for Explosion Protection

P+F's manufacturing unit in Chennai...

- Technologies for Explosion Protection
- Project Management

Q What is your advice to the prospective buyers?

A Plant safety ensures Human Safety, Asset Management and Profitability. These Critical Management parameters are achieved only through diligent implementation of the 'right' Safety Solutions and regular audit and maintenance of its parameters.

Any customer, who wants to achieve the above goals need to essentially partner with the 'right' solution provider, who can study plant requirements, offer fitting solutions, implement installations and support the same for its life cycle and ensure Safety of Human and Assets. Pepperl+Fuchs has been such a proud partner to all reputed industries in the country for the last two decades for Automation & Electrical Safety Products / Solutions.

Vishay ESTA - A Specialist in Power Capacitors

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

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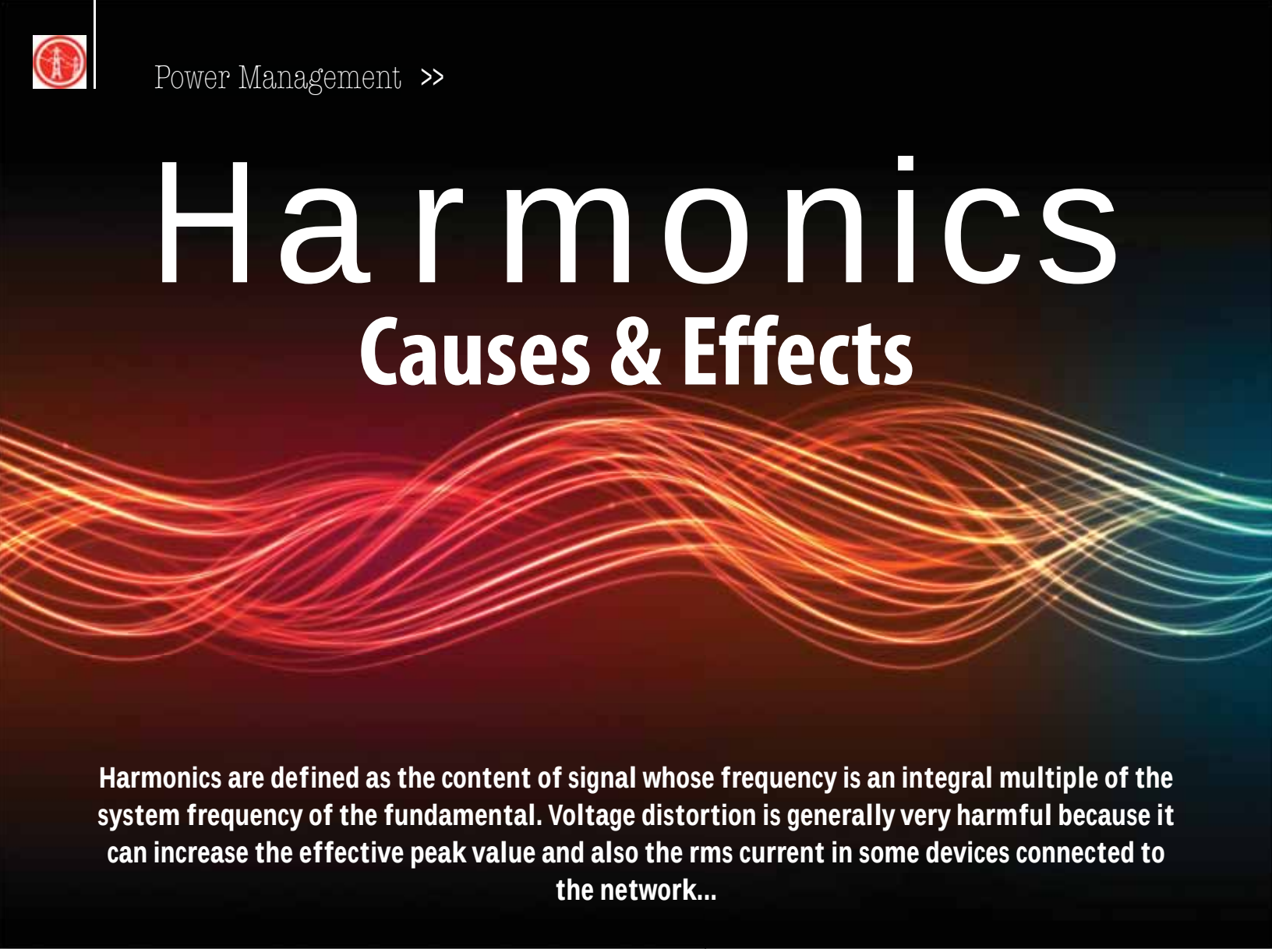
Harmonics
Causes & Effects



Harmonics are defined as the content of signal whose frequency is an integral multiple of the system frequency of the fundamental. Voltage distortion is generally very harmful because it can increase the effective peak value and also the rms current in some devices connected to the network...

Harmonics is defined as the content of the signal whose frequency is an integral multiple of the system frequency of the fundamentals. Harmonics current generated by any non-linear load flows from the load into the power system. These harmonic currents degrade the power system performance and reliability and can also cause safety problem. Harmonics need to be clearly located, sources identified and corrective measures taken to prevent them.

Electrical load is categorised under two categories

i. **Linear load:** Such load draws voltage and current in essentially sine wave shape but at varied phase shift (power factor). Example: resistors, inductors, capacitors and their combinations are classified as linear load. Linear loads have smooth, straight and predictable response.

ii. **Non-linear load:** Power supplies in non-linear load draw current in abrupt pulses rather than in smooth sinusoidal wave. It indicates distorted or suddenly changing response. Example-modern electronic/ electrical equipments consisting of rectifying, charging /discharging and phase control circuits.

Harmonics: The distortion in a sinusoidal wave is generally defined in terms of various harmonics components. Harmonics are defined as the content of signal whose frequency is an integral multiple of the system frequency of the fundamental. Typical harmonics for a 50 Hz system (fundamental frequency) are the 5th (250 Hz), 7th (350 Hz), 9th (450 Hz).

The harmonics of a periodic wave can be represented by a Fourier series:

$f(wt) = A_O + A_1 \cos wt + A_2 \cos 2wt + B_1 \sin wt + B_2 \sin 2wt + \text{-------}$

f(wt) = Given non sinusoidal periodic wave form with angular velocity w = 2 Σ f

A_0 = Const.

A_1, A_2, A_3 --------- A_n coefficient of cosine terms, nth is the order of harmonic.

B_1, B_2, B_3, -------- B_n coefficient of sine terms, nth is the order of harmonic.

Effects of harmonics: Harmonics current generated by any non-linear load flows from the load into the power system. These harmonics currents degrade the power system performance and reliability and could also cause safety problem. Harmonics need to be clearly located, sources identified and corrective measures taken to prevent these problems. THD (Total Harmonic Distortion) can be computed as per IEE-519 standard as:

$$\text{THD} = \sqrt{\frac{\sum_{n=2}^{N} h^2}{n}} \times 100\%$$

Where h_n is the individual harmonics of nth order.

Source of harmonics: (1) Transformers under no load and light loads (2) Saturated Reactors (3) Thyrister controlled motor drives (4) Arc Furnaces (5) Arc Welders (6) Conduction Furnaces (7) Gas discharging lighting-low pressure/ high pressure Sodium vapour lamps (8) High-pressure Mercury vapor lamps (9) CFL/fluorescent tube lights (10) Energy conservation devices e.g. soft starters, electronics ballast and fan regulators (11) Rectifiers (12) UPS (13) Static VAR compensator (14) HVDC transmission system (15) Solar power conversion.

Why to worry for harmonics: Voltage distortion is generally very harmful because it can increase the effective peak value and also the RMS current in some devices connected to the network. For a capacitor, impedance decreases drastically as it is inversely proportional to the frequency. Under normal circumstances the voltage distortion in primary electrical distribution network is minimal and can usually be ignored from a practical point of view. On the other hand distortion of current wave shape is common particularly when electronic equipment is connected to the network or when non-linear loads are connected. Current distortion, in general, causes overheating due to increase in the losses and affects all electrical machines, transformers etc. This causes derating of equipment. The amount of derating will depend upon which harmonics are present and the magnitude of the individual current and resistance.

Classification of harmonics

Name	F	2nd	3rd	4th	5th	6th	7th	8th	9th
Frequency	50	100	150	200	250	300	350	400	450
Sequence	+	-	0	+	-	0	+	-	0

Positive sequence harmonic component would generate a magnetic field, which rotates in the same direction as the fundamental. A negative sequence harmonic would generate the rotating magnetic field in the reverse direction. The zero sequence harmonic would not rotate the magnetic field in any direction.

Limits of harmonic levels: Depending upon the system network, various countries have adopted different limits for deciding the tolerance levels of harmonic distortion. The ranges of limits generally adopted are indicated below.

System Voltage	Individual percentage voltage distortion		Total percentage voltage distortion
	Odd	Even	THD
415V	4	2	5
Up to 11KV	3 to 4	2	4
11 to 66KV	2	1	3 to 4
66 to 220 KV	1	0.5	1.5

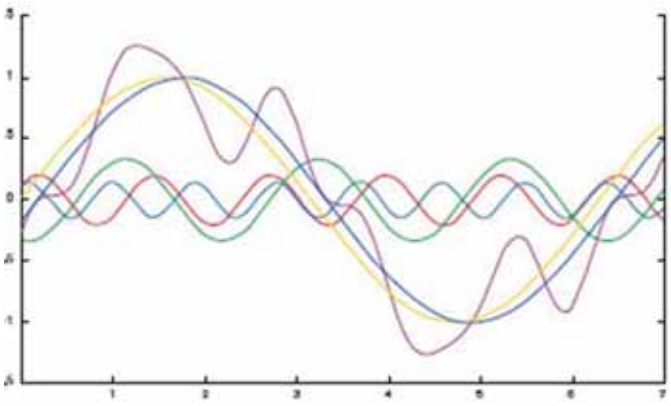
It is necessary to fix the limits of the harmonics generation levels and make mandatory to the users. However, in our country still no regulations have been made in this regard. The regulation is only for variation of rated voltage which is ± 10% and ± 2% of frequency.

