Vol 54 No 7 July 2014 ₹ 100

Since1961

Electrical India

India's oldest magazine on power and electrical products industry

Fifty-fourth Year of Service to the Power Industry 54

Technological Issues and Advancement of **Smart Meters** against tampering

Scan the QR Code to know more about EI Website

Articles

Newsline

A Diary Publication

Follow us on LinkedIn in.linkedin.com/in/electricalindia

LARSEN & TOUBRO

www.Lntebg.com

Ready for tomorrow, today.

We go the extra mile.

Modular design means that when your business grows, so will the features of L&T Omega ACB. Its matrix releases have pluggable and withdraw-able modules, designed for flexibility, scalability and customization of your electrical system.

This is just one of the many innovative features that make the Omega smarter and safer, more compact and convenient.

Take a look at some of the others: Ics=Icu=Icw, arc chute interlocking, in-built electrical anti-pumping, O-LED display, password protection and touch-screen technology in releases.

And all this in what everyone agrees is among the most compact ACBs in industry. Yes, the extra mile goes a long way.

U-POWER
OMEGA
Air Circuit Breakers

SMS LNT<space>61 to 56161 for any query

Customer Interaction Centre (CIC)
BSNL / MTNL (Toll free): 1800 233 5858 Reliance (Toll free): 1800 200 5858
Tel: +91 22 6774 5858 Fax: +91 22 6774 5859 E-mail: cic@Lntebg.com

L&T SWITCHGEAR
SAFE & SURE

TAURUS
Innovative Technologies
An ISO 9001 : 2008 Company

"Taurus MAX-3" the only choice of Overhead Transmission Line Fault Analysis is now "MAX-3 EHF" with more power and faster Analysis

The Legacy Continues...

> MAX-3 EHF ready for upto 1200 kV Line 2500 Km distance fault analysis

Overhead EHV AC Transmission Line Analyser
MAX-3 EHF

www.tauruspowertronics.com
info@tauruspowertronics.com

https://www.facebook.com/TaurusPowertronicsPvtLtd
https://www.linkedin.com/company/tauruspowertronics-pvt-ltd

Mahadevan Iyer
Editor, Publisher & Managing Director
miyer@charypublications.in

New possibilities for electrical energy storage in the future

The priority before the new government is adequate power supply for crisis ridden states. All India installed capacity of power stations as of May end stands at 248,509 MW that needs to be enhanced. Since power supply systems are constantly evolving, their protection systems also need to be reviewed regularly to ensure they meet new emerging requirements and do keep contingency back-ups.

Recent developments in energy storage technologies have provided new opportunities, to operate the electric grid more efficiently. 'Energy Storage at Generation and Transmission levels' explains how the recent developments in supercapacitors and superconducting Magnetic Energy Storage systems provided new possibilities for electrical energy storage in the future.

Further, an article 'Natural gas requirements for Indian power sector' reveals worldwide use of natural gas has increased in preference to coal. As on date, the indigenous production is not keeping pace with the growth and increased import of natural gas and exploration of alternatives such as biogas and coal bed methanisation is becoming inevitable in the near future.

The modern power system of electrical network is very complex. A laboratory review on 'Short-Circuit Performance Evaluation of Surge Arrester' details about the electrical system due to advent & advancement of supercomputers, to solve problems arising out of various complex systems interconnected to protect without any outage.

All the more, we present a new layout for you and would like feedback from our patrons, readers, advertisers and subscribers.

Do send in your comments at miyer@charypublications.in

Mahadevan

Vol. 54 • No. 7 • July 2014

Office Address:

Editorial, Subscription & Advertisement Office :
201, Premalaya,
Next to Cafe Coffee Day,
Opp. Telecom Factory,
Deonar, Mumbai - 400 088.
Tel.: (022) 2507 3300 / 01
www.electricalindia.in

Director/Publisher
Pravita Iyer
Mahadevan Iyer

Editor
Mahadevan Iyer
miyer@charypublications.in

Associate Editor
Gopal Krishna Anand
edit@charypublications.in

Sub-Editor
Kshitija Kolhapure

Editorial Co-ordinator
Natisa Kaisar
natisa@charypublications.in

Advertisement Department
Yasmeen Kazi
yasmeen@electricalindia.in
Kaushalya Kadam
advt@electricalindia.in

Design
Rakesh Sutar, Sandeep Amte

Subscription Department
Hemant Yelave
Natisa Khan
sub@charypublications.in

Administration
Dattakumar Barge
Bharati Solanki

Social Media
Abbas Safee

Single Issue: Rs.100
Annual Subscription: Rs. 1000

Printed, Published and owned by Mahadevan Iyer from 311, Raikar Chambers, Govandi (E), Mumbai 400 088 and Printed at Print Tech., C-18, Royal Ind. Estate, Naigaum Cross Road, Wadala, Mumbai 400031.

Editor : Mahadevan Iyer

A Chary Publication

FLIR

The Next Generation of Test & Measurement

Delivering world-class test & measurement tools with the accuracy, reliability, and versatility you need to tackle your most challenging jobs

LIMITED WARRANTY LIMITED

To learn more about our new products that have what it takes, and see a video of FLIR's A-Team of tactical test equipment in action at www.flir.com or Contact

FLIR Systems India Pvt. Ltd. 1111, D Mall, Netaji Subhash Place, Pitampura, New Delhi – 110034
Tel: +91-11-4560 3555 Fax: +91-11-4721 2006
E mail: flirindia@flir.com.hk Website: www.flir.com

CONTENTS

Vol 54 | No 7 | July 2014

Departments

Interview

Derik Lhundup
Bussiness Unit Head - India
Glantek India Private Ltd

Dr Satish Kumar
Energy Efficiency Ambassador and Vice President
Schneider Electric India Pvt Ltd

Transforming IDEAS into REALITY

TITAN
COMPANY
Automation Business

'Titan Automation Solutions' is a part of Titan Company Ltd, a Tata group company. We are in the business of providing world class turnkey assembly and testing solutions.

We cater to various industry segments like:

- Electrical & Electronics
- Automotive
- Medical Devices & Health care
- Other Engineering

WE HAD OFFERED

MCB, MCCB Assembly Lines

Power Meter Assembly Lines

Contactor Assembly Lines

Connector Assembly Lines

Testing Lines

For Enquiries Contact

Head Office:-
Mr. Hari.E
+91-9442267678
harie@titan.co.in

Northern Region:-
Mr. Siddarth.B
+91-9582554858
siddarth@titan.co.in

Western Region:-
Mr. Kiran Naik
+91-94421165044
kiran@titan.co.in

Southern Region:-
Mr. Senthil Kumar.M
+91-9442615899
senthilm@titan.co.in

Reach us at:
TITAN COMPANY LIMITED
Titan Automation Solutions, PED, No. 28, Sipcot Industrial Complex, Hosur - 635 126, TamilNadu, India.
Tel.: +91 43 44 664 840 / 842 / 848 / 876 email: infotas@titan.co.in Website: www.titanautomation.in

Enhance Resources and Energy Conservation to Protect Climate

> *Way to improve energy conservation in buildings is to use an energy audit*

Gopal Krishna Anand

Energy need and energy conservation are essential ingredients of power. Diversification of energy resource as well as measures for conservation of energy is the emerging opportunity. Obviously, solar energy in absolute and wind power dependent on - specific geographical location, have the huge potential among sources of renewable energy.

Expressing concern over India's insufficient energy resources, President Pranab Mukherjee told to scientists of CSIR-sponsored Indian Institute of Petroleum at Dehradun in 2013, 'In today's context, the importance of energy and energy security is paramount. With rising crude oil prices, depreciating domestic currency and increasing oil imports, we stare at an acute prospect of having to incur huge foreign exchange outgo to buy expensive energy.' It has been projected that by 2030, we would have to meet 90% of crude oil, 60% of natural gas and 57% of coal requirements through imports.

One of the primary ways to improve energy conservation in buildings is to use an energy audit, an inspection and analysis of energy, usage and flows for energy conservation in a building, process or system to reduce the amount of energy input into system, un-affecting output. Some countries employ carbon taxes to motivate energy users to reduce consumption. With priorities and increasing requirements of power, in these changing times, social media emerging concepts can raise deep awareness on conservation. More than the education, incentives on increasing conservation can be more encouraging.

Energy conservation differs from efficient energy use, which refers to using less energy for a constant need. For measuring energy usage by metering, you may need to measure energy usage for few particular areas, rather than for whole buildings, to know, how you would focus on your savings incentives. There is an evolving scope of improving technological assistance, ensuring a high standard of expertise in energy management and energy efficiency. By conserving energy resources, we can, step on to reduce green house gases; expect healthier environment and help protect the climate.

Ravin

EVOLVING TECHNOLOGY. ENERGIZING LIVES.

HOW DO YOU MAKE THE SUN WORK HARDER?

Harnessing the power of the sun effectively, needs equal parts of innovation and imagination. The Solar Tracker from Ravin is designed to harness the maximum amount of solar energy from the sun. 35%* more than fixed solar panels. And it does this just the way sunflowers do, by tracking the movement of the sun, the entire day. So you get the maximum energy from the Earth's cleanest energy source.

Ravin Infraproject Pvt. Ltd.

RENEWABLE ENERGY | CABLES | PROJECTS & SERVICES | EHV & ACCESSORIES | POWER EQUIPMENTS | RETAIL ENERGY SOLUTIONS

Head Office: B – 403, Akruti Trade Centre, Road No. 7, MIDC, Andheri (E), Mumbai – 400093. T +91 29215000 | F +91 29215011 | E sales@ravingroup.com | W ravingroup.com

*Applicable only for dual axis systems and is subject to irradiation and area of installation.

SJVN's 600 MW Kholongchu HE Project in Bhutan

Narendra Modi Prime Minister of India laid foundation stone of the 600 MW Kholongchu HE Project in Bhutan, at Parliament House building of the Government of Bhutan, Thumphu in the presence of Prime Minister of Bhutan Tshering Tobgay & distinguished personalities. It is being executed by public sector SJVN Limited in joint venture with Druk Green Power Corporation Limited of Bhutan. On completion the project will generate 2568.52 GWh of energy in a 90% dependable year (with 95% machine availability), he said. The project is estimated to cost ₹ 3868.87 crore which will be shared in the ratio of 50:50 by the two joint

venture partners, he added. The Inter-governmental Agreement for the project was signed between Royal Government of Bhutan & the Govt. of the Republic of India during April 2014. SJVN Limited and Druk Green Power Corporation Limited shall have equal shareholding in the joint venture of the Company. In terms of the agreement the project shall be financed under a debt equity ratio of 70:30. For the 70% saleable energy generated, long term Power Purchase agreements shall be entered into with the beneficiaries and the balance power shall be sold through market mechanism. The DPR prepared by SJVN has been approved by the Central Electricity Authority, Govt. of India and Royal Govt. of Bhutan. Major works on implementation of the Project are likely to commence soon. R P Singh, CMD, SJVN assured that the project shall be constructed on a fast track mode and monitored constantly for timely completion. For implementation of the project a joint venture is being formed with a MD from SJVN and joint MD from Druk Green Power Corporation Limited.

