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Publisher's Letter

Mahadevan Iyer

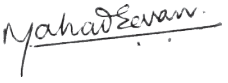
> ***India is completely dedicated and determined to address the Greenhouse challenges...***

Whatever be the outcome of COP 21, India has set its target beforehand to take the Green path for its power generation in future. According to Piyush Goyal, Minister of State (IC) for Power, Coal & New and Renewable Energy, the government of India in its submission to the United Nations Frame Work Convention on Climate Change on Intended Nationally Determined Contribution (INDC) has stated that India will achieve 40% cumulative electric power capacity from non-fossil fuel based energy resources by 2030 with the help of transfer of technology and low cost international finance including that from Green Climate Fund.

The government has up-scaled the target of renewable energy capacity to 175 GW by the year 2022, which includes 100 GW from solar, 60 GW from wind, 10 GW from bio-power and 5 GW from small hydro-power. Naturally the question arises, how should the government accomplish this mammoth task?

Well, the government is well prepared to give shape to this big plan. Besides the ongoing policies and programmes of the government in renewable energy sector, several policy measures initiated recently by the government to achieve this up-scaled target, inter-alia, include suitable amendments to the Electricity Act and Tariff Policy for strong enforcement of Renewable Purchase Obligation (RPO) and for providing Renewable Generation Obligation (RGO); setting up of exclusive solar parks; development of power transmission network through Green Energy Corridor project and so on. Thus, India as a nation is completely dedicated and determined to address the Greenhouse challenges.

Do send in your comments at miyer@charypublications.in



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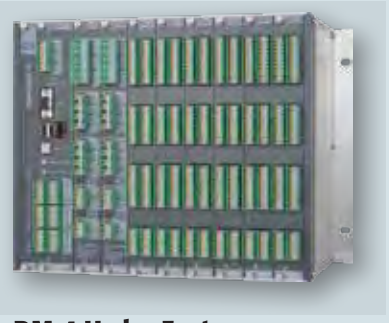

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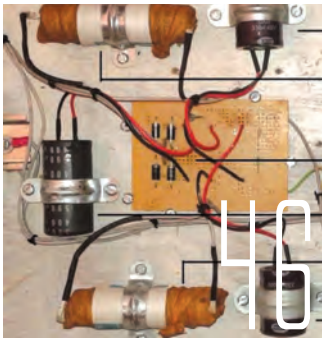

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P K Chatterjee (PK)

Innovative Energy Saving Motors

Motors consume around 45% of electrical energy produced globally. Even today we are mostly dependent on the fossil fuels, which are not only harmful to the environment – but also depleting fast. Under such circumstances, it is quite pleasing to note that some innovators are working on reducing energy consumption in motors. Some of the research works have already started yielding practical and promising results. Also, the energy saving technologies are being offered through innovative terms.

"Some of the research works have already started yielding practical and promising results. Also, the energy saving technologies are being offered through innovative terms..."

For example, Kansas City inventor Joe Flynn and his co-workers at QM Power are continuously working to develop high efficiency motors. Recently, the company has rolled out Q-Sync Smart Synchronous Motors, a new class of energy efficient motors that reduces energy consumption up to 80%. Q-Sync is currently available for refrigeration applications – and will expand into additional markets in 2016. The company states that Q-Sync improves the power quality and reliability of fan motors and provides businesses and OEMs with significant new energy savings retrofit opportunities for the same cost as legacy fan motors. In order to popularise their technology, QM Power is also offering a risk-free financing and services programme for Q-Sync to make it easy for businesses to begin reducing their energy costs immediately. Interested businesses can retrofit their equipment with Q-Sync motors at no cost in exchange for sharing their energy savings with QM Power under contract. In the words of PJ Piper, Co-founder, President and CEO of QM Power, "With Q-Sync, we've reinvented the fan motor to exceed modern-day energy and environmental requirements, deliver bold new energy savings opportunities – and dramatically reduce grid congestion. The motor can now be the next meaningful retrofit and OEM opportunity for energy savings in commercial buildings."

I feel, the 'emerging energy-saving technology' as quoted by the (US) Department of Energy (DOE), has created a good instance at a time when cross-sector participants from businesses, governments, finance, UN, NGO and civil societies are to seriously discuss the future roadmap for sustainable innovations at COP 21 in Paris.

Please e-mail me your views at pkchatterjee@charypublications.in

P. K. Chatterjee

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Government is set to announce reforms in the power sector

At the opening session of the World Economic Forum's National Strategy Day on India, Arun Jaitley, Minister of Finance, Corporate Affairs and Information and Broadcasting of India, said, "Steadfast commitment to reforms and concrete steps taken over the last 18 months have revived confidence of international and domestic investors in the Indian economy." The government is set to announce reforms in the power and railways sectors in the coming days, and is determined to see a key land acquisition legislation through parliament in its forthcoming session, he revealed.

Image Courtesy: World Economic Forum

Klaus Schwab (L) and Arun Jaitley (R) are on dias at the opening session of the WEF's National Strategy Day on India…

India has jumped 16 places to a 55th rank in the World Economic Forum's recently released Global Competitiveness Report 2015-2016. In conversation with Jaitley, the Forum's Founder and Executive Chairman Klaus Schwab said that this is a 'significant and unprecedented jump.'

Jaitley said that major reforms are imminent in the power sector, where the poor financial health of state distribution companies has led to a situation where more power is being produced than can be consumed – due to lack of last-mile connectivity – even as large parts of the country are without access to electricity. Another sector where large public investment and reforms are in store is the railways.

NTPC disseminates its actions to support the 'Make in India' campaign

AK Jha, CMD, NTPC is sharing various activities being undertaken by NTPC…

In line with the theme of Make in India, IITF – 2015 (35th India International Trade Fair), Ministry of Power had set up a pavilion in Hall no. 11 at Pragati Maidan, showcasing the contribution of the Indian power sector towards the theme of the fair. NTPC the largest power utility of the country currently celebrating 40 years of sustainable growth was also a part of the power pavilion.

NTPC's efforts to power India's growth through inclusive growth had been displayed through dioramas and LED backlit panels providing an overview of its contribution and achievements. A power quiz also helped visitors know more about the success of the 'Make in India' campaign. RP Pandey, Additional Secretary, Ministry of Power visited the pavilion, where AK Jha, CMD (of NTPC) shared various activities being undertaken by NTPC with him on the occasion. PK Sinha, General Manager (CC) and senior officials of NTPC were also present.

NTPC plays a vital role in supplying the much needed power to the country and thereby contributing towards share in the Make in India programme initiated by the Government of India. The company has developed strategic alliance and joint ventures with leading national and international companies encouraging them to invest more, and enlarge the production base in India for supplying equipment & services.

Power minister admires EESL for distributing over three crore LED bulbs

Piyush Goyal

Recently, while officially announcing the milestone of distributing over three crore LED Bulbs by Energy Efficiency Services Limited (EESL) under DELP programme, Piyush Goyal, Union Minister for Power, Coal and New & Renewable Energy has said that the world today is looking for the massive roll out of LED programme in India.

According to Goyal, there is a need for correction of the retail market price of LED bulbs. He has suggested the industry to look for more innovative retail platforms in order to make it more affordable to the people. In this regard, he has urged the industry to join the 'Make in India' programme for manufacturing the basic components of LED bulbs in the country. Appreciating the efforts of EESL for achieving the historic milestone, Goyal has said that the success of the programme will strengthen India's stand at forthcoming COP21 at Paris and will present India as a responsible nation. He has also released 'Monitoring and Verification Report of Street Lighting and DELP Projects' on the occasion.

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Power minister is confident to achieve RE targets by 2022

While delivering the keynote address at 95th Annual Event of ASSOCHAM, Piyush Goyal, Union Minister of State (IC) for Power, Coal and New & Renewable Energy, said that energy efficiency is one of the biggest achievements of Prime Minister Narendra Modi led government.

He informed that targets of Renewable Energy (RE) has been scaled up to five times, and at present provides opportunity

for $110 bn investments. The minister said, "We are not only going to achieve RE targets by 2022, but also we are going to achieve it with grid parity."

Talking about the functioning of government, Goyal said that it is focusing its efforts to bring structural improvements in the country. We are working towards socio-economic transformation of the nation through holistic development of its citizens. The minister also added that focusing on principles of good governance will take India to a golden age of sustainable development rather than shortcut measures.

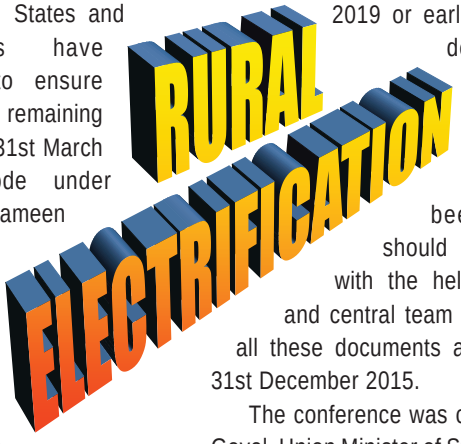
Union cabinet approves Ujjwal Discom Assurance Yojana

The union cabinet has recently approved the Ujjwal Discom Assurance Yojana (UDAY). UDAY provides for the financial turnaround and revival of Power Distribution Companies (DISCOMs). While addressing investors in a meeting held in Mumbai, Power Minister Piyush Goyal said, "The weakest link in the power value chain is distribution, wherein DISCOMs in the country have accumulated losses of approximately 3.8 lakh crore over the past few years."

He further added that DISCOMs were trapped in a vicious cycle with operational losses being funded by debt. According to him, many DISCOMs are not charging fair tariff for the electricity consumed – and thus financially stressed DISCOMs are neither able to supply adequate power at affordable rates & nor in a position to go for development.

The new scheme UDAY lays thrust on four initiatives for financial turnaround of Discoms: (i) Improving operational efficiencies of DISCOMs; (ii) Reduction of cost of power; (iii) Reduction in interest cost of DISCOMs; and (iv) Enforcing financial discipline on DISCOMs through alignment with state finances.

States agree to electrify all the un-electrified villages



Power Ministers of all States and Union Territories have unanimously decided to ensure electrification of all the remaining un-electrified villages by 31st March 2017 in mission mode under Deendayal Upadhyaya Grameen Jyoti Yojana (DDUGJY).

The two day conference of Power, New Renewable Energy and Mines Ministers of States and Union Territories, which concluded on November 07, 2015, has also resolved to work in mission mode to complete the activities in the roll out plan for achieving the '24x7 Power For All' by 2019 or earliest. It has been decided that the states whose plan documents on 'Power For All' have not been prepared should get it expedited with the help of consultants and central team members so that all these documents are completed by 31st December 2015.

The conference was chaired by Piyush Goyal, Union Minister of State (Independent Charge) for Power, Coal and New & Renewable Energy.

States have also resolved to ensure expeditious implementation of Integrated Power Development Scheme (IPDS) projects by implementing them within 30 months from the date of sanction. They have also resolved to achieve 15% Aggregate Technical and Commercial Losses (AT & C) at national level by 2019-20.

States have also resolved to set targets for replacement for all existing conventional street lights and incandescent bulbs with LED by 2019.

Nine States namely Haryana, Uttar Pradesh, Punjab, Maharashtra, Karnataka, Tamil Nadu, Madhya Pradesh, Andhra Pradesh and Telangana have decided to replace 10% of existing agricultural water pumps with energy efficient pumps including solar within one year.

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Tata Power Solar installs a solar plant at the Lotus Temple

Tata Power Solar has successfully commissioned a 120 kWp solar plant at the Bahá'í House of Worship, popularly known as Lotus Temple, located in New Delhi. Tata Power Solar collaborated with the Lotus Temple enabling them to take their first step towards going green and manage a quarter of their annual power requirement (i.e. 45,600 units) through solar energy. This project will also help the temple displace nearly 120 tonnes of carbon dioxide per annum.

"By employing the solar energy route, we want to set an example and encourage our followers as well as visitors to the Lotus

Temple to take on a sustainable way of living. We have had a good experience working with Tata Power Solar – and would like to thank them in enabling us to realise our green energy goals. The Bahá'í House of Worship is frequented by a number of foreign diplomats and the project has been highly applauded by them. This initiative is in line with our philosophy of being in harmony with nature and will go a long way in creating a sustainable solution," commented Shaheen Javid, General Manager, Bahá'í House of Worship.

Commissioned within three months under SECI's (Solar Energy Corporation of India) solar rooftop subsidy programme, this project was set up using Tata Power Solar modules. Funded by the temple's donations, the solar rooftop system is built on the temple's existing accommodation facilities and basement. The project design is harmonious with the distinctive architecture of the temple.

Sorang hydropower project starts commercial operation

Sale of power from the 100 megawatt (MW) run-of-the-river Sorang hydropower project in Himachal Pradesh has started recently. At full capacity, it can supply emissions-free electricity to 500,000 homes.

"We are keen to participate in meeting India's growing energy needs through the completion of this project, which provides cost-efficient power and helps develop renewable energy sources. Sorang is our third major project to be completed this year, with two other projects set for completion by the

Image Courtesy: TAQA

A view of the Sorang hydropower project…

end of 2015," said Saeed Mubarak Al-Hajeri, TAQA (Abu Dhabi National Energy Company PJSC) Chairman.

The Sorang hydropower project is powered by the Sorang Khad river, which originates in the Himalayas. It uses run-of-the-river technology to convert the river's natural water flow to electricity, eliminating the need for a reservoir. "I would like to congratulate our team in India for safely completing this very challenging project in difficult terrain. This has been achieved nicely, thanks to a disciplined approach to project execution as well as the strong partnerships we have built with the local community and government," added Al-Hajeri.

Sterling commissions generators in Andaman & Nicobar

Sterling Generators has commissioned 2 x 3000 kVA generators that will provide continuous and uninterrupted electricity supply to the entire Andaman & Nicobar Islands. The company was appointed to implement this project by the Joint Electricity Regulatory Commission (JERC) due to its excellent project execution capabilities, quality of product, low fuel consumption, and eco friendly diesel generators.

Andaman & Nicobar Islands are one of the most loved tourist destinations in India, and requires power and electricity 24x7. However, due to the geographical and topographical peculiarities of these islands,

A view of the Sterling's generator…

including separation by sea over great distances, there is no single power grid for all the electrified islands.

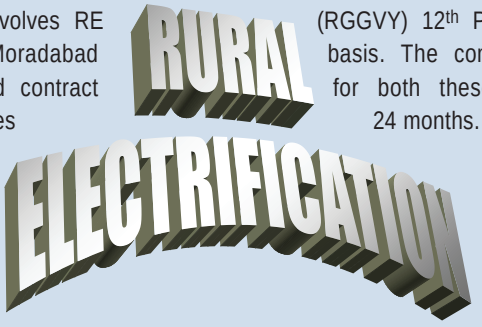
In order to overcome its everyday power requirement challenges, JERC turned to Sterling and Wilson Powergen Pvt. Ltd. for a cost effective, highly reliable, and timely solution through its robust diesel generators that are built to operate in the toughest conditions.

Speaking on the commissioning of the diesel generator powered electricity plant at Port Blair, Sanjay Jadhav, President of Sterling and Wilson Powergen Pvt. Ltd. said, "We are delighted to have had the opportunity of setting up a technologically robust and efficient diesel generator powered electricity plant for JERC in Port Blair. The generators supplied by us for this project are extremely fuel efficient, tough, easy and safe to handle, and eco-friendly.

IL&FS bags new contracts in Uttar Pradesh

IL&FS Engineering and Construction Company Limited (IL&FS Engineering Services) has bagged two individual contracts from PVVNL (Paschimanchal Vidhyut Vitran Nigam Limited), a DISCOM of Uttar Pradesh state for Rural Electrification (RE) works with value of ₹ 145.55 crores, and ₹ 94.05 crores respectively totaling ₹ 239.6 crores in Uttar Pradesh.

The first contract involves RE work of villages of Moradabad district, and the second contract involves RE work of villages of Amroha (JP Nagar) district in Uttar Pradesh under Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) 12th Plan on turnkey basis. The completion period for both these contracts is 24 months.



Siemens, TÜV Rheinland set up a skill centre in Mumbai


Sunil Mathur

Siemens India, in collaboration with TÜV Rheinland India, has together set up the Global Skill Centre for Occupational Safety in Mumbai. The training centre has been specifically designed by Siemens and TÜV Rheinland to provide practical training on the latest safety equipment and techniques – and thus taking the first step towards the 'Zero Harm Culture' that enables individuals to work responsibly and run projects without accidents. The centre will conduct certified training courses that develop 'Safety Leaders' in the project-based businesses and industries.

Thomas Fuhrmann, CEO & Managing Director, TÜV Rheinland South Asia, said, "Siemens has a deep commitment to improving the safety of construction / project sites in India, and TÜV Rheinland is proud to be able to support Siemens in this venture. As the training partner, TÜV Rheinland will bring global training expertise to ensure the highest standards of health and safety are taught to participants."

Sunil Mathur, Managing Director and Chief Executive Officer, Siemens Limited, said, "The Global Skill Centre for Occupational Safety is a critical milestone in Siemens' journey of driving a culture of Zero Harm in the industry. The training centre is designed to meet the requirements of the industry for high-quality training on site safety measures. We hope to be the catalysts of a transformation in the approach toward safety, and support the industry's efforts to maintain a Zero Harm Culture at project sites & manufacturing units."

The flagship programme of the Centre – SITRUST or Siemens & TÜV Rheinland Unique Safety Training – is a 3-day program that includes extensive practical training using a simulated construction site environment. The course provides an experiential learning of Hazard and Risk Identification, Safety Planning, Risk Mitigation and Implementation of Controls. The unique feature of the practical training program is the concept of Story Boards – a case study-based learning on safety management at the workplace.

Velcan Energy gets clearance for its HEP

Velcan Energy has received techno-economic clearance for Tato-1 Hydro Electric Power Project (HEP), a 186 MW project in Arunachal Pradesh, from the Indian Central Electricity Authority. Tato-1 HEP is the second largest and furthest downstream in a cascade of three projects totaling 571 MW on the Yarjep River that Velcan has been developing since 2007.

The Detailed Project Report (DPR) approved by the CEA had been submitted in May 2013. All of its technical and economic features were examined by 19 separate directorates. The approval thus validates and sets the technical characteristics, the costs estimates and the tariff of the forthcoming hydropower plant. This TEC is only the sixteenth clearance given to a hydropower project by the CEA in India since early 2013.

Once built, the Tato-1 project will generate a gross 802 million kWh per annum at a competitive price, based on Design Energy. Its budget is of USD 230m for a construction period of 50 months after financial close. The concession period is set at 40 years after commissioning.

This clearance allows Velcan Energy to begin negotiations for a Power Purchase Agreement (PPA) with prospective clients and seek financing with various interested parties and banks. With energy sales, net of the State's free share, amounting to 691.27 million kWh (based on Design Energy) at a levelised price of 4.40 rupees per kWh (indexed at November 2020 by the CEA) turnover will be USD 46m per annum at current exchange rates.

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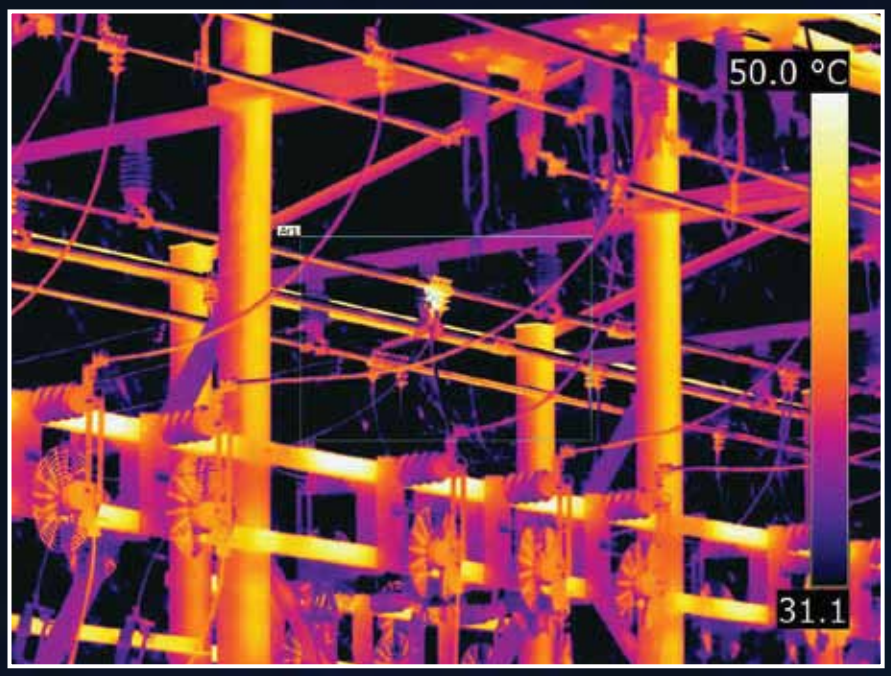

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Gamesa gets type certification for its G114-2.5 MW turbine

José Antonio Malumbres, Gamesa's Chief Technology Officer, was handed this certification in person by Hergen Bolte, Head of DEWI-OCC, during the EWEA 2015 Trade Fair…

Gamesa, a global company in wind energy, has secured type certification for its G114-2.5 MW turbine from DEWI-OCC, the accredited independent certification body of the UL/DEWI group. The new G114-2.5 MW turbine, designed for class II wind speeds, is underpinned by proven technology, validated in the Gamesa 2.0 MW platform, one of the most reliable in the market, having been installed in 35 countries (cumulative installed capacity: 20.9 GW). It comes with a longer blade and increases nominal capacity to 2.5 MW, enabling it to produce 29% more power than the G97-2.0 MW.

José Antonio Malumbres, Gamesa's CTO, was handed this certification in person by Hergen Bolte, Head of DEWI-OCC, during the EWEA 2015 Trade Fair. The first prototype, located in Alaiz (Navarra, Spain), began to generate power in June of this year.

To date, the company has already secured orders for the supply of 280 MW of this new model to wind farms being developed in Sweden, Belgium, the UK and Turkey. "The G114-2.5 MW is Gamesa's first 2.5 MW turbine, and it belongs to a new generation of 2.0-2.5 MW turbines that is changing the wind power cost paradigm. A sizeable team of Gamesa engineers has been involved in developing this entire new product range, which builds on the track record implied by the existing 2.0 MW platform's millions of operating hours and has entailed an extensive component and sub-system validation programme," explained Malumbres.