Harmonic current

Theoretical value of the harmonic current = I/h

I = fundamental value of the current

h = Order of harmonics



Electrical waveform with harmonic distortion...

Harmonic Order	Harmonic current as per unit value of fundamental
1	1
2	0.5
5	0.2
7	0.142
11	0.09
13	0.0769
17	0.0588
18	0.0526

Higher the harmonic order, lesser is the harmonic current.

Harmonic effects on various components

i. **Transformers:** Harmonics in transformers cause an increase in the iron and copper losses. Voltage distortion increase losses due to hysteresis and eddy currents and causes overstressing of the insulation material used. The primary effect of power line harmonics in transformer is, thus the additional heat generated. Other problems include possible resonance between the transformer inductance and the system capacitance, thermal fatigue due to temperature cycling and possible core vibrations.

ii. **Motor and generators:** Harmonic voltage and current cause increased heating in rotating machines due to additional iron and copper losses at harmonic frequencies. This lowers the machine efficiency and affects the torque developed. The flow of harmonic currents in the stator induces current flow in the rotor. This results in rotor heating and pulsating or reduced torque. Rotor heating reduces the efficiency and life of the machinery whereas pulsating or reduced torque results in mechanical oscillation causing shaft fatigue and increased ageing of mechanical parts.

iii. **Thyrister drives:** AC variable frequency drives with thyrister converter when operated at slow speed, generally result in poor power factor.

iv. **Power cable:** Normal level of harmonics currents cause heating in cables. However, cables involved under system resonance condition may be subjected to voltage stress and corona, which can lead to insulation failure.

v. **Metering equipments:** In general, harmonics flowing in induction type metering equipment will generate additional coupling paths thereby increasing the speed of the disc and hence an apparent increase of costs.

vi. **Switchgear and relay:** Harmonics current increases heating and losses in switchgear there by lowering its normal current capacity and shortening the life due to voltage stress fuses require derating due to the heat generated by harmonics.

vii. **Earthing system and computer performance:** In a 3 phase and neutral system- when 3rd harmonics and multiples are expected, the neutral conductor size should be the same size as the phase conductor size.

Computer hanging up, loosing instructions, data or misbehaving can be as much attributed to poor quality of power. Eearthing of computer equipment should be independent and be fixed into the mains earthing at one point – preferably at the entry point only. Multipoint earthing introduces coupling to various other equipments.

viii. **Communication network:** The induction coupling between the AC power transmission lines containing harmonics and the neighbouring communication network causing high noise levels.

ix. **Capacitor:** Capacitors for power factor correction are always present in industrial installations and are worst affected if harmonics are present. Capacitors do not generate harmonics, but provide network loop for the possible resonance. Capacitive reactance decreases with frequency whereas inductive reactance increases directly with frequency. At the resonant frequency of any inductive capacitance (LC) circuit, the inductive reactance will equal the capacitive reactance. In an actual electrical system utilising power factor correction capacitor, both series and parrelel resonance and a combination of the two can occur. In the case of a series circuit, the total impedance at the resonant frequency reduces to only the resistive component of the system. If this component is small, high current magnitudes will result at the resonant frequency. In the case of a parallel circuit, the total impedance at the resonant frequency is very high (approaching hypothetically infinity) thus, when excited from even a small source at the resonant frequency; a high circulating current will flow between the parallel capacitor and inductor. The voltage across the parallel combination could be quite high. Consequently, if the resonant point of either or both these type of circuits happens to be close to one of the frequencies generated by the harmonic sources in the system, the result may the flow of excessive amount of harmonic current and/ or the appearance of excessive harmonic voltage. These occurrences may cause such problems as capacitor bank failures; excessive capacitor fuse operation and dielectric break down of insulated cables. In most low voltage installations, the following guidelines may be followed:

1. If the KVA of the harmonic generating loads is less than 10% of the transformer KVA rating capacitor can be installed without concern for the resonance.
2. If the KVA of the harmonic generating load is less than 30% of the KVA rating and the capacitor KVAR is less than 20% of the transformer KVA rating, capacitor can be installed without concern for the resonance.
3. If the KVA of the harmonic generating load is more than 30% of the transformer KVA rating capacitors should be applied as filters.

The above guidelines are applicable when transformers with 5 to 6% impedance are used and the system impedance is less than 1% at the transformer base.

Filters for harmonics

For healthy operation of power system, two things serve as guidelines:

1. The consumer is responsible for maintaining current distortion within permissible/acceptable levels.
2. The electricity board is responsible for maintaining voltage distortion within permissible/acceptable levels.

There are different types of filters:

- Single tuned filters.
- High Pass (first, 2nd or third order etc.)

A capacitor with a series reactance can be so designed as to tune to a given harmonic. It offers almost a zero impedance parallel path and absorbs a particular harmonic. At the fundamental frequency, it also helps in power factor correction. Thus, wherever filters are required, a portion of the P.F. capacitor bank is converted into a filter or filters. A filter bank increases the cost of capacitor installation because of extra circuit breakers and reactors.

Undesirable harmonic current is prevented from flowing into power system by use of high series impedance to block them or direct them by means of low impedance shunt path.

Series filters should be designed to carry full load current and should be insulated to full rated voltage of the system, while shunt filters are less expensive and provide reactive compensation in fundamental frequency. Therefore, it is generally preferred to use shunt filters.

Basant Kumar
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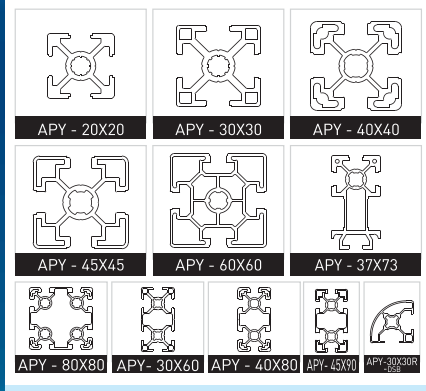

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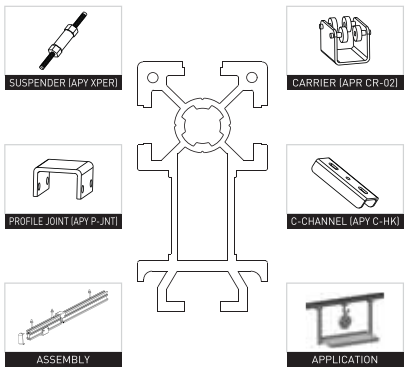
PROFILE IMAGE

ALUMINIUM PROFILE ACCESSORIES



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DEIF Completes 3.6 MW Project

DEIF with its experience and expertise in the field of power generation control solutions introduced the Automatic Solar Controller...

DEIF India Pvt. Ltd. – a subsidiary of DEIF A/S, has installed its solar solution – the Automatic Solar Controller, ASC in the northern and western parts of India. Recently DEIF has completed a 3.6 MW project of India's largest integrated solar company that has commissioned EPC projects of 175 MW till date. The project is spread across three different client sites namely, Pune, Rohtak and Kasna for India's largest – and Asia's third largest paint company, with a turnover of 141.83 billion rupees and with global presence.

DEIF's scope of supply included concept designing, engineering, getting it approved, manufacturing and supply, FAT, commissioning, SAT, training and documentation, working closely with EPC, Inverter supplier, vendors and the end customer, thus providing a comprehensive solution that exceeded customer's expectation.

Application challenge

The customer was keen to use solar power even in the absence of utility supply. The backup power was delivered by diesel genset – and the solar systems were to be designed to supply power along with the diesel genset and the load had to be shared between the two groups. An inappropriate design could cause burning of excess diesel by the genset or a varying load could cause an inadvertent reverse power in the genset.

Solar block diagram...

Project highlights

- 3 sites at different locations, total installed solar PV capacity 3.6 MW
- Maximum solar penetration, fast ROI
- Intuitive and user-friendly Advanced Graphical Interface system
- Display of single line diagram of the Solar PV system with status of breakers and busbar condition
- Display of real time kW reading of the Solar PV, Mains incomers
- Real time graphical view of the Active Power (kW), Reactive Power (kVAR) and Apparent Power
- Monitoring of alarms and source of alarms
- Less diesel consumption, reduced emission leading to decreased maintenance and operation cost.

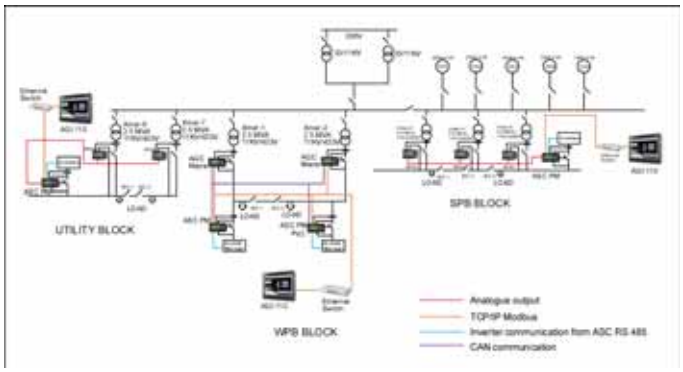
The DEIF solution – first of its kind

DEIF with its experience and expertise in the field of power generation control solutions introduced the Automatic Solar Controller - ASC, which provides integrated solution for systems with utility, diesel and solar power source.

The Automatic Solar Controller serves as an interface between solar and the diesel/gas genset controllers/Utility Power, namely Advanced Genset Controllers AGC-4, over the CAN bus to adjust power output to meet the load requirement such that the solar system takes the maximum load share. This solution enables you to share the load between solar PV group and diesel genset with or without presence of utility power with maximum solar penetration, thus resulting in maximised savings even during utility failure.