Siemens gets order to supply gear units for coal-fired power plants in India

Siemens Drive Technologies Division will be supplying large gear units and gear components for vertical mills to BHEL to cover their overall demand in the coming three years. Since India's demand for energy is growing rapidly, coal-fired

power plants are constantly being built & expanded. The Flender gear units from Siemens are deployed in vertical mills with an output of 800 and 1000 kW, which are used for coal grinding in the power plants. Due to their rugged design, these powerful and reliable drives are ideal for the harsh ambient conditions in power plants and permit smooth operation. The value of the order is in the (Euro) double- digit million range. The Flender gear units supplied by Siemens consist of a combination of a bevel gear stage with a planetary stage. Thanks to the special design developed by Siemens for use in coal grinding, a high power density is achieved and at the same time the forces from the grinding operations are transferred to the foundation via the gear casing. The operating company thus benefits from smooth operation and very fine coal grinding, which is required for efficient combustion. "We see this major order as a convincing vote of confidence from BHEL in reliability of the Flender gear units & the commitment and cooperation of our employees," says Dr. Bernhard Hoffmann, Head of the Mechanical Drives Segment in the Siemens Industry Sector. BHEL is India's largest engineering and manufacturing company of its kind engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products, systems and services for the core sectors of the economy, like Power, Transmission, Industry, Transportation, Renewable Energy, Oil & Gas and Defence.

UNIDO: Sustainable Energy for All

UN Secretary General Ban Ki Moon launched Sustainable Energy for All (SE4ALL) initiative in 2011, with three global targets: to ensure universal access to modern energy services, to double the global rate of improvement in energy efficiency, and to double the share of renewable energy in the global energy mix by 2030. Sustainable Development ensures inclusive and environment friendly growth that requires overcoming limitations which the current state of technology imposes on environment. Finding a solution to energy poverty in an environmental friendly way would mark a turning point for Sustainable Development. India's progress in increasing the installed capacity for electricity generation and extension of the grid in rural areas has been impressive; however, many assets remain under-utilized as availability of energy remains uncertain. The UN's Country Team in India dedicated June 2014 for advocacy on Sustainable Energy for All. Convened by UNIDO, 12 organizations including APCTT, FAO, IFAD, ILO, UNDP, UNESCO, UNFPA, UNHABITAT, UNICEF, UN Women and WHO, seek to find energy solutions in the four cross-cutting themes of livelihood, natural resource management, health and sanitation. These would help reduce poverty, improve health and local ecosystems and also to reduce vulnerability of rural poor to the effects of climate change, and help India achieve a better Human Development Index. According to the 2013 UN HD Index, India ranks 136 out of 186 countries. A key factor affecting India's ranking are the 4As which remain unaddressed causing deficiency in reliable and modern energy supplies. Achieving SE4All requires that the factors – accessibility, availability, affordability and accountability – are addressed.

riello ups

Reliable Power for a Sustainable World.

Riello UPS win *Product Leadership Award* 2013

FROST & SULLIVAN

Global Leaders in Uninterruptible Power Supply Systems

Riello: 1st European manufacturer to rate its product for Eco-Energy Level efficiency

- Riello is one of largest manufacturer of UPS System
- Complete range from 1kVA - 6400 kVA
- RPI has delivered over 5000 successful installations in India & Indian Subcontinent
- Technical Support Team at your service 365 days 24 x 7
- PAN India presence with offices in all major cities

When it comes to expertise in Uninterrupted Power Supplies Riello PCI India has it all

- IGBT Rectifier / IGBT Inverter with built in galvanic isolation transformer
- Advanced Battery Management
- Very Low Total Harmonic Distortion (THDI < 3%)
- High Input Power Factor > 0.99
- High Output: 0.9 (High Watt)
- Overall efficiency upto 95%

★★ Dealers and Distributors are Invited ★★

Riello PCI India Pvt. Ltd.

(A joint venture between RPS S.p.A., Italy and PCI Ltd., India)

Prism Tower, Plot No: 267-268, Udyog Vihar, Phase – II, Gurgaon-122015, Haryana (India) Tel: +91-124-6650000 Fax: +91-124-4871650 Email: ups@riello-pci.com Website: www.riello-ups.in

Acme Solar wins 30 MW Projects, Solar Power Portfolio increases to 180 MW

ACME Solar, the leading solar power player in India, a JV between ACME CSL, EDF EN and EREN, announced that it has emerged as the developer for 30 MW solar PV power projects at the bid-opening event at Raipur under RFP floated by Chhattisgarh State Power Distribution Company Limited (CSPDCL) during April. As per the terms and conditions of the bidding document, the selected developer would sign 25 year long PPA with the CSPDCL on the uniform tariff submitted in the bid. Commenting on this momentous occasion, Manoj Kumar Upadhyay, CEO, ACME Solar said, "This contract was won in a fierce tariff-based competition among 16 developers of international fame. It is a testimony to the prowess of ACME Solar and further strengthens our emergence as the leading solar power producer in the country. With this addition, our solar power portfolio has reached 180 MW and we are on way to generate 1000 MW by year 2017. We thank the Chhattisgarh State Authorities and look forward for support from all stakeholders to help us in achieving the dream of making Chhattisgarh a model state for energy-efficiency." This project would entail an estimated investment of $ 40 mm/ Rs. 240 crores. As per Chhattisgarh State Regulatory Commission order dated September 18, 2013 the distribution licensee shall prepare a plan for procurement of power from RE source under its long term power procurement plan so as to comply with minimum RPO target of 6.75% (of total consumption) by FY 2014-15.ACME Solar is a three-way joint venture between ACME Cleantech Solutions Limited, EDF Energies Nouvelles (EDF EN), the renewable energy arm of French state-run electricity utility Électricité de France S.A., and Luxembourg-based natural resources saving group EREN.

Suzlon Group's 100.8 MW Rajasthan wind power project for CLP India

Suzlon Group, the world's fifth largest wind turbine manufacturer, announced that it has received the Notice to Proceed (NTP) from CLP India, a leading investor-owned power business in Asia and one of the largest foreign investors in the Indian power sector, for a 100.8 MW wind power project. The project, located at Tejuva in Rajasthan, will comprise 48 units of Suzlon's robust S97- 2.1 MW wind turbines featuring Doubly Fed Induction Generator (DFIG) technology. This is the latest addition to Suzlon's wind portfolio of over 8000MW projects across eight states. Upon completion, this project will boost CLP India's wind power portfolio to close to 1000 MW, reinforcing its position as the leading independent power producer in the wind sector in India, foreign or domestic. Rajiv Mishra, Managing Director, CLP India said: "India is the fifth largest country in terms of total installed capacity of wind power, with large reserves of untapped potential that spells out a great opportunity for this sector to grow exponentially. We have always firmly believed that accelerated development of the Indian power sector requires investments across all sources of renewable & conventional energy, which is critical to achieving a certain degree of energy security over a period of time. Wind portfolio has been a key area of thrust for us over the past 4-5 years, with a sustained growth of about 200 to 300 MW every year and we are committed to growing it over the next few years as well. Tulsi Tanti, Chairman, Suzlon Group stated through our comprehensive capabilities across wind energy value chain and end-to-end solutions, we will assist CLP India in further expanding their wind energy footprint in India.

Steria contracts for New Settlement System as Part of Electricity Market Reform Legislation

Steria wins 6 year contract with EMR Settlement Limited, a wholly owned subsidiary of ELEXON Ltd, to build and run a new settlement system for the UK Energy sector. Steria, a leading provider of IT-enabled business services, has today announced that it has won a contract with EMR Settlement Limited, a wholly owned subsidiary of ELEXON Ltd, to license its RT Easy1 software as part of a new settlement system for energy generators and energy suppliers. The system covers both Contracts for Difference (CfDs) and the Capacity Market (CM) as part of the UK Government's Electricity Market Reform programme. The contract, worth an initial £5.8m, includes software licences, configuration and implementation activities, hosting of the infrastructure on a cloud based solution, application support and maintenance, and business process services to manage the payments to energy providers. Gavin Chapman, Chief Operating Officer, Steria UK, said, "The scope of this contract will form an important cornerstone for the changes that Government is looking to bring in to incentivise new investment in electricity generation and ultimately production of low carbon forms of electricity. As a trusted transformation partner in both the private and public sectors, Steria has extensive experience of working with many of Europe's leading energy and utility companies. This is an important infrastructure project that will help transform the UK energy sector and I'm delighted we are able to act as technology and business process partner to ELEXON for EMR." Peter Haigh, Chief Executive of ELEXON, commented, "This is a significant step in the EMR programme and for ELEXON.

ENERGY AND INDUSTRIAL SYSTEMS
APPLIANCES AND HVAC
HIGH TECH
BUILDING MATERIALS
LARGE FORMAT BATTERIES
WIND ENERGY
SOLAR ENERGY
LIGHTING
WIRELESS AND EMC
MEDICAL AND LABORATOR
OTC AND PHARMACEUTICAL
WIRE AND CABLE

HAZARDOUS LOCATIONS

LIFE SAFETY AND SECURITY
PLASTICS AND COMPONENTS
CLEANING PRODU
DIETARY SUPPLEM
DRINKING WATER
FOOD AND BEVERAGE
FURNITURE AND
JEWELRY AND WA
PERSONAL CARE A
PREMIUMS, PROMO
AND LICENSED GO
PLUMBING PRODUCTS
AND SYSTEM COMPONENTS
TEXTILES, APPAREL AND FOOTWEAR
TOYS AND JUVENILE PRODUCTS

KNOW UL? THINK AGAIN.

The challenges and goals you face in today's market look different than they did 10, 5, or even 2 years ago – so does UL. While our focus on the testing, evaluation, and certification of safe equipment for hazardous locations remains unchanged, we continue to invest in ways to meet your needs on a broader level. For instance, by covering IECEx, ATEX, INMETRO, GOST-R and many other global specifications, UL helps eliminate duplicate testing to reduce costs and accelerate time-to-market. Tell us your needs, our portfolio may surprise you. Customer first, safety always.