Lekela Power signs MoU for wind power station in Egypt

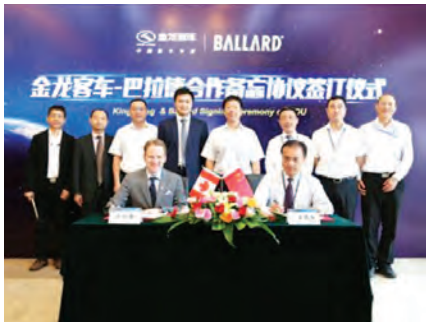
Actis controlled Lekela Power, a $1.9bn pan-African renewable power generation company has signed a Memorandum of Understanding (MoU) with the Egyptian Electricity Transmission Company for a 250 MW wind power station in Egypt's Gulf of Suez area. Lekela Power is owned 60% by Actis, a leading emerging markets investor and 40% Mainstream Renewable Power, a global wind and solar company.

This latest power station is Lekela Power's third project in Egypt following two power stations signed earlier this year (one 50MW solar power station and one 50MW wind power station). This latest project will be situated in the Gulf of Suez area to capitalise on Egypt's unique wind resources and will be managed with a Build, Own & Operate (BOO) framework.

Commenting on the signing, Chris Antonopoulos, Chief Executive Officer of Lekela Power said, "We are delighted to have agreed heads of terms for our third project in Egypt and we look forward to continuing to provide clean, safe, and cost competitive energy to the Egyptian people through our wind and solar projects."

Dr. Sherif Elkholy, Director at Actis, a leading emerging markets investor added, "Actis is a committed, long-term investor in Egypt. We have invested over US$700m in Egypt to date, and the completion of this project will mark an important milestone for Actis in Egypt. It is an honour to have met with President Al-Sisi in London, and we look forward to working on the next phase of the project in a timely manner."

Ballard collaborates with King Long



A view of the MoU signing ceremony…

Ballard Power Systems has signed a Strategic Collaboration Agreement with Xiamen King Long United Automotive Industry Co., Ltd. ('King Long'), a leading global developer, designer and manufacturer of buses, to design and deploy fuel cell-powered buses. The signing ceremony was held at King Long's global headquarters in Xiamen, China.

The companies have agreed to collaborate on the development, optimisation and production of a prototype fuel cell bus, with Ballard supplying its proprietary fuel cell engine along with Technology Solutions support for this purpose.

The companies also plan to collaborate on key deployments of fuel cell buses, initially in China and eventually in King Long's global network.

Randy MacEwen, Ballard's President and CEO said, "We are delighted to be working with the second largest bus OEM in the world on this important fuel cell bus design and market opportunity."

"We are to optimise the design to improve performance, while lowering cost. This'll help drive FC buses to cost parity with incumbent bus technologies. King Long's commitment to FC bus represents further validation of the substantial potential for zero-emission mass transit solutions in China & beyond."

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DEWA eases the procedure for getting electric connection

Dubai Electricity and Water Authority (DEWA), with Dubai Land Department (DLD), has launched Takamul, a service that allows customers to instantly open a DEWA account at Real Estate Regulatory Agency-accredited offices once they are registered. This supports the directives of HH Sheikh Mohammed bin Rashid Al Maktoum, VP and PM of the UAE and Ruler of Dubai, to improve govt services to the highest international standards.

"At DEWA, we adopt this approach by linking our services with other government departments that will contribute to reducing the number of visitors to government departments," said Saeed Mohammed Al Tayer, MD & CEO of DEWA.

Through Takamul initiative, a customer in the residential sector is able to submit a copy of the lease contract issued by the landlord and a copy of his or her Emirates Identity Card to RERA (Real Estate Regulatory Agency) and pay the fees to receive an Ejari certificate. Then, the customer receives an email from DEWA that includes a weblink enabling him or her to pay insurance fees online. The weblink also includes all information about the account, such as account number, and the number of the property. Once the customer pays insurance premiums, whether online or by any other payment methods, DEWA will instantly connect the electricity and water services to the customer.

MHPS receives order for ultra-supercritical-pressure boiler

Mitsubishi Hitachi Power Systems, Ltd. (MHPS) and Daelim Industrial Co., Ltd. of Korea together have secured an order for a boiler to be installed at the Shinseocheon Thermal Power Plant, a 1,000 megawatts (MW) class coal-fired ultra-supercritical-pressure (Note) thermal power generation plant to be newly constructed by Korea Midland Power Co., Ltd. (KOMIPO).

The boiler will be a core component of the large-scale high-efficiency power generation plant that is slated to commence operation in September 2019. The Shinseocheon Thermal Power Plant will be built at a site approximately 200 kilometers south of Seoul, in the Seocheon County of South Chungcheong Province. Once completed, the power plant, which is being built in line with Korea's 6th Basic Power Supply & Demand Plan (2013-2027), will supply power to meet the vigorous demand in the area.

KOMIPO is a power generation company of Korea Electric Power Corporation (KEPCO), Korea's national electric power supplier. Its current power generation methods include coal-fired, oil-fired, and natural-gas-fired Gas-Turbine Combined-Cycle (GTCC). Earlier, MHPS received an order for two M501GAC gas turbines for KOMIPO's combined heat and power supply plant in Seoul through Doosan Heavy Industries & Construction, a Korean recipient of MHPS's related technology.

Daelim Industrial is a major engineering and construction company in Korea that handles civil works as well as the construction of bridges, highways, tunnels, ports and power generation facilities. MHPS has collaborated with the company on many power plant construction projects.

Leoni inaugurates first wiring systems plant in Paraguay

Leoni, the leading European provider of cables and cable systems to the automotive sector and other industries, recently officially opened its first location in Paraguay. The facility located at San Lorenzo near Asuncion will manufacture wiring harnesses for several customers from both the commercial vehicles and the passenger car segment.

"The new plant in San Lorenzo will help us to realise further business growth in the Americas," states Martin Gloesslein, CEO Region Americas of Leoni's Wiring Systems Division. The company is already operating three wiring systems productions in Mexico and Brazil. The additional plant in Paraguay will deliver its products to customer plants in Brazil and Argentina.

Image Courtesy: LEONI AG

Horacio Manuel Cartes Jara (2nd), President of Paraguay is talking to Martin Gloesslein, CEO Region Americas of Leoni's Wiring Systems Division during the opening ceremony...

Leoni is investing a total of EUR 12 million in the new building and equipment. The main advantage of the investment in Paraguay is to produce for reasonable cost, have excellent logistic flows and labour availability as well as taking advantage of the Mercosul benefits as economic trade zone. With an area totalling about 28,000 square metres and a production space of almost 10,000 square metres, the plant provides space for up to 1,000 employees when running at full capacity. Serial production has already started earlier this year.

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Jha has taken over as the CMD of PGCIL

I S Jha

Prior to this assignment, he has successfully served as Director (Projects) and Executive Director (Engineering) in POWERGRID...

In pursuance of office order dated November 10, 2015 of Ministry of Power (India), I S Jha, Director (Projects), POWERGRID has assumed the charge of the post of Chairman and Managing Director of Power Grid Corporation of India Limited (PGCIL) with effect from November 10, 2015.

Jha is an electrical engineer from NIT, Jamshedpur – and is a well known electrical power system professional. Prior to this assignment, he has successfully served as Director (Projects) and Executive Director (Engineering) in PGCIL. He has also worked as Executive Director – Corporate Monitoring Group and held the position of Executive Director of North Eastern Region of the company. Apart from these functions, he was a Lead Member in Planning, Engineering and Execution of APDRP and RGGVY schemes in POWERGRID.

Jha has published numerous articles, technical papers in the field of power system in various international and national conferences/ symposia. He was appointed as a Director on POWERGRID's Board in September, 2009.

PGCIL, the Central Transmission Utility (CTU) of India under the Ministry of Power is one amongst the largest power transmission utilities in the world.

GE gets a new President & CEO of Europe

Mark Hutchinson

Prior to this, he was the President & CEO of GE Greater China, responsible for GE's growth strategy and leading a team of 18,000 people...

GE has appointed Mark Hutchinson as President & CEO of its European region. He succeeds Stephan Reimelt, who has been appointed President & CEO, GE Power Conversion effective from 19th October.

Mark will report to John Rice, GE's Vice Chairman and President & CEO of GE's Global Growth Organisation.

In addition, he will retain his current position of Integration Leader for the Alstom transaction, GE's largest-ever industrial acquisition. In this capacity, he will continue to report to GE CEO & Chairman Jeff Immelt.

Prior to his current role, Mark was the President & CEO of GE Greater China, responsible for GE's growth strategy and leading a team of 18,000 people across manufacturing, sourcing, sales and other functions. During his tenure in China, he developed and executed a shared growth strategy for all the GE businesses helping in driving double-digit growth year on year under his leadership. He is an officer and Vice President of GE and a member of the company's Corporate Executive Council. A native of the U.K., Mark previously was Head of Barclay's Merchant Bank Asian project advisory team, based in Hong Kong.

EWEA appoints Giles Dickson as CEO

Giles Dickson

Prior to taking up this role, he was the Vice President of Global Public Affairs at Alstom – even before he served as a civil servant in the UK...

Giles Dickson, the former Vice President of Global Public Affairs at Alstom, has joined The European Wind Energy Association (EWEA) as Chief Executive Officer (CEO). Before taking up this assignment, he was a civil servant in the UK government for over fifteen years.

Dickson comes to The European Wind Energy Association with substantial experience and knowledge of European energy and climate policies – having led negotiations on environment at the UK Permanent Representation in Brussels – and having overseen Alstom's engagement on these issues with governments worldwide.

"I'm delighted to join EWEA, an association with such a high standing in Brussels and beyond at this critical juncture for the European wind industry and the energy sector. Wind is central to delivering the goals of the EU Energy Union. The ongoing discussions on electricity markets, the governance of further renewables expansion and the reform of the ETS are the key to ensuring the wind industry can play its part. Meanwhile, the Paris climate summit will see more ambition on renewables globally with new opportunities for a vibrant European wind industry. I look forward to leading EWEA and to tackling challenges ahead of us," said Dickson.

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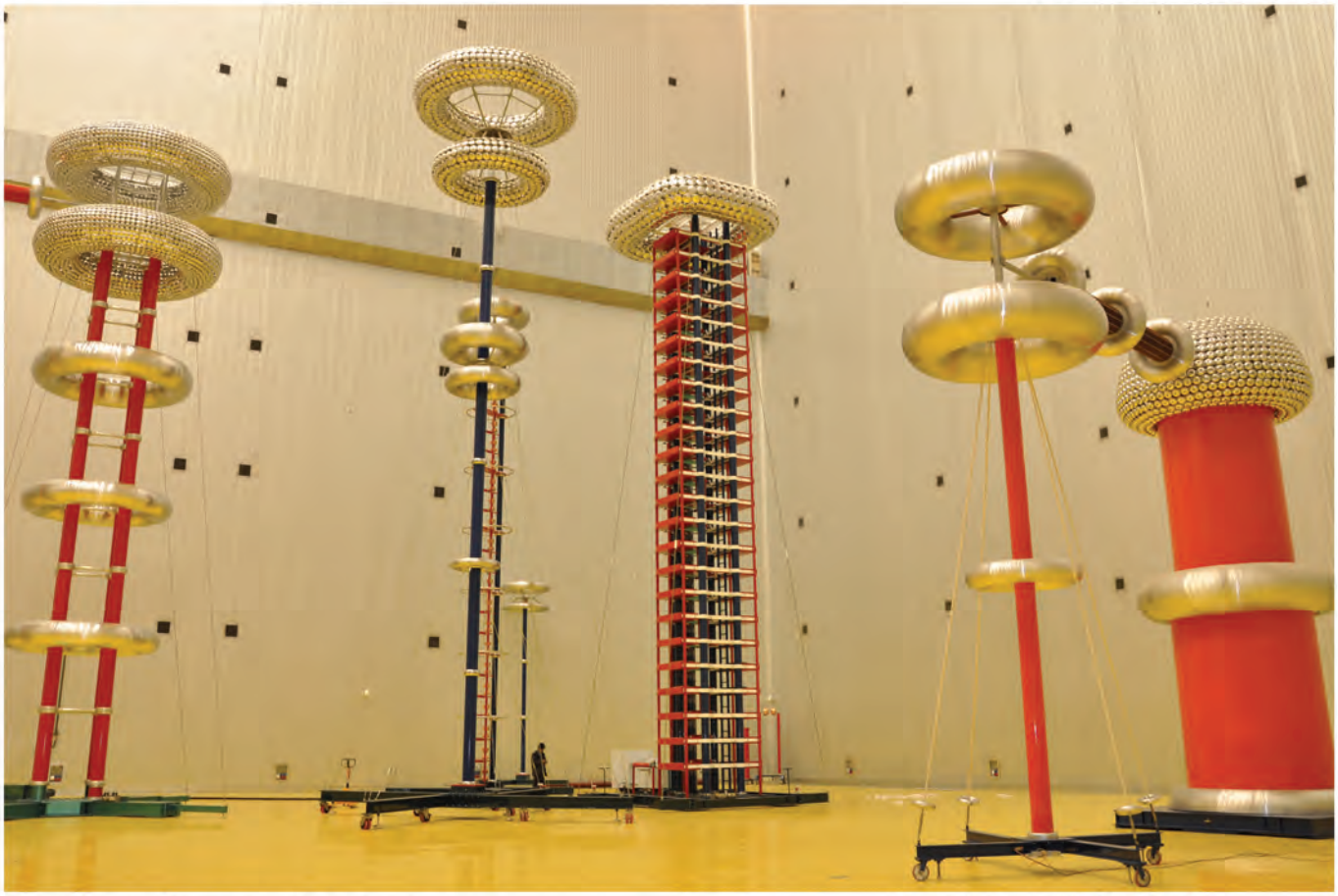

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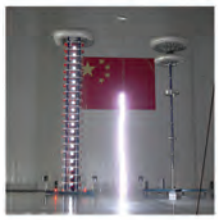



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Meeting CO_2 Emission Standards

EPRI details advanced coal generation technologies to meet CO_2 emissions limits without carbon capture and storage...

Carbon capture with underground storage (CCS) is considered by many to be the best option to reduce carbon dioxide emissions from coal-fired power plants. But development and application of CCS systems face significant technology, policy and cost challenges.

The Electric Power Research Institute (EPRI) looked at several technologies available or in development that have the potential to enable power plants fueled solely by coal to significantly reduce CO_2 emissions through more efficient combustion and use of heat.

The results of Electric Power Research Institute's study have been published in a new white paper, 'Can Future Coal Power Plants Meet CO_2 Emission Standards Without Carbon Capture and Storage?'

EPRI's paper analyses current and anticipated U.S. and global CO_2 emission standards for coal plants, identifies key challenges associated with CCS deployment, and provides detailed descriptions of coal-only technologies that are not ready for commercial deployment but that present significant opportunities to reduce CO_2 emissions.

Today's most efficient coal-fired plants are the 'ultra-supercritical' plants that produce steam at high temperature (above 593°C or 1100°F) and emit approximately 800 kg (1760 lb) CO_2/MWh. EPRI looked at several technology options for increasing the thermal efficiency of the processes for generating electricity with coal, including:

- Rankine cycles (used by most of today's coal plants) with higher steam temperatures;
- Combined heat and power applications (also known as cogeneration); and
- Coal gasification integrated with one of four systems – combined cycles (gas turbine plants), supercritical CO_2 Brayton cycles (which use the CO_2 instead of water or steam as the working fluid), Solid Oxide Fuel Cells (SOFCs), and 'triple cycles' (a combination of combined cycles and SOFCs).

However, none of the options considered in EPRI's analysis are currently commercially available, economically viable, and suitable for broad deployment.

National R&D programmes in the United States and elsewhere are making progress, but additional public-private R&D investment is needed to accelerate the deployment of many of these technologies.

"It's critically important for the electric power industry to have as many generation technology and fuel options as possible," said EPRI Vice President of Generation Tom Alley.

"Reducing emissions will be one of the key drivers as the industry makes decisions about existing assets and about the designs and fuels used in the next generation of power plants. EPRI research like this can be invaluable in informing those decisions," added the EPRI Vice President of Generation.

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Strong Direction Is Needed From **Paris Climate Summit**

By 2040, China's net oil imports are nearly five times those of the United States, while India's easily exceed those of the European Union...

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Power plant pollution...

An extended period of lower oil prices would benefit consumers, but would trigger energy-security concerns by heightening reliance on a small number of low-cost producers, or risk a sharp rebound in price – if investment falls short, says the International Energy Agency (IEA) in the 2015 edition of its flagship World Energy Outlook publication (WEO-2015). The report finds that the plunge in oil prices has set in motion the forces that lead the market to rebalance, via higher demand and lower growth in supply, although the adjustment mechanism in oil markets is rarely a smooth one. In the central scenario of WEO-2015, a tightening oil balance leads to a price around $80 per barrel by 2020.

But WEO-2015 also examines the conditions under which prices could stay lower for much longer. Since prices at today's levels push out higher-cost sources of supply, such a scenario depends heavily on the world's lower-cost producers: reliance on Middle East oil exports eventually escalates to a level last seen in the 1970s.

Such a concentration of global supply would be accompanied by elevated concerns about energy security, with Asian consumers – the final destination of a huge share of regionally-traded oil – particularly vulnerable. Developing Asia, a region in which India takes over from China as the largest source of consumption growth, is the leading demand centre for every major element of the world's energy mix in 2040 – oil, gas, coal, renewables and nuclear. By 2040, China's net oil imports are nearly five times those of the United States, while India's easily exceed those of the European Union.

"It would be a grave mistake to index our attention to energy security to changes in the oil price. Now is not the time to relax. Quite the opposite: a period of low oil prices is the moment to reinforce our capacity to deal with future energy security threats," said IEA Executive Director Fatih Birol.

The report also underlines that the single largest energy demand growth story of recent decades is near its end: China's coal use

reaches a plateau at close to today's levels, as its economy rebalances and overall energy demand growth slows, before declining. India – the subject of an in-depth focus in WEO-2015 – moves to centre stage in global energy, with high levels of economic growth, a large (and growing) population and low (but rising) levels of energy use per capita all pushing energy demand to two-and-a-half-times current levels.

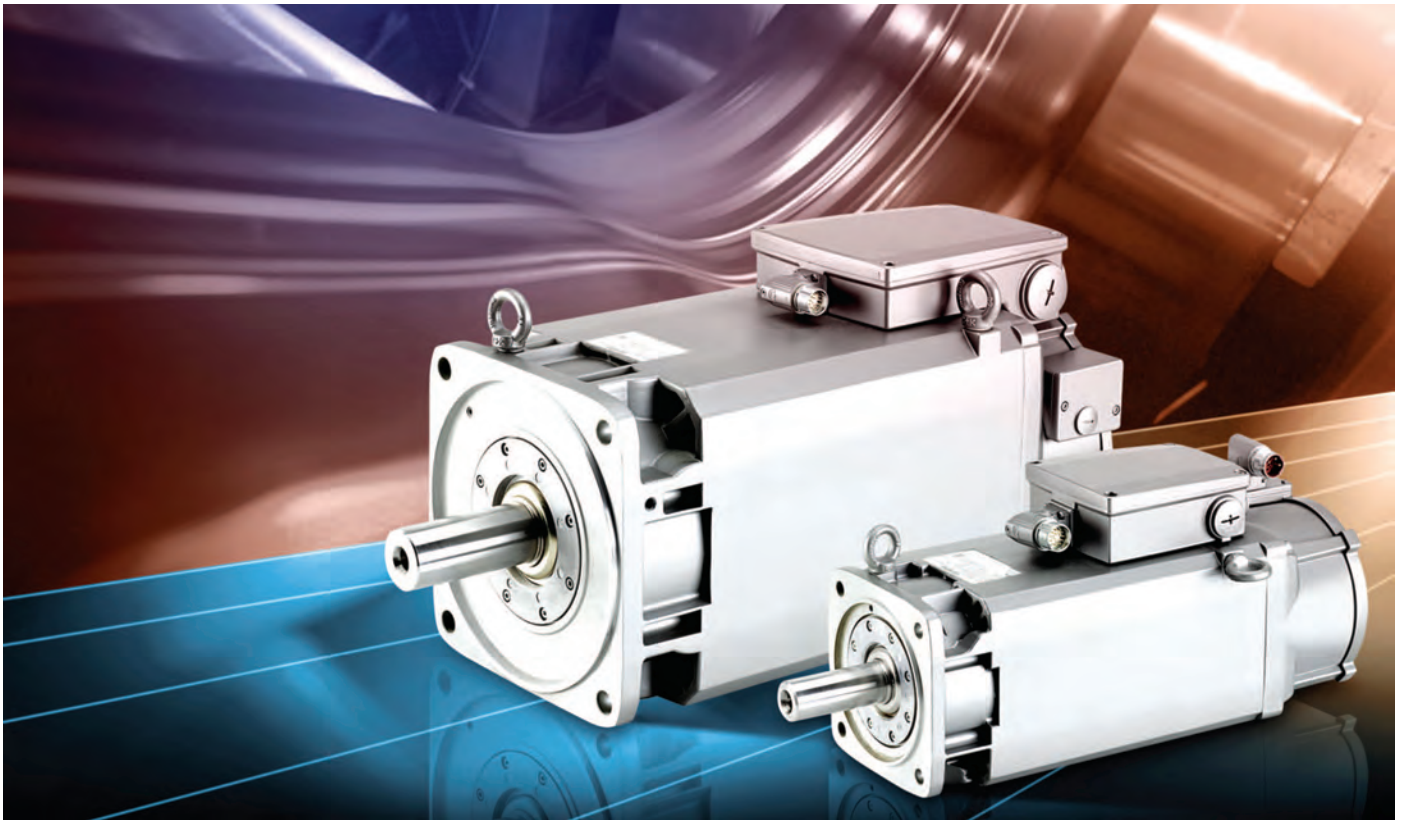
Overall, world energy demand grows by nearly one-third between 2013 and 2040 in the central scenario of WEO-2015, with the net growth driven entirely by developing countries. The links between global economic growth, energy demand and energy-related emissions weaken: some markets (such as China) undergo structural change in their economies and others reach a saturation point in demand for energy services. All adopt more energy efficient technologies, although a prolonged period of lower oil prices could undercut this crucial pillar of the energy transition; diminished incentives and longer payback periods mean that 15% of the energy savings are lost in a low oil price scenario. Lower prices alone would not have a large impact on the deployment of renewables, but only if policy-makers remain steadfast in providing the necessary market rules, policies and subsidies.