The system uses power management features of DEIF viz., fixed power mode and mains power import/export mode to achieve relevant operation philosophy. If the solar power output decreases due to bad sunlight, the deficit will be met by diesel genset through the CAN bus communication between ASC and AGC-4, thus ensuring reliable supply of power to the paint plant in all conditions.

A graphical interface solution to each of the ASC and the AGC mains is provided by connecting the same to DEIF's AGI-110. All the TCP/IP output of the ASC and AGC mains is connected to an Ethernet switch and from the Ethernet switch AGI is connected to monitor the ASC. A case diagram for one of the plant is depicted below for your reference.



Case Diagram (2 MW Solar power plant)...

For further information: india@deif.com

3 Triple Safety
- Arc Chute
- Terminal Shroud
- Phase Separator

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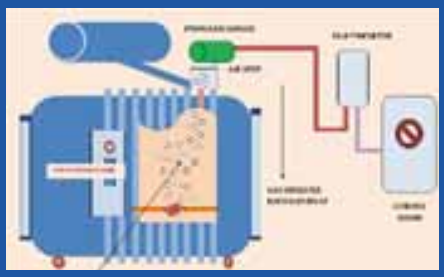

Illustration of On-line Fault Sensor

Sensor Unit

Display cum Control Unit

Technologies are available for commercialization

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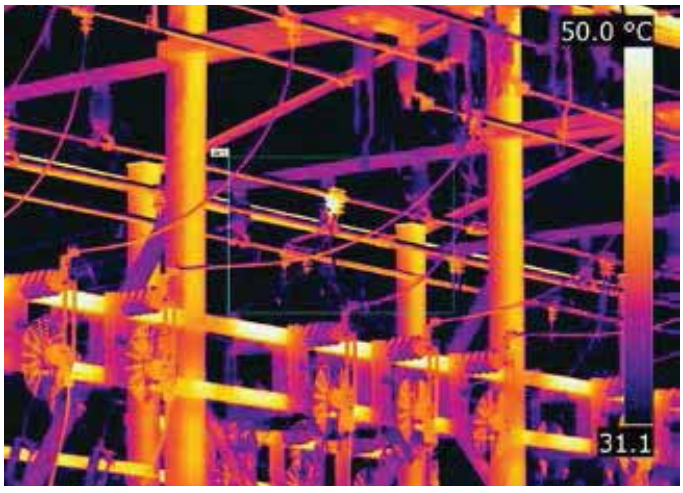
"The Infrared Resolution Is Simply Tremendous"

The engineering firm Adler in Herten in the German Ruhr area is using the top-of-the-range FLIR T1020 handheld thermal imaging cameras for maintenance applications...

The engineering firm Adler has been providing highly qualified industrial thermal imaging services since 1996. The focus here is on thermographic inspections of electrical switching and distribution systems in all voltage ranges. However, Martin Adler's engineering services also include thermography of mechanical equipment and components as well as measurements inindustrial settings for process analysis, diagnosis, process optimisation, product development and research, and the inspection of machines, equipment and insulation. In addition, he advises clients in the planning of installed, user-specific infrared measurements and offers problem analysis and troubleshooting for already installed IR-measuring systems.

Twenty years of thermography experience

Of course Martin Adler's many years of practical experience is the most important factor here. There is hardly an industrial thermographer in Germany, who has this much experience. Even during his studies at the University of Applied Sciences in Gelsenkirchen at the beginning of the nineties, Martin Adler programmed his own evaluation software for infrared measurements at



Thermography of high-voltage components always requires a relatively large safety distance. The UltraMax feature can be particularly helpful in this regard by providing good resolution and accuracy even from a distance...

Contactor with pronounced abnormality of the right phase on the lower terminal connection. The possible cause could be increased resistance at the terminal connection, an internal connection or the contactor. The labels are also easily recognizable here thanks to the MSX feature...

the laboratory for energy technology. "There were no standardized solutions at the time and therefore individual initiative was required," Adler recalls. From the passion he developed as a student, he then established his own company in 1996, which celebrated its 20th anniversary in April 2016 (www.ingenieurbuero-adler.de). Even back then, the focus was on electrothermography."It became clear to me: there was a great interest in thermographic inspection in the industrial sector, but there was a fairly meager selection of qualified services. In 1996, there was still no recognized qualification for thermographers in Germany and only two years later the first certifications were introduced here according to the American standard."

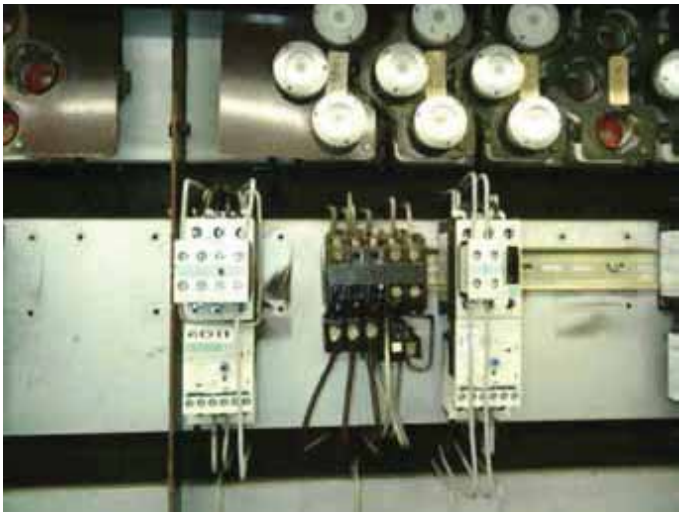
Measurements conducted by inexperienced service providers were often not reproducible and some of his competitors offered little more than colorful pictures with their infrared cameras. Martin Adler recalls a particularly horrific scenario involving an energy provider. An inexperienced thermographer had inspected insulators on high voltage lines on an extremely sunny day and thus found a high number of overheated units. "However, most of the insulators were perfectly in order, and the man simply did not have the necessary experience. Outdoor recordings often simply do not provide useful results in strong sunlight. Such faulty inspections at that time brought the whole industry into disrepute."

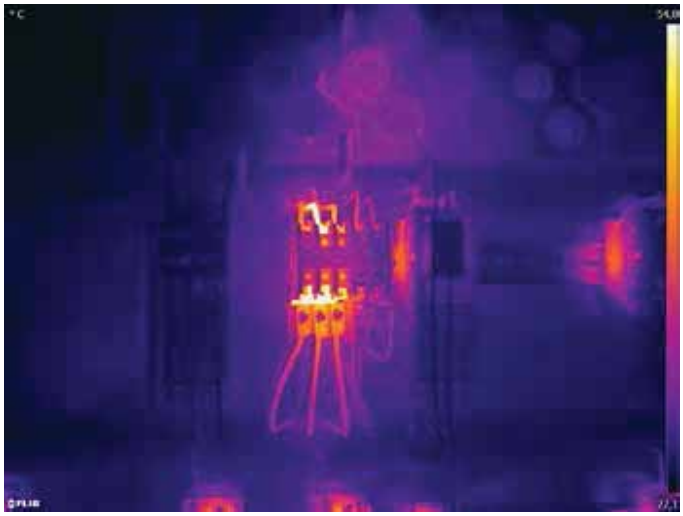
Based on his studies, Martin Adler took a very different and much more systematic approach, which he has remained faithful to. Regularly repeated inspection of critical components under reproducible conditions plays the decisive role here. "Back then, I first had to gain the confidence of my customers," Adler recalls. "Often a whole year passed between the first phone call, the first appointment, a demonstration of the technical measurement possibilities, internal coordination between the customer's technicians and the purchasing department, and the actual order." And the initial investment of 120,000 Deutsche marks for a thermal imaging camera from FLIR's predecessor company Agema didn't make the start any easier for Martin Adler. It took several years to fully amortize this investment and Martin Adler used the time to develop his excellent reputation. To this day, this reputation obliges him to use the best available thermal imaging camera model.

Martin Adler taking thermal images of a low-voltage main distribution...

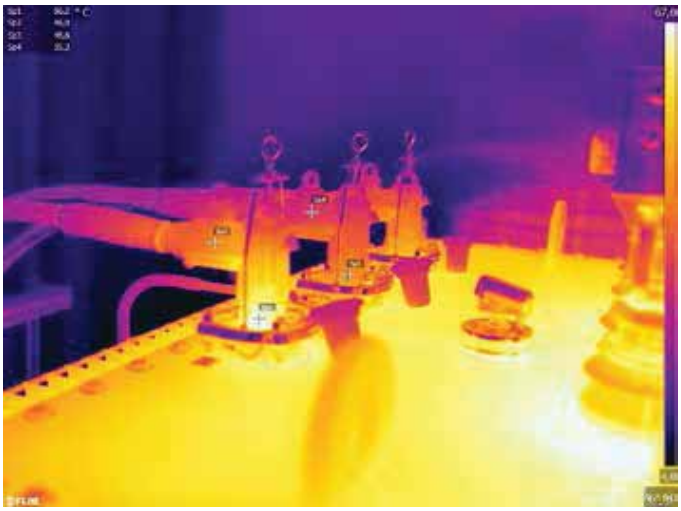
The FLIR T1020

With the T1020, Martin Adler is using the absolute top of the range of industrial thermography from FLIR. "The detector's IR resolution is huge,"





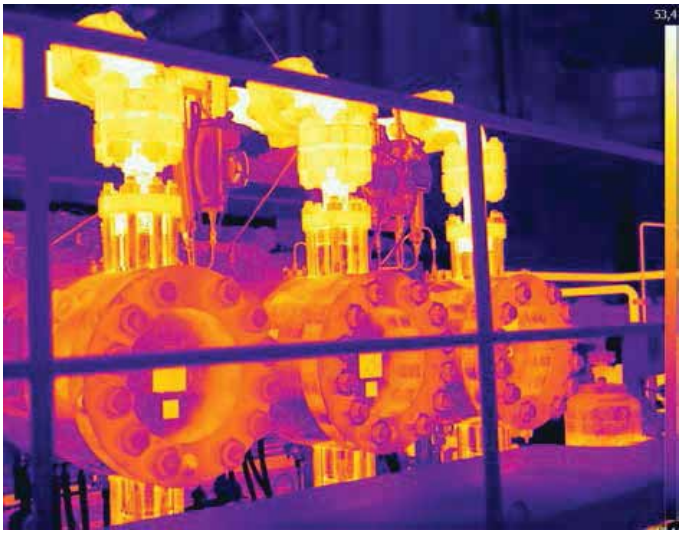
The middle phase of this motor protection switch looks abnormal. This could indicate increased resistance at the terminal connection...