For more information on UL services for HazLoc,
please contact Shashi Shekhar at M: +91.99720.13868
T: +91.80.4138.4400 / E: Sales.in@ul.com

UL.COM/HAZLOC

Mercom Capital Group's India Consumer Survey for Renewable Energy Sources

Mercom Capital Group, llc, a global communications and consulting firm, released results of a consumer awareness study on renewable energy focused on gauging people's and businesses' perception & attitudes toward non-conventional sources of energy in India. Over 1,700 residential and commercial and industrial customers were surveyed. The "India Consumer Perceptions on Renewable Energy Survey," conducted by Mercom Communications India, a wholly-owned subsidiary of Mercom Capital Group, found that power cuts have a moderate to major effect on more than 93% of businesses polled. Calling for an uninterrupted supply of electricity, a whopping 94% of commercial establishments that took part in the survey said steady power supply could bring a moderate to great improvement in their businesses. Raj Prabhu, CEO and Co-founder of Mercom Capital Group, commented, "Not only is this a significant finding, but it is a wake-up call & erases any doubt of the impact power cuts are having on businesses. Improving the power shortage situation is urgently needed if we want to see greater economic growth in India." About 65% of surveyed businesses rely on backup diesel generators during power cuts. The poll highlighted that solar has emerged as the most recognized source of renewable energy, with 91% of commercial respondents and 83% of residential respondents being familiar with it. Nearly 58% of both groups strongly favor solar energy as a future source of energy generation for India. it is very important for India to develop and generate more solar power.

India's trade fairs on electronic components and production technology

India's leading trade fairs on electronic components and production technology this year will be hosted at BIEC, Bengaluru from 23-25 September, 2014. electronica India 2014 and productronica India 2014 are the platforms that showcase innovations and provide networking opportunities for the electronics manufacturing industry. With concurrent conferences, buyer-seller meets, B2G Meets (Business to Government) and exclusive pavilions from IESA, IPC INDIA, LEDMA, CLIK, ELCINA and International country pavilions from China, Germany, Hong Kong, Singapore, Taiwan and UK, it is a perfect meeting point for the industry. The trade-fairs are also supported by various electronic manufacturing associations like ELCINA, IESA, LEDMA, DEMA, IPC, IPCA, MAIT, CLIK, NSIC, and more. The current edition of electronica India 2014 has participation from industry leaders and visionaries from the electronic components segment. Key players like Rabyte Electronics, Millennium Semiconductor, and many more will present their latest technologies and product solutions. India's demand for electronic products is forecasted to rise nearly 10 times during this decade to reach $400 billion by 2020. With no major local manufacturing in India; policy makers are worried that electronic imports could exceed those of Oil. The gap between electronic hardware production and demand for electronic products has been growing over the last few years, while production has grown at 10-12% per year, demand has been racing ahead at nearly 25% every year. "It gives me great pleasure to once again ring in the fifteenth edition of electronica India 2014 and productronica India 2014, India's largest trade fair on electronic manufacturing and production technology. The show would continue to help break fresh ground within the electronics manufacturing community, taking the Indian electronic sector to an altogether different platform in the global arena" said Bhupinder Singh, Deputy CEO, MMI India. Indian Electronics Semiconductor Association (IESA) and electronica India 2014 and productronica India 2014 will present the maiden edition of Deftronics conference – an industry symposium focused on aerospace and defense electronics.

Honeywell opens 6th Manufacturing facility in Gujarat

Honeywell added its sixth manufacturing facility in India with the inauguration of a plant that will manufacture solar water heating systems for its Environmental and Combustion Controls (ECC) business, adding to other manufacturing facilities the business has in Chennai and Dehradun. The 50,000 sq ft Vadodara facility will manufacture solar water heating (SWH) systems for residential, commercial and industrial applications for the domestic market in India as well as for export to Southeast Asia and North Africa. Honeywell's Vadodara facility will manufacture 10 solar water heater variants of stainless steel (SS) and galvanized iron (GI) material ranging from 100 to 300 liters per day. "Honeywell is a technology leader in energy efficiency and clean energy generation, with more than 50% of the company's portfolio linked to energy efficiency," said Beth Wozniak, president, Honeywell Environmental and Combustion Controls, who was at Vadodara to officially launch the facility. "Solar water heating technology is evolving as one of the most energy-efficient methods of heating water. The opening of this facility marks Honeywell's entry into the renewable energy product manufacturing, and adds to our already broad portfolio of energy focused products and technologies for customers worldwide." Honeywell ECC is global industry leader in integrated products and solutions in heating, ventilation and air conditioning (HVAC), building management systems, and industrial burners and combustion controls. Honeywell's solar water heating system works on the thermo-siphon principle that allows heat exchange without the need for a pump. The system uses an advanced triple layer evacuated tube technology with high absorption and low emission characteristics.

NV Energy selects Tendril to deliver energy efficient solutions

Tendril®, the leading provider of Energy Services Management (ESM) solutions, announced it has been selected to deliver innovative engagement solutions to more than 100,000 consumers of NV Energy, a utility that provides a wide range of energy services to 1.3 million customers throughout Nevada. After a competitive bid, NV Energy chose the Tendril ESM Platform to deliver Home Energy Reports designed to increase awareness of energy usage and provide personalized recommendations to reduce consumption. "NV Energy has long focused on delivering a diverse set of tools to help its customers better manage their energy use and save money," said Adrian Tuck, CEO, Tendril. "By selecting Tendril to support the delivery of Home Energy Reports, they are now doubling down on the power of data to further engage an already enlightened customer base. I am confident that our approach to delivering highly targeted and personalized information will have an immediate positive impact on the energy consumption habits and satisfaction rates of Nevada's residential customers." Tendril and NV Energy will begin delivering Home Energy Reports to Nevada residents in July 2014. The reports will be offered via physical mail and email and will provide information on an individual's energy usage, recommendations for reducing consumption and offers for related products and services. In these reports, the content is highly tailored to the user. This unique approach is enabled by Tendril's patented home simulation model, which leverages multiple stores of data including historical energy consumption and demographic information from public sources. According to programs in progress today, leveraging this data to create accurate customer profiles and delivering targeted content drives participation rates up to five times higher, compared to those achieved through traditional methods.

Eurelectric's Industry Award 'Company of the Year' for Opower

Opower, the global leader in cloud-based consumer engagement solutions for the utility industry, was named as the winner of EURELECTRIC's Industry Award, in acknowledgment of its proactive and innovative approach to energy efficiency. The award, now in its seventh year, recognises companies or individuals that have made a pioneering contribution towards the development of the electricity industry. The decision on Opower's winning entry was taken by a jury composed of representatives from the electricity industry, think tanks and academia, from a list of nominees submitted to Eurelectric over recent months. On receiving the award at Eurelectric's annual conference, Alex Laskey, co-founder and President of Opower commented, "It's a huge honour to accept this award. In 2007 when we started out we knew we had a powerful idea, but the revolutions in clean energy, distributed generation, smart meters, smart thermostats and customer expectations have changed the game, faster than any of us could have predicted. In the world in which we now live, utilities have to empower their customers in order to get ahead – trust, transparency, customer engagement and clean energy is where the future needs to be for the energy market, and we're proud to be playing a role in supporting this." Using behavioural science and big data analytics, Opower creates innovative software that motivates utility customers to save energy and better manage demand. Since 2007, Opower has become an industry trendsetter, working with 93 utilities and serving 32.1 million households worldwide. To date, the company has helped consumers save over $460 million dollars – over 338 million euros and over 4 terawatt hours of electricity.

Lapp Group: connectors, junction boxes and cables for solar systems at Intersolar 2014

At this year's Intersolar trade fair, numerous new products from the solar industry are introduced. Components from Lapp Group ensure the right connection for new systems. The company is expanding its range for the solar market and presents two new cables from the ÖLFLEX SOLAR series, a new PV connector for systems with 1.5 kV operating voltage as well as connectors for use in inverters, string boxes and circuit breakers. The product highlight at Lapp's trade fair stand is the new, extremely compact EPIC®SOLAR MAP Easy junction box for crystalline modules. "The Lapp product portfolio for the solar industry continues to grow, because we believe that solar energy will make a valuable

contribution towards the future energy mix – and this will come about in part thanks to high-quality technical components and innovations from Germany", states Michael Collet, Managing Director of Innovation at U.I. Lapp GmbH. EPIC SOLAR MAP Easy is the name of the new, particularly compact, economical and automatically mountable junction box for crystalline photovoltaic modules with three cell strings. The new clinching connection system allows different materials to be fitted together quickly and easily. There is no requirement for heat as there is with welding or soldering, and no other additional materials such as welding wire, solder or flux agents are needed. The layer of tin on the ribbons remains undamaged, therefore providing permanent corrosion protection. The new junction box occupies a mere third of the space required by comparable solutions. And, significant cost savings can be achieved for transport & storage. The compact size offers a design advantage which is particularly advantageous for double glass modules. The EPIC SOLAR MAP Easy also impresses with its very low contact resistance which remains constant for years. The new junction box is particularly compact, economical and automatically mountable.

SCOPE

Circuit Breaker Testing Re-Defined..
with DCRM & HISAC Ultima from SCOPE

Test all types of Circuit Breakers up-to 800kV...

Single operation gives all parameters of Circuit Breaker
Substantially reduces Over Stressing during Testing
Reduces Downtime COST.!!

Corporate Office
402, Arrus Chamber, Annex - A,
S. S. Amrutwar Marg, Worli,
Mumbai 400 018, INDIA

Phone : +91 22 4344 4244,
FAX : +91 22 4344 4242
e-mail: marketing@scopetnm.com,
Web site: www.scopetnm.com.

Research Alliance for energy systems of the future

In line with its new company strategy, Siemens is reorienting its research activities toward the innovation fields of electrification, automation and digitalization in order to further strengthen its leading technology position in these areas. Siemens is the first company to form a research alliance with leading universities and institutions in this connection – an alliance that aims to combine outstanding expertise with a new, all-inclusive approach and make possible wide-ranging innovations in processes and systems. Siemens and Friedrich-Alexander-Universität Erlangen-Nuremberg (FAU) will cooperate in the future to conduct research in sustainable, affordable and reliable energy systems. The alliance aims to develop innovative systems that will remain competitive in the constantly changing energy environment and make a substantial contribution to the success of Germany's energy transition. The research alliance Future Energy Systems (FES)

Campus, which was founded in December 2013, will provide a shared platform for the joint research activities. When brought to market readiness, research results will be either incorporated into the Siemens portfolio or assigned to startup companies. In addition to private-sector research projects, there will also be publicly sponsored projects and research activities with Siemens' key customers – an arrangement that will make the research campus highly attractive not only for companies but also for universities and research institutes. Plans also call for involving German research institutes such as the Helmholtz Association and the Fraunhofer Gesellschaft as well as other German universities and international institutions in the campus's research activities. Research results will be reported in position papers, which will include recommendations for governments and society on energy supply and the electricity market. Extensive doctoral and post-doctoral programs are also planned. The campus will make a major contribution to strengthening the regional economy and enhancing Germany's standing as a science and business location by, for example, enabling around 50 doctoral candidates to complete their degrees within its framework. 'This cooperation agreement between Siemens and FAU makes it clear once more that – to master the challenges of tomorrow's world – science and industry will have to work hand-in-hand,' said FAU President Professor Karl-Dieter Grüske.