In advance of the critical COP21 climate summit in Paris, there are clear signs that an energy transition is underway: renewables contributed almost half of the world's new power generation capacity in 2014 and have already become the second-largest source of electricity (after coal).

The coverage of mandatory energy efficiency regulation has expanded to more than one-quarter of global energy consumption. The climate pledges submitted in advance of COP21 are rich in commitments on renewables and energy efficiency, and this is reflected in the WEO-2015 finding that renewables are set to become the leading source of new energy supply from now to 2040.

Their deployment grows worldwide, with a strong concentration in the power sector where renewables overtake coal as the largest source of electricity generation by the early-2030s. Renewables-based generation reaches 50% in the EU by 2040, around 30% in China and Japan, and above 25% in the United States and India.

The net result of the changes seen in the WEO-2015 central scenario is that the growth in energy-related emissions slows dramatically, but the emissions trajectory implies a long-term temperature increase of 2.7 °C by 2100. A major course correction is still required to achieve the world's agreed climate goal. "As the largest source of global greenhouse-gas emissions, the energy sector must be at the heart of global action to tackle climate change. World leaders meeting in Paris must set a clear direction for the accelerated transformation of the global energy sector. The IEA stands ready to support the implementation of an agreement reached in Paris with all of the instruments at our disposal, to track progress, promote better policies and support the technology innovation that can fulfill the world's hopes for a safe and sustainable energy future," said Dr. Birol.



Speed Control Of Induction Motor Drive

Recently, attention has been given to the identification of the instantaneous value of the rotor resistance while the drive is in normal operation...

Indirect Field Oriented Controlled (IFOC) induction motor drives are being increasingly used in high-performance drive systems, as induction motors are more reliable because of their construction and less expensive materials used, than any other motors available in the market today. As indirect field orientation utilises an inherent slip relation, it is essentially a feed forward scheme and hence depends greatly on the accuracy of the motor parameters used in the vector controller – particularly to the rotor resistance. It changes widely with the rotor temperature, resulting in various harmful effects – such as over (or under) excitation, the destruction of the decoupled condition of the flux and torque, etc. Recently, attention has been given to the identification of the instantaneous value of the rotor resistance while the drive is in normal operation. So far, several approaches have been presented. A new sliding mode current observer for an induction motor is developed. Sliding mode functions are chosen to determine speed and rotor resistance of an induction motor in which the speed and rotor resistance are assumed to be unknown constant parameters. In, a method

using a programmable cascaded low pass filter for the estimation of rotor flux of an induction motor, with a view to estimate the rotor time constant of an indirect field orientation controlled induction motor drive, is investigated. The estimated rotor flux data has also been used for the on-line rotor resistance identification with artificial neural network. Despite all these effects, rotor resistance estimation remains a difficult problem.

AC motor drives are extensively used in industrial application requiring high performance. In high performance systems, the motor speed should closely follow a specified reference trajectory regardless of any load disturbance, parameter variations and model uncertainties. In order to achieve high performance, field-oriented control of induction motor drive is employed. However, the control design of such a system plays a role in system performance. The decoupling characteristics of vector-controlled induction motor have adversely affected the parameter changes in the motor. The speed control of IM issues are traditionally handled by fixed gain PI and PID controllers. However, the fixed gain controllers are very sensitive to parameter variations, load disturbances etc. Thus, the controller parameters have to be continuously adapted. The problem can be solved by several adaptive control techniques such as model reference adaptive control, Sliding Mode Control (SMC), Variable Structure Control (VSC) and self tuning PI controller etc. The design of the entire above controller depends on the exact system mathematical model. However, it is often difficult to develop an accurate mathematical model due to unknown load variation and unavoidable parameter variations due to saturation, temperature variations and system disturbance. To overcome the above problems, Fuzzy Logic Controller (FLC) is being used for motor control purpose. There is some advantage of fuzzy logic controller as compared to conventional PI, PID and adaptive controller; it does not require any mathematical model – it is based on linguistic rules within 'if then' general structure, which is the basic of human logic. In this article, the configuration and design of fuzzy logic controller of indirect vector control of induction motor has been investigated. The performance of FLC has been successfully compared with conventional PI controller.

Indirect Field-Oriented Induction Motor Drive

The indirect vector control method is essentially same as the direct vector control, except that the unit vector generated in an indirect manner using the measured speed r and slip speed sl. The following dynamic equations are taken into consideration to implement indirect vector control strategy.

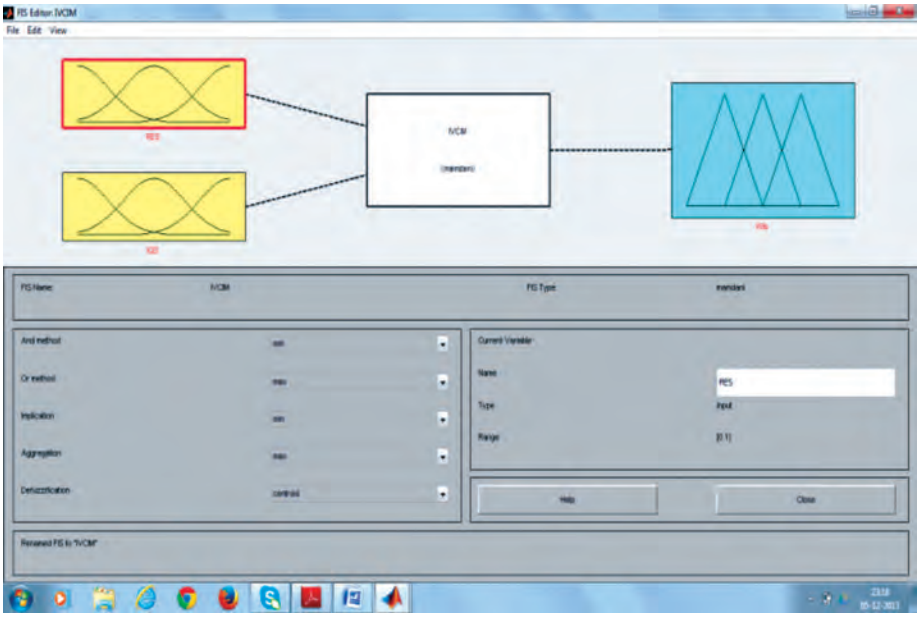


Fig 1: Block Diagram of Fuzzy Logic Controller...

The decoupling characteristics of vector-controlled induction motor have adversely affected the parameter changes in the motor...

$\theta_e = \omega_e \, dt = (\omega_r + \omega_{sl}) = \theta_r + \theta_{sl}$

Slip frequency can be calculated as

$$\omega_{sl} = \frac{Lm\ Rr}{Lr}\ i_{qs}$$

For constant rotor flux ψr and dψr/dt=0, substituting in equation yields the rotor flux set as $\psi_r = L_m\, i_{ds}$

Design of Fuzzy Logic Controller for Induction Motor Drive

Fig. 1 shows block diagram of speed control system using Fuzzy Logic Controller (FLC). Here, the first input is the Temperature 'T' and second is the Change in Temperature 'ΔT' at sampling time 't_s.' The two input variables 'T' and 'ΔT' are calculated at every sampling time as functional block diagram of Fuzzy Logic Control. In this block, number of inputs and number of outputs are estimated and any relationship is appeared between inputs and outputs are checked. The crisp values for the inputs and outputs are noted down. The entire information regarding the application to be solved is noted down here. The rotor resistance with respect to temperature & change in temperature are noted down here.

Where 'w_{ls}' denotes the Slip frequency, r *(ts) is the reference rotor speed, r(t_s) is the actual speed, e(t_s-1) is the value of error at previous sampling time. The output variable is the rotor resistance. As shown in Fig. 2, the Fuzzy Logic Controller consists of four blocks, Fuzzification, inference mechanism, knowledge base and Defuzzification.

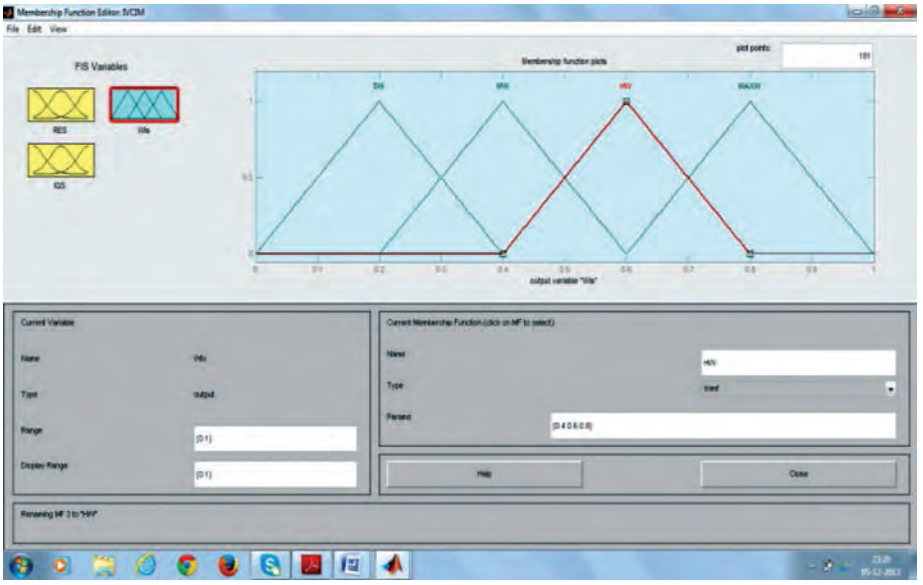


Fig 2: Fuzzy Logic Controller Membership Functions...

- **Fuzzification Block:** In this stage the crisp variables of input are converted into fuzzy variables. The fuzzification maps the error and change in error to linguistic labels of fuzzy sets. Membership function is associated to each label with triangular shape which consists of two inputs and one output. The proposed controller uses following linguistic labels. Each of the inputs and output contain membership function with all these seven linguistics.

- **Knowledge Base & Inference Stage:** Knowledge base involve defining the rules represented as 'if-then' rules statements governing the relationship between input and output variables in terms of membership function. In this stage, the input variables 'T'and 'ΔT' are processed by the inference mechanism that executes 49 rules represented in rule table shown below. Considering the first rule, if temperature is NS and change in temperature is SS, then the output will be NR. Here, Mamdani's algorithm for inference mechanism used.

Figure 2 shows the configuration of the proposed fuzzy logic rotor resistance estimation. The functions F and F_0 are first calculated respectively from the estimated variables ids; iqs; vds; vqs; !e and the reference value. The inputs temperature and change in temperature are the variables, which are used as inputs for the FLC. The internal structure of the fuzzy logic rotor resistance estimation is chosen similar to that of a Fuzzy Logic Controller, which consists of fuzzification, inference engine and defuzzification. For the successful design of FLC's proper selection of these gains are crucial jobs, which in many cases are done through trial and error to achieve the best possible control performance. Then the crisp variables are converted into fuzzy variables using triangular membership functions as in Figure 3. These input membership functions are used to transfer crisp inputs into fuzzy sets.

The expert's experience is incorporated into a knowledge base with 49 rules (7x7). This experience is synthesised by the choice of the input-output (I/O) membership functions and the rule base. Then, in the second stage of the FLC, the inference engine, based on the input fuzzy variables, uses appropriate IF-THEN rules in the knowledge base to imply the final output fuzzy sets as shown in the Table 1, where NS, NM, NL, Z, PS, PM, PL correspond to Negative Small, Negative Medium,

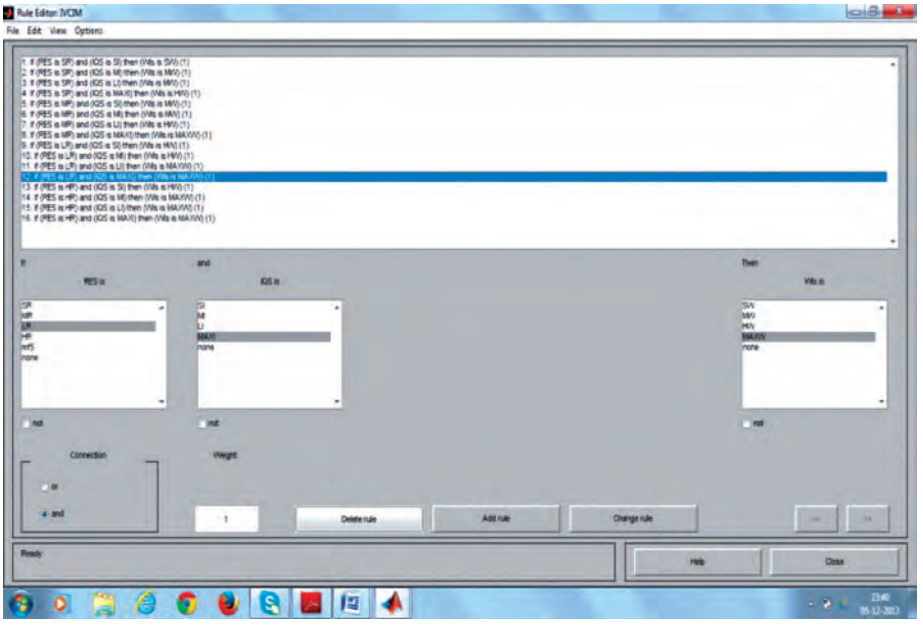


Fig 3: Rule Base Editor...

T/ΔT	NS	NM	NL	Z	PS	PM	PL
SS	NR	NR	NR	ZR	PR	PM	PL
MS	NR	NR	NR	ZR	PR	PM	PL
S	NL	Z	Z	PS	PS	PS	PM
M	NL	Z	PS	PS	PM	PM	PL
ML	Z	Z	Z	PS	PM	PL	PL
L	Z	Z	PS	PS	PM	PL	PL
MAX	PS	PM	PL	PL	PL	PL	PL

Table 1: Rule base for rotor resistance estimation...

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Fig 4: Membership Function of Fuzzy Variables in the output form...

Negative Large, Zero, Positive Small, Positive Medium, Positive Large respectively.

- **Defuzzification:** This stage introduces different methods that can be used to produce fuzzy set value for the output fuzzy variable T. Here the centre of gravity or centroids method is used to calculate the final fuzzy value. Defuzzification using COA method – means that crisp output is obtained by using centre of gravity – in which the crisp output variable is taken to be the geometric centre of the output fuzzy variables where it is formed by taking the union of all the contributions of rules with the degree of fulfillment greater than zero. Then the COA expression with discretised universe of discourse can be Te * – obtained by integration which is used to calculate variation of rotor flux, where it is observed that in case of PI controller it will take more time to reach to steady state value. But in case of fuzzy controller it will take less time to reach steady value.

In the defuzzification stage, the implied fuzzy set is transformed to a crisp output by the center of gravity defuzzification technique as given by the formula (19), zi is the numerical output at the ith number of rules and _(zi) corresponds to the value of fuzzy membership function at the ith number of rules. The summation is from one to n, where n is the number of rules that apply for the given fuzzy inputs. This value added to the reference rotor time constant (T_{ref}) gives the estimated time constant (T_r), which is used as an input to the F.O.C. block of Figure 1 to ensure the correct orientation operation of the drive. Without considering the effects derived from the saturation (L_r constant), R_r−est is obtained from the estimated rotor time constant Figure 2. Therefore, this rotor resistance estimation value used in the control model must match its real value in order to maintain a high performance of the induction motor drive as will be shown later. The input/output mapping of the FLC rotor resistance estimation is shown in Figure 4, which is a continuous highly non-linear function. Detailed discussion about FLC construction is referred in.

Simulation Results

The configuration of the overall control system is shown in Figure 1. It is essential that the simulation model is designed to approach as close to reality as possible. Therefore, for the simulation of the whole drive system according to Figure 1, a mathematical model has been developed based on the induction motor equations and the equations for estimating the rotor resistance which have been derived in Section III. In addition, a mathematical model for all the remaining drive system units was necessary to complete the simulation model.

In order to analyse the drive system performance for their flux and torque responses, with rotor resistance variation, the above-presented system has been simulated using MATLAB/SIMULINK software.

A squirrel cage induction motor with a rated power of 1.5 kW has been used. A constant reference flux of 0.695 Wb is assumed and the speed was held constant at 1000 rpm.

The rotor resistance was stepped or ramped from 100 to 200% of its rated value, thereby simulating a change in rotor resistance due to a temperature change. The system was first started up to 1000 rpm with a full load of 10 N.m. At 1.5 sec, the rotor resistance was stepped from 100 to 200% of its rated value.

It is observed in this figure that when the estimated rotor resistance deviates from its real value, the field orientation scheme is detuned and the command torque (Te) instead of stabilising at its rated value, it is increased to 17 N.m to compensate the drop in speed which equals approximately 12 rpm.

But in the actual operating conditions, the rate of change of temperature is very slow and so the resistance variation. Accordingly, at 1.5 sec a ramp change of rotor resistance for an uncompensated case is applied linearly from 100% of its rated value to 200% till 4.5 sec, then, this value is maintained for 2.5 sec.

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MAGNA START

New Generation Slip-Ring Motor Starter

Rheostatic starters utilise one or several resistors for obtaining stated motor torque characteristics and for limiting current. During starting period, it cuts out successive one or several resistors provided in the rotor circuit...

Slip-ring motors are widely used when high starting torque is required. Rheostatic and liquid immersed resistance starters are used for starting the slip ring motors. In this article, we have explained concept of eddy current effect of inducers for starting slip-ring induction motors.

The major advantages of slip-ring induction motor are:

- High starting torque compared to squirrel cage induction motors about 2.5 times full load torque.
- Pull out torque can be achieved at even zero speed.
- Squirrel cage induction motors take 6 to 7 times full load current but slip-ring induction motors take low starting current approx 2.5 to 3.5 times full load current.
- Speed can be controlled easily.

Starters For Slip Ring Induction Motors

Rheostatic rotor starter

Rheostatic starters utilise one or several resistors for obtaining stated motor torque characteristics and for limiting current. During starting period, it cuts out successive one or several resistors provided in the rotor circuit.

The value of resistance is chosen on the basis of the mean torque required during starting. The rated data of the motor can be used to calculate the resistance that will give rated current and rated torque on starting. The resistance R2 is worked out with the formula

$$R_2 = U_2 / \sqrt{3} \times I_2$$

Where U_2 =Rotor Voltage at standstill

I_2 = Rotor Current at rated power

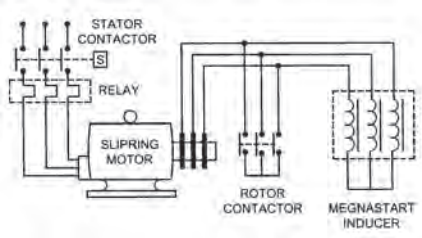
This method has following major drawbacks:

- Reduction in resistance is achieved by timers as the motor accelerates. Design parameters of the resistance do not take into account the varying load conditions.
- Each starter has to be individually designed to suit the motor and once installed, its starting characteristics can rarely be altered to suit changing requirements of the customer.
- By virtue of large number of contactors and other moving parts, resistance banks are bulky, complex and liable to malfunction.
- These have a limited starting capability.

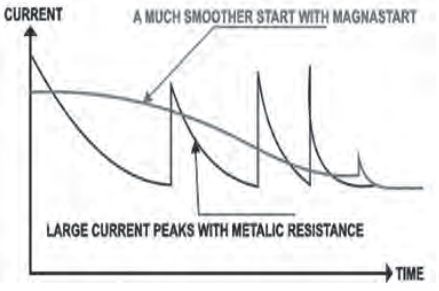
Magna Start System – New Generation Slip Ring Induction Motor Starter

Magna Start System is a specifically designed system for starting slip-ring induction motor, which consists of control and protection system with magna start inducer for rotor circuit. The Magna Start inducer is physically much smaller than the equivalent resistance, requires only one shorting contactor because of which the size, and complexity & cost of the overall system gets considerably reduced. All the components are enclosed in a single dust & vermin proof enclosure.

The schematic arrangement of Magna Start System is given in Figure 1. The major advantage of Magna Start System is that it provides smooth acceleration to full speed (the time – current characteristic is given in Figure 2), and thus reduces electrical stress.



Schematic Diagram of Magnastart System...



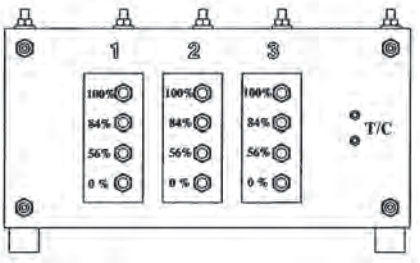
Time Current Characteristics of Starting...

Advantages Of Magna Start:

- **Size:** Though physically smaller than conventional systems, the large thermal capacity of Magna Start permits the starting of high inertia loads without problems.
- **Simplicity:** Magna Start requires only one shorting contactor, reducing overall system complexity, size and cost.
- **Maintenance:** Magna Start has no moving parts and does not use liquids or chemicals. Magna Start will give many years of service without any maintenance or adjustment.
- **Reliability:** The robust construction permits heavy usage under the most arduous conditions. Comprehensive thermal protection prevents any possibility of damage.
- **Flexibility:** Each inducer model is designed to start a wide range of motors. The front panel (Fig.1) allows the user to select the exact starting torque and current he/she requires.
- **Smooth starting:** Smooth acceleration to full speed reduces electrical stresses in the motor and mechanical wear.
- **Performance:** Magna Start is ideal for inching, reversing and plug braking without any additional controls in the rotor circuit.

Working Principle of Magna Start Inducer

The Magna Start inducer consists of 3 coils wound on specially shaped steel cores. Eddy currents in these cores are reflected in the windings as impedance, which is dependent on rotor frequency. When power is applied to the motor, the frequency in the rotor is the same as



Front Panel of Magnastart inducer...

that in the stator. As the motor accelerates, the rotor frequency and the inducer impedance decrease. This results in a smooth acceleration to full speed at which point the slip-rings are short circuited.

The heavy mass of core material allows the inducer to absorb a considerable amount of heat. The advanced thermal insulation protects the coils that remain relatively cool and several consecutive starts may be obtained on drives with high inertia loads.

Each of the coils is tapped at 56% and 84%, all four connections brought out to studs on the front panel in a rectangular array. The front panel of Magna Start Inducer is shown in Figure 3. By using star and delta combinations as given in Table 1, up to 17 different starting impedances are available. Thus, the inducer can be set to provide the exact starting characteristics required on a wide range of impedance for the motors.