Alternator with abnormality on the primary front plug connector. A bent pin on the angle plug connector is found to be the cause...

explains Adler enthusiastically "which of course increases efficiency: On a significantly sharper and more detailed thermal image, you can discover problems much more easily and with much more certainty. You can even discover small anomalies, which may not have been recognizable with the other camera or a lower resolution." And camera operation has also become increasingly easy over the years according to Martin Adler: "This reduces the error rate, not only during camera usage, but also in the evaluation phase." Adler used to always have a notepad and pen ready to write down the errors found. "It's a familiar problem: the notes cannot always be clearly assigned later on. Today, descriptions are stored in the camera in advance. Therefore my T1020 "knows" exactly where it is, e.g. in property No. 1, building No. 10, switch room on the first floor. If, for example, I discover a problem in the 39th object, then its position is automatically linked with the thermal image, thus avoiding confusion."

Martin Adler also praises the camera's sophisticated concept: "With over 50 years of experience, FLIR is not only the technology and global market leader when it comes to thermal imaging, but to my knowledge it is the only thermal imaging camera manufacturer that does everything itself, including designing the camera, the detector, the electronics and even the software. You can really see this in the final product."



High pressure compressor heads in a chemical plant (within the area at risk of explosion)...

Electrothermography

Electrothermography is the most important area of use for Martin Adler. Detecting malfunctions before they bring a chemical plant to a halt, for example, not only makes sense for fire protection and security reasons, but also with regard to economic aspects. "In chemical plants, a half hour standstill can incur 6-digit costs, and this is not only due to interrupted production. The plant must be commissioned again as stipulated and certain components inside the system may need to be removed in order not to cause negative effects. Fast procurement of spare parts for older components can also require great effort and thus be expensive." To make sure that none of this happens, Martin Adler conducts regular inspections according to a clearly defined schedule.

Thermal imaging in areas at risk of explosion

Inspections in areas at risk of explosion are also part of Martin Adler's everyday work, even though he finds far fewer errors in this setting. "Areas at risk of explosion are from the outset so critical that a high value is placed on safety. Of course this applies to the electrical and mechanical installations, so here we find errors significantly less often." Nevertheless, the inspections here are anything but superfluous, because any abnormalities in such areas could pose very significant risks.

Lining of furnaces

Industrial furnaces consist of a furnace shell which is protected by a fire-resistant inner lining against the extreme temperatures of the molten metal. Of course this lining is exposed to normal aging processes: It is exposed to wear in operation and is eventually damaged to the extent that it requires replacing. The time between two linings is called the "travel time," and the longer the journey, the more economic the operation can be. However, a furnace with a defective lining could also have disastrous consequences. The molten metal would destroy the shell and, in addition to high costs, this could even cause injury in the worst case. Using a thermal imaging camera, it is possible to determine the condition of the lining from outside the furnace even during operation. Regular thermography inspections ensure safety and prevent economic losses.

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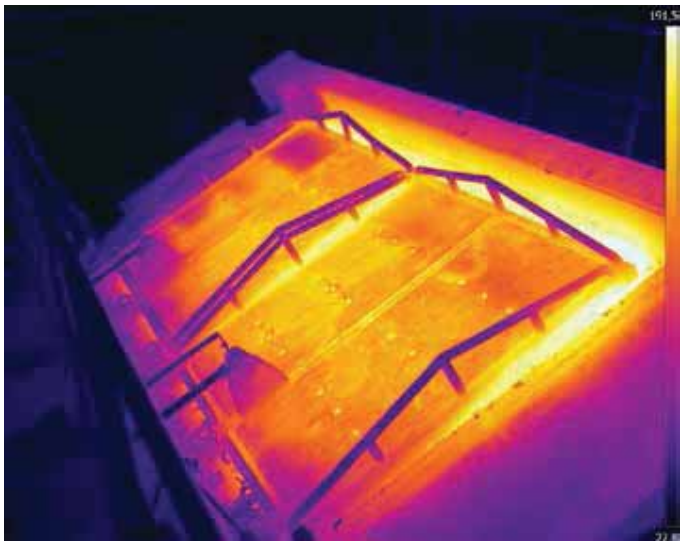
Agitator drives below a mixing tank in an area at risk of explosion in a chemical operation...



Regular thermal images of a melting furnace allow for determining the condition of the lining...

Qualification and certification

Today, Martin Adler is one of the most sought after thermography specialists with certifications according to the European DIN EN ISO 9712 Level III, the ASNT, the CFPA and the VDS in addition to his many years of experience. This can be seen in his continually growing order volumes. Adler doesn't worry about competition from inexpensive thermal imaging cameras: "Cheap devices hardly play a role in the area of professional industrial thermography. Plant operators may sometimes purchase them for the occasional inspection, but they can't meet the insurance requirements with regard to systematics and accuracy with these devices."

Therefore Martin Adler continues to have good prospects for his company. After all, he has 20 years of experience in industrial thermography and, in his opinion, the best thermal imaging camera hardware on the market.

For further information: www.flir.com/instruments

Eaton launches products to reduce costs for utility-scale projects

As per the company, the Eaton solar inverter technology yields best-in-class Levelised Cost of Energy (LCOE)...

Eaton has launched higher-power models of its Power Xpert Solar and energy storage inverters for grid-tied utility-scale projects. The Power Xpert 2,000 kilowatt (kW) and 2,200 (kW) solar inverters and 2,500 (kW) energy storage inverters offer some of the highest power ratings for grid-tied, utility-scale projects.

Chris Thompson, Grid Power Business Unit Manager, Eaton, said, "Eaton scaled up the size of our inverter platform to provide customers with an even more cost-effective solution for large-scale projects."

"Over the last few years, Eaton has deployed numerous energy storage and solar solutions around the world and our Power Xpert inverter technology offers customers industry-leading performance and reliability," he further revealed.

As per the company, the Eaton solar inverter technology yields best-in-class Levelised Cost of Energy (LCOE). The solar inverters are designed, structured and tested to meet the Underwriters Laboratories (UL) 1741 standard. These inverters are designed to boost electrical resiliency in large-scale applications and work with a wide-range of battery chemistries to store and transmit power. The inverter design also helps provide precise power ramp rate control, and frequency regulation to improve the consistency of electrical power transmission and distribution.

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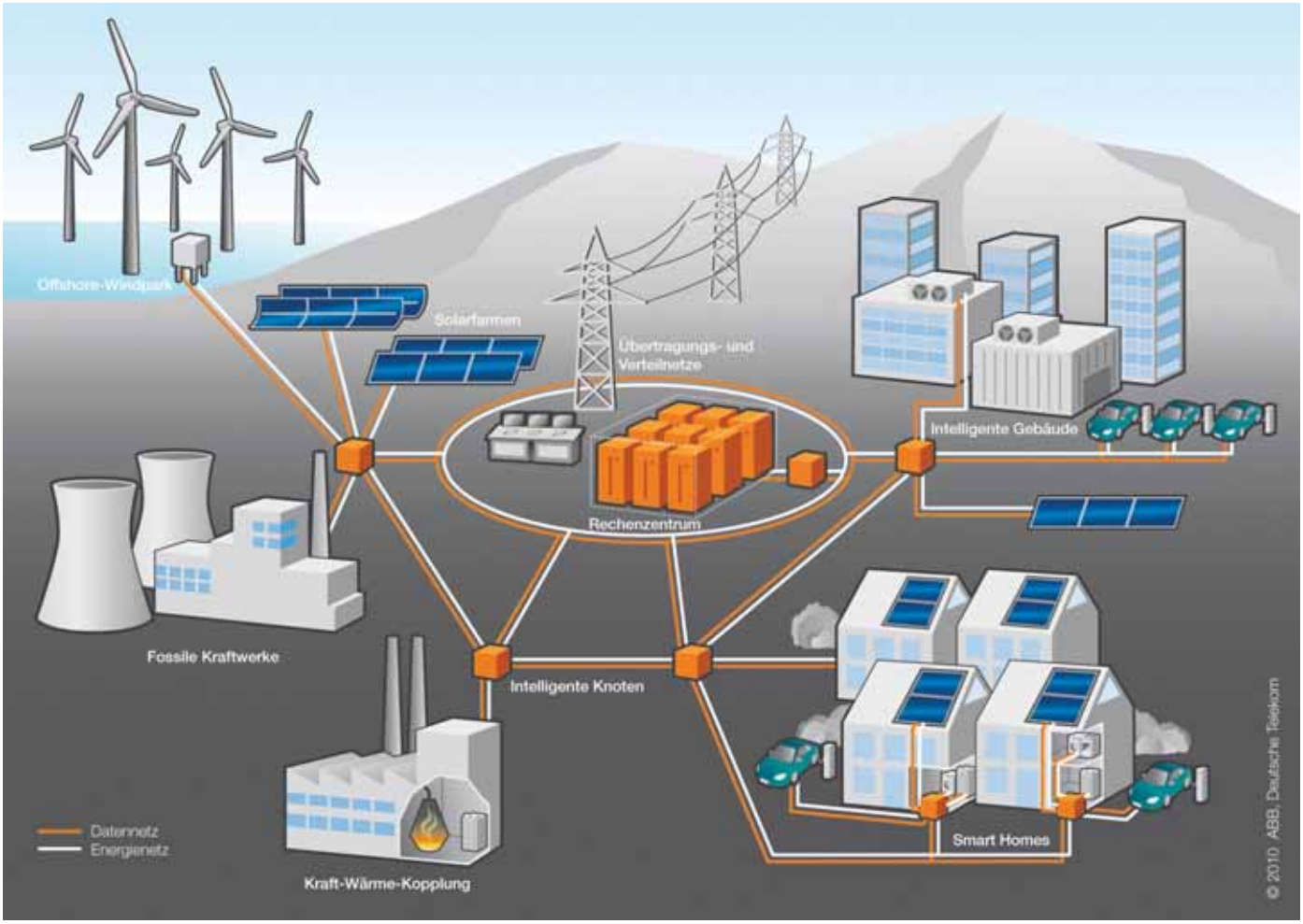
The Promising Transition