Gamesa unveils G132-5.0 MW offshore turbine at the 2014 Global Offshore Wind trade fair

The new turbine, based on the 5.0 MW platform's proven technology, boosts power output with respect to the G128-5.0 MW by 3%. Gamesa, a global technology leader in wind energy, is showcasing its new 5.0 MW turbine, the G132-5.0 MW, at the 2014 Global Offshore Wind trade fair, one of the sector's hallmark events, in Glasgow (UK) on 11 and 12 June. The new G132-5.0 MW turbine leverages the know-how and experience acquired during the exhaustive validation of the 5.0 MW platform, which culminated recently with the receipt of type certification for the G128-5.0 MW from independent expert DNV-GL, as well as tapping its proven and tested technology. The G132-5.0 MW wind turbine, with a blade length of 64.5m and a rotor diameter of 132m, generates 3% more power than the G128-5.0 MW. It is designed with redundant modules, guaranteeing reliable performance and maximising energy output, thereby streamlining the cost of energy. The turbine also stands out for its light weight, which reduces the cost of related wind farm civil engineering work. The G132-50 MW offshore turbine is capable of generating enough energy to supply 5,000 households a year. With the launch of this new turbine, certification of which is slated for completion in 2015, Gamesa has achieved another milestone in its offshore strategy & extended its product range to cater to every customer's needs.

Aclara offers new Service Offerings for Water Utilities

As part of its STAR_select solution for water utilities, Aclara Technologies LLC, a provider of intelligent infrastructure technologies for water, gas and electric utilities, announces a new high – level services program for water utilities that makes it easier to implement a successful AMI strategy. For assured system performance with end-to-end network management, The Aclara PLATINUM_services can accelerate deployment of a full, hosted A MI network for water utilities. The solutions are a cost – effective way for water utilities to reduce up - front costs and risks related to implementing advanced metering infrastructure (AMI). Aclara designs, deploys and maintains for the utility a high - performing AMI network infrastructure and related server & head-end software. PLATINUM_ services offers everything needed for implementation of a complete AMI system, including data collection units & the network communications center Additional offer ings in these cost – effective service bundles are installation, preventative and ongoing maintenance etc, & hosting with disaster recovery. PLATINUM_services is a part of STAR_select, Aclara's powerful and proven collection of scalable solutions connect company's fixed -network communications with a host of integrated product offerings & professional services for water utilities.

USER-FRIENDLY ONLINE CONDITION-MONITORING SYSTEMS

Integrated.
Open.
Distributed.
Scalable.

**The futuristic Entek XM Series,
from the globally renowned Rockwell Automation,
is designed to accommodate your ever-growing protection requirements.**

It is well known that predictive maintenance can significantly reduce maintenance, repair & operating costs which in turn has a great impact on increasing the operative life of machines and their uptime. Information gathered through the continuous monitoring allows maintenance personnel to track developing faults & ensure timely corrective action before production gets impacted or safety gets compromised. To augment the predictive potential of maintenance personnel, Rockwell Automation has developed the Entek XM Series which allows mission-critical machine assets to be monitored and protected intelligently & efficiently.

XM Series uses the facility's existing network infrastructure and requires less wiring than traditional rack-based protection systems. Moreover, its modular design makes it scalable for users to add machinery to the system, and each XM module being hot-swappable allows for quick & easy module replacement without requiring a power shut-down. XM's discrete DIN rail-mounted modules can be added to existing control panels or installed close to the machines since the modules do not require any special enclosure, power or cooling. The modules can communicate directly with programmable controllers and can even interface with condition monitoring software.

**CALL US TO LEARN MORE OR IDENTIFY WHICH CONDITION MONITORING SYSTEM IS IDEAL
FOR YOUR COMPANY OR HOW YOU TOO CAN PROTECT & MAXIMISE THE PERFORMANCE OF YOUR MACHINES**

PRIME GROUP
LOOKING BEYOND TOMORROW

PCI LTD.
POWER & ENERGY DIVISION

CORPORATE OFFICE: Prime Tower, 287 - 288 Udyog Vihar, Phase II, Gurgaon 122 016, INDIA
Tel: 91 124 4111960 (30 lines), 91 124 5555999 (30 lines) Fax: 91 124 4871698 - 99
E-mail: primegroup@prime-pci.com Web: www.primegroupindia.com
BRANCHES/SERVICE CENTRES: • DELHI • MUMBAI • HYDERABAD • BANGALORE • CHENNAI • KOLKATA • BHUBANESHWAR • COCHIN • CHANDIGARH • VIZAG • JAIPUR • KANPUR • PUNE • AHMEDABAD • NOIDA • GURGAON • MANESAR

Rockwell Automation

PCI offers state-of-the-art equipments for: ELECTRICAL TESTING & MEASUREMENT • VIBRATION CONDITION MONITORING • PREDICTIVE & PREVENTIVE MAINTENANCE • THERMAL IMAGING • PARTIAL DISCHARGE MEASURING • CABLE FAULT LOCATORS • ONLINE DGA & MOISTURE MANAGEMENT SYSTEMS • EMERGENCY RESTORATION SYSTEMS • METERS & POWER QUALITY ANALYZERS • POWER CONDITIONING SYSTEMS

Kinetic Group and Ikaros of Belgium announce Joint Venture in Solar Energy

Kinetic Group, announced a joint venture between Kinetic and Belgium based Ikaros Solar Group, a leading international company operating in the PV market. The joint venture is registered under the Indian company's act and will be known as Ikaros Kinetic Solar Private Ltd. The joint venture is a focused step by Kinetic and Ikaros in their journey towards providing sustainable energy solutions. The venture will combine the technological proficiency, domain knowledge of Ikaros and engineering expertise & local know how of Kinetic in the Indian manufacturing and business space. The joint venture will provide customized solutions for business clients offering turnkey PV systems including the assurance of optimal yields once the system has been commissioned. The JV will provide customized solutions to cater to low capacity solar PV installations of 20KWp to 1 MW focusing residential and commercial roof top instillations used in educational institutes, industrial sheds, shopping malls, hotels and resorts, godowns and hospitals. It will also cater to EPC requirements of utility scale PV projects from 1 MW & above for developers under National Solar Mission, state policies, large manufacturing facilities like Steel, Pharma, Automobiles, Textiles etc, and is also keen to develop solar farms under favorable tariffs. The Shareholding pattern of the joint Venture is IKAROS, Beljium – 51%, Kinetic Group – 25% & Intelux India (A pune based company specialized in power electronics) holds 24%. Speaking on this occasion, Sulajja Firodia Motwani, Vice Chairperson of Kinetic Engineering Ltd and Director of Ikaros Kinetic Solar said, "Our objective is to create sustainable alternative solutions to the ever growing shortage of natural resources.

UAE Ranks third among World Nations in Total CSP Capacity

Masdar's Shams I concentrated solar power (CSP) plant in Abu Dhabi catapulted the United Arab Emirates to its new ranking as third among the world's nations in both 2013 CSP technology investment and total CSP capacity. The UAE now ranks only behind Spain and the United States in total CSP generation; India and China round out the world's top five. The rankings were recently unveiled in a report by REN21, an international multi-policy stakeholder network that promotes a rapid global transition to renewable energy. According to REN21, the 100 megawatt CSP plant in Abu Dhabi's western region is one reason why CSP's growth in emerging markets almost tripled during 2013. Although Spain and the U.S. are still by far the market leaders in CSP, investment in this technology is accelerating most rapidly in regions that receive high amounts of daily sunshine—or in industry terminology, high direct normal irradiation (DNI). Worldwide since 2004, global CSP capacity has increased 10-fold, and last year surged 36% to a total of 3.4 gigawatts of energy generated. While this industry continues to grow, it is also marked by the use of a more standardized design. CSP plants in the past decade have incorporated several designs and technologies over the past years, but in 2013, all newly constructed CSP plants used the parabolic trough design—which is in use by Shams 1. Overall trends in the industry are favoring larger plants to take advantage of economies of scale, as in the case of the Shams 1 plant, one of the largest CSP plants worldwide.

ABB inaugurates new power products plant in Czech Republic

ABB, the leading power and automation technology group, today, inaugurated a new manufacturing unit for high-voltage components in Brno, Czech Republic. The new unit will employ around 200 people and shall be part of the company's global gas-insulated switchgear (GIS) factory network. The campus is spread over 12,500 square meters and incorporates engineering, assembly, and testing facilities.

"This latest unit will further strengthen our regional and global manufacturing footprint. It will also enable us to ensure a steady supply of high quality components and in turn help us to serve our customers more efficiently" said Giandomenico Rivetti, head of ABB's High

Voltage business within the company's Power Products division. Switchgear is used to control, protect and isolate electrical equipment, thereby enhancing the reliability of power supplies and regulating the flow of electrical power in a transmission or distribution network. With GIS technology, key components including contacts and conductors are protected with insulating gas. Compactness, reliability and robustness make this a preferred solution where space is a constraint, for instance busy cities or harsh environmental conditions. ABB pioneered high-voltage GIS in the mid-1960s and continues to drive technology and innovation, offering a full range product portfolio with voltage levels from 72.5 kilovolts (kV) to 1,200 kV. ABB's GIS are designed to enhance grid reliability with minimized footprint, lifecycle costs and environmental impact. As a market leader in high-voltage GIS technology, ABB has a global installed base of more than 23,000 bays.

India's No.1 UPS & Power Electronics Company for the last two decades

Source : Soft Disk

Uninterrupted Power Round the Clock.

Welcome to the world of Numeric UPS, a world with two-fold benefits. Not only do we have a range of UPS systems to suit every IT infrastructure demands with ease of integration, simplicity and adaptability, but we also support your needs with the largest sales and service network in India. That is why discerning companies think it makes perfect business sense to opt us as a single window partner for their critical power back up needs.

Modular UPS

Trimod & Archimod
10 - 120 kVA

1 Phase UPS Systems

HF Max
1 to 20 kVA | HPE 20-60 kVA | HPL Series
0.5 to 80 kVA

3 Phase UPS Systems

HPE 33 10 kVA to 60 kVA | HPE i 33 10 to 500 kVA

Line Interactive UPS Systems

LI & LI SW Series
0.6 to 3 kVA

Energy Storage Systems

NUMERIC VRLA Batteries
7.2 Ah to 200 Ah

Support Power Products

HPH HR | I PDU | Iso Safe | Volt Safe

A Group brand | legrand®

Toll Free 1800 425 3266

"Numeric House" No.5, Sir P. S. Sivaswamy Salai, Mylapore, Chennai – 600 004.
Tel.: +91-44-2499 3266, Fax: +91-44-2499 8210 Email: info@numericups.com www.numericups.com

Short-Circuit Performance Evaluation of Surge Arrester - a Laboratory Review

In the modern power system the electrical network is so complex that, the conventional analytical methods could not catch up the problems arising from the complex network system. It is a great boon to the electrical system due to advent & advancement of super computers to solve the problems arising out of the non-synchronization of various complex systems interconnected to protect without any outage. In the electrical network surge arrester is only conventional protective device safe guards the system from lightning & switching surges generated within the system and also from out of the system with high magnitude of currents. The material & technology is used in manufacturing of the surge arresters over the years undergone many changes and its reliability is being verified in laboratory tests. This article mainly explain all about short-circuit (pressure relief) tests, which is the most severe in demonstrating the performance of the surge arrester itself and also to safeguards the electrical equipment within the vicinity of the surge arresters.