Features Of Magna Start

- Naturally automatic step-less operation
- Intrinsically load sensitive starting
- Constant torque, constant current acceleration
- Suitable for online plugging

Electrical Characteristic And Performance

Magna Start design ensures that a high power factor (0.8 or more) is maintained in the rotor circuit in order to prevent excessive starting currents being drawn. Magna Start also provides a good linear characteristic of impedance against frequency (a representative graph of impedance v/s speed is shown in Figure 4) so that a constant current is drawn and the same torque is delivered during the run-up. This enables the fastest possible run-up time within a given current limit. There is a value of current where maximum starting torque is obtained. Any current lower or in excess of the above value will give lesser torque. Refer Figure 5.

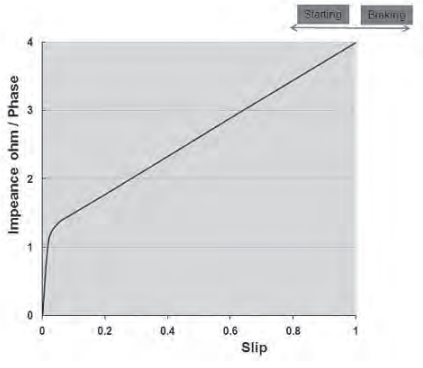


Figure 4

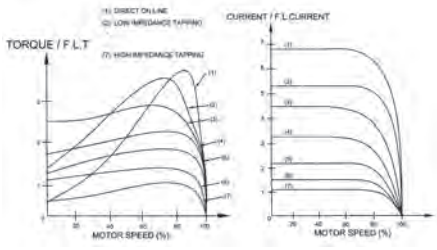


Figure 5

CONNECTION	1	2	3	4	5	6	7	8	9
COIL TAPPINGS 100% / 84% / 56% / 0%									
IMPEDANCE	100	80	67	54	41	34	26	20	15

Table - 1: Impedance Combination...

Model No.		M30	M45	M90	M125	M175	M350
Motor rating, kW		37	55	110	150	200	370
Maximum Ratings	Start / Hr	9	7	6	6	5	4
	Rotor Voltage, V	600	600	800	800	1000	1200
	Rotor Voltage Heavy Duty, V	500	500	550	600	800	900
	Rotor Full Load Current, A	75	125	240	240	300	430
	Rotor Starting Current, A	140	275	425	525	625	1100

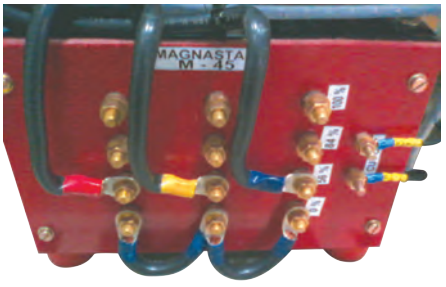
Table - 2 : Inducer - Technical Details...

Selection Of Magna Start Inducer

The size of the inducer required is decided solely by motor HP rating and the required starting duty. Factors to be considered in determining the starting duty are:

- Number of starts per hour
- Starting time
- Maximum permissible rotor starting current as a factor of full load rotor current

The ratings of the standard Magna Start range have been calculated on the basis of 10-second starts, drawing a maximum of 3 times the full load rotor current. Technical Information of inducer is given in Table 2. The user can check the maximum rotor current and rotor voltage from the motor name plate. Other rating inducers can be developed as per requirement of customer.



Conclusion

- Magna start system provides load sensitive starting and smooth time current characteristic.
- Magna start system has advantage of size, simplicity and no maintenance
- Required impedance can be achieved by adjustment of tapping of the inducer.

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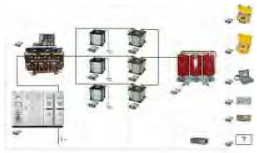

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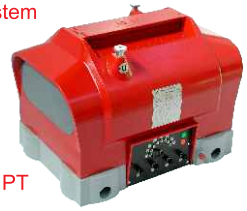

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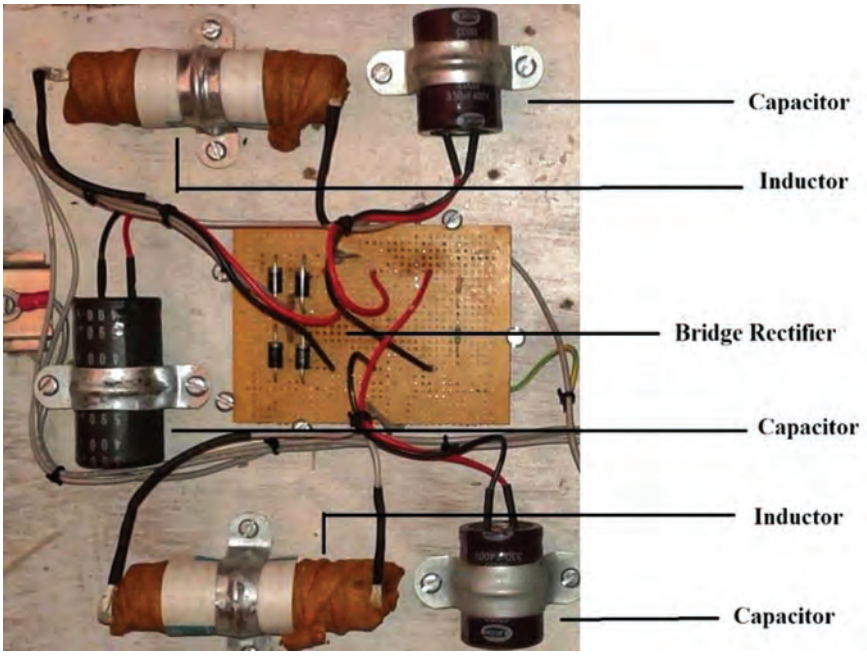
Z-Source Inverter Fed Induction Motor

This article presents a simplified analysis of ZSI and the steady state operation of 3-ϕ induction motor fed by ZSI. Results of simulation study and experimentation are also included...



The traditional general-purpose motor drive or Adjustable Speed Drive (ASD) system is based on the Voltage Source Inverter (VSI), which consists of a diode rectifier in the front end with the DC link capacitor, and Inverter Bridge. The VSI is a buck (or step-down) converter that can only produce an AC voltage limited by the DC link voltage that is equal to 1.35 times the line voltage. Because of this nature, the VSI based ASD system suffers from the following limitations and problems:

- The voltage obtained at output is limited which is less than the input line voltage
- The ASD systems are limited by the voltage sags and results in shut down of the system at critical loads. Also, the DC capacitor in an ASD system cannot hold DC voltage above the operational level due to its relatively low energy storage capacity under such voltage sags
- The ride-through capacity is lagging in VSI, which leads to serious problem for sensitive loads driven by ASDs
- The ASD system can be accompanied with fly back converter or boost converter having energy storage capacity or diode rectifier to achieve ride-through; but, these combined circuits suffer with disadvantages of cost, size/weight, and complexity
- Diode rectifier produces inrush and harmonic current, which can further pollute the line. The traditional ASD system also suffers from low power factor
- EMIs majorly responsible for miss-gating, which can cause shoot-through that lowers the performance of the inverter
- The dead time needed to avoid shoot-through creates distortion and unstable operation at low speeds.

Z-Source Inverter (ZSI)

The ZSI is shown in Fig. 1. It consists of voltage source from the rectifier supply, impedance network, and three phase inverter with A.C. motor load. AC voltage is rectified to DC voltage by the rectifier. The rectifier unit consist of six diodes, which are connected in bridge way. This rectified output DC voltage fed to the Z-network, which consists of two equal inductors (L_1, L_2) and two equal

capacitors (C_1, C_2). The network inductors are connected in series arms and capacitors are connected in diagonal arms.

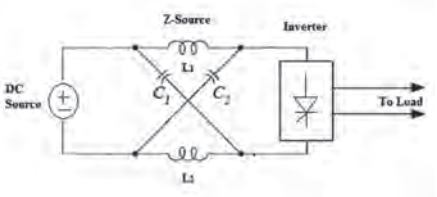


Fig 1: Z-Source Inverter...

The impedance network is used to buck or boost the input voltage depends upon the boosting factor. This network also acts as a second order filter. The output voltage from impedance network is fed to the three phase inverter main circuit. The inverter main circuit consists of six switches. Gating signals are generated from the driving circuit and fed to the inverter operates and the output of inverter is fed to the AC load or motor.

Equivalent Circuit of ZSI

The three phase impedance source inverter bridge has nine switching states unlike the traditional VSI that has eight switching states. Because of this special structure, the ZSI has an additional switching state, when the load terminals are shorted through both the upper and lower switching devices of any phase leg, which called the Shoot-Through (ST) state besides the eight traditional Non-Shoots Through (NST) states. The ZSI has two operating modes: non-shoot-through mode and shoot-through mode, as shown in Fig. 3 and 4 respectively. During the ST switching state, the input diode is reverse biased; the input DC source is isolated from the load, and the two capacitors discharge energy to the inductors and to the load. During the NST switching states, the input diode turns ON, and the DC input voltage source as well as the inductors transfer energy to the load and charge the capacitors, as a result the DC-link voltage of bridge is boosted.The impedance source inverter bridge has one extra zero state, when the load terminals are shorted through both upper and lower devices of any one phase leg or all three phase legs. This shoot through zero state is forbidden in the VSI, because it would cause a shoot- through. This network makes the shoot through zero state possible. This state provides the unique buck-boost feature to the inverter. The equivalent switching frequency from the impedance source network is six times the switching frequency of the main inverter, which greatly reduces the required inductance of the impedance source network. The equivalent circuit of the ZSI is shown in Fig. 2.

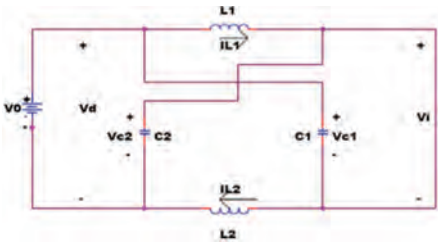


Fig 2: Equivalent circuit of ZSI...

Mathematical Analysis of Z-Source Network

The impact of the phase leg shoot through on the inverter performance can be analysed using the equivalent circuit shown in Fig. 3 and Fig. 4. Assume the inductors (L_1 and L_2) and capacitors (C_1 and C_2) have the same inductance and capacitance values respectively; the Z-source network becomes symmetrical.

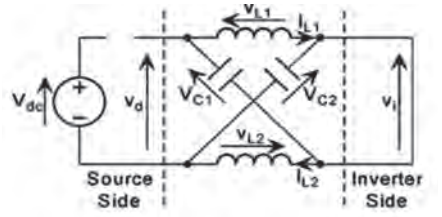


Fig 3: Equivalent circuit when ZSI in shoot through state...

In shoot through state the inverter side of Z-Source network is shorted during time interval T_0 as in Fig. 3. Therefore, L_1=L_2=L and C_1=C_2=C.

$V_{c1} = V_{c2} = V_c = V_{L1} = V_{L2} = V_L$

$V_d = V_L + V_c = V_c + V_c = 2\ V_c$ .....(1)

$V_i = 0$

Alternatively, when in non-shoot through active or null state current flows from Z-Source network through the inverter topology to connect AC load during time interval T_1. The inverter side of the Z-Source network can now

> *The equivalent switching frequency from the impedance source network is six times the switching frequency of the main inverter...*

be represented by an equivalent circuit as shown in Fig. 4.

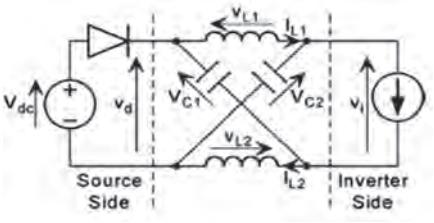


Fig 4: Equivalent circuit when ZSI in non-shoot through state...

The following equations can be written:

$V_L = V_{dc} - V_C$

$V_d = V_{dc}$

$V_i = V_C - V_L$

Putting $V_L = V_{dc} - V_C$ in above equation

$V_i = V_C - (V_{dc} - V_C) = V_C - V_{dc} + V_C = 2\ V_C - V_{dc}$ ..... (2)

Averaging the voltage across a Z-source inductor over a switching period (0 to T),

$V_C = T_1 / (T_1 - T_0)\ V_{dc}$ ..... (3)

Using equations (2) and (3)

The peak DC-link voltage across the inverter bridge is

$V_i = 2\ V_C - V_{dc}$

$= 2\ [T_1 / (T_1 - T_0)\ V_{dc}] - V_{dc}$

$= (2\ T_1 - T_1 + T_0) / (T_1 - T_0)\ V_{dc}$

$= (T_1 + T_0) / (T_1 - T_0)\ V_{dc} = (T_1 + T_0)/(T_1 + T_0 - 2T_0)\ V_{dc}$

$= (T) / (T - 2T_0)\ V_{dc}$

$= 1 / (1 - 2T_0/T)\ V_{dc}$..... (4)

$V_i = B.\ V_{dc}$.....(5)

Where, $B = T/(T_1 - T_0)$ i.e. ≥ 1 and B is a boost factor, T-Switching period.

The peak AC output phase voltage, For Z- source

$V_{ac} = M.V_i/2 = B.M\ V_{dc}/2$

In the traditional sources, $V_{ac} = M.\ V_{dc}/2$, where M is modulation index. The output voltage can be stepped up and down by choosing an appropriate buck – Boost factor BB = B.M (it varies from 0 to α), where α = firing angle. The Buck – Boost factor BB is determined by the modulation index M and the Boost factor B. The boost factor B can be controlled by duty cycle of the shoot through zero state over the non-shoot through states of the PWM inverter.

The shoot through zero state does not affect PWM control of the inverter, because it equivalently produce the same zero voltage to the load terminal. The available shoot through period is limited by the zero state periods that are determined by the modulation index.

Description of ZSI - Hardware

A ZSI has been fabricated using IGBT switches and associated control circuits and a microcontroller. A switching frequency of 10kHz is used. The parameters of Z-network are $L_1 = L_2 = 1mH$; and $C_1 = C_2 = 900\mu F$. The inductors and capacitors were oversized in the prototype for possible regenerative operation during deceleration or inverter trips.

Fig 5: Hardware configuration...

An uncontrolled rectifier using diodes whose output voltage is 314 volts DC is fed to the Znetwork. The ZSI is used to control a 3-Φ squirrel cage induction motor whose specifications are given in Table I.

ZSI and loading arrangements are shown in fig. 5. The block diagram of the circuit is also shown in fig. 6.

Simulation & Experimental Results

Simulation Results

For carrying out simulation a model of ZSI and induction motor is developed in MATLAB-SIMULINK using Power System blockset. This model is shown in fig. 7. The simulation studied out for no load, rated conditions and a step change of load from no-load to half load. The waveforms of line voltages and rotor speed build up are shown in fig. 8 and fig. 9 respectively. The following MATLAB simulation is done for loaded condition i.e., the three phase induction motor used in the simulation circuit is loaded mechanically by providing an input torque of 6.26 N-m.

KW/Power rating	0.37/0.5HP
Stator voltage	240 V
Frequency	50 HZ
Number of poles	8
Stator resistance	2.585 ohm /phase
Stator leakage inductance	0.00246 H/phase
Rotor resistance	1.93 ohm /phase
Rotor leakage inductance	0.00246 H/phase
Mutual inductance	0.5937 H
Inertia	0.2 kgm^2
Friction factor	0.005752 N.m.s

Table 1: Specifications of 3-ϕ squirrel cage induction motor...

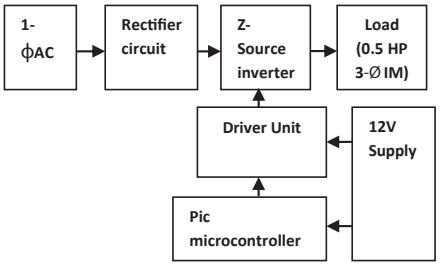


Fig 6: Block diagram of proposed circuit...

i) Inverter Output Line to Line Voltages (V_L):

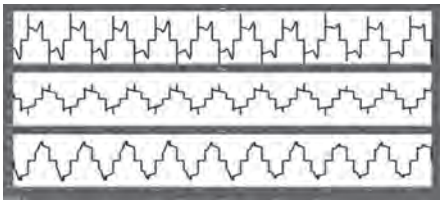


Fig 8: Inverter output line to line voltages...

ii) Rotor Speed (N):

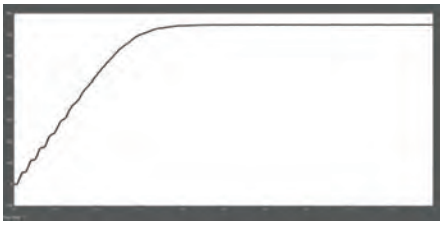


Fig 9: Rotor Speed...

Parameters	Inverter line voltage AC (Volts)	Line Current (Amps)	Motor Speed (rpm)
No Load Condition	245.1	0.99	743.8
Loaded Condition	242.2	2.14	729.2

Table 2: Comparison of Simulation Results...

Hardware Results:

Table II indicates the variables of interest under no-load and rated load conditions with an AC input voltage of 230V (line-line). The rectifier output voltage is seen as 326.3V on

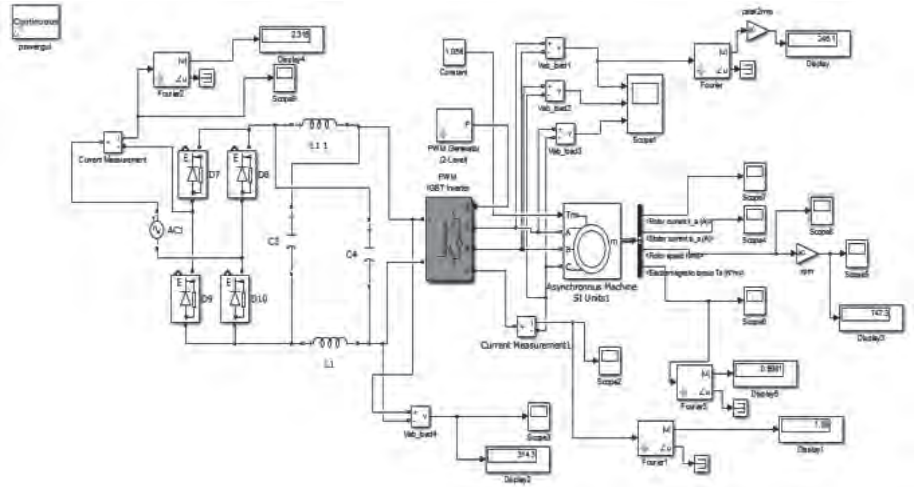


Fig 7: Simulation circuit for Z-Source Inverter fed Induction Motor...

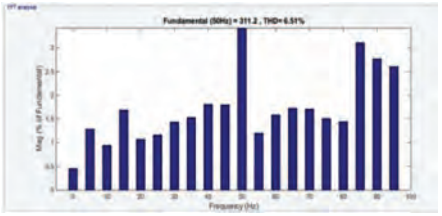


Fig 10: THD analysis of ZSI...

no-load operation of the motor as shown in fig. 11. The inverter voltage could not be pushed up to rated value and the load test has to be carried out at value of 215 V to limit the current to safe values.

Load Test: A load test was carried out on the Z-Source unit to measure the full load current that the inverter would supply three phase induction motor.

Parameters	Inverter line voltage (Volts)	Line Current (Amps)	Speed (rpm)
No-Load Condition	230	1.32	748.8
Rated Condition	215	1.85	693.5

Table 3: Hardware Results at no-load and rated condition...

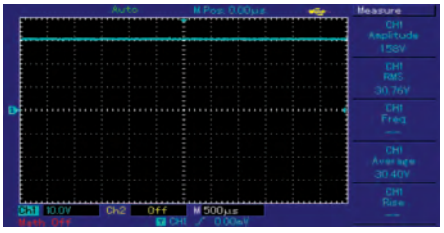


Fig 11: Rectifier output voltage (No load)...

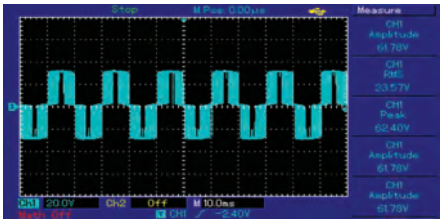


Fig 12: Inverter line to line voltage V_{ab}...

From Table III it is seen that the full load current the proposed inverter circuit can supply is 1.85 Amperes.The line voltage V_{ab} and rectified voltages are shown in fig.11 and 12 respectively.

Conclusion

This article has presented a simplified analysis of ZSI and the steady state operation of 3-Φ induction motor fed by ZSI. Results of simulation study and experimentation are also included and there is a fairly close agreement between the simulation and experimental results.