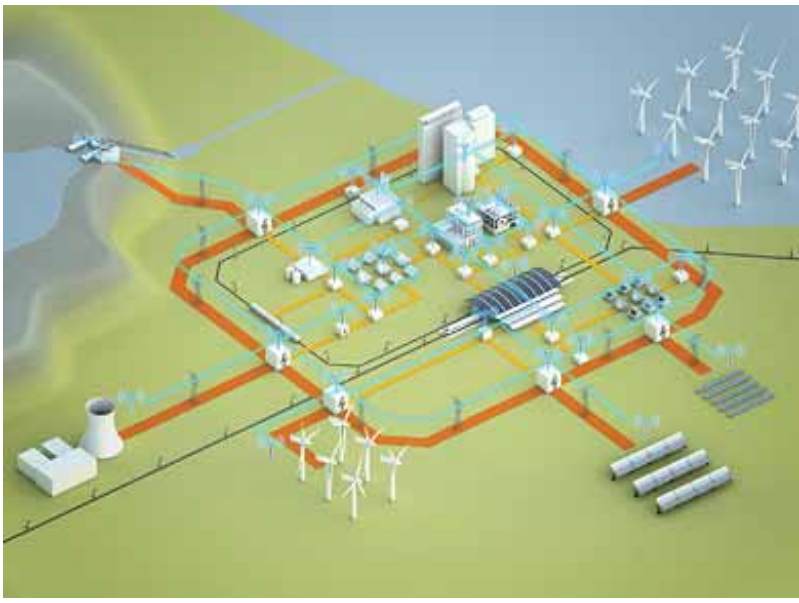
Electricity demands increase day by day causing imbalance in the present power grid system, which results in various problems like load shedding and unbalanced voltage, ultimately affecting consumers. To avoid all such situations, the only option is to meet increasing demand for electricity by generating more power. However, since we lack conventional natural resources, the use of renewables may perhaps be the only way out...

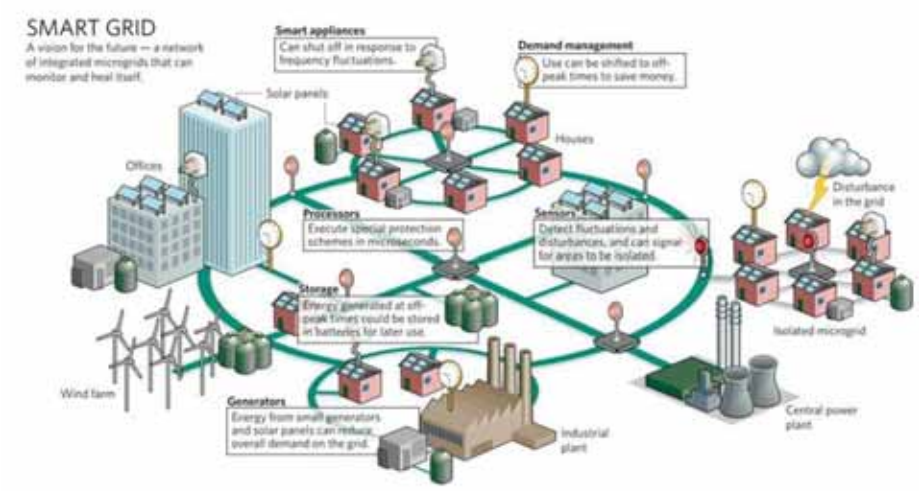
A smart grid provides power utilities with digital intelligence to the power system network. It comes with smart metering techniques, digital sensors, and intelligent control systems with analytical tools. It enables the two-way flow of energy from power to plug to be automated, monitored and controlled.

The smart grid has been described as the 'Energy Internet', which can turn the electric power infrastructure into a two-way network built on a standard Internet Protocol (IP) network. It uses a large number of smaller, discrete distributed plants instead of single high-producing plants, so reduces the risk of attacks and natural disasters. Even if such a major problem should occur, the smart grid, being a self-healing network, will restore itself quickly by isolating the particular line and re-routing the power supply.

Increasing renewable electricity generation is an essential component in achieving a doubling of the renewable energy share in the global energy mix. Such a transition is technically feasible, but will require upgrades of old grid systems and new innovative solutions to accommodate the different nature of renewable energy generation. In particular, smart grids are able to incorporate the following characteristics:

- **Variability**: Some forms of renewable electricity, notably wind and solar, are dependent on an ever-fluctuating resource (the wind and the sun, respectively). As electricity supply must meet electricity demand at all times, efforts are required to ensure that electricity sources or electricity demand is available that is able to absorb this variability.
- **Distributed generation**: Distributed renewable generation—smaller-scale systems, usually privately owned and operated—represent a new and different business model for electricity. Traditional utilities are often uneasy about allowing such systems to connect to the grid due to concerns over safety, effects on grid stability and operation, and the difficulties in valuing and pricing their generation.
- **High initial cost**: Renewable electricity generating technologies typically have higher first costs and lower operating costs than fossil-fuelled electricity generating technologies. Although renewables may be 'cost-effective' on a lifecycle basis, some electricity systems—particularly in developing countries—simply do not have access to sufficient capital to invest in renewables. Smart grid technologies can directly address these three challenges of renewable electricity generation. In addition, smart grids have added benefits that can further ease the transition to renewables.

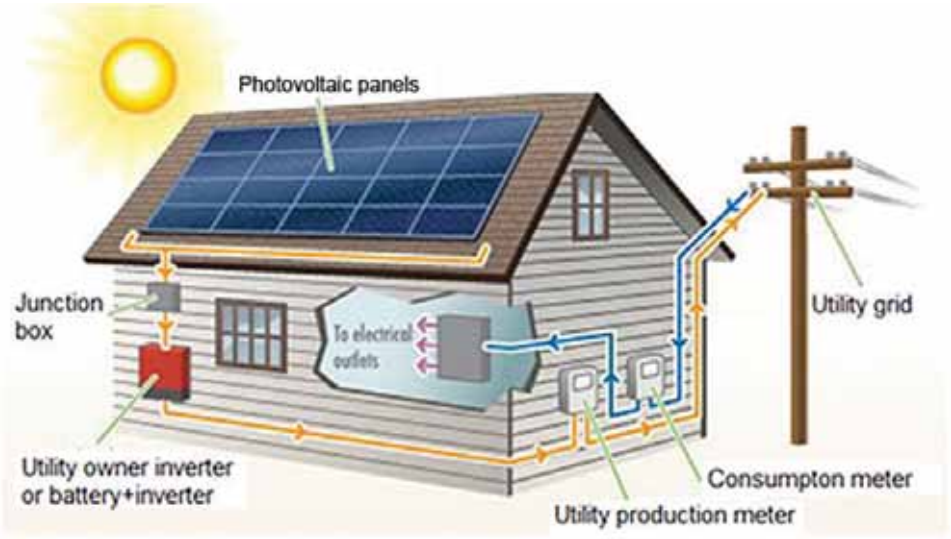




Smart grid technologies are divided roughly into three groups:

- **Well-established**: Some smart grid components, notably distribution automation and demand response, are well-established technologies that directly enable renewables and are usually cost effective, even without taking into consideration the undeniable benefits of sustainability related to renewable energy integration.
- **Advanced**: Smart inverters and renewable forecasting technologies are already used to increase the efficiency and productivity of renewable power generation, yet tend to entail additional costs. These devices start to help noticeably when capacity penetration for renewables reaches 15% or more (on any section of the grid) and become essential as this capacity penetration approaches 30%, although there is little downside to choosing smart inverters even at low penetration levels.
- **Emerging**: Distributed storage and micro-grids are generally not 'entry level' smart grid technologies, and thus are less well developed. Most utilities should focus on other technologies first, except in special circumstances (such as with grant funding, high reliability requirements, or remote locations).

Historically, integration of small-scale renewable energy sources into a traditional grid causes problems. These include voltage fluctuations and harmonic distortions, which require synchronisation of the sources with the grid. Smart grid, on the other hand, optimises these problems by preventing outages and allowing consumers to manage energy usage. This technology enables various options to add energy to the grid at transmission and distribution levels through distributed generation and storage.



In other words, the smart grid makes better use of renewable energy resources. It gives grid operators new tools to reduce power demand quickly when wind or solar power dips, and it has more energy storage capabilities to absorb excess wind and solar power when it isn't needed, then to release that energy when the wind and solar power dips. In effect, energy storage will help in smoothing out the variability in wind and solar resources, making them easier to use.

One of the principal challenges in operating an electricity system is ensuring that the demand for electricity is always exactly equal to the supply. It is difficult to store electricity (although the technologies to do so are steadily improving – and thus electricity system operators must continually adjust the output of power plants to match demand.

Most traditional fossil-fuelled power plants will operate at a set output level – and so electricity system operators can generally depend on these plants to provide a steady and predictable amount of electricity. In addition, power plants fuelled by diesel and natural gas are often designed to allow for continual fine-tuning of their electricity output. This makes the challenge of matching electricity supply and demand manageable. Some forms of renewable electricity, however – notably wind and solar PV – are dependent on a continually fluctuating resource. If the wind slows or clouds obscure the sun, then the output of these plants drops, leaving electricity system operators scrambling to find other sources of electricity. When wind and solar PV provide a small fraction of total electricity – in the order of a few percent – it is usually straightforward to manage the fluctuations. However, when these 'variable resources' begin to provide a significant fraction of the system's total electricity, maintaining system reliability can become increasingly challenging. Even when renewables provide a small fraction of a system's total electricity, they may be providing a large fraction of electricity on a smaller time scale or larger geographic area.