B V Raghavaiah and Yugal Agrawal

A lightning arrester is essentially a collection of billions of microscopic junctions of Metal Oxide Grains that turn on and off in microseconds to form a current path from the top terminal to the ground terminal of the arrester. Surge arresters protect equipment of transmission and distribution systems, worth several magnitudes more than the arresters themselves, from the effects of lightning and switching overvoltages. If properly designed and configured, they are extremely reliable devices, able to offer decades of service without causing any problems.

CPRI is a pioneer testing organization in India with five decades expertise in the short circuit and dielectric testing, short circuit design data reviews, quality control checks and stage inspection of various power system equipments. Presently CPRI is rendering its testing services globally with International Institutions such as ASTA Intertek U.K., UL India and also as a member of STL for testing and certification of various L.V. & M.V. Switchgears and Power & Distribution Transformers as per International Standards. CPRI has tested so many lighting arresters ranging from 11kV class to 120kV class for High current short circuit test & Low current short circuit test as per IEC: 60099-4 of porcelain and polymer type design, out of that only 50-60% were fulfilled the testing requirement as per IEC standard.

Surge arrester type tests demonstrate the general ability of an arrester design to withstand the electrical, mechanical, thermal and environmental stresses which might occur within the lifetime of a surge arrester. These test are performed once on a certain number of samples and are to be repeated when significant changes of the arrester design are introduced. Apart from test on arrester units (e.g. short circuit test), certain tests on complete arresters (e.g. artificial pollution test) have to be performed.

Technology

The technology of surge arresters has undergone major changes in the last 100 years. In the early 1900's, spark gaps were used to suppress over voltages. In the 1930's, the silicon carbide (SIC) replaced the spark gaps. In the mid 1970's, zinc oxide gapless arresters, which possessed superior protection characteristics, replaced the silicon carbide arrester.

Metal Oxide Varistor (MOV) type arresters entered the market around 1976. The metal oxide arresters are without gaps, unlike the SIC arrester (Fig. 1). This "gap-less" design eliminates the high heat associated with the arcing discharges. The MOV arrester has two-voltage rating: duty cycle and maximum continuous operating voltage, unlike the silicon carbide that just has the duty cycle rating. A metal-oxide surge arrester utilizing zinc-oxide blocks provides the best performance, as surge voltage conduction starts and stops promptly at a precise voltage level, thereby improving system protection. Failure is reduced, as there is no air gap contamination possibility; but there is always a small value of leakage current present at operating frequency.

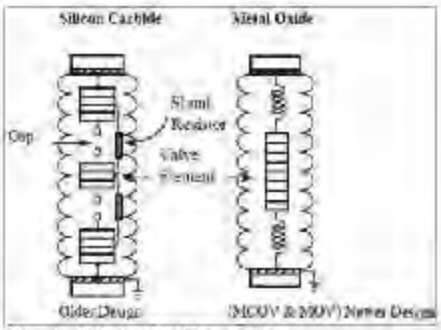


Fig. 1: SIC & MOV Arresters

Polymer arresters are gaining popularity over the porcelain arresters. When a reclose operation occurs and the fault has not cleared, the arrester is subjected to a second fault current.

Polymer arresters are gaining popularity over the porcelain arresters. When a reclose operation occurs and the fault has not cleared, the arrester is subjected to a second fault current. This second operation often leads to arrester explosion since the porcelain had already been weakened by the first fault. If the pressure relief rating of the arrester is exceeded, the arrester may fail violently, since it cannot vent the excess gasses. This type of failure can lead to other equipment being damaged or injury to personnel who may be in the vicinity of the failure. Due to the ability of the polymer station arrester to vent out the side, the housing is not weakened when exposed to the fault current. Therefore a polymer arrester can be reclosed on multiple times without the fear of a violent failure. The polymer arresters are less expensive than the porcelain arrester and appear to avoid some of the in service problems, such as moisture ingress, that often occur in porcelain arrester. Fig. 2 shows the construction of porcelain & polymer surge arrester.

Verification of Surge Arrester Design

To ensure safe operation and an appropriate lifetime of surge arresters, type and routine tests (Table 1) are to be performed. The most important standards covering type and routine testing of surge arresters are IEC 60099-4 and IEEE C62.11. While the type tests proof the general functionality of a surge arrester design, the purpose of the routine tests is to ensure the quality of each individual arrester unit.

However in this article deals mainly with the performance characteristics of the surge arrester against short-circuit faults.

Short Circuit Tests on Arrester as Per IEC Standard

Arrester for which short circuit rating is claimed by the manufacture shall be tested in accordance with, test shall be performed in order to show that an arrester failure does not result in a violent shattering of the arrester housing and that self-extinguishing of open flames (if any) occurs within a defined period of

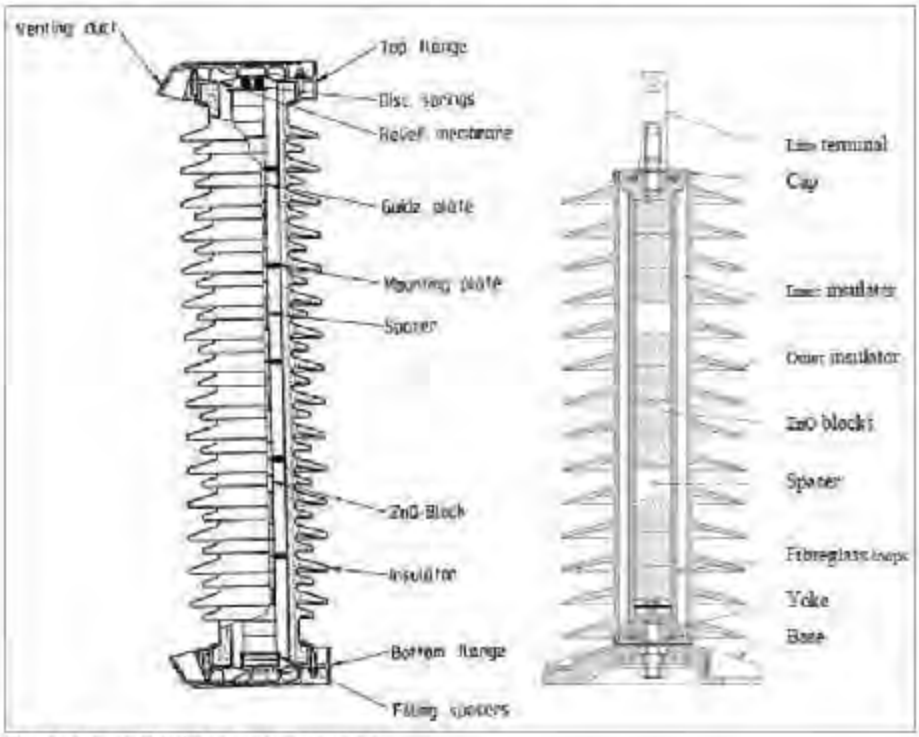


Fig. 2: Porcelain & Polymer Arresters

S. No	Test	Purpose
1	Insulation withstand test	Demonstrates the ability of the arrester housing to withstand voltage stresses under dry and wet conditions.
2	Residual voltage test	Demonstrates the protective level of the arrester. Usually, the sum of the residual voltages of the MO elements is calculated rather than performing a residual voltage test on the arrester unit.
3	Long duration current impulse withstand test	Demonstrates the ability of the resistor elements to withstand dielectric and energy stresses without puncture or flashover.
4	Operating duty test	Demonstrates the thermal stability of the arrester under defined conditions.
5	Short circuit test	Demonstrates the ability of the arrester to withstand short-circuit currents without violent shattering of the housing. For polymer housed arresters this test also demonstrates the ability self-extinguish any fire caused by the arc.
6	Artificial pollution test for porcelain housed multi unit arresters	Evaluation of the temperature rise of the internal parts due to a non-linear and transient voltage grading caused by the pollution layer on the surface of the arrester housing Usually only applicable for "A" and "D" arresters of HVDC stations, generally not for SC arresters.
7	Internal partial discharge test	Measures the internal partial discharge rate and Demonstrates the absence of partial discharges which might be caused by internal voids in the materials used or by particles.
8	Seal leak rate test	Demonstrates that the sealing system was correctly assembled and that the arrester is gas and watertight.
9	Current distribution test for multi column arrester	Determination of the current through each column of parallel resistors.
10	Bending moment test	Demonstrates the ability of the arrester to withstand the values for bending loads claimed by the manufacturer.
11	Environmental tests	Demonstrates that the sealing mechanism and the metal parts of the arrester are not impaired by environmental conditions.
12	Measurement of reference voltage	Demonstrates the correct rating of the arrester, i.e. the use of a correct number of MO elements during assembly.

Table 1: Tests Requirement as per IEC

	Required No. of test sample	Initiation of short circuit current	Ratio of First current peak value to r.m.s value of sc current					
			Test voltage: 77% to 107% of Ur			Test voltage:<77% of Ur		
			Rated SCI	Reduced SCI	Low SCI	Rated SCI	Reduced SCI	Low SCI
Design -A porcelain	4	Fuse wire along the surface of MO resister; within or as close as possible to, the gas channel	Prosp.:≥2,5 Actual: no requirement	Prosp.: ≥√2 Actual: no requirement	Actual: ≥√2	Actual ≥2,5	Actual: ≥√2	Actual: ≥√2
Design -A polymer-housed	4 or 5	Fuse wire along the surface of MO resister; within or as close as possible to, the gas channel	Prosp.:≥2,5 Actual: no requirement	Prosp.: ≥√2 Actual: no requirement	Actual: ≥√2	Actual ≥2,5 or: Actual: ≥√2 on longest unit and Actual ≥2,5 on a unit with Ur≥ 150 KV	Actual: ≥√2	Actual: ≥√2
Design -B polymer-housed	4	Fuse wire along the surface of MO resister; locked away as possible from the gas channel	Prosp.: ≥√2 Actual: no requirement	Prosp.: ≥√2 Actual: no requirement	Actual: ≥√2	Actual: ≥√2	Actual: ≥√2	Actual: ≥√2
Design -B polymer-housed	4	Pre-failing by constant voltage or constant current source	Prosp.: ≥√2 Actual: no requirement	Prosp.: ≥√2 Actual: no requirement	Actual: ≥√2	Actual: ≥√2	Actual: ≥√2	Actual: ≥√2