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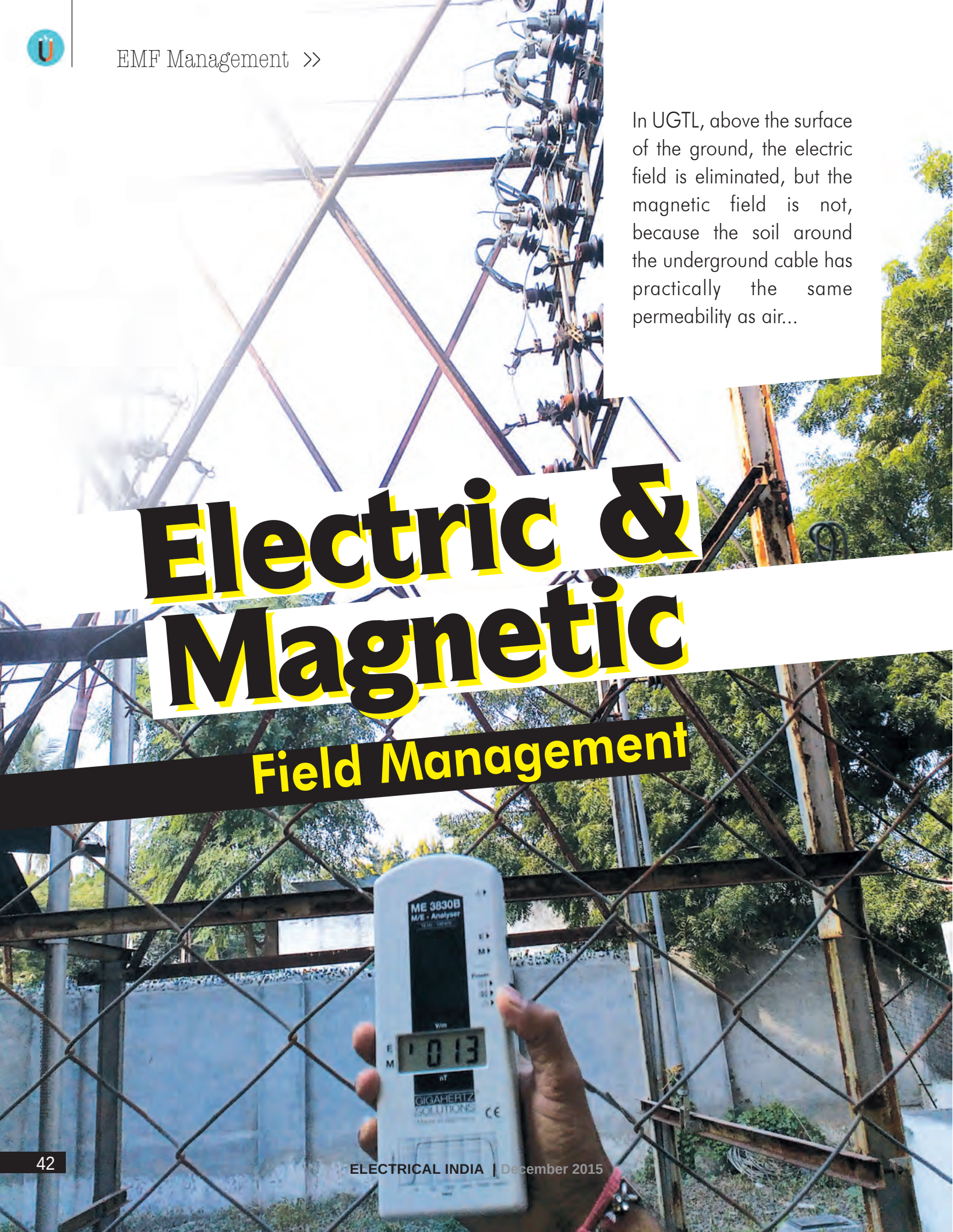
In UGTL, above the surface of the ground, the electric field is eliminated, but the magnetic field is not, because the soil around the underground cable has practically the same permeability as air...

Electric & Magnetic Field Management



Electrical facilities produce power frequency electromagnetic fields. It is reported that these power frequency fields may disturb working of sensitive electronic equipment. Even a human's biological system is reported to be sensitive to these non-ionizing Extremely Low Frequency Electromagnetic Fields (ELF EMF). Concerns for technical as well as health effects of ELF EMF around power frequency sources were evaluated in history and they are still continuing. Even after extensive efforts common and uniform opinion is not drawn technically or clinically. However, professional organisations, like EPRI, have started their efforts towards field management research. Several research programmes were initiated on long run to identify exact association of power frequency fields with instruments and humans. These programmes have the objective to examine and identify ways to reduce the level of exposure to electric and magnetic fields around transmission and distribution lines, substations and other electrical utilities. EPRI or WHO's research programme provides common platform to all the efforts concentrated towards effects of ELF EMF. It avoids the duplication of work as well as helps to test and evaluate the most promising ideas in this concern so that they can be adopted technically. According to EPRI, 'EMF Management' is much more than simply reducing the fields. It may include a variety of activities like communication programs, EMF measurement and assessment, research programs, design of power system components with low EMFs, modification of power system to reduce EMF, tracking ground and net current flows, shielding the sources of EMF, shielding the areas occupied by people or sensitive equipment and reduction of exposure to EMF by selective use of space and time. This article explores all the issues in concern to power frequency ELF EMF management.

EMF measurements

EMFs are generated by generation plants, equipments, T&D lines, and almost all the appliances that work on electric power. Electric field is produced by voltage, whereas current is the source of magnetic field. Major sources of electrical fields are overhead high voltage transmission lines, high voltage equipments in generating stations, overhead distribution lines, special laboratory or industrial equipment and electrical appliances. Magnetic fields are produced by conductors and buses in generating stations and electrical substations, substation equipments, overhead and underground transmission lines, water lines, water mains when carrying ground currents of the power system, electrical wiring of residences, commercial and industrial buildings, electrical appliances and industrial equipment that contains motors or transformers or high current conductors.

The IEEE has set a detailed set up for measurement of electric and magnetic fields.

EMF calculation

In the last few decades, concern about the health effects of EMFs has increased rapidly worldwide. Therefore, the main purpose of calculating the electric and magnetic field sources, such as distribution lines, overhead transmission lines, transmission cables, substations, and residential as well as commercial and industrial sector is to minimise the impact of their dangerous effects.

The electric field can be calculated near the power line at 1 metre above from ground is essentially vertical along the route of the power line. On the other hand, magnetic fields may be calculated 1 metre above from ground is essentially having both vertical and horizontal components. The calculation shall be done at the location of maximum line sag and shall provide MF values at 1 metre above ground level. For more accurate result of magnetic fields from sets of conductors in 3D BIOT- SAVART law is used,

Mathematically it can represent as

$$B(r) = \frac{\mu_o}{4\pi} I \int_C \frac{d\mathrm{l} \times \hat{r}'}{|r'|^2}$$

Where,

B = magnetic field

dl = differential element length

$\hat{r}$ = vector dl to the field point

I = current flows in the conductor

The electric field is determined by the following parameters, such as:

- Working voltage of equipment or line
- Diameter of conductors
- Number of conductors per bundle
- Distance between phases
- Distance of conductors from the ground etc.

Distribution line EMF MGT

Overhead distribution lines generate an electric field around the line that influences the human being and the nearby objects located at ground surfaces. Normally, distribution lines electric fields are so small that they do not produce any effects like spark discharge. But in case of magnetic field management or reducing the magnetic field produced by the distribution system created two special challenges. First one is associated with the large societal cost of an overall change in distribution system. The 2nd one is related to the different techniques that are required to reduce the magnetic field caused by phase and net current.

EMF MGT for transmission lines

Among all the sources of EMF, Overhead Transmission Line (OHTL) produced the greatest EMF. Nowadays, Extra High Voltage (EHV) is transmitted through OHTL. The installations and distribution of EHV transmission line produce the highest electric fields near the ground surface. OHTL produces Extremely Low Frequency (ELF) EMF, which requires reducing to minimum level. In the age of electrification, the evolution of EHV, people are to stay around ELF field sources, which may further be held responsible for biological effects of human as well as living beings. Electric and magnetic field management of overhead transmission lines required in different factors of line design and technique for reduction of EMF have low value. Electric field is reducing to extremely low values using grounded grids of densely spaced wires. And also it's possible to significantly reduce the magnetic field of lines with voltage up to 115 kV or by using loops cancellation method. Underground cabling is the alternative solution to minimise the electric field.

EMF MGT for transmission cables

EMF is an issue that concerns overhead transmission lines. Concern about possible health effects due to EMF overhead transmission line is replaced by Underground

Transmission Line (UGTL) as the solution of EMF problem. In UGTL, above the surface of the ground, the electric field is eliminated, but the magnetic field is not, because the soil around the underground cable has practically the same permeability as air. Thus, near the surface of the ground MF from underground transmission line is higher than that of overhead transmission line as shown below.

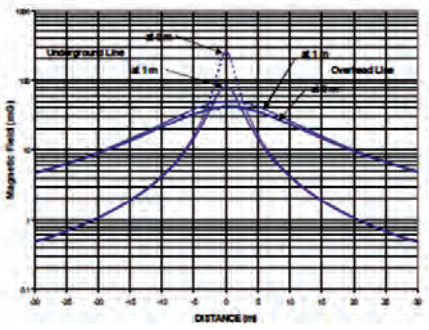


Fig 1: Magnetic field profiles for overhead and underground (Solid Dielectric Cables) transmission lines...

EMF management for substations

Substation is a key component of electrification of any region for smooth operation and reliability of transmission and distribution system. The substation having mainly major components as transmission line, step up/step down transformers, substation buses, sub transmission feeders, and generating circuits.

The EMF produced by substations may expand outside the substation perimeter, where residential and commercial activity takes place. Management of EMF near the substation is very complex issues. Sources of Electric Field (EF) in the substation are the substation buses and HV equipment. Electric field can be controlled at minimum value by design of buses and their geometry and also be reduced by increasing the space between ground and buses.

On the other hand, sources of magnetic field around the substation are substation buses, incoming and outgoing cables, capacitor banks used for reactive power etc. Management of MF around a substation has mainly two purposes: the first is associated with the field level inside the substation to ensure safety for workers, and second one is to minimise the MF outside the perimeters of the substation where residential and commercial settlements are found. This can also be reduced by modeling of conductors and buses.

Residential EMF management

EMF is also produced near the residential area due to the HV transmission line cross over in case of urban areas. People spent most of the time in the home, over the contact of EMF issues. Electric field in the home is relatively small and insignificant as compared to the magnetic field.

Sources of magnetic fields in residential areas are as follows:

- Grounding system of the residence
- Overhead power distribution line
- Electrical appliances
- Electrical wiring
- Overhead transmission lines
- Ground connection at electrical subpanels

Most of the magnetic fields generate in the residential area due to the electrical appliances such as electric heater, air-conditioning, computer etc. placed in the residential environment. It has been a concern because a number of epidemiological studies have indicated to some dangerous diseases – such as leukemia, breast cancer, miscarriage etc.

School, commercial and industrial EMF management

Electric and magnetic fields are not only produced in generation and transmission systems – but they are also produced in the distribution system. The main purpose of management of electric and magnetic fields in schools, colleges, commercial and industrial premises is lowering the exposure to EMF. Sources of MF in industrial areas are mainly the electrical machinery, and equipment that are used in electrical distribution and transmission. According to the survey of EPRI, magnetic field sources in school, commercial are given below.

Sources in school

- Net currents in electrical wiring
- Fluorescent lights
- Electrical typewriters
- Air conditioners and computers
- Aquariums etc.

Sources in office

- Net currents in electrical wiring
- Fluorescent lights
- Currents in cables
- Portable heaters
- Switches and relays in electrical distribution
- Fans, computers etc.

EMF values in the industrial areas are higher than the residential or commercial areas. Therefore, need for management of their EMFs is very important. Their harmful effects include breaking of the bones and tissues.

Conclusions

- Exact association of power frequency fields with instruments and humans is still being evaluated – and efforts are going on worldwide.
- Electric and magnetic fields around transmission and distribution lines, substations and other electrical utilities can be reduced by various technical approaches.
- Communication programmes, EMF measurement and assessment, research programmes, design of power system components with low EMFs, modification of power system to reduce EMF, tracking ground and net current flows, shielding the sources of EMF, shielding the areas occupied by people or sensitive equipment and reduction of exposure to EMF by selective use of space & time are the steps that are used for EMF management.

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Smart Money Is Backing Renewable Energy

According to a recent report titled "India's Electricity Sector Transformation: Global Capacity Building," by Tim Buckley, Director of Energy Finance Studies, Australia; and Jai Sharda, Equitorials under the aegis of the Institute for Energy Economics and Financial Analysis (IEEFA), India has witnessed investments worth more than US$100 billion over the past nine months, which is driving an unprecedented shift to renewable energy development in the country. The report charts the accelerating influx of global capital into India as the country moves toward its goal of installing 175 gigawatts of renewable energy by 2022.

"In India's so-called 'seven horses of energy' electricity sector transformation, renewable energy is ahead of the pack and rapidly gathering pace," says Buckley. "In early 2015, global financial markets were skeptical about whether good intentions and big promises could be turned into concrete actions. But today the figures speak for themselves, with well over US$100 billion of firm commitments signed and sealed. This includes deals with state-owned enterprises, leading Indian power companies, a number of Indian billionaires new to the power sector and leading global renewable-energy firms and global utilities," he adds.

India is executing one of the most radical energy sector transformations ever undertaken, and this year has shown that the flow of finance is matching the ambition…

Significant moves in 2015 have included:

- Four of the world's largest solar manufacturers advancing plans to build Indian solar manufacturing capacity (Trina Solar, JA Solar, Hanwha Q CELLS, LONGi)
- Three of the world's top renewable energy utilities acquiring top Indian renewable project-development firms (EDF Energies Nouvelles, ENEL Green Power, ENGIE)

- Four of North America's top solar-development companies accelerating project development in India (Sky Power of Canada, First Solar, SunEdison & SunPower)
- Numerous leading Asian innovators and utilities targeting Indian renewables (Foxconn of Taiwan, SoftBank of Japan, Sembcorp of Singapore, CLP Group of HK)
- Major Indian energy sector conglomerates initiating multiple new investment programs in renewables (Adani Power, Tata Power and Reliance Power)
- Several of India's wealthiest companies entering the power markets to invest in renewables (Aditya Birla Group, the Dilip family, Bharti Enterprises, Jindal Steel and Power)
- Global development banks and leading equity investors providing innovative green finance (International Finance Corp, the World Bank, KfW of Germany, Asia Development Bank, Abu Dhabi Investment Authority, GE, Goldman Sachs, Actis Capital).

October 2015 alone saw more than a dozen major deals in India's renewable-energy sector, Buckley said, most notably Sany Group, China, announcing plans to invest US$3 billion by 2020, Chint Group, China, announcing plans to invest US$2 billion by 2020, the new SoftBank/Foxconn/Bharti joint venture signing its first US$2 billion memorandum of understanding in Andhra Pradesh for 3GW of renewables – and the German government pledging €1.5 billion over five years to support India's solar energy expansion through a German-Indian solar partnership.

The November 2015 SunEdison solar auction win of 500MW at ₹ 4.63/kWh (US7.1c/kWh) set a record low solar price, 10% lower than the previous record low a few weeks earlier, Buckley cites.

"The consequences for imported thermal coal are stark. The trend, however, is in line with Energy Minister Piyush Goyal's repeated assertion that India's reliance on thermal coal imports is not sustainable," says Tom Sanzillo, IEEFA's Director of Finance.

"This all reinforces the fact that seaborne thermal coal is in structural decline. Coal India Ltd's production and dispatch growth continued to accelerate in the seven months to October 2015, up 10% year-on-year, a gain forecast by no one just one year ago," Buckley says.

"While there is quite simply no rational economic case for imported coal, the speed of renewable developments is now undercutting domestic fossil fuels," he adds. As a case in point, Reliance Power, one of the major private electricity generators in India, is reported to be exiting almost its entire coal and gas fired generation plant expansion plans that included 10 gigawatts of capacity. Reliance Power is also looking to sell its 4-gigawatt Sasan coal-fired Ultra-Mega Power Plant, a project was only fully commissioned at the start of this year.

"Smart money is backing renewable energy. India is executing one of the most radical energy sector transformations ever undertaken, and this year has shown that the flow of finance is matching the ambition," Buckley opines.

ENERGY MONITORING SYSTEM

A Step Towards GREENER FUTURE

The data recorded and reported by the energy monitoring system includes the three-phase voltages, currents and frequencies, total power factor and total active energy...

From the time the seeds of industrialization were sowed with the advent of the industrial revolution, the demand for fossil fuels to power factories and manufacturing units is only increasing. Extensive exploitation of the energy resources and an endless increase in demand for power has caused depletion of resources and hike in power tariff. As the criticality of the situation demands, industries have found it beneficial to deploy energy monitoring systems that aim to maximise power savings. In these systems, a database of electrical data is created. Power wastage can be minimised by closely analyzing the monitored electrical data and implementing a corrective plan of action. This will not only help cut down on hefty electricity bills for industries, but more importantly, promise a better, greener future.

In India, much attention is being given to the energy sector. India has limited fossil fuel reserves, which are depleting at a rapid pace. Taking into account the current reserves to production ratio, India's oil and natural gas may last for less than 20 years, while the coal reserves may last for about 200 years. It is the need of the hour to utilise these precious resources efficiently and to minimise their wastage. Energy monitoring and management system are deployed in industries to ensure energy efficient operations and consumption.

Many such energy monitoring and management systems have been developed over the years for industries as well as for homes. Energy management systems based on ZigBee, IEC 61970 and IEC 61850 international standards, PLC etc. have been proposed, to name a few.

A simple energy monitoring system discussed here has the capability to acquire data from a three-phase supply network, store the acquired data in a relational database and to display the data from the database in the form of reports and trends. It acquires data from the supply using a power measurement module. The power measurement module measures electrical data in a three-phase supply network. The three-phase voltages and currents are fed as inputs to the power measurement module. Based on these input values, total power factor, total active energy and frequencies of the three phases are calculated.

The Programmable Logic Controller (PLC) is programmed to acquire the electrical data from a remote station (where the PLC-based system is installed). The acquired data is stored in a relational database. Modbus TCP communication is used to retrieve live data from the remote station. A Supervisory Control and Data Acquisition system is conceptualised

and developed. It has the capability to generate reports and trends of the data recorded in the relational database. Any wastage of energy can be sensed and corrective action can be taken by monitoring the recorded data.

Hardware Requirement

The energy monitoring system aims to create a relational database. The main hardware used in the energy monitoring system is listed below:

- PLC (Ethernet Programmable field bus Controller): to acquire electrical data from a three-phase supply network and log the data in the database. A Programmable Logic Controller (PLC) is a digital computer which is used to read inputs from input devices, process the input values based on certain logic, and writes output in the output devices. The logic is programmed in PLCs through PLC programming software. Live data of the three-phase supply is obtained through Modbus TCP communication.
- Power Measurement Module: to measure electrical data in the three-phase supply network. Based on the measured current and voltage values, other electrical values are calculated.
- Ethernet Cable: for communication between the PLC and the PC.
- Current Transformers: to step-down the three-phase current supply to be safely applied to the power measurement module.
- End Module: to complete the internal circuitry for proper termination of the module assembly.
- Power supply unit for controller & modules
- MCBs, terminal blocks, DIN rails and panel box

The system is fitted in a panel box, which has two rails attached to it. The controller, power measurement module, end module, power supply unit for the controller and modules, MCBs (Havel's switches) and terminal blocks are mounted on one DIN Rail. Terminal blocks are mounted on the other DIN rail.

The relational database of the electrical data is created in SQL Server. A Supervisory Control and Data Acquisition (SCADA) system is a communication and control system used for monitoring, operation and maintenance of energy infrastructure grids. The SCADA is conceptualised and developed in Visual Studio. It has the capability to allow the user to filter data between two dates and to generate graphs of the data. In this article, the electrical data is acquired by the PLC in every 20ms. The SCADA system displays the data in the form of graphs and reports.

Architecture of the Energy Monitoring System

Electrical System Architecture

Fig. 1 shows the one-line diagram or single-line diagram of the electrical distribution system for which the energy monitoring system is installed. The energy monitoring system monitors the data at the Low Tension (LT) panel highlighted in Fig. 1, i.e., the LT-2 panel. The LT-2 Panel mainly supplies power to the two mold shops & the air compressor. Air Circuit Breaker (ACB) is used as switchgear for the LT-2 Panel.

The current and voltage connections of the three-phase supply from the LT-2 Panel are made to the power measurement module channels. As the current values of the three-phase supply is too high to be directly applied to the power measurement module, current transformers (CTs) of turns ratio 400:5 are inserted between the LT-2 Panel and the power measurement module to step down the currents to a value which can be safely applied to the module. The maximum current that the module can measure is 5A.

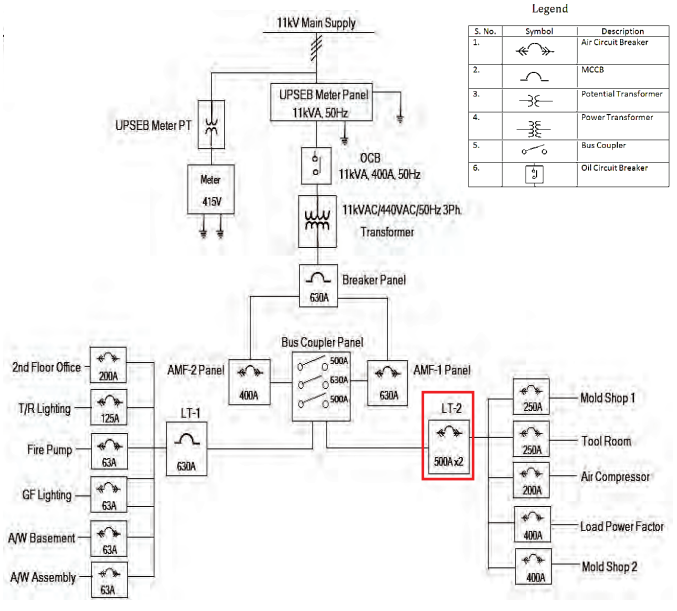

Fig 1: One-line diagram of the electrical distribution system...

Automation System Architecture

Fig. 2 shows the automation system architecture of the energy monitoring system. The architecture depicts how the various

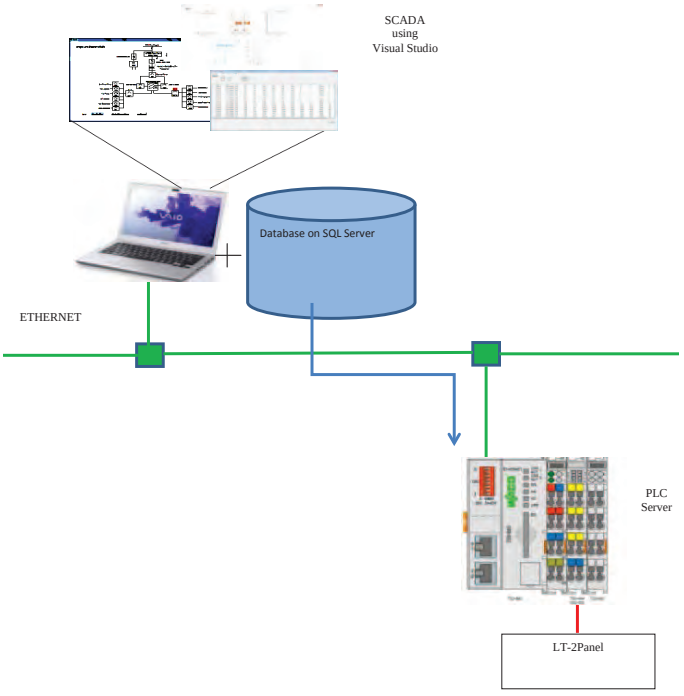

Fig 2: Automation Configuration...

components of the proposed system are connected. Wire connections are made from the LT-2 panel to the power measurement module. The 3-phase power measurement module takes the three-phase voltages and currents as inputs from the LT-2 Panel.