Smart grid technologies can do much to help meet that challenge. In essence, a smart grid makes it possible to integrate renewables with a wide range of diverse electricity resources. For instance, imagine a PV system and a set of commercial and industrial electricity consumers on an interruptible rate, all tied together with smart grid communication and control technologies. If the PV system output drops due to a cloud, then the smart grid interrupts service to those customers on the interruptible rate. When the cloud moves on, their service resumes.

Demand response provides an opportunity for consumers to play a significant role in the operation of the electric grid by reducing or shifting their electricity usage during peak periods in response to time-based rates or other forms of financial incentives. Demand response programs are being used by electric system planners and operators as resource options for balancing supply and demand. Such programs can lower the cost of electricity in wholesale markets, and in turn, lead to lower retail rates.

The smart grid offers multiple opportunities to develop demand response programs. For example, sensors can perceive peak load problems and utilise automatic switching to divert or reduce power in strategic places, removing the chance of overload and the resulting power failure. Advanced metering infrastructure expands the range of time-based rate programs that can be offered to consumers and smart customer systems.

Benefits of integration

Leading characteristics of renewable resources that impact their integration into power grids are their size (generation capacity as compared to other sources of power generation on a system), their location (both geographically and with respect to network topology), and their variability (minute-by-minute, daily, seasonally, and intermittently). Renewable integration - reducing our nation's dependence on foreign coal by enabling the seamless integration of cleaner, greener energy technologies into our power network. Normally, renewable resources are connected at the distribution level and as larger resources (wind farms, solar farms) are connected at the transmission level.

1. Future energy sustainability: Renewable energies are making a significant contribution to climate protection, diversify resources, ease dependence on fossil resources, not produce any type of contamination, domestic energy carriers and therefore contribute to regional value creation and help in securing employment. Hence, renewables as future energy provides sustainability.
2. Empowering grid in peak hours: Integration of more renewables and storage support the smart grid with real time information and substituting renewable energy sources whenever possible. Increasing proportion of renewables in generation mix not only improves operational efficiency but also reduces peak demands.
3. Energy management: Smart metering helps in adopting energy management techniques, such as demand side management at consumer level, demand response usage leads to optimum utilisation and results into saving of energy.
4. Independent systems: RE system works as an isolated system during grid failure, and reduces impact on customer. Industrial and commercial consumers adopt grid connected RE systems, which help in reducing power demand. Sometimes isolated systems in residential areas conserves the energy.
5. Upgrading electrical market: Power exchange provides an electronic platform to facilitate trading of electricity at national level. It initiated renewable energy trade since 2011. India ranks fourth for its market potential in renewable energy.

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Distributed renewable generation, notably rooftop PV, is a particularly promising renewable technology. Smart grid technologies can do much to promote greater use of distributed renewable generation. They can provide system operators with continual, real-time information on how these systems are operating and allow full control over these systems. This information and control can be used in several ways, including, for example:

- Reducing output of, or even disconnecting, distributed generation as needed to maintain reliability, match load, or protect workers.
- Providing real-time data on distributed generation electrical output.
- Supporting the distribution system through, for example, tighter control of voltage.

Utility system operators may be uncomfortable with electricity generation that they cannot monitor and control. Smart grids can provide this monitoring and control – and thus encourage utilities to consider distributed renewable generation as an alternative to traditional utility-scale power plants. Smart grids can also make it possible to more accurately price and value distributed renewables. Distributed generation can have multiple impacts on distribution systems, from voltage regulation to administrative cost. Detailed data on distributed renewables' output and performance, such as that available from a smart grid, can help the utility or system operator put an accurate figure on the value of the distributed renewables. Similarly, the data can help the utility determine the proper price to pay the distributed renewable system owners or operators for their systems' output.

Challenges in integration of renewable with smart grid

Variable generation, provided by many renewable-energy sources, is a challenge to electric grid operations. But when used in integration with smart grid as responsive distributed generation, it can be a profit to system operations if coordinated to relieve stress in the system (e.g., peak load, line overloads etc.). Smart grid approaches can reduce barriers and facilitate integration of renewable resources. The challenges can be categorised as technical, financial, business and societal issues.

Technical

1. Advanced Control Strategies: Solar and wind power plants exhibit changing dynamics, non-linearities, and uncertainties. Hence, smart grids require advanced control strategies to solve effectively. The use of more efficient control techniques would not only increase the performance of these systems, but would increase the number of operational hours of solar and wind plants and thus reduce the cost per kilowatt-hour (KWh) produced.
2. Wind and solar energy are both intermittent resources. Wind behaviour changes daily and seasonally, and sunlight is only available during daylight hours. Both wind and solar energy can be viewed as aggregate resources from the point of view of a power grid, with levels that vary within a 10 minute to 1 hour time frame, so they do not represent the same form of intermittency as an unplanned interruption in a large base-load generator.
3. Research in technology is still in progress. Hence, existing generation and delivery infrastructure (i.e., legacy) of RE systems must be adaptive to work with new technologies.
4. Being flexible to changing technologies require identifying the vital interface between technology components.
5. Achieving association across service providers, end-users and technology suppliers is difficult particularly in the growing international market place. Exchange of knowledge and information can allow multiple parties to connect their devices and system for proper interaction, but attaining interoperability is difficult.

Business and financial

1. Understanding and communicating the value proposition of a smart grid deployment for each stakeholder in the electricity supply chain is scary.
2. The financial environment risk and reward can challenge business plan for smart grid investments as well as in Renewable energy system.
3. Regulatory understanding and sensitivity to providing an appropriate environment for smart grid investment takes place. Regulatory decisions (or lack of decisions) can create new challenges.
4. Developing an appropriate incentive structure that aligns economic and regulatory policies with energy-efficiency and environmental goal needs to be tailored to each member economy.

Societal

1. Strategies need to account for a variety of policy objectives (affordability, sustainability, growth and cultural values).
2. Assigning value to externalities, such as environmental impacts, is difficult, but necessary, in balanced decision-making.
3. Understanding and accounting for the beneficial aspects of smart grid investments as a mechanism for job creation and advancing a technically skilled workforce needs development.
4. Greater awareness about capabilities of smart grid and there benefits for improving energy-efficiency and renewable resource integration policies.
5. Research and development activities: the speed with which new ideas and deployment tactics are being generated.

Conclusion

Renewable generation has the benefit of enhancing sustainability (reducing environmental impacts), reducing Greenhouse Gas (GHG) emissions, reducing dependence on local or imported fossil fuels, and increasing energy security through diversification of energy sources. Smart grid technology can control renewable resources to effect changes in the grid's operating conditions – and can provide additional benefits as distributed generation assets or when installed at the transmission level. Distributed generation can support weak grids, adding grid voltage and improving power quality. In certain circumstances, distributed generation can be used in conjunction with capacitor banks for management of power flows or to manage active and reactive power balance.

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Ceramics Help In Producing Electricity From Waste Heat

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Currently, less than half of the energy used in industrial processes, transport or households is actually utilised. The majority of primary energy still escapes despite numerous energy-saving measures as waste heat into the environment. Thermoelectric Generators (TEG) can help in transforming this wasted heat energy into electricity. However, there are still obstacles in terms of cost efficiency, availability of raw materials, processing and environmental sustainability of the applied thermoelectric materials.

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Ceramic materials provide a solution with an exceptionally flexible property range. They can be produced through environmentally friendly ways from readily available raw materials. Up till now, ceramic TEGs for only limited tasks and low energy conversion efficiency were realised.

Fraunhofer IKTS has extensive know-how regarding the production of ceramic thermoelectric materials. As the first German research institute, IKTS managed the cost-effective production of fully functional ceramic TEGs that have a long lifetime and can be used at high temperatures, which makes them energetically interesting.

"We offer our customers economically attractive ceramic TEG modules, with which valuable waste heat can be converted into electricity independently and reliably – and at temperatures of up to 1000 °C. Such robust, maintenance-free and particularly durable TEGs are attractive for a variety of applications, e.g., in metallurgical processes, or in the hot zones of internal combustion engines," says Hans-Peter Martin, Head of the group 'Nitride Ceramics and Structural Ceramics with Electrical Function,' at Fraunhofer IKTS.

Scientists at the Fraunhofer IKTS offer a customised development of ceramic TEG modules – adapted for the conditions of the host process.

Therefore, the ceramic components are optimised in terms of electrical parameters, chemical interactions and geometrical requirements, and – on request – integrated into the individual thermal system.

The expertise to build such TEGs at Fraunhofer IKTS is derived from the institute's decades of experience with electrically functionalised high-temperature materials, such as heat conductors, evaporators and ceramic foams.

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Integrated Control System For Batteries

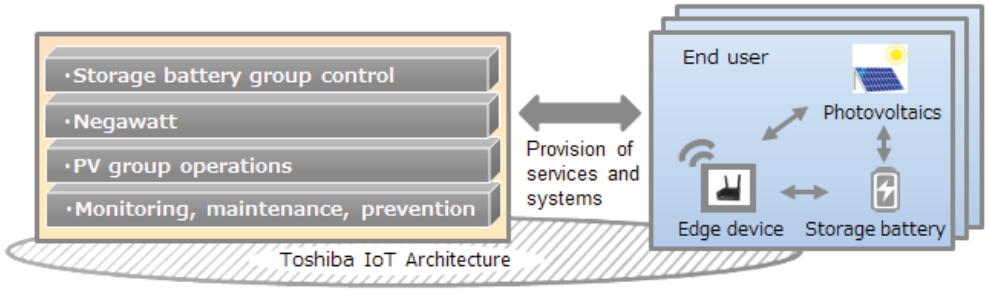
The company will participate in the demonstration trials with TEPCO EP and Yokohama as verve toward promoting the construction and commercialisation...

Toshiba Corporation recently, entered into an agreement with Tokyo Electric Power Company Energy Partner, Inc. (TEPCO EP) and the city of Yokohama, Japan, to promote a demonstration trial of the control of multiple, grouped storage batteries as the source for building a battery service business.