Table 2: Test requirement

Vashi Electricals Pvt. Ltd.
35
WORLD CLASS BRANDS
UNDER ONE ROOF
SIEMENS
Switchgear
Finolex
Wires & Cables
Bonfiglioli
Geared Motors
SIEMENS
Motors
POLYCAB
Wires & Cables
legrand
MCB's / Wiring Acc.
hindustan
ELECTRIC MOTORS
Motors
Panasonic
Compact AC Geared Motors
OMRON
Indl. Components
Castrol
Industrial Lubricants
PHILIPS
Lighting
EMERSON
Network Power
Network Power Solution
connectwell
Terminal Blocks
UNISTAR
Elastomeric Cables
V - Belt
SKF
Rolling Bearings
OUR PRESENCE
Mumbai
Gurgaon
Indore
Gujarat
Bangalore
Chennai
Kolkata
TOLL FREE No. - 1800 266 1658
Mumbai | Pune | Nashik | Nagpur | Goa | Gurgaon | Indore | Chandigarh | Vadodara | Ahmedabad | Vapi | Surat | Kolkata | Bangalore | Chennai | Hyderabad
www.vashielectricals.com
Follow us on :-
sales@vashielectricals.com

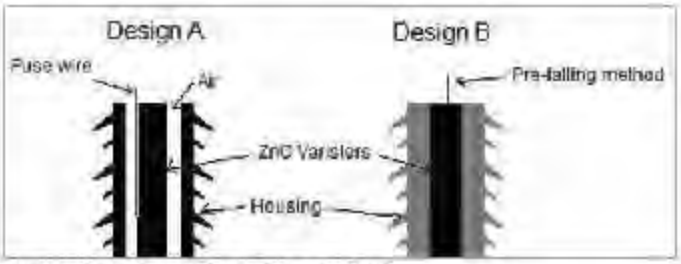


Fig. 3: Fuse wire & Pre-failing method

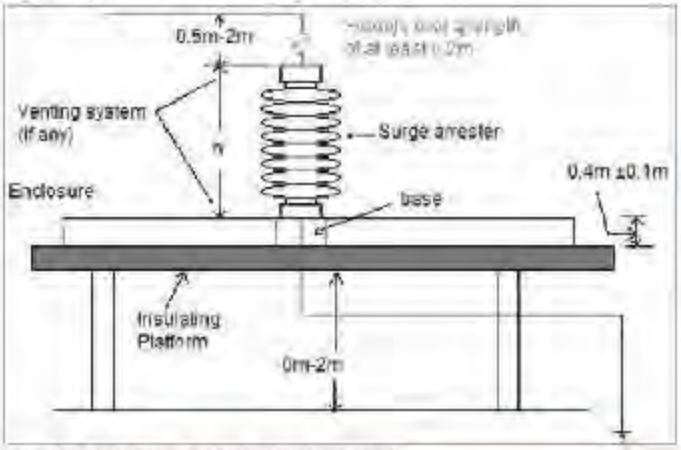


Fig. 4: Test Set-up of Short-Circuit test

Fig. 5: 120kV porcelain clad surge arrester before test

Fig. 6: 120kV porcelain clad surge arrester after test

time each arrester type is tested with four values of short circuit currents.

For the high current tests the test samples shall be the longest arrester unit used for the design with highest rated voltage of that unit used for each different arrester design.

For the low current test sample shall be an arrester unit of any length with the highest rated voltage of that unit used for each different arrester design.

In case a fuse wire is required, the fuse wire material and size shall be selected so that the wire will melt within the first 30 electrical degrees after initiation of the test current

Test requirement is shown in Table 2 (source table 14 & 15 of IEC60099-4).

Preparation of Sample for Short Circuit Test

Each surge arrester is tested with two groups of short circuit currents:

- High short circuit current values consisting of the rated short circuit current and two reduced short circuit currents
- Low short circuit current

For the rated and reduced short circuit current, the method of test sample preparations depends upon the arrester construction. For an arrester fitted with a pressure relief device the active resistors are externally bypassed by a fuse wire. For an arrester without a pressure relief device, the active resistor may be pre-failed by over voltage or may be bypassed with an internal fuse wire installed in a drilled hole through the resistor.

Figure 3 shows the Fuse shorting & Pre failing method.

As per IEC standard the short circuit setup shown in Figure 4.

Figure 5 is the photograph of 120kV porcelain clad surge arrester before test.

Figure 6 is the photograph of 120kV porcelain clad surge arrester after test.

Figure 7 is the photograph of polymer surge arrester before test.

Figure 8 is the photograph of polymer surge arrester after test.

High Current Short Circuit Test

Three samples shall be tested for the rated short circuit current which will be based on nominal discharge current i.e. given in Table 3.

Test shall be made in a single phase test circuit with an open circuit test voltage of 77% to 107% of the rated voltage of the test sample.

CPRI, Bhopal carry out this test at reduced voltage which is less than 77% of rated voltage and the total duration of the test current flowing through the circuit shall be 0.2s.

For "Design A" porcelain arrester tested at the rated short circuit current the peak value of the first half cycle of the actual arrester test current shall be at least 2.5 times the rms value of the symmetrical component of the actual arrester test current. The rms value of the symmetrical component shall be equal to the rated short circuit current or higher. The peak value of the actual arrester test current, divided by 2, 5 shall be quoted as the test current, even though the r.m.s. value of the symmetrical component of the actual arrester test current may be higher. Typical oscillogram of High current Short-Circuit is shown in Figure 9.

For "Design B" arresters tested at rated short circuit current, the peak

SIEMENS

SINAMICS V90

The performance-optimized and easy-to-use servo drive system

siemens.com/sinamics-v90

SINAMICS V90, along with SIMOTICS S-1FL6 servomotor, makes a seamless drive system to meet basic servo applications. This system offers positioning as well as speed and torque control ensuring optimized servo performance.

SINAMICS V90 can be easily commissioned-just plug & play. Further, it can be easily integrated with the automation landscape with a high degree of reliability.

For more details and enquiries mail to: drives.india@siemens.com or SMS sinamicsv90 to 9223011000

SINAMICS V90 servo drive system, making the choice easy for you:

- Optimized servo performance
- Cost-effective
- Easy to use
- Reliable operation

Answers for industry.

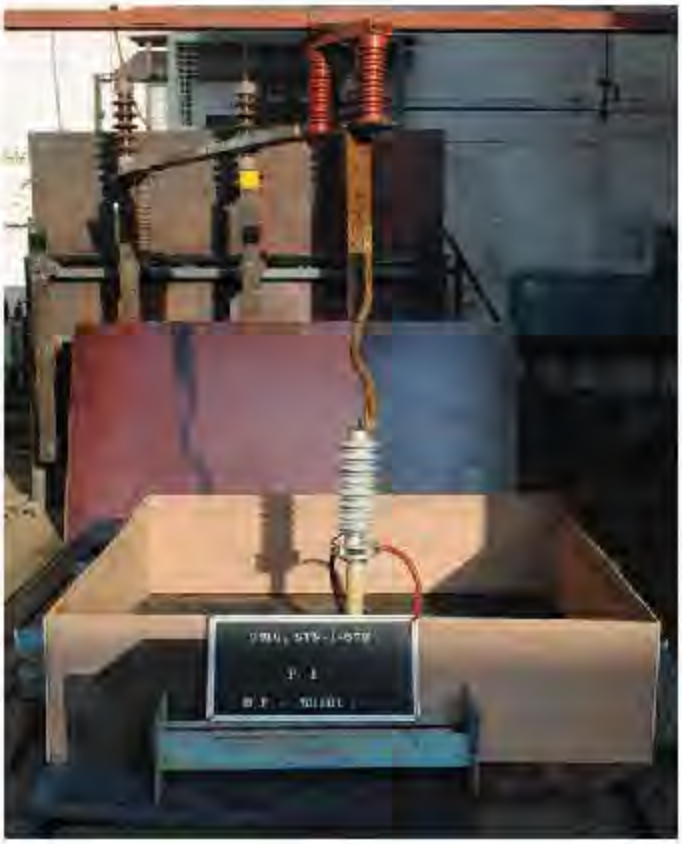


Fig. 7: The photograph of polymer surge arrester before test

Fig. 8: The photograph of polymer surge arrester after test

Arrester class = nominal discharge current	Rated short circuit current Is	Reduced short circuit current ±10% tol.		Low short –circuit current with a duration of 1 Sec.
A	A	A		A
20000 or 10000	80000	50000	25000	600±200
20000 or 10000	63000	25000	12000	600±200
20000 or 10000	50000	25000	12000	600±200
20000 or 10000	40000	25000	12000	600±200
20000 or 10000	31500	12000	6000	600±200
20000 or 10000 or 5000	20000	12000	6000	600±200
10000 or 5000	16000	6000	3000	600±200
10000, 5000, 2500 or 1500	10000	6000	3000	600±200
10000, 5000, 2500 or 1500	5000	3000	1500	600±200

Table 3: Required Currents for Short-Circuit Testes

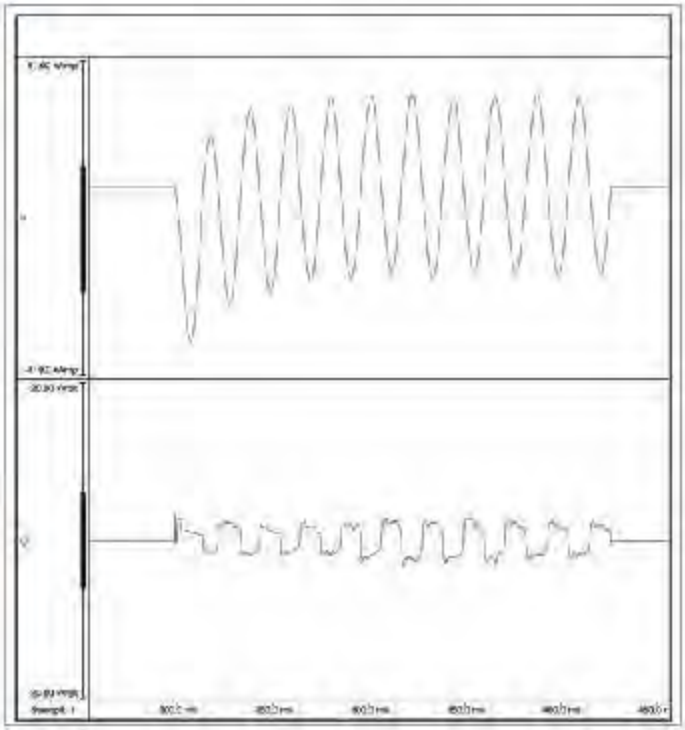


Fig. 9: The waveform of High Current Short-circuit test

value of the first half cycle of the porcelain–housed and polymer-housed arrester test current shall be at least 2 times the rms value.

For all the reduced short-circuit currents the rms value shall be in accordance with Table 3 (Source Table 15 of IEC 60099-4) and the peak value of the first half-cycle of the actual arrester test current shall be at least 2 times the rms value of this current.