Based on these input values, total power factor, total active energy and frequencies of the three phases are calculated by the module. The power measurement module uses 6 analog/digital converters for acquisition of the current and voltage levels in all three phases.

The power measurement module is connected to the PLC and transfers the measured data to the PLC via data contacts. The PLC communicates with the PC via Ethernet. The PLC is programmed to periodically transfer the measured data to the relational database. PLC programming is done in the software used to program PLCs. The last byte of the IP address of the PLC is manually set using the DIP switch present in the PLC. The values measured are logged in the database after every 20ms. The electrical data logged in the database is as follows:

- Voltage, Current and Frequency of Phase-L1
- Voltage, Current and Frequency of Phase-L2
- Voltage, Current and Frequency of Phase-L3
- Total Power Factor
- Total Active Energy

The relational database for the system is created in Microsoft SQL Server 2012. For the database, a table is created in which every variable is assigned a column. The data is logged into the table row wise by the logic written in programming software to connect to the SQL server database and move the data to the database table. The data recorded and reported by the energy monitoring system includes the three-phase voltages, currents and frequencies, total power factor and total active energy.

Reporting the Data

The database created in the SQL server is linked to self-conceptualised and developed SCADA in Visual Studio software. The SCADA is linked to the relational database in which the electrical data from the PLC is stored. The SCADA displays the data in user-friendly, easy-to-understand form, in order to help operators analyse the power data quickly. It has been proved that an effective SCADA system can save significant amount of time and money.

The proposed SCADA system can display the data that is logged in the relational database in a graphical form. The representation of power data in graphical form eases its study and analysis as well as any discrepancies in the values can be easily noticed.

It also displays the data in a tabular form. Data can also be searched for a single day or between two dates. It provides the operator with the facility to filter data of a specific day or days for a focused study.

The SCADA system also has the ability to display the live electrical values. This is possible with the help of Modbus TCP communication. For Modbus TCP communication with Visual Studio software, a communication related library file is required. MBT.dll has been used, which has inbuilt commands for Modbus TCP communication.

Conclusion

Energy monitoring systems are an effort to contribute to energy conservation. It ensures energy efficient operations in industries, and thus strives to create an energy efficient environment.

The energy monitoring system discussed here fetches data from the three-phase supply network through Ethernet and Modbus TCP communication. The system logs the measured and calculated electrical data in a relational database, creating a record of the data for analysis.

The SCADA developed allows the operator to view the logged data in a graphical form. It also allows data to be viewed in tabular form and to search data between two dates.

The data logged can be viewed and analysed to take measures to save power and minimise its wastage. The logged data also gives an idea of the load distribution in the three phases of the supply. Any sudden changes in power values at any point in time, is also recorded.

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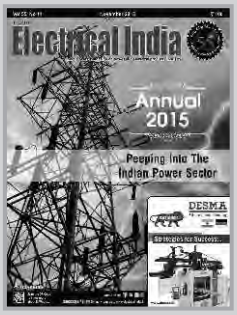

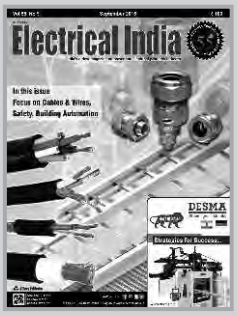

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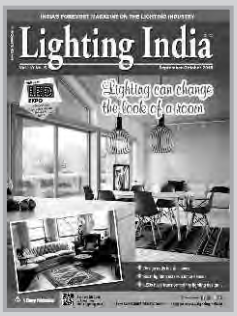

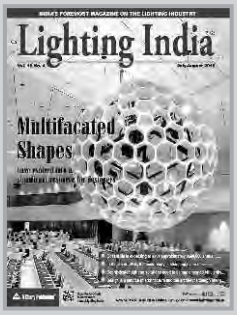

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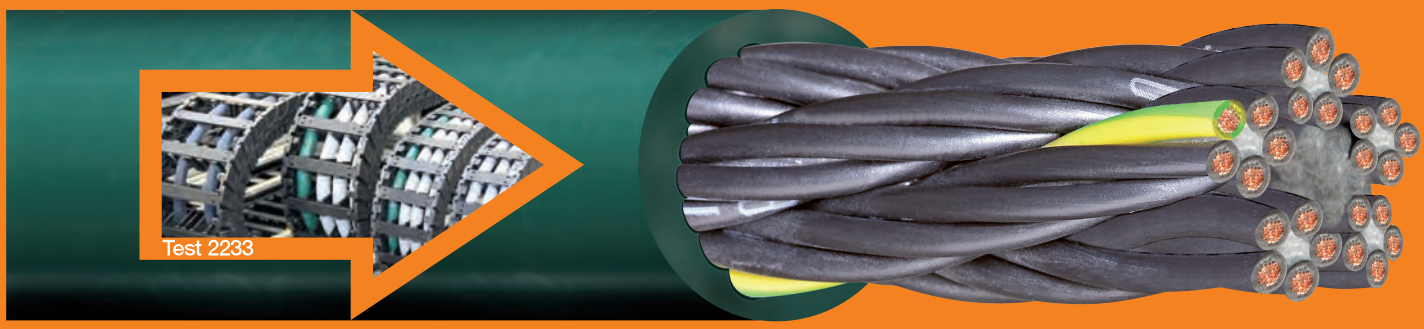

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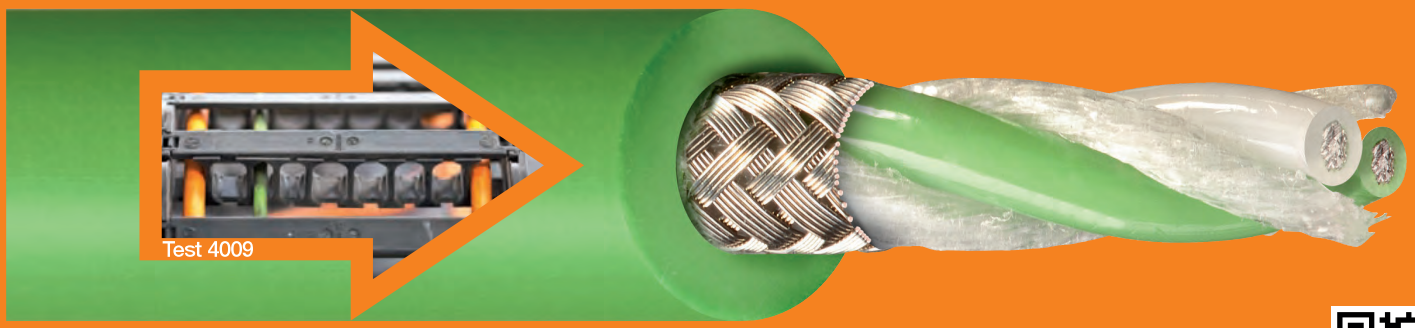

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Heat Integration Of A Milk Plant

Many manufacturing industries use processes in which there are a large number of hot and cold streams, thus making the design of total heat recovery network more complicated...

In grass root stage, if the energy system of a milk processing plant is properly planned with heat recovery options, a good amount of electricity (power) and steam can be saved.

Energy analysis of 2,000 litres per day is shown in nutshell – along with pinch point identification for minimum energy, with respect to heating and cooling load. Modern techniques are also discussed for energy efficient milk processing.

Objective of this article

Due to improper energy resource conservation planning, many dairy complexes consume more than optimum energy. Grass root level energy analysis, pinch point identification and timely incorporation of energy efficient equipments keep dairies energy efficient.

In this article, an attempt has been made for 2 lakh litres per day milk plant.

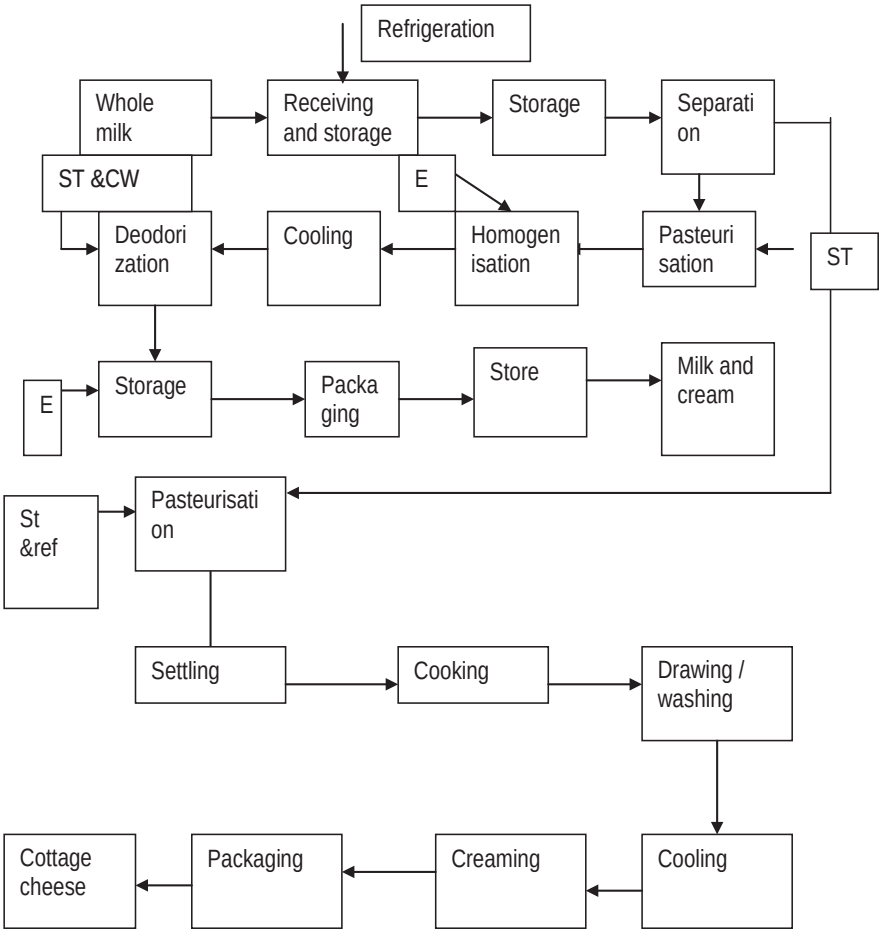

Fig 1: Flow diagram of a milk plant...

Flow diagram and process energy analysis

Energy analysis of two lakh litre milk plants per day.

A typical milk plant use

Both electricity and heat. Heat is used at different temperature from ten degrees to 121 degrees Celsius. Here, heating and cooling load are required.

In depth and accurate energy analysis at every process stage can yield some interesting integration areas.

Normally overlooked at grass root construction level, two lakh litres per day milk processing plant is taken for analysis.

Process integration

Many manufacturing industries use processes in which there are a large number of hot and cold streams, thus making the design of total heat recovery network more complicated affair with large network of heat exchangers to consider.

For many years, the approach to such network was either by thumb rule or, a systematic mathematical examination of all possible configurations to try to achieve the best layout. Both approaches led to good answers but neither claimed to generate optimum solutions because neither could identify the ideal amount of heat recovery.

Another approach to network design has been developed and gaining popularity in process – because of basic methods that allow the user to identify optimum heat recovery, and the arrangement of heat exchanger, which will achieve this recovery. This approach is named as Pinch technology.

The Pinch concept

Pinch analysis (or pinch technology) is a rigorous, structured approach that may be used to tackle a wide range of improvements related to process and site utility. This includes opportunities such as reducing operating costs, de-bottlenecking processes, improving efficiency, and reducing and planning capital investment. Major reasons for the success of Pinch analysis are the simplicity of the concepts behind the approach, and the impressive results it has obtained worldwide.

It analyses a commodity – principally energy (energy pinch), hydrogen (hydrogen pinch), or water (water pinch) – in terms of its quality and quantity, recognising the fact that the cost of using that commodity will be a function of both.

In general, we are using high-value utilities in our process and rejecting waste at a lower value. For example, if we consider energy, we may be burning expensive natural gas to provide the process with high temperatures heat, and are rejecting heat at low temperatures to cooling water or air. In the case of water, we feed pure water to our process and reject contaminated waste water to treatment plants.

For process gases, such as hydrogen, the expensive utility is the pure gas that is either produced on-site or imported. Pinch analysis now has an established track record in energy saving, water reduction, and hydrogen system optimisation. In all cases, the fundamental principle behind the approach is the ability to match individual demand for a commodity with a suitable supply. The suitability of the match depends on the quality required and the quality offered. In the context of utility management, the commodity may be heat, with its quality measured as temperature; or it may be water or hydrogen, the quality of which would be purity or pressure, for example.

By maximising the match between supplies and demands, we minimise the import of purchased utilities.

Energy analysis

Pasteurisation: It is a process where milk and cream temperature is raised to 73^0C for a short while in order to destroy all bacteria, steam at 121^0C is used as heating medium. Here, milk and cream at 10^0C is after sudden heating to 73^0C is cooled to 37.7^0C. This is illustrated in the tables around.

Stream No.	Identification	Flow (kg/hr)	KW/C	T_1	T_2	ΔH(KW)	Type
3	steam	13323	230.7	121	62	8720	Hot
4	Milk-cream	8174	9.5	30	73	+598	cold
5	Milk cream	8174	9.5	73	37	-337	hot

Stream No.	Identification	Flow (kg/hr)	Kw/c	T_1	T_2	ΔH	Type
1	Raw Milk	8333	105.59	4.49	8.88	458.81	cold

Electricity is lost in form of heat...

Stream No.	Identification	Flow (kg/hr)	Kw/c	T_1	T_2	ΔH	Type
2	Milk, cream, skim milk etc	8333	105.59	8, 8	10	122.79	cold

Electricity is consumed @ 1844 kWh per day...

Stream No.	Identification	Flow (kg/hr)	KW/C	T_1	T_2	ΔH(KW)	Type
3	steam	13323	230.7	121	62	8720	Hot
4	Milk-cream	8174	9.5	30	73	+598	cold
5	Milk Cream	8174	9.5	73	37	-337	hot

Table 1...

Process Stage-Pasteurisation and Cooling							
Stream No.	Identification	Flow in kg/hr	Kw/c	T_1	T_2	ΔH(kw)	Type
6	Milk, Cream	8174.6	26.39	37.7	0.55	-926.9	Hot

De-odorisation							
Stream No.	Identification	Flow in kg/hr	Kw/c	T_1	T_2	ΔH(kw)	Type
7	MILK	7936.5	60.23	0.55	3.33	+167.44	Cold
8	steam	158.73	64.16	121.11	82.22	-2496.5	Hot
9	Cooling water	3968.25	110.74	23.8	35	+1240.31	Cold

Process Stage-Storage							
Stream No.	Identification	Flow in kg/hr	Kw/c	T_1	T_2	ΔH(kw)	Type
10	MILK,	238.5	4.029	0.55	3.33	+11.16	COLD

Process Stage-Pasteurisation							
Stream No.	Identification	Flow in kg/hr	Kw/c	T_1	T_2	ΔH(kw)	Type
11	Skim milk	158.73	1.77	3.3	73	+128.23	cold
12	STEAM	190.476	72.58	121.1	82.2	-2831	hot

Process Stage-Settling							
Stream No.	Identification	Flow in kg/hr	Kw/c	T_1	T_2	ΔH(kw)	Type
13	Skim milk	158.73	1.77	0.55	3.33	+4.92	cold

Process Stage-Cooking							
Stream No.	Identification	Flow in kg/hr	Kw/c	T1	T2	ΔH(kw)	Type
14	Skim milk	158.73	1.908	3.3	100	+184.14	cold
15	STEAM	238	96.24	121.1	82.2	-3744	hot

Settling

In the process of settling of skimmed milk, the temperature is gained from 0.55^0C to 3.33^0C, the heat gain is definitely loss since in next processing stage, the hthr summarises in table (Electricity is lost in form of heat...)

Separator

Here, by application of electricity, the milk is separated into skimmed milk & cream fraction. The overall heat transfer is represented as (*Electricity is consumed @ 1844 kWh per day...*)

Temp	Cumulative Kilocalorie
0.55^0C	0
3.33	263.43
10	1602.49
23	6530.14
26	6796.75
73	30454.67
82.2	30557.76
100	177857.75
121.1	384394

Table 2: Composite Curve Data for Streams Requiring Heating...

Temp	Cumulative Kilocalorie
0.55	nil
3.33	73.36
23.38	641.37
26.66	733.60
37.7	1024.94
73	1362.40
82	1362.40
100	9524.41
121	19174.28

Temp	Cumulative Kilocalorie
121	19174
100	9524.41
82	1362
73	1362
37	1024
26	733.60
23	641
3.3	73.36

Table 3: Composite Curve Data for Streams Requiring Cooling...

Pasteurisation- 2nd stage: It is a process where milk and cream temperature is raised to 73^{0}C for a short while in order to destroy all bacteria, stream at 121^{0}C is used as heating medium. Here, milk and cream at 10^{0}C is after sudden heating to 73^{0}C is cooled to 37.7^{0}C. This is illustrated as (Table 1). Here, condensate discharged at 82^{0}c is a loss. This loss is recoverable in the form of flash steam which can be used to generate hot water.

Homogenisation

Milk is homogenised by constant stirring at a temperature of 37^{0}C; electrical power is used in mixing process. Other processes are pasteurisation, cooling deodorisation, drying etc.

At Pinch point when ΔT=0, minimum external cooling load is 0 kCal ΔT =10^{0}C below Pinch total cooling load is nil and heating load is 3.75 lakh kCal

The energy design below Pinch point, total external cooling load was 7568 kW, heat recovery network eliminated heat load of 691 kW plate heat exchangers can be used in addition of existing.

Process Stage, Drawing, Wash and Cooling							
Stream No.	Identification	Flow in kg/hr	Kw/c	T1	T2	ΔH(kw)	Type
16	Skim milk	13.66	1.21	100	26.66	-88.74	hot
17	STEAM	88.79	13.04	23.88	35	+145.11	cold

Process Stage-Creaming							
Stream No.	Identification	Flow in kg/hr	Kw/c	T1	T2	ΔH(kw)	Type
18	Skim milk	142.8	1.69	26.6	23.38	-5.58	hot

Process Stage-Packaging							
Stream No.	Identification	Flow in kg/hr	Kw/c	T1	T2	ΔH(kw)	Type
19	cheese	142.85	1.94	23.38	3.3	-39	hot

Process Stage-Storage							
Stream No.	Identification	Flow in kg/hr	Kw/c	T1	T2	ΔH(kw)	Type
20	cooling water	120.48	3.35	23.3	35	+39	cold

Pinched design:

Hot stream at pinch = 20^{0}c

Cold stream at pinch = 0^{0}c

Extl heating duty = 3.75 lakh Kilocalorie

Extl cooling duty = nil

Existing heating KCal demand: 239.682x1013 kcal

Pinched kCal demand -3.75x105 Kilocalorie

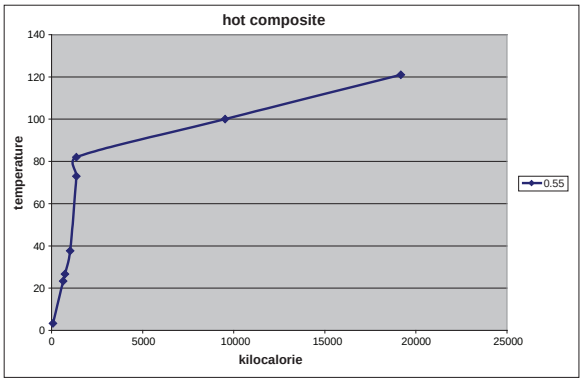

Fig 2: Hot composite curve...

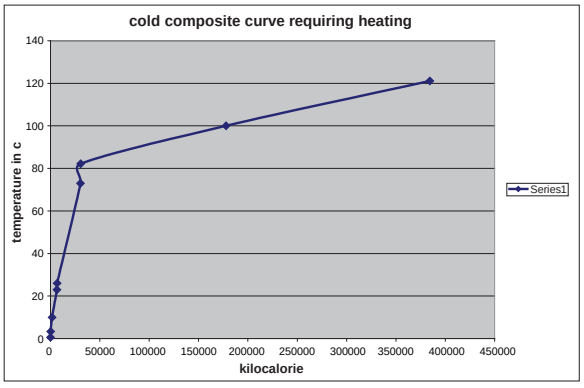

Fig 3: Cold composite curve...

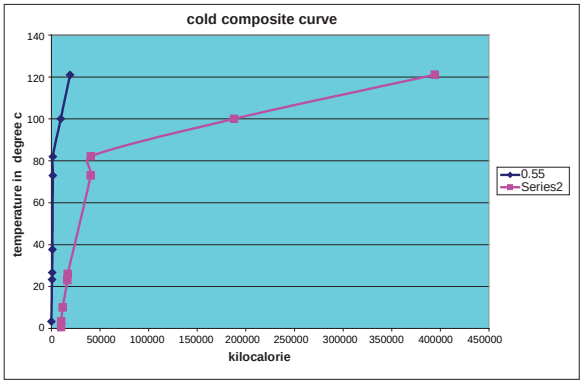

Fig 4: Hot and cold superimposed showing pinch...

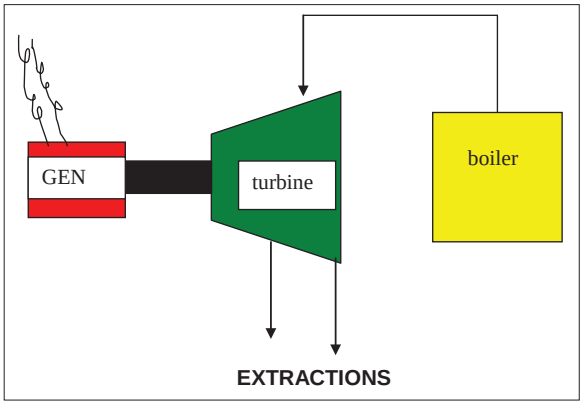

Fig 5: Sketch of cogeneration plant...

Option of cogeneration

In a 2 lakh litre/day dairy plant, the electrical load is 12093 kWh/day, and steam demand is 13920 kg/hr the elect: steam ratio is (12093 x 860 / 13920 x 662 x 24) or, 1:2, a oil fired boiler with back pressure turbine having extraction will reduce cost of production.

A simple system sketch is shown (Fig. 5). The initial investment will offset production cost of electricity and steam.

New energy efficient technologies

On-thermal pasteurisation methods: A key focus of the relevant new technologies for dairy processing is non-thermal methods for pasteurisation and bacterial control. Benefits of such technologies include reduced energy use and extended product shelf-life. Three potential pasteurisation technologies at varying stages of development are identified: micro filtration; high hydrostatic pressure; and electrical field effects.