In Japan, since the Great East Japan Earthquake, easing reliance of rigid supply systems based on traditional large-scale centralised power sources while ensuring efficient and steady use of rapidly expanding renewable energy has become a serious issue.

The Ministry of Economy, Trade and Industry (METI), adapting to this situation is promoting the construction of 'virtual power plants,' which apply advanced energy management technologies to centralised control of end-user side resources, such as demand response, renewable energy, storage batteries and so on, scattered throughout the power grid.

The company will participate in the demonstration trials with TEPCO EP and Yokohama as verve toward promoting the construction and commercialisation of a service business for controlling multiple storage batteries in groups, a prerequisite for fully running virtual power plants.



Smart Resilience VPP system block diagram...

In the trial, storage battery equipment will be installed in elementary and junior high schools designated as regional disaster centres in Yokohama. TEPCO EP will utilise storage battery group control systems developed by Toshiba to adjust power supply (demand response) during normal hours, while City of Yokohama will utilise them to supply electric power in the event of a disaster or other crisis. The features of the technology are as follows:

Storage battery group control technology

This project encourages Toshiba to create charge and discharge plans for fixed-type storage batteries (10kWh) installed in Yokohama school, based on accurate forecasts of charge and discharge capacities that fluctuate according to power consumption quality, seasonal fluctuations, weather, and so on.

These strategies will decide the most suitable times for battery charging and discharging in order to offer additional services and minimise imbalance costs.

Effective use of renewable energy will be achieved by using additional photovoltaic power to charge the batteries.

Adding up functions necessary for a VPP to fixed-type storage batteries that have so far mainly been utilised to support business stability planning will create a new value proposition, which can be provided to regions, businesses and end-users.

Negawatt technology

On demand response led by METI since 2013, Toshiba has participated in demonstration project. The result showcases that negawatt amounts of power can be realised by allocating target reductions of power for individual consumers according to their capacity to trim down electricity demand.

In their new venture, by combining the storage batteries installed in Yokohama schools by TEPCO into the network, Toshiba aims to curtail the response time for the negawatt system, and make available the end-user side with enhanced services.

Toshiba IoT Architecture

IoT (Internet of Things) is the interconnection of various devices such as industrial devices, sensors, etc., via the Internet. The Toshiba Internet of Things (IoT) Architecture makes available the service platform for the system to be established in the current demonstration trial.

This architecture merges the potential of the IoT domain with know-how in infrastructure and industrial systems that the company has gained over many years of business.

By making use of cloud technology, the Toshiba Internet of Things architecture is proficient enough to quickly realise the development of business applications and construction of systems, and is also an exceptional base for supporting business expansion efforts.

All India Installed Capacity (MW) Region-wise As On 30 06 2016

	Thermal				Nuclear	Hydro	RES	Grand Total
Region	Coal	Gas	Diesel	Total				
Northern	45864.50	5331.26	0.00	51195.76	1620.00	18311.78	8630.13	79757.67
Western	72373.01	10815.41	0.00	83188.42	1840.00	7447.50	15314.92	107790.84
Southern	37042.50	6473.66	842.84	44359.00	2320.00	11558.03	18154.12	76391.15
Eastern	30622.87	190.00	0.00	30812.87	0.00	4289.12	475.39	35577.38
North-East	310.00	1698.30	36.00	2044.30	0.00	1242.00	263.72	3550.02
Islands	0.00	0.00	40.05	40.05	0.00	0.00	11.10	51.15
ALL INDIA	186212.88	24508.63	918.89	211640.40	5780.00	42848.43	42849.38	303118.21

Source: Central Electricity Authority of India

Industry Gears Up for Renewable Energy India Expo

A UBM Event

Global Investments & Technological breakthroughs mark the 10th edition...

UBM India will host the 10th edition of its flagship event, Renewable Energy India Expo (REI) from 7 to 9th September 2016 at the India Expo Center, Greater Noida. REI is a global platform where India's green economy community including overseas participants will congregate to discuss industry trends, challenges and market insights including the Indian regulatory framework. The event aims to further upscale and mainstream the applications of renewable energy resources, showcase product launches, innovations and augment the forethought through international exhibition and conference platform.

REI 2016 will see participation from countries such as India, Japan, Switzerland, USA, Korea, Taiwan, China, Australia, Italy, Canada, Malaysia, Netherlands, Israel, Germany, Spain, Singapore, Belgium and is supported by the Ministry of New and Renewable Energy, Govt of India (MNRE), Indian Renewable Energy Development Agency Ltd (IREDA), Solar Energy Corporation of India Limited (SECI), National Institute of Wind Energy (NIWE) and International collaboration through Indo German Energy Forum (IGEF) and Bloomberg New Energy Finance (BNEF).

The expo is certified by UFI, The Global Association of the Exhibitions Industry and will see the presence of key dignitaries, Upendra Tripathi, Secretary, Ministry of New and Renewable Energy, Government of India; Ashvini Kumar, Managing Director, SECI; KS Popli, CMD, IREDA; Simon Stolp, Lead Energy Specialist, World Bank; AK Jain, CMD, Rajasthan Electronics and Instruments Limited; Justin Wu, Head of Asia, Bloomberg New Energy Finance; James Gordon Carr, Minister of Natural Resources, Canada and Munehiko Tsuchiya, Executive Director, NEDO, Japan amongst others.

Bringing together manufacturers, EPC, and service provides, the expo will have over 650 exhibitors including companies like Lerri Solar, Adani, Skypower, Trina Solar, Tata Power, JA Solar, KRYFS, Suzlon, Solargise, Waaree, Vikram Solar, L&T, Rays Power, Canadian Solar, Sova Power, Azure Power, Delta Power, Fronius, SMA India, Huawei, Bosch, ABB India, Moser Baer, Talesun Power, Mahindra Susten, GCL, Senvion, Gamesa India, Inox Wind, DHHI, Renesola amongst others. The show will feature country pavilions from Japan, Canada, Italy, Taiwan and China.

Highlights of the expo include a power packed three-day conference themed 'Renewables : Surging Ahead' with content rich sessions by MNRE, Bloomberg New Energy Finance, IBA, IGEF, Bridge to India, Solar Thermal Federation of India, Council on Energy Environment and Water (CEEW), Mercom and NIWE. The sessions will cover various key topics such as 'Market landscape: Taking stock of India's RE goals; milestones achieved; and challenges ahead', 'Tipping Point: The rising trend of Competitive Bidding, 'Wind: Policy Roadmap for the 60 GW target; How far we have reached; What are the specific challenges of the sector; Financing challenges for the Offshore and policy incentives', 'Looking Beyond Installation: Operation and Maintenance towards Sustainability of Long Term Projects', 'On Top of the Roof: Assessing the 40 GW of Rooftop target in respect to residential Solar' and 'Riding the Manufacturing high: , How Much? How Far? How Long? Make in India' to enhance the usage of Renewable Energy in India.

Eminent industry speakers from across the world such as Simon Stolp, Lead Energy Specialist, World Bank; Praveer Sinha, CMD, Tata Power DDL; Sanjay Sharma, Head of Contracts, SECI; Sanjay Mandavkar, Sr. President, Corporate Finance, YES BANK; Sunil Jain, MD, Hero Future Energies; Gyanesh Chaudhary, MD & CEO, Vikram solar; David Keck, President and CEO, GTAT Technologies, USA ; Pankaj Batra, Chief Engineer, Central Electricity Authority, Gerhard Mütter,Technical Director, Alternative Energy Solutions GmbH, Austria; Dr. Klaus Eberhardt, Technology Manager, M+W Group; and Juergen Sutterlueti, Head of Energy Segment and Business Development, Gantner Instruments Group, Austria are amongst other industry stalwarts, who will discuss the key issues and trends related to Renewable Energy.

Other highlights include World of Innovation Arena for Tech talk & Product launch, Multiple workshops, CEO conclave, Session on Smart Grid, Finance Roundtable and a Skill development program by National Institute of Wind Energy. EI

Develop Supply Chains: Research

Commissioned by the UK Foreign Commonwealth Office and working in close collaboration with India and UK industry partners and India's Ministry of New and Renewable Energy (MNRE), a recent research from Ricardo Energy & Environment presents recommendations to develop supply chains to accelerate the take-up of Photovoltaic (PV) mini grids...

Image Courtesy: www.mlinda.org

100 AH battery and 400 VA inverter of the 225 W household micro grid system...

Although India's electricity grid has expanded significantly over the past decade more than 33% of households still do not have access to grid electricity. As part of its commitment to bringing electricity to the entire country by 2022, India is undergoing a number of radical power sector reforms. Sustainability is an important part of this process, and PV mini grids present a powerful method of quickly bringing energy generation to rural areas. However, there is a need to develop international supply chains, national policy and financial structures to make renewable technology practical and financially viable.

The research – which follows a year of close collaboration between Ricardo Energy & Environment's technical specialists, government ministries and power sector stakeholders – recommends a series of immediate actions to scale up the Indian PV mini grid market. This includes supporting private sector and local supplier innovation, developing business models to 'de-risk' solar energy projects, and defining technical standards for mini grid design and installation. The close involvement of international supply chains for the development and manufacture of PV components is also highlighted as a critical component for success.

"India's economy is growing rapidly, and the country has ambitious plans for widespread electrification. Renewable energy resources and technologies have an important role to play in these plans. By reaching out and sharing knowledge between government ministries and mini grid developers, financiers and suppliers, we have been able to offer solutions that make solar power a practical and profitable option to electrify India's rural regions," said John Harvey, Ricardo Energy & Environment Project Manager.

Ricardo Energy & Environment has a strong working relationship with the Government of India and has supported a number of energy and environmental projects in the region. This includes sharing knowledge on energy market reform to support the development of an efficient, reliable and financially robust power sector.

SK Negi, MD, GETCO is addressing the assembly...

SWITCH

Electrical Engineering | Innovation Showcase | World Market

To Light Up New Opportunities

Vadodara is all set to host- Switch, the biggest electrics expo of the nation. It will be a home for some of the biggest names in the power sector...