Low Current Short Circuit Test

The test shall be made by using any test circuit that will produce a current through the test sample of 600A±200A r.m.s. measured at approximately 0.1 s after the start of the current flow. The current shall flow for 1 s or, for "Design A" porcelain-housed surge arrester until venting occurs. Typical oscillogram of Low current Short-Circuit is shown in Fig. 10.

Test Evaluation

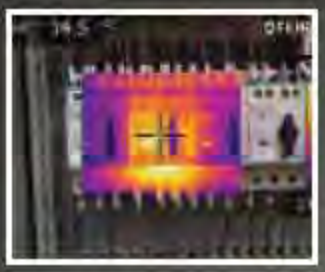
The following criteria are considering for successful the Test:

- No Violent shattering
- No Parts of the test sample shall be allowed to be found outside the enclosure, except for-

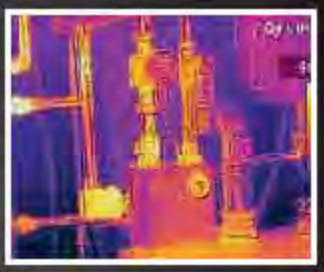
FLIR

EXperience

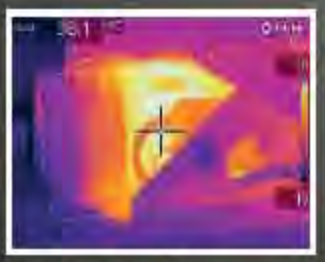
the world of thermal imaging



Avoid overheated fuses



Inspect central heating system



Check the condition of electrical engines fast

Discover problems in mechanical installations

FLIR EX-Series

Thermal imaging camera for fast electrical and mechanical inspections

FLIR Ex-Series cameras are point-and-shoot thermal imaging cameras that give you access to a new dimension. A FLIR Ex- Series camera is an affordable replacement for a spot pyrometer. It provides a thermal image with temperature information on every pixel. Electrical and mechanical problems can be spotted fast and accurate.

With an Ex-Series thermal imaging camera, you can see internal fuse damage, locate electrical problems, inspect electrical cabinets, check bearings, find motor problems, prevent down time and production loss.

All Ex-series are equipped with FLIR's patented Multi Spectral Dynamic Imaging (MSX®) feature.

If you want to have more information about the FLIR Ex-Series or any other FLIR thermal imaging camera please contact:

FLIR Systems India Pvt Ltd
1111, D Mall, Netaji Subhash Place,
Pitampura, Delhi - 110034 INDIA
Tel: +91-11-4560 3555
Fax: +91-11-4721 2008
E-mail: flirindia@flir.com.hk
Website: www.flir.com

www.flir.com

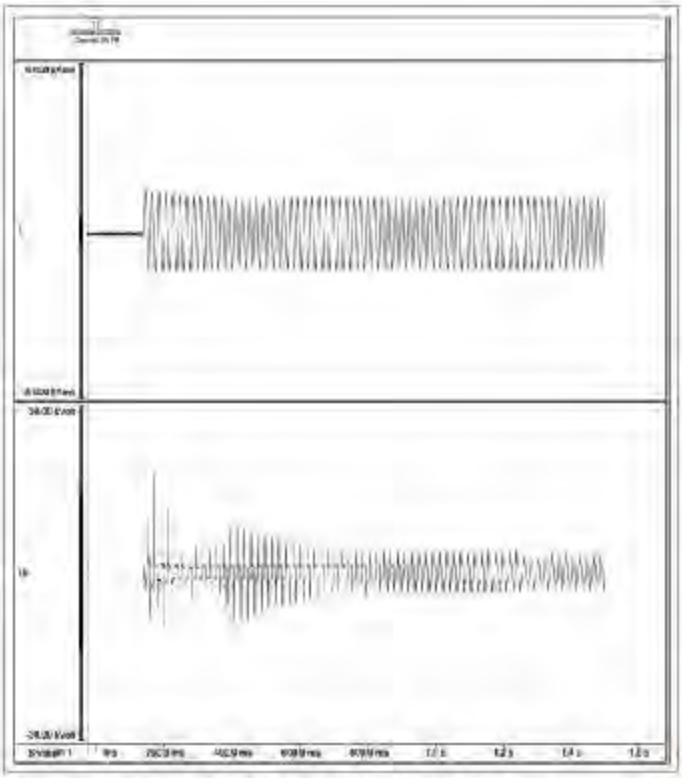


Fig. 10: The waveform of Low current Short-circuit test

- Fragments, less than 60 g each, of ceramic material such as MOV or porcelain.
- Pressure relief vents, covers and diaphragms.
- Soft parts of polymeric materials.

- The arrester shall be able to self extinguish open flames within 2 min after the end of the test. Any ejected parts inside or outside the enclosure must also self extinguish open flame within 2 min.

Causes of Failure

The following failure may come due to the following reasons

- Ingress of moisture.
- Active elements overloaded by energy or current.
- Due to energy or current discharge which leads to power frequency over load causes damage of some blocks in some or several units.
- Mechanical overloading which leads to an electrical failure.
- High temporary overvoltage.

Remedies to Improve the Design

- The internal pressure must be able to relieve quickly through the enclosure.
- Block (and other) pieces of hard material must not be expelled through the specified enclosure.
- The enclosure must be held together as much as possible.
- The arc should not be allowed to be established nor stay within the enclosure.
- The material shall be self-extinguishing.
- The design must be able to handle failures occurring within the block volume close to the centre.
- The current arc must be commutated to the outside as quickly as possible.

Conclusion

During the short circuit tests, the most severe case is failure of the ZnO blocks close to the centre, which requires improved quality of the blocks.

The most important part of porcelain and polymer tube design surge arresters with respect to reliability and safety is the sealing and pressure relief system. The sealing system must be designed to prevent ingress of moisture for the whole lifetime. In case of an arrester failure due to internal short circuit, the pressure relief system must release the pressure inside the housing which is caused by the arc heat before the housing is violently destroyed by the pressure shock wave.

Polymer-housings results in arrester design with lower weight and better pollution performance than conventional porcelain arresters. Thermal performance, in general, will be better which could be used to improve protection levels and/or acceptance of higher ambient temperatures above IEC stipulation. A high short-circuit capability could be obtained as well.

Profile

B V Raghavaiah

post graduate from JNTU, Hyderabad, has presented several technical papers. Presently he is Additional Director and Unit Head of CPRI, Bhopal. He is a member of BIS, CIGRE, Development Council for Heavy Electrical & Allied Industries, GoI, Ministry of Heavy Industries & Public Enterprises, Department of Power and MPERC. He also visited ABB Switzerland, CESI Italy test laboratories, represented CPRI at Malaysia for preparation and finalization of transformer specifications for Global bids for TNB, Malaysia, visited Japan to witness the tests as international inspector of STL.

Yugal Agrawal

ME, joined CPRI and has presented several technical papers, Lectured in various forums and Development of new test facilities as per the requirements of standards. Presently he is Engineering Officer-4 in STDS, CPRI Bhopal. He visited South Korea as International inspector of Short Circuit testing Liaison (STL) & Malaysia for deliver the training to TNB Engineers. He is member of Institution of Engineers, India & Member of Peer Group for review of course content of training themes for capacity building under R-APDRP for PFC, Delhi.

"Success is neither magical nor mysterious. Success is the natural consequence of consistently applying the basic fundamentals."

Amit JINDAL
Chairman & Managing Director
B.E. (Electrical, Electronics & Power)
amit@shivalic.com

- **CPRI Tested for 100 KA Short Circuit.**
- **CPRI Tested for 6000 Amps Temperature Rise .**
- **An ISO : 9001 : 2008 Certified Company.**

Shivalic Power Control Pvt. Ltd is one of the leading manufacturers of custom-built Electrical Panels and also executes Turnkey Projects. "*Shivalic*" works with an aim to provide human safety, product quality with technical competency and timely solutions to its customers, thus we enjoys an enviable market share in India and Abroad.




We heartily welcome you in Shivalic come and see our infrastructure & World Class facilities any time.

Shivalic
Make Things Possible

Shivalic Power Control (P) Ltd.

Corporate Office: 3E/35, B.P., 1st Floor, N.I.T., Faridabad 121001
Factory: Plot No. 18, Sector-24, Industrial Area, Faridabad - 121004
Phone:. +91 129 4059168, 4059169
E-mail: sales@shivalic.com | Web : www.shivalic.com

Technological Issues and Advancement of **Smart Meters** against tampering

In the present scenario, Non Technical Loss (NTL) during transmission of electrical energy is a major problem. Hence it is very essential to keep track of electrical consumption accurately. To maintain accurate readings of electricity consumed and to reduce Non-Technical Loss caused due to theft, tampering, etc., smart meters are being employed in many areas. Smart meter is a digital meter that records the energy consumption for the specified interval of time for which it is programmed. Smart meter with high accuracy, efficiency, security and theft resistance has replaced classical electrical meters. Nevertheless, unauthorized acts are still being continued even in smart meters.

Priyanka Halu, Shishir Patne, Dr M S Shashikala

This article focuses on denting the tampering and bypassing of smart meters. The paper illustrates some of the technological features that can be incorporated for advancing the smart meter technology by using ultra-low-power tilt sensors and energy metering chips or sensors (in case of meter manipulation) and by setting multiple password to optical ports (in case of cyber crimes) in order to detect and/or prevent theft.

In the electrical industry today, the buzzword "smart" is everywhere. It describes the modernization of the electrical network in general and also qualifies various categories of equipment. Smart meters, for example, are replacing antiquated mechanical devices and bringing valuable new functions to residential metering (i.e. two-way communication, remote disconnects, bi-directional energy measurement, time of use rates etc.).

Smart metering is a topic that recently has attracted much attention. An Advanced Metering Infrastructure (AMI) offers the possibility for additional energy related services such as Demand Side Management and realization of virtual power plants. With the emerging trend in the development of Technology there has been an urge to save and conserve energy by utilizing the useful resources available.

Smart meters have various advantages over previous classical meters for which they have got good stand in electrical industry, but as every technology has some drawback, even smart meter lags behind in few aspects. The security level in smart meter is being questioned in present scenario. Many issues on meter spying, tampering and health hazards caused due to meter are being raised. But since time immemorial as every budding technology has faced many drawbacks until it has reached its stability so do present smart meters are lagging behind in few security aspects. As the

technology is flourishing the same way hackers are finding many alternative ways to break the security and implement theft.

Since the vision of introducing smart meter was to eliminate unscrupulous energy consumption and to have better environment, this paper put forth some idea of enhancing the security of smart meter and meter data from being tampered and hacked.

Smart Meter

A smart meter is usually an electrical meter that records consumption of electrical energy in intervals of an hour or less and communicates that information wirelessly to the utility for monitoring and billing purposes. Fig. 1 Show how a smart meter looks.