Ultraviolet light non-thermal bacterial control: UV light systems are already commercialised for processes such as water disinfection in breweries, but are not used extensively in dairies. Although it is not directly applicable to milk streams, UV systems of different types are applicable to bacterial control for disinfection of whey and water, such as for recalculated water flows.

Vacuum superheated steam drying: This highly efficient drying method, allows for the reuse of recovered evaporation as useful steam. Vacuum operation is used to ensure adequately low operating temperature. The technology is commercially applied in Europe in other industries.

Pulsed drying systems: A number of such technologies have been developed, which can reduce energy inputs to drying operations. Some technologies have been commercialised, although not yet extensively applied to dairy processing's Enzyme-based cleaners. The use of enzyme-based cleaners allows for a reduction of heating requirements for CIP operations. Enzyme - based cleaning chemicals are now being introduced into the market.

Just-in-time dairy concept: This concept from automobile industry is now in R&D stage by equipment manufacturers. It could reduce/eliminate raw and product storage, and reduce refrigeration requirements.

Energy efficient motor

The energy efficient motor reduces energy loss through improved design, better material & improved manufacturing techniques. Replacing a motor may be justifiable solely on electricity cost savings derived from an energy efficient replacement. This is true if the motor runs continuously.

Maximum demand controller

The consumers have to pay a maximum demand charges in addition to the usual charge for the number of units consumed. This charge is based on highest amount of power used during some period say 30 minutes, during metering month. The maximum demand charge often represents a large proportion of total bill. MD controller turns off non-essential load during high power use period.

Conclusion

Process integrations coupled with energy efficient devises use can reduce energy bill to bare minimum, at grass root level dairy establishment. A dairy should be located besides refinery, chemical plant where steam is a by-product.

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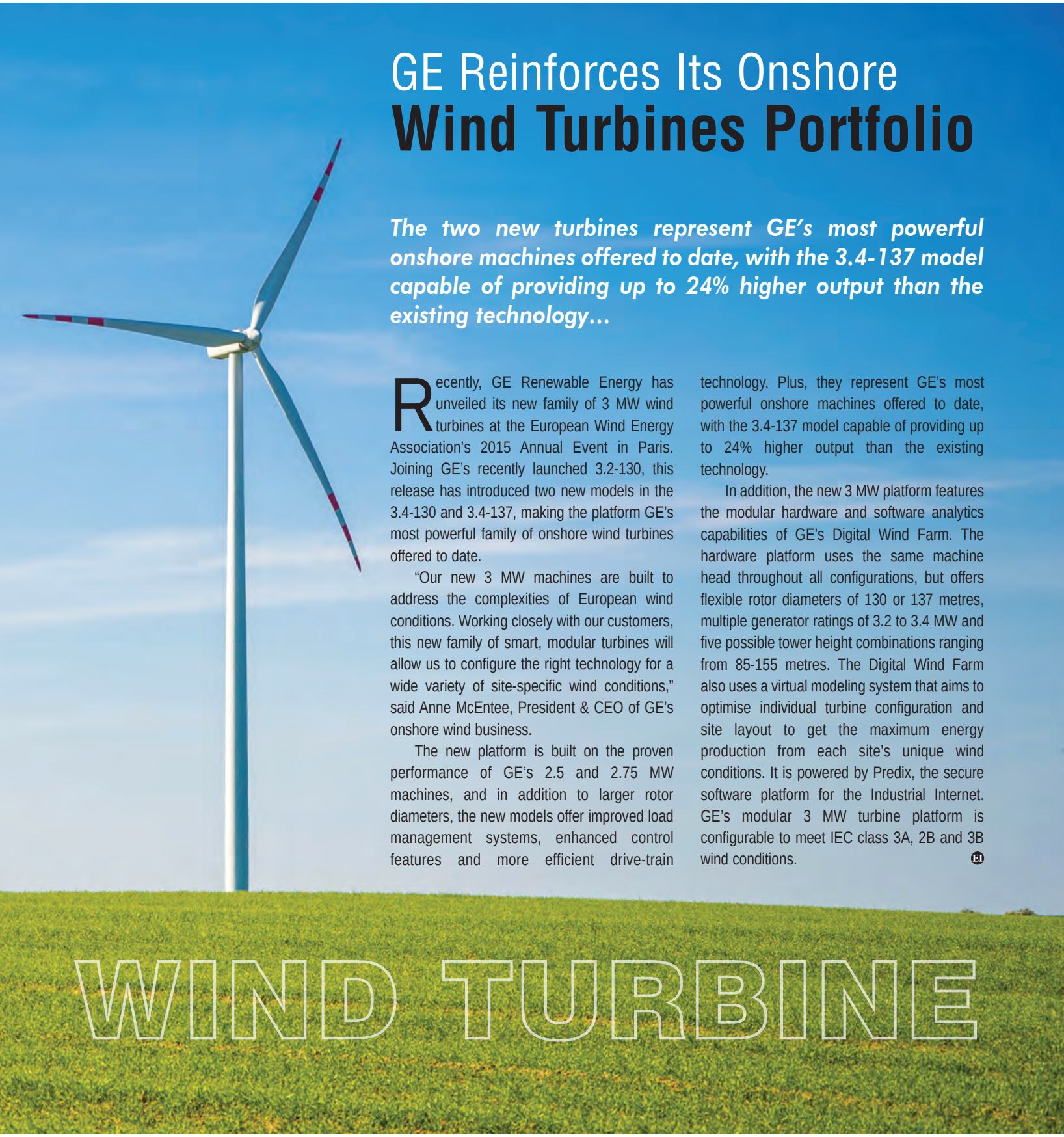

GE Reinforces Its Onshore **Wind Turbines Portfolio**

The two new turbines represent GE's most powerful onshore machines offered to date, with the 3.4-137 model capable of providing up to 24% higher output than the existing technology...

Recently, GE Renewable Energy has unveiled its new family of 3 MW wind turbines at the European Wind Energy Association's 2015 Annual Event in Paris. Joining GE's recently launched 3.2-130, this release has introduced two new models in the 3.4-130 and 3.4-137, making the platform GE's most powerful family of onshore wind turbines offered to date.

"Our new 3 MW machines are built to address the complexities of European wind conditions. Working closely with our customers, this new family of smart, modular turbines will allow us to configure the right technology for a wide variety of site-specific wind conditions," said Anne McEntee, President & CEO of GE's onshore wind business.

The new platform is built on the proven performance of GE's 2.5 and 2.75 MW machines, and in addition to larger rotor diameters, the new models offer improved load management systems, enhanced control features and more efficient drive-train technology. Plus, they represent GE's most powerful onshore machines offered to date, with the 3.4-137 model capable of providing up to 24% higher output than the existing technology.

In addition, the new 3 MW platform features the modular hardware and software analytics capabilities of GE's Digital Wind Farm. The hardware platform uses the same machine head throughout all configurations, but offers flexible rotor diameters of 130 or 137 metres, multiple generator ratings of 3.2 to 3.4 MW and five possible tower height combinations ranging from 85-155 metres. The Digital Wind Farm also uses a virtual modeling system that aims to optimise individual turbine configuration and site layout to get the maximum energy production from each site's unique wind conditions. It is powered by Predix, the secure software platform for the Industrial Internet. GE's modular 3 MW turbine platform is configurable to meet IEC class 3A, 2B and 3B wind conditions. EI

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90% of Indians Like Energy Efficient Products

Who doesn't use hot water for bath in the country? But how many of us are aware of the ongoing trends and customers' preferences when it comes to buying electric water heaters? GFK's latest survey reveals some interesting facts about this industry...

There are various different methods of obtaining hot water for bathing purpose in India, but many of today's modern Indian households are turning to the convenient method of using the electric water heater. GfK point of sales data revealed that people in the country spent over USD 178 million (over 2.1 million pieces) in the past 12 months on this appliance.

According to the latest findings, consumers in India prefer storage water heaters over the instant type with every seven in ten units sold being the storage type. The cheaper, instant water heaters account for the remaining 30% of sales volume.

"Although Indian households utilise several different methods of heating up water such as boiling, using immersion heating rod, solar water heaters, and gas water heaters; many are increasingly turning to electric water heaters for safety reasons," highlighted Dheeraj Mukherjee, Senior Director, Technology and Home & Lifestyle for GfK in India.

"Although storage water heaters are more expensive, they are preferred due to the larger family sizes in India, which makes more financial sense in the long run," he added.

GfK reports also showed that demand for the various capacity electric water heaters vary according to regions. For instance, in the last 12 months, the northern region reported a higher proportion (45%) of sales volume for the 25 litre capacity, while the southern and eastern regions prefer the smaller 15 litre (35% & 27% respectively) sized electric water heaters. Meanwhile, 39% of electric heater sales volume in the western regions was contributed by the 3 litre sized models.

It is interesting to highlight that demand for electric water heater in India tend to surge in the last quarter of the year. For example, 43% of full year's sales volume was concentrated in that period of the last year. In the month of October 2014 when the festive period of Diwali took place, the market grew by 78% in volume terms as compared to normal months due to the impact of festive period and change of season.

In a separate consumer study conducted by GfK in 2014, 9 in 10 Indians said they would choose energy efficient products when buying consumer durables. This attitude is further reinforced by the latest GfK point of sales data on electric water heater, where 90% of all storage water heaters sold in the country were rated either 4 star or 5 star in energy efficiency.

"In the foreseeable future, competition is likely to heat up as manufacturers start to recognise the untapped potential of this market and start to actively launch more brands and innovative models, and market the electric water heater as a necessity to complete the home," Mukherjee concluded.

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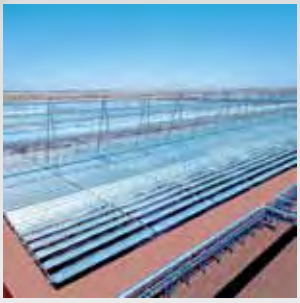

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ABB Rolls Out The Ten Millionth Low Voltage Drive

Compatible with virtually all types of processes, motors, automation systems and users, ABB's all-compatible drives are designed to tackle any motor-driven application in any industry, whatever be the power range...

The 10 millionth ABB drive and Gu Yi, Vice President of Wuhan Guide Electric Group Co., Ltd...

> ***Drive number 10 million is an ACS880 industrial drive. The innovation behind all-compatibility is the new drive architecture, which simplifies operation, optimises energy efficiency and helps maximise process output...***

The ten millionth drive will control a port crane...

There is definitely something to cheer on a big achievement in ABB... Yes, 10 million is quite a big size. Also, if we focus on the carbon saving that ABB's drives have offered globally, the figure is significantly big...

Recently, in November 2015, the ten millionth ABB low voltage drive rolled off the production line at ABB's Beijing factory.

The ten millionth drive is going to Wuhan Guide Electric Co., Ltd. in China, a system integrator manufacturing electric control systems for port cranes.

"The outstanding Direct Torque Control (DTC) motor control technology and built-in crane control software of ABB's industrial drives help us maximise crane performance. For our customers – the ports – ABB industrial drives mean improved safety, high availability, and high total efficiency, resulting in lower energy costs," says Li Xiang, CTO of Wuhan Guide Electric Group Co., Ltd.

Drive number 10 million is an ACS880 industrial drive, part of ABB's all-compatible drives portfolio.

ACS880 industrial drives series is part of ABB's all-compatible drives series...

Compatible with virtually all types of processes, motors, automation systems and users, they are designed to tackle any motor-driven application in any industry, whatever be the power range.

The innovation behind all-compatibility is the new drive architecture, which simplifies operation, optimises energy efficiency and helps maximise process output. The ACS880 series consists of single drives, multidrives and drive modules.

"We place high demands on our suppliers, especially concerning product quality, reliability and service. ABB drives live up to our requirements, and for ten years now we've had a strategic partnership with ABB," says Li Xiang.

ABB developed its first AC drive in the 1970s, and today they offer the most advanced range of variable speed drives in the world. ABB drives cover a wide power and voltage range, including voltages up to 13.8 kilovolts and power up to 100 megawatts.

Using variable speed drives to intelligently control motors increases energy efficiency. Over the 40 years that ABB has been delivering millions of drives to all industries, a huge amount of energy has been saved. The installed base of ABB drives saved 445 TeraWatt-hours (TWh) in 2014 alone, equivalent to the consumption per year of more than 110 million households in the EU. If that 445 TWh would have been generated by fossil fuel-powered electricity plants, ABB drives reduced CO_2 emissions in 2014 by about 370 million metric tons, corresponding to the yearly emissions of more than 90 million cars. EI

dena Presents Energy Efficiency Awards

Lidl, Bauer, InfraLeuna and Bharat Forge received the awards for their outstanding contributions...

The Deutsche Energie-Agentur, popularly called 'dena' (the German Energy Agency), has named the winners of the Energy Efficiency Award 2015. Retail company Lidl won the first prize for developing an energy-efficient branch type and implementing it at 217 locations. The second prize went to medium-sized company Bauer Group for its systematic reduction of electricity and heat consumption with a corporate energy management system. The third prize was bagged by InfraLeuna, an operator of infrastructure facilities, for a company-wide, optimised medium-pressure steam system. In addition, Bharat Forge, a forming company domiciled in India, received an honorary mention for the demand-based and optimised control of its cooling systems.

"The winners of the Energy Efficiency Award show that it pays to invest in energy efficiency," said Andreas

The group of award winners with their certificates...

Kuhlmann, Chief Executive of dena at the award ceremony during the 6th dena Energy Efficiency Congress in Berlin. "Returns on investment of over 20% prove it – this is how the applied energy transition works, and how energy efficiency can become a success model in industry and businesses. Many companies can benefit from these award-winning examples, if they tap their own potential," he added. EI

Climeon AB Bags F&S's Award

The technology provides customers with superior operating efficiency...

Climeon AB has been awarded 'Technology Innovation Award' at the 'Excellence in Best Practice Award Banquet' hosted by Frost & Sullivan (F&S) in Frankfurt, Germany.

F&S also released a report on Marine Waste Heat Recovery Solutions rating Climeon as #1 with a scoring of 9.2 (excellent) on a scale from 1 to 10. In their report, F&S conclude that the technology 'provides customers with superior operating efficiency' and that Climeon delivers 'a high return on investment' to its customers.

"It's a great honour for us winning such a prestigious award," says Climeon CEO Thomas Öström. In their conclusion F&S states that they '...fully expect this system to take off within the marine industry.' EI

Climeon AB receives the award from F&S...

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Date
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Bombay Exhibition Center, Mumbai

Date
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Renewable Energy India Expo 2016

Venue
India Expo Centre, Greater Noida

Date
07 to 09th Sep. 2016

INTERNATIONAL

POWER-GEN Europe

Venue
MiCo Milano, Milan, Italy

Date
21st to 23rd June, 2016

POWER-GEN Natural Gas

Venue
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Date
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Venue
Kintex, Seoul, South Korea

Date
20th to 22nd Sep. 2016

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Venue
Expo Centre, Moscow, Russian Federation

Date
25 to 27th Oct. 2016

India-Born Businessman Launches
A Bicycle That Generates Electricity

India-born billionaire businessman and philanthropist Manoj Bhargava has launched a stationary bicycle that can generate electricity...

The new stationary bicycle that generates electricity...

India-born billionaire businessman and philanthropist Manoj Bhargava has launched a stationary bicycle that can generate electricity. The product, named Free Electric, has potential to mitigate power shortage in rural India. Just one hour of pedaling the bicycle can generate enough electricity to meet the demand of a rural house for 24 hours.

According to Bhargava, the bicycle will be able to simultaneously power 24 bulbs, an electric fan and charge a cell phone. Around 10,000 such bicycles are expected to hit the Indian market by March 2016. Those will initially be manufactured in the US, and are expected to cost between INR 12,000 to 15,000. Bhargava also has a plan to later start up their production in India to reduce cost.

According to Wikipedia, the free encyclopedia, Bhargava was born in 1952, grew up in Lucknow, India – and moved to Philadelphia in 1967 at the age of 14. There he graduated from The Hill School in Pottstown. He was considered a math whiz, and received a scholarship to attend a private boarding school called The Hill School. In 1972, he attended Princeton University for one year.

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- Radiology & Imaging equipment technology
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- Ophthalmic Instruments
- Oral & Dental Equipment
- Optical Equipment and supplies
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Hannover Messe 2016 Beckons Indians

The world's leading trade fair for industrial technology will next be staged from 25 to 29th April 2016 in Hannover, Germany. The upcoming HANNOVER MESSE will feature five parallel shows: Industrial Automation, Energy, Digital Factory, Industrial Supply and Research & Technology...

In HANNOVER MESSE 2016, major emphasis will be placed on four areas, namely Industrial Automation & IT; Energy & Environmental Engineering; Industrial Subcontracting, Production Engineering & Services; and Research & Development.

The United States will be the Partner Country of HANNOVER MESSE 2016, after a successful India Partner Country programme at HANNOVER MESSE 2015. For many years, HANNOVER MESSE (HM) has been forging deeper ties with the U.S. industry, staging business summits and inviting American delegations to Hannover to promote transatlantic trade relations.

"HANNOVER MESSE 2016 is tremendously important to the development of transatlantic trade relations. With the USA as Partner Country, HANNOVER MESSE is an opportunity to present the complete scale of our business relations and to further expand them," remarks Dr. Peter Wittig, German Ambassador to the United States.

For HANNOVER MESSE, winning the United States as Partner Country is a great success that makes the 2016 event even more attractive. "President Barack Obama has committed himself to strengthening America's domestic industry. The modernization of America's industrial sector and the digital integration of its production plants and equipment are proceeding there at a rapid pace.

The goal of the U.S. government is to regain its status as one of the world's leading production locations, which predestines the United States to be Partner Country at HANNOVER MESSE," reports Dr. Jochen Köckler, Member of the Managing Board at Deutsche Messe.

"HANNOVER MESSE is one of the largest and most preferred industrial shows for engineering and manufacturing sector. It is the best platform to conduct business and build international bilateral trade for the industry and various government organizations. We at EEPC (Engineering Export Promotion Council) have been participating with HANNOVER MESSE for more than 15 years, with showcases of more than 100 Indian companies. Last year, HM had been a milestone for us with India Partner Country programme that showed a participation from more than 352 Indian Companies, high level delegation from corporates and various state & central governments. This year at HM 2016, we will continue the momentum of promoting Indian Exports from India with our participation. The response for Hannover Messe 2016 is great this year and the United States is one of our key trade partners. We look

(L2R) Vijay Saheta, Managing Director, Connectwell Industries Pvt. Ltd.; Bhaskar Sarkar, Executive Director & Secretary, EEPC; Marc Siemering, Senior Vice President, Hannover Messe, Deutsche Messe and Mehul Shah, Managing Director, Hannover Milano Fairs India Pvt. Ltd...

forward to another great year and more business opportunities at HM," says Bhaskar Sarkar, Executive Director & Secretary, Engineering Export Promotion Council (EEPC).

The USA's Partner Country programme will concentrate first and foremost on drawing foreign investment and increasing U.S. exports. In this context, the country will showcase itself as a business-friendly location – and reinforce its reputation as a top-level manufacturer of competitive, high-quality products. Thematic focal points for Partner Country USA include energy efficiency and energy generation, state-of-the-art production engineering, smart technologies, education & training, and transatlantic partnerships.

Last edition of HANNOVER MESSE 2015 saw a successful partner country programme with India and generated a great interest for its 'Make In India' campaign in the manufacturing sector. The event witnessed participation of more than 6500 companies and 2,20,000 trade visitors. Close to 352 exhibitors were from India.

According to Marc Siemering, Senior Vice President, HANNOVER MESSE, "In 2015, 'Make in India' has recorded numerous successes, with Foreign Direct Investment (FDI) in India jumping 27% in the first quarter. HANNOVER MESSE 2016 is the perfect opportunity for the Indian companies to continue that momentum and not only strengthen relationships established in 2015, but also initiate new business contacts and attract further foreign investments. As the world's number one showcase for Industry 4.0 technology, HANNOVER MESSE is the perfect place for visitors from India's manufacturing industry to learn about innovative ways to boost efficiency in their factories." While narrating his experience on HANNOVER MESSE as an Indian participant, Managing Director of Connectwell Industries Pvt. Ltd., Vijay Saheta, informed that he was participating in the event since 1998. Saheta has been successful in disseminating his company's ability to the world through the platform of HANNOVER MESSE.

As per his observation, last year participation from India increased in the trade fair, and he successfully tapped Indian customers from Hannover. The event brings exposure to several new articles that are being introduced newly in the industry. He has contacted and appointed global distributors for his products through this event. Also, he has received Indian distribution offers for some foreign goods.

Already more than 30 companies from Indian power sector (only) have registered to participate in the HANNOVER MESSE 2016. Aren't you coming?