Today, the world is witnessing extensive depletion of fossil fuel resources. It is anticipated that India by 2025 will be the fifth largest country with regards to energy consumption. There are complications at different levels not only due to the threat of global warming caused by GHGs' (Green House Gases) emissions but also an increase in carbon footprint due to the burning of fossil fuels. We are left with no other option but to adhere to Renewable Energy resources like wind and solar energy and utilise them to the fullest.

Vadodara- Transformers Hub

Gujarat is believed to be the home for more than 23% of India's Electrical Industry. Vadodara, over the years, has emerged and evolved as an electrical manufacturing hub – and now it is all set to host- Switch, one of the biggest electrics expo of the nation. It will be a home for some of the biggest names in the power sector from October 6 to 10, 2016. The Government of Gujarat promotes this expo and the Federation of Gujarat Industries organises and implements it.

Geeta Goradia, Managing Director, Jewel Consumer Care Private Limited is delivering her speech...

Janak Sheth, Senior Vice President, Federation of Gujarat Industries is gathering information in the event...

This biennial platform represents the biggest network of electrical manufactures, ideas, technologies, trends and partners. Basically, this expo aims to speed up the evolution of the nation's power sector – and provide a boost to the electrical industry. Govindbhai Patel, Minister of Energy and Petrochemicals, Science and Technology, has explained, "The time is now right for new investments and developments in the power sector. Switch 2016 is a visionary exhibition that will power up India's sustainable future."

Switch Global Expo- Pre-event

The curtain raiser for Switch global expo, held in Mumbai included dignitaries like, S K Negi, Janak Sheth and Geeta Goradia, who promoted the event. In India, Switch is poised to become the biggest electrical ecosystem platform for everything connected to electricity. The infrastructure at the global expo is benchmarked to the world's best standards.

The amenities are designed to facilitate smooth business interactions – creating new relationships or consolidating existing ones. The exhibition will be spread over 80,000 square metres with 1000 stalls. It is assuring presence of over 8,500 key buyers and over 1, 00,000 visitors. The World Electrical Buyers Summit (WEBS) is structured concurrently with Switch.

The WEBS is basically organised as a one point stop to meet the customers sourcing needs. In the words of Saurabh Patel, Minister of Energy and Petrochemicals, "Switch 2016 will become an important meeting platform for new entrepreneurs and proven technocrats in the field of electrical engineering and power generation."

The Switch global expo expects dignitaries from all over the country and abroad. It expects Power Ministers over 15 countries around the globe, 30 Power Ministers from various states in India, Power Secretaries of various States of India, delegations from 95 foreign Utilities and 102 Indian Utilities, 1150 large corporates of India and participation from 91 countries.

Among its International participants, it has received confirmation from 200 buyers from Africa, 80 buyers from Europe, 75 buyers from Middle East, 100 buyers from SAARC and China.

The major companies that have confirmed their bookings are ABB, General Electric, Siemens, Torrent Power, Aditya Birla, CTR, DICABS and RR Kabel.

Intersection Point

Switch 2016 will be a catalyst to develop start-ups and solicit commitments from financial institutions and/or investors to support and sustain these start-ups. It will be the intersection point across the industry spectrum from manufacturing, supply chain, product development, investment, technology partnership, networking and knowledge sharing. Therefore, the expo assures a key growth opportunity for all players in the power sector.

The event, in order to foster and support new ideas and technologies, has scheduled a day for 'Innovations.' Further, the event will be highlighting the topic 'Asset Management', which will emphasise on integrated approach for renovation and modernisation of aged assets for 24X7 power supply to end customers. With the objective to harness energy to the fullest extent and understand challenges in grid integration, the last day of the event will focus on the subject 'Renewable Energy Portfolio.'

One of the prime factors in the growth of any industry is the technology exchange carried out by concerned organisations. The technology exchange platform at Switch will permit transfer of technical know-how – and assist in creation of 'Technology Transfer Network' to identify novel utilisation of technology. Hence, Switch 2016 is the perfect place for industrialists to grow their network in the electrical industry.

Focus Areas

• Traditional Electrical Industry • Industry Innovations & Innovation Dome • Lighting Industry • Electrical Services • MSME • Electrical Gadgets and • Electrical Ancillary Products.

What Can You Expect From Switch 2016?

Switch will help the power sector players grow and build relations across the globe as it will be a one stop shop for both national and international players. It will be a perfect platform for players who are into the process and development of various power projects as they can seek ideas and guidance from appropriate companies or individuals during the event.

Every visitor and exhibitor will have something to gain from the global expo. This will make each of them more resourceful with enriched knowledge of latest technologies, and first-hand feel of the state-of-the-art products that are being introduced or used in the power sector worldwide.

Dhanya Nagasundaram
Electrical India

Larson Electronics rolls out industrial Light Fixtures

Larson Electronics has launched a 250 watt high bay industrial LED light fixture for general area use. The GAU-HB-250W-LED high bay light fixture provides operators with a powerful and energy efficient alternative to traditional gas burning luminaires. This 250 watt high bay light fixture provides 24,000 lumens of high quality light. It is also available in a 3000K, a 4000K, or a 5000K colour temperature.

The aluminium body, prismatic borosilicate glass lens, and solid state light emitting diodes give this light exceptional durability and resistance to vibration and impacts. The housing on this unit is particularly designed to dissolve heat, increasing the efficiency and lifespan of the luminaires. This high bay LED light fixture is multi-voltage capable. It can be operated on 100 to 277 volts AC. It can also be operated on an optional 347 or 480 volts for those extreme voltage applications. The unit is pendant mounted via user supplied conduit. This low profile LED fixture is an ideal replacement for metal halide and high pressure sodium fixtures as it requires less energy consumption.

For further information: www.larsonelectronics.com

NOJA Power enhances Automatic Circuit Recloser Firmware

Electrical switchgear engineers NOJA Power has released Relay Firmware 1.15, the latest version of its firmware platform for OSM series Automatic Circuit Reclosers (ACR or 'auto-recloser'). With the release of Firmware 1.15, NOJA Power has included major new functionality to further enhance its OSM series ACR's suitability as fundamental elements of smart grids – advanced, computerised electricity distribution networks – including IEC61850 communication protocols, synchronisation to simplify connection of Renewable Energy Distributed Generation (REDG), greater configuration flexibility and enhanced protection element performance.

Chief among the new functionality of Firmware 1.15 is the implementation of Manufacturing Message Specification (MMS) and Generic Object Oriented Substation Events (GOOSE) protocols which form part of IEC61850, a family of international standards for the electricity distribution industry. MMS enables the OSM Series RC control and communication cubicle to communicate with and accept control from IEC61850 Human Machine Interface (HMI) clients such as Supervisory Controls and Data Acquisition (SCADA) equipment.

GOOSE messaging is used for high-speed sharing of process coordination and automation functions across Ethernet networks linking Intelligent Electronic Devices (IEDs), regardless of the equipment's manufacturer. (NOJA Power's RC control and communications cubicle has an Ethernet interface fitted as standard.) Such messaging facilitates, for example, protection schemes requiring short transfer times. In addition, GOOSE messaging compensates for network variability while protecting data integrity and can be transported over networks for communication with IEDs beyond a substation.

For further information: www.nojapower.com

Schneider Electric launches Easy9 range of MCBs for the retail market

Schneider Electric has launched Easy9 range of Miniature Circuit Breakers (MCBs), Residual Current Circuit Breakers (RCCBs) and Isolators for the retail market. The products comply with the utmost global standards on green certification and also provide savings through low energy utilisation apart from offering reliable protection and safety.

The MCBs, RCCBs and Isolators will be manufactured at the company's state-of-the-art India Green Buildings Council (IGBC) and ISO certified facility in Chennai that will cater to the pan-India market through the company's channel network. The Chennai facility is a National Award for Manufacturing Competitiveness (NAMC) Gold Certified global plant of Schneider Electric – supplying products to more than 100 countries across the world besides fulfilling the demands of the Indian market.

For further information: www.schneider-electric.co.in

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Yokogawa launches DM7560 Digital Multimeter

The DM7560 not only contributes in high sampling rates of up to 30 kS/s with high accuracy but also makes available all the basic functions of a Digital Multimeter. It can be applied to a wide range of applications with its capability to monitor transitional voltage variations.

The Multimeter provides, stability (As a 1 2 6 digits benchtop DMM, the DM7560 contributes towards excellent stability and reliability. It keeps its good performance even at high sampling rates), Visibility (As one of the most advanced bench-top DMMs, the DM7560 makes available various display formats. This contributes to intuitive and comprehensive operation in today's demanding measurement scenarios) and Productivity (With a wealth of I/O and communication interfaces, and advanced analysis functions, the DM7560 helps in improving productivity of a wide range of automated testing systems).

For further information: www.yokogawa.com

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Field of activities

- Repair, Rewinding, Overhauling & testing of rotating electrical machines (Steam/Gas/Hydro) Generators of lower, higher voltages & power ratings more than 250 MW & Power Transformers (220 KV)
- Manufacturing of Transposition coils and remaking the same.
- Commissioning of all electrical equipments.
- Dynamic balancing of Rotors, Fans & Impellers.
- Generators Redesigning & uprating of capacity of existing machines without disturbing the rotor winding.
- Redesigning of cooling systems like air cooled to water cooled and vice versa.
- Redesigning with change in voltage like 415V to 660 volts or 3.3KV to 6.6KV or 11KV to 15KV & vice versa.

Profile

- RKEW is one of the premier and experienced service outfit in the field of electrical motors, generators and transformer repair in India.
- RKEW an exclusive expertise in executing Repair/Rewinding & Refurbishment of worst damaged industrial steam generators, motors & power transformers. It extends expert service to various locations of its large industrial clients spread across the globe.
- RKEW team that includes management, technical & skilled man power understands the urgent need of its clients and is well prepared to deliver faster services (with no limitations on size of the machine) to client's satisfaction.

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