Status Of Nuclear Power Generation In India

Plant	Unit	Type	Capacity (MWe)	Date of Commercial Operation
Tarapur Atomic Power Station (TAPS), Maharashtra	1	BWR	160	October 28, 1969
Tarapur Atomic Power Station (TAPS), Maharashtra	2	BWR	160	October 28, 1969
Tarapur Atomic Power Station (TAPS), Maharashtra	3	PHWR	540	August 18, 2006
Tarapur Atomic Power Station (TAPS), Maharashtra	4	PHWR	540	September 12, 2005
Rajasthan Atomic Power Station (RAPS), Rajasthan	1	PHWR	100	December 16,1973
Rajasthan Atomic Power Station (RAPS), Rajasthan	2	PHWR	200	April 1,1981
Rajasthan Atomic Power Station (RAPS), Rajasthan	3	PHWR	220	June 1, 2000
Rajasthan Atomic Power Station (RAPS), Rajasthan	4	PHWR	220	December 23, 2000
Rajasthan Atomic Power Station (RAPS), Rajasthan	5	PHWR	220	February 4, 2010
Rajasthan Atomic Power Station (RAPS), Rajasthan	6	PHWR	220	March 31, 2010
Madras Atomic Power Station (MAPS), Tamilnadu	1	PHWR	220	January 27,1984
Madras Atomic Power Station (MAPS), Tamilnadu	2	PHWR	220	March 21,1986
Kaiga Generating Station (KGS), Karnataka	1	PHWR	220	November 16, 2000
Kaiga Generating Station (KGS), Karnataka	2	PHWR	220	March 16, 2000
Kaiga Generating Station (KGS), Karnataka	3	PHWR	220	May 6, 2007
Kaiga Generating Station (KGS), Karnataka	4	PHWR	220	January 20, 2011
Kudankulam Atomic Power Project, Tamilnadu	1	VVER -1000 (PWR)	1000	December 31, 2014
Narora Atomic Power Station (NAPS), Uttarpradesh	1	PHWR	220	January 1,1991
Narora Atomic Power Station (NAPS), Uttarpradesh	2	PHWR	220	July 1,1992
Kakrapar Atomic Power Station (KAPS), Gujarat	1	PHWR	220	May 6, 1993
Kakrapar Atomic Power Station (KAPS), Gujarat	2	PHWR	220	September 1,1995

Status Of Projects Under Construction

Project	Capacity (MWe)	Expected Commercial Operation
Kudankulam Atomic Power Project	1 x 1000	Unit 2 – Dec-2015 (First Criticality)
Rajasthan Atomic Power Project	2 x 700	Unit 7 – Jun-2016 Unit 8 – Dec-2016
Kakrapar Atomic Power Project	2 x 700	Unit 3 – Under Review Unit 4 – Under Review

Source: Nuclear Power Corporation Of India Ltd.(NPCIL)

Tentative State-wise Break-up Of Renewable Power Target To Be Achieved By The Year 2022, So that Cumulative Achievement is 1,75,000 MW

State/UTs	Solar Power (MW)	Wind (MW)	SHP (MW)	Biomass Power (MW)
Delhi	2762			
Haryana	4142		25	209
Himachal Pradesh	776		1500	
Jammu & Kashmir	1155		150	
Punjab	4772		50	244
Rajasthan	5762	8600		
Uttar Pradesh	10697		25	3499
Uttrakhand	900		700	197
Chandigarh	153			
Northern Region	**31120**	**8600**	**2450**	**4149**
Goa	358			
Gujarat	8020	8800	25	288
Chhattisgarh	1783		25	
Madhya Pradesh	5675	6200	25	118
Maharashtra	11926	7600	50	2469
D. & N. Haveli	449			
Daman & Diu	199			
Western Region	**28410**	**22600**	**125**	**2875**
Andhra Pradesh	9834	8100		543
Telangana		2000		
Karnataka	5697	6200	1500	1420
Kerala	1870		100	
Tamil Nadu	8884	11900	75	649
Puducherry	246			
Southern Region	**26531**	**28200**	**1675**	**2612**

State/UTs	Solar Power (MW)	Wind (MW)	SHP (MW)	Biomass Power (MW)
Bihar	2493		25	244
Jharkhand	1995		10	
Orissa	2377			
West Bengal	5336		50	
Sikkim	36		50	
Eastern Region	**12237**		**135**	**244**
Assam	663		25	
Manipur	105			
Meghalaya	161		50	
Nagaland	61		15	
Tripura	105			
Arunachal Pradesh	39		500	
Mizoram	72		25	
North Eastern Region	**1205**		**615**	
Andaman & Nicobar Islands	27			
Lakshadweep	4			
Other (New States)		600		120
All India	**99533**	**60000**	**5000**	**10000**

DEIF's Hydro Turbine Control Solutions

Conventional hydro turbine control systems are generally complex and fragmented setups that include a general purpose PLC, separate generator protection relays, synchronisers, governors, water level controls and other auxiliary control systems. These old generation hydro turbine control and protection systems may no longer be up to the task of meeting today's requirements for cost-effective and reliable operation of the hydro power plant. These systems may also be vulnerable to failures due to their complex nature. The suppliers/ manufacturers of these systems are diverse and SMEs, which implies that you as a customer may not get the support when required, which could result in decreasing availability and deteriorating operational reliability of your power plant that can land in loss of revenue.

DEIF, a company of Danish origin with global presence, is one of the world leaders in control solution for the power generation systems on land and marine segments. DEIF with its eight decades of experience has developed control solutions for hydro power, the largest and most economical source of renewable energy. In order to guarantee optimised power plant operations, increase safety and simplify maintenance; DEIF has developed integrated solutions that are capable of performing large number of functions compared to standard systems. Due to their integrated products and solutions they can reduce the maintenance costs to a minimum. DEIF India Pvt. Ltd., a subsidiary of DEIF A/S, Denmark, is the Centre of Excellence for Hydro Power applications. DEIF India develops and provides innovative solutions for power management and control of micro, mini and small hydro power generating sets for the whole world. Their systems have been installed successfully in large number of hydro power plants countrywide over a very short time span. Their product Delomatic, is used by numerous renowned OEMs and end users including Himachal Pradesh State Electricity Board Ltd. and Uttarakhand Jal Vidyut Nigam Ltd., the states with maximum hydro power potential in India.

Globally Local Existence

Their 'glocal' approach combines leveraging global experience with strong local presence and expertise. Their local experts work hand-in-hand with you to meet your exact needs at every stage of the project. DEIF's process helps define problems, identify solutions and develop ideas in a manner that will provide the most successful and appropriate end results.

DEIF HYDRO is supported by global sales and service setup, which gives them a global reach and the ability to serve their customers in any corner of the world. After completion of the project, DEIF offers an extensive local support network in order to ensure high availability of maintenance and other services. Thus, they offer the highest degree of operational safety and efficiency.

Technology through Innovative Solutions

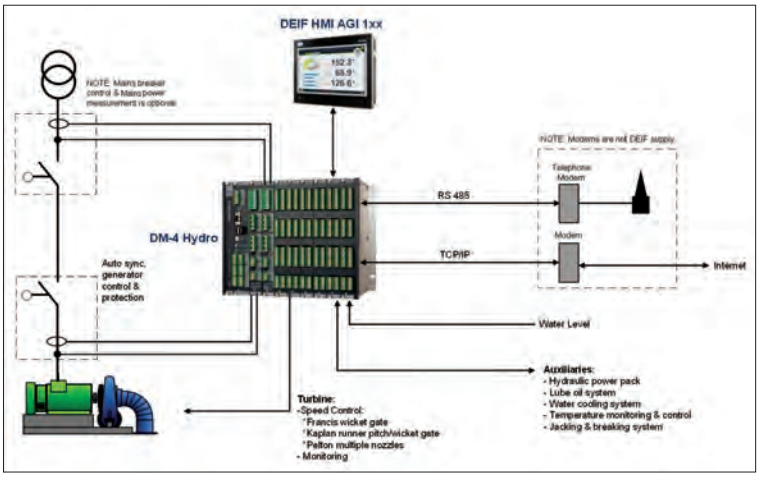
DEIF invests heavily in research and development globally, to provide state-of-the-art technology that meets customers' needs and stay at the forefront of technological innovation. The expertise and vision of their designers and their partnership with different fields of power control equipment, such as Marine, Steam, Gas and Diesel; allow them to consistently offer cutting-edge technology to their customers in hydroelectricity generation sector as well.

Tailor-made Solutions for Specific Requirements

Every project is different in terms of challenges and requirements. Local conditions or budget limitations are also determining factors for hydropower projects. DEIF offers integrated and cost-efficient solutions of different scope according to the customer-specific requirements and capabilities. In the development process their goal is to maximise efficiency by customising their solutions to reach the best possible solution for each client, thus gearing up the customer's profit to a higher level.

Hydro Turbine Generator Control

A customised solution, DEIF's integrated hydro turbine generator control solutions economize installation costs significantly – by using fewer components and lesser wiring compared to systems that require multiple units to provide synchronisation, protection and PLC functionality. Delomatic 4 (DM-4) Hydro-controlled plants offer fully automated control for stable optimised operation and require less maintenance and fewer man hours. The Delomatic 4 Hydro is compatible with all types of turbines and flexible and easy to adapt with simple parameter settings. Critical functions such as speed governing, generator protections and synchronising are fully integrated with password-protected features for maximum security. The controller's Human Machine Interface (HMI) is



easy to operate. Based on the graphic screens embedded in the DM-4 Hydro unit itself, the screens are uploaded to a PC like any other interactive webpage graphics using USB or TCP/IP communication, enabling simple password-protected remote control and monitoring. The advantages to DEIF's Delomatic solution go beyond savings, wiring, construction, engineering and maintenance. It is also a flexible solution equally suited for new installations and retrofits, designed to control hydro turbine generators ranging from 2 kW to 20MW along with its auxiliary equipment.

Delomatic Hydro Features

- Hydro Turbine Controller for Parallel with Mains or Stand-alone Generator
- Speed and Load Control
- Valve Controls (main/drain/fill)
- Water Level Control
- Turbine control, auxiliary control, protection and supervision
- Generator control, Auto synchronisation protection and supervision
- Dedicated HMI touch screen operator panel

DEIF's hydro control systems are not only suitable for new installations but also can be used to upgrade existing plants that can give you following key benefits.

Key Benefits

- Product dedicated to hydro turbines, for new & retrofitted plants
- Modular design
- Extremely reliable and robust
- Can sustain the harshest conditions
- Short commissioning time, easy installation and operation
- Increased plant availability, operational flexibility, reliability, and safety
- Amplified power generation
- Boosted revenues
- Optimized plant operating life
- Reduced service & maintenance costs.

For more information: india@deif.com

Features of Delomatic 4 Hydro	Types of hydro turbines		
	Francis	Kaplan	Pelton
Automatic Start-Stop control	✓	✓	✓
Sequencing Control (Auxiliaries Controls)	✓	✓	✓
Speed & Load Control	✓	✓	✓
Over speed protection with Redundant speed sensor input	✓	✓	✓
HMI with Mini SCADA	✓	✓	✓
Future proof communication (TCP/IP)	✓	✓	✓
Protection – Turbine & Generator	✓	✓	✓
Synchronisation – Auto & Manual	✓	✓	✓
Voltage & Power Factor control	✓	✓	✓
Site selectable CT & PT inputs	✓	✓	✓
Standalone (island) control	✓	✓	✓
Parallel with grid control	✓	✓	✓
Load sharing	✓	✓	✓
Water level control	✓	✓	✓

On-line Partial Discharge Monitoring

MONGEMO – Continuous on-line PD monitoring system for preventing dielectric failure in rotating machines...

MONGEMO – Permanent on-line PD monitoring of hydro generators, turbo generators and electrical motors...

The new MONGEMO on-line Partial Discharge (PD) monitoring system from OMICRON continuously assesses the dielectric condition of stator insulation in rotating machines under load, such as turbo generators, hydro generators and electrical motors. The permanently-installed system collects and analyses PD data over time and identifies insulation defects that could lead to dielectric failure and machine outages.

Customizable system

The system is customizable to match the exact requirements of various rotating machines. It consists of coupling capacitors for PD detection, a 4-channel PD acquisition unit, and a central computer with monitoring and PD analysis software. With the convenient web interface, users can remotely configure the monitoring system, view real-time data and historical trends, and analyse the collected raw data.

Advanced technology

The high PD measurement sensitivity of the MONGEMO monitoring system is based on advanced OMICRON technology for noise suppression and PD source separation. Multiple PD sources are distinguished from external noise through synchronous multi-channel measurements and advanced methods like 3PARD (3-Phase Amplitude Rela-tion Diagram) and automatic cluster separation for convenient visual evaluation.

Actionable data for assessing risk

MONGEMO monitoring software displays real-time data and historical trend diagrams of statistical parameters for each monitored machine, such as PD magnitude and PD pulse frequency. Users are also provided with an event log that displays warnings and alarms when PD activity reaches or exceeds pre-defined threshold values. The related raw PD data can be evaluated further using the system's expert software for in-depth analysis. The actionable data allows users to assess the risk of dielectric failure in their machines and to optimize their maintenance and asset planning.

Seamless integration

MONGEMO supports multiple industrial communications standards. This enables PD monitoring data from MONGEMO to be easily exported to SCADA systems.The system also displays monitoring data from other third-party devices, such as temperature sensors.

Expert advice and support

OMICRON provides users with complete guidance and support during the design, set-up and use of the MONGEMO monitoring system. This includes on-site consultations to evaluate monitoring needs; customized system design, installation, commissioning and training; as well as support with data evaluation & reporting.

PD monitoring detects defects

Statistics for rotating electrical machines show that a major source of their failure is linked to defects in stator insulation. A majority of these defects can be detected early through the continuous, permanent monitoring of PD activity. PD occurs in the stator insulation system of generators and motors, where local electric field stress exceeds the local electrical strength.

Insulation degradation indication

Insulation materials typically used for rotating machines are resistant to a certain level of PD. But, a rise in PD activity over time often indicates insulation defects and degradation caused by operational stress factors and aging processes.

Optimizing maintenance strategy

On-line PD monitoring is a well-established technique used to continuously assess the condition of a stator winding insulation system. The actionable data helps to optimize asset management, maintenance efforts and investment planning. Machine failures can be avoided through the timely implementation of maintenance and repair measures to ensure a longer service life.

130 % stronger

igus offshore energy chains with new separators

igus GmbH, Cologne, has developed new e-chain separators that are extremely abrasion-resistant and are especially suitable for stiff cables and the high fill weights that are typical in the offshore industry. The holding forces of the separators are now 130 per cent greater than those of the usual locking separators of the E4.1 series. The motion plastics specialist has thus supplemented its extensive product range of safe, low-maintenance and energy-efficient systems in the offshore area, enabling customers to improve the technical performance of their systems & considerably reduce their costs.

In order to move several cables and hoses safely in an energy chain, separators within the individual chain links help to keep the cables and hoses securely in position. In applications where heavy or stiff cables are used, as is frequently the case in offshore applications or on vessels, considerable force is exerted on the separators. "We developed the new locking and clamping separators to provide more safety in this context", explained Harald Nehring, responsible for e-chainsystems at igus. "They can be positioned precisely and fastened to the chain link and cannot be removed without the chain link or separator being destroyed." This also ensures a high degree of loss prevention.

Highly abrasion-resistant plastic for less weight and more safety

Injection moulding is used to make the new locking and clamping separators, which are made of the same highly abrasion-resistant plastic that the rest of the energy chain links consist of. "The solutions made of our high-performance plastic are much lighter and easier on the cables than systems with steel chains", said Harald Nehring. "For improved stability, the two available sizes of the new locking and clamping separators are 63 per cent and 78 per cent respectively heavier than the standard locking separators. However, in relation to the total savings of several metric tonnes compared to steel chain systems, this is hardly significant." Due to their robust and corrosion-free, the energy chains from igus are very suitable for use in applications involving high humidity or in contact with oil and grease. In the maritime area, for example, from ships to oil rigs and offshore wind-power stations, igus has been offering safe and reliable customised solutions for more than 20 years, whereby users can achieve weight savings of up to 50 per cent compared to steel chains. At the same time, the users are supported by an experienced partner who supplies complete solutions from a single source and who is there to help them in their work all the way from planning to implementation.

Website: www.igus.in

EX205T & EX210T: True RMS MultiMeters

Both models are autoranging True RMS meters providing a more accurate reading when measuring distorted waveforms. EX210T with built-in IR Thermometer allows for quick noncontact Temperature measurements.

Features:

- True RMS for better accuracy when measuring distorted waveforms
- Patented built-in IR Thermometer with laser pointer for locating hot spots with 4:1 Distance to Target Ratio (EX210T model only)
- 2000 count large backlit dual LCD with easy-to read digits
- Low current capability with resolution to 0.1µA
- Max Hold
- Input fuse protection
- Auto power off and Data Hold
- Complete with test leads and 9V battery.

Website: www.extech.com

3 in 1 Prepaid Meter

Recovering electricity dues remains one of the major challenges in the power sector. Most distribution companies face serious problems in recovering electricity bills especially from government departments / apartment blocks / commercial complex etc.

El Measure has developed a unique 3 in 1 Contactless Prepaid Energy Meter, whereby in process parameters such as water, gas etc. can be integrated, and its consumption can be monitored along with electrical parameters. The design is completely microcontroller based, thus providing an effective and reliable solution to the service providers. The service provider needs to just install the meter and further activities involve the consumer. It is sufficient for the service provider to have just one manpower to recharge the card as per the consumer's request. The consumer will have to display the card in the front fascia of the meter for three seconds. The advanced microcontroller electronics inside the meter stores the number of units recharged and measures the energy consumption. When the purchased units are used up by the consumer the meter disconnects the power supply until the next recharge.

Main Features

- Compact wall mounting design
- Dual Source Measurement (EB & DG)
- 3 in 1 meter with option to integrate process parameters
- Pre-paid metering system using contactless smart cards
- Accuracy Class 1.0
- Cost effective 'Pay as you use' three phase electricity metering.

Application

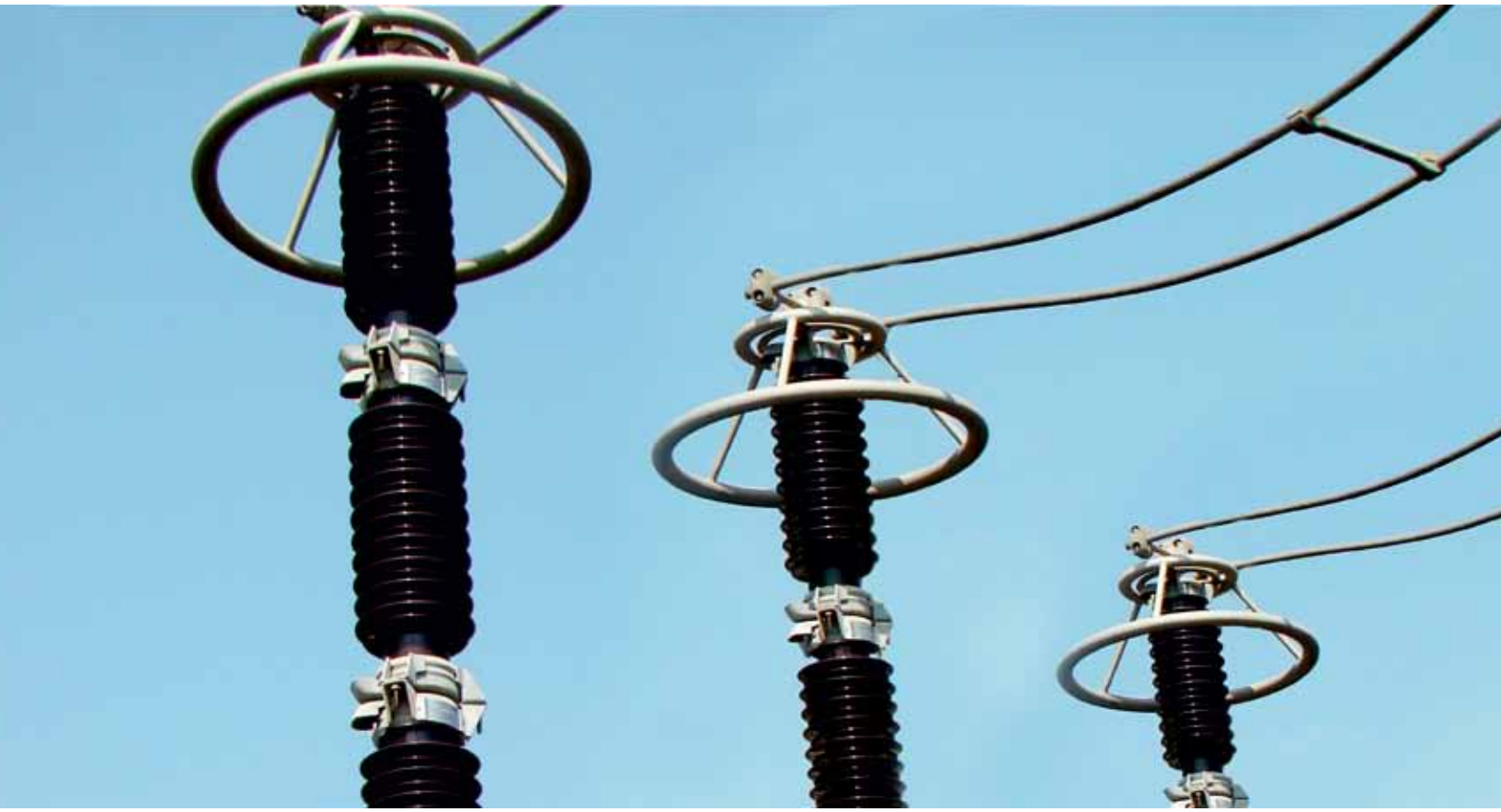
- Shopping Malls / Multiplexes • Residential Townships / Apartments
- Commercial Buildings • Employee Quarters

Advantages

- Upfront payment for electricity and hence low over heads for service providers
- Advanced RF card technology and tamper proof construction
- Cost of manpower for billing / collection is substantially reduced
- This avoids the hassles of human intervention as there is no need to enter the data into the meter. This makes it more user friendly
- Displays balance energy in the meter, thus enabling the consumer to plan when to recharge
- No billing disputes
- Allows consumer to budget electricity expenses
- Helps consumer to contribute towards energy conservation
- Available in single phase and three phase system.

For further information: marketing@elmeasure.com

SCOPE



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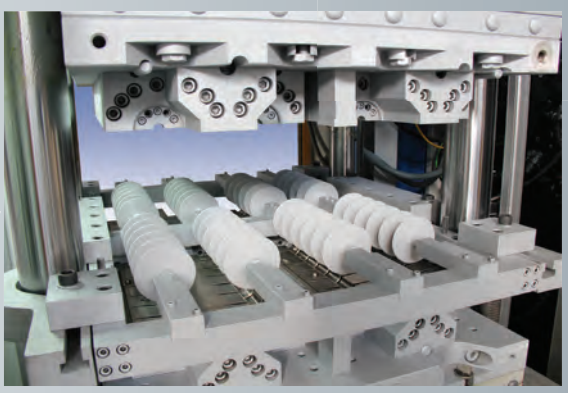

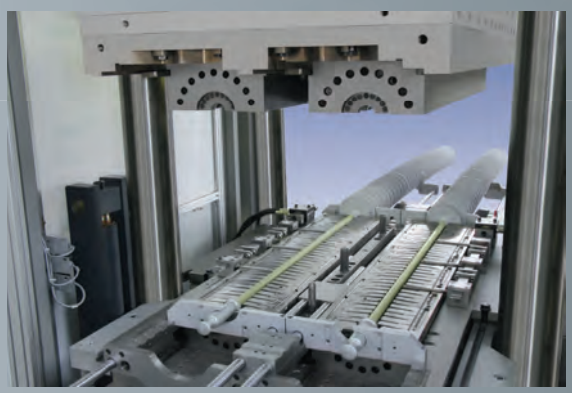

Strategies for Success in Rubber and Silicone Injection Moulding

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