Fig. 1: Smart Meter

Smart meters enable two-way communication between the meter and the central system or utility. This helps both consumers as well as utility sectors in many ways.

The benefits of Smart Meters to customers, the state, and utilities, include the following.

- Allows for faster outage detection and restoration of service by a utility when an outage occurs and therefore, less disruption to a customer's home or business.
- Provides customers with greater control over their electricity use when coupled with time-based rates
- Allows customers to make informed decisions by providing highly detailed information
- Helps the environment by reducing the need to build power plants, or avoiding the use of older, less efficient power plants as customers lower their electric demand.

A smart meter is usually an electrical meter that records consumption of electrical energy in intervals of an hour or less and communicates that information wirelessly to the utility for monitoring and billing purposes.

- Increases privacy because electricity usage information can be relayed automatically to the utility for billing purposes without on-site visits by a utility.

Fig. 2: Energy Information loop

Fig. 2, shows the path information from smart meter to electricity bill.

Energy Information Cycle

- Smart meter - On an hourly basis, the amount of electricity you use is tracked by the smart meter on your home.
- Collectors - Each day, the hourly information tracked by smart meter is sent by wireless connection or through telephone or power lines to a data collector located in your neighborhood.
- Meter data collection - These collectors relay energy usage information to your Local Distribution Company which ensure that all the meters have been read and all the necessary information have been captured.
- Operational systems - The Local Distribution Company then sends this information to the smart meter data repository which calculates how much electricity was used during the three price periods. Only authorized parties, such as Local Distribution Companies, have access to highly secure data base.
- Customer information & billing - Information from the data repository is sent back to Local Distribution Companies and other billing agents so it can be used to prepare invoices.
- Home energy management - Most home owners can access this energy use data on their electricity bill or through a secure Local Distribution Company's web site. New services are also emerging allowing consumers to monitor and control their energy use.

Tampering in Smart Meter

Smart grid is a much generalized word. It

includes diverse kind of sub-infrastructures. One of the important infrastructures is Advanced Metering Infrastructure (AMI). Due to many advantages of AMI, every community has the desire to install this system for its ease. AMI is an infrastructure which has many functions but it can also be used to control electricity theft. AMI is an infrastructure & smart meter is an entity which can be placed at each and every home/industry, replacing eletromechanical meters.

AMI provides a new sensor based approach. If sensors are installed in electrical equipment, then AMI can be useful in a way that utility or power distributing companies can predict load of specific area. This is useful for utility in a way that they will design a correct and efficient load flow to certain area. This technique is efficient to save many of economic issues for installing an infrastructure for any area.

Since the day the first meter was deployed, unscrupulous people have attempted to alter meters to steal utility-provided resources. Some approaches are simplistic but others are sophisticated. As security technology evolves so does the inventiveness and sophistication of the criminals.

The tampering done in smart meter is causing various issues in utility sector like inaccurate billing which in turn is causing serious imbalance at supply side. Also the use of electronic smart meters also introduces the threat of cyber attack or alteration of meter data. This loss in electricity is unseen as the losses occurring are non technical in nature. Hence it has become very essential to monitor theft and keep track of electrical consumption accurately.

There are many different ways in which energy theft occur, and much like other criminal activities, the methods shift constantly as new countermeasures are created and installed by power utilities. However, these ever-changing methods can be categorized into a few basic forms of energy theft happening around the world.

- Physical tampering of meter
- Cyber tampering of meter.

Physical tampering of meter – Physical tampering of meters can occur in following ways:

- Taking connections directly from distribution lines.
- Grounding the neutral wire.
- Interchanging input output connections.

Cyber tampering of meters – Cyber tampering of meters can occur in following ways:

While authenticating, data tampering occurs, using software hacking. False authentication can be used to authenticate the password and hack the data from smart meter.

Some hardware hacking, specially designed for fraud purposes are also designed by professionals like descrambler boxes, which reads data from smart meters and are used for illegal purposes.

Losses due to Electricity Theft

Electricity theft are basically an illegal way of getting the energy for different uses, resulting in loss for utility companies. Losses consist of technical and non technical losses. There are about $25 billion of losses annually in the world. Losses can actually be computed by finding the energy supplied, subtracting the amount of energy billed/paid. If one has to calculate nontechnical losses (NTL) simply one way of calculating it is to calculate technical losses (TL). We can evaluate it as follows.

Total Energy Losses = Energy Supplied - Bills Paid (2)

Total Energy Losses = NTL+TL (3)

Combining equation 2 and 3, we get

NTL = Energy supplied - Bills Paid - TL (4)

Hence we can find the amount of energy stolen in form of non-technical losses.

Communication with the Utility

Communication with the utility follows a systematic procedure as follows:

Firstly, smart meter measures the energy owing through it by recording the values using micro controller and correspondingly updates the values in its registers.

In the next step if there occurs any problem in wireless data transfer, it will re-check wireless device resolves the issue and re-update data in smart meter.

One of the technical way of theft is to make a meter read slow. These type of theft can be examined and checked physically to make all devices operate through legal connection.

The data is then transferred to utility with out allowing an intruder to hack it or distort it. This data transfer is also an important phase, and it needs attention. In the final step the data is stored at the server and is made available for technical computation, that is billing procedure, etc.

Advancement of Smart Meter against Tampering

The primary concern for the advancement is the security protections for smart meters that can be physically and remotely accessed for unauthorized acts. It is obviously cost prohibitive to the utility to physically secure all meters from individuals who are intent on theft, but meters and systems can be armed with safeguards, alerting utilities to physical tamper and preventing cyber tampering.

Features that can be Incorporated for Advancement of Smart Meter against Tampering

- Using ultra low power tilt sensors

These sensors detect for any movement in position of object form a fixed/reference position. The complete sensor occupies an area of under 2.5 m times 2.5 mm. Whenever there is any physical tampering taking place which involves tilting the meter for some adjustments, the tilt sensors provide both tilt warnings and outage notifications which can be sent to alert the utility of possible physical tampering with the devices. And the meters that show a pattern of power outages that do not match neighboring meters cue the utility to schedule a site visit or look for other evidence of theft.

Even though by making such advancement in smart meters if at all a person tries to access the data through serial port of meter, he/she has to set off tilt sensors. In the event if an individual were able to open a meter without removing or tilting the meter, the person must possess a detailed expert knowledge level of the specific device to enable successful connection to a serial port which is quite difficult as design varies from each manufacturer.

- Layered security and multiple passwords -

Whenever there is any cyber tampering taking place which involves unauthorized access of meter data, the layered security and multiple passwords helps in blocking these acts over local optical port. Field configuration and testing are accomplished using a local optical port connection. Password authentication is required to establish successful connection to

the meter via optical port. Assuming that the single layer is breached, the would-be thief now has "read-only" access to the meter data. An additional level of authentication is required before the meter will accept changes to any power consumption configuration settings. The last level requires that the thief possess extensive and detailed knowledge of the data table structures that contain the configuration-data.

- Using sensors at distribution transformers.

Layered Security refers to security systems that use multiple components to protect operations on multiple levels, or layers. Whenever there is any remote theft taking place the same can be detected by comparing the summation of data of all the meters connected to a particular distribution transformer with the data from sensor which is installed at respective distribution transformer to read to data being distributed, i.e.,

$$Y = \sum_{i=1}^{n} Xi \qquad (1)$$

where,

Y = Data recorded by sensor at distribution transformer for particular area.

Xi = Data of meter of ith home

This method can be done by considering the summation of pulse count (data inferred by pulse count i.e., number of units of power) of each meter connected to distribution transformer and comparing it with pulse count (data inferred by pulse count i.e., number of units of power) of sensor installed at distribution transformer. If equation (1) satisfy, then there is no theft taking place, else we can infer that there is either physical tampering or cyber tampering taking place. In case, equation (1) do not satisfy then the pattern of power of all the meter connected to the respective transformer is checked and compared with its neighboring meters, and if there is any unusual pattern of meter then utility can schedule a visit and look for other evidence of theft.

Conclusion

Smart meters are a powerful tool in helping utilities and grid operators' combat non-technical losses such as energy theft. All of the features of new technologies should be explored to find out how they can play a role in a utility's security and non-technical-loss prevention. Many emerging technologies demonstrate unforeseen benefits beyond just what they were designed for, and can provide new, innovative solutions to old challenges. The most important tool of the smart meter, in the fight against non-technical losses is information capture. This article highlights some ideas that can be implemented to detect and reduce/eliminate non-technical-losses. When information is available, you can better plan, measure results and act more accurately, increasing process efficiency. Hence, we can have a better environment and better society.

Profile

Priyanka Halu
is currently a student of VIII SEM BE in the Department of E&EE, SJCE, Mysore. Her areas of interest are Advanced Energy Management, Core Electrical and Control Systems.

Shishir Patne
is currently a student of VIII SEM BE in the Department of E&EE, SJCE, Mysore. His areas of interest are Advanced Energy Management and Control Systems.

Dr M S Shashikala
BE, MSc (Engg), PhD is currently Professor in Department of E&EE, SJCE, Mysore. Her areas of research are Demand Side Management, Advanced Metering Infrastructure and Energy Conservation. She has many publications in the area of Demand Side Management and Advanced Metering Infrastructure.

With increased concerned about sustainable development there is rapid growth in wind energy harvesting systems. Because of its desirable features like operation at cost-effectiveness, variable-speed, constant frequency, control of active and reactive power independently. A major share of the said system uses doubly fed induction generators (DFIG). Modeling allows investigation of effect of such systems on the various operating parameters and the control strategies of the power system. This article presents a critical review of the various DFIG models that have been proposed in the literature for voltage stability and power flow analysis. The models are followed by a thorough analysis of the results observed and discussion on the same.

Sneha Patil, D S Bankar & D B Talange

Reference Frame Analysis & Modeling Techniques of **Doubly Fed Induction Generator**

With rapid climate change and increased concern about sustainable development many countries have set up new renewable energy targets which can be achieved only by utilizing a wide share of electricity from wind energy harvesting systems. As the contribution of wind power enlarges it is important to ensure that power system retains its power quality, security, and reliability under normal conditions and during contingencies. DFIGs are gaining more attention due to its various desirable features like the generation at variable speed, enhanced power quality, individual real and reactive power control. Also there are enhancements in the area of power electronics.

Modeling is a mathematical or diagrammatic representation of the system which characterizes its behaviour. It is performed in order to predict the system behaviour in various operating conditions. DFIG can be modelled in 1st, 3rd or 5th order. In the initial order model the dynamics of both the stationary and rotating parts are and hence swing equation alone is considered. It can be conveniently used for study of dynamics occurring in the system in long term by taking into account the load characteristics of the induction machine. A third-order model ignores the dynamic behaviour of the stator and has significant importance in the transient analysis of the system whereas a full order induction generator model includes large dynamics and can be used for design of current controller or predicting system performance at varied operating conditions.

Fifth order	Third order	First order
$d\psi_{sq(d)}/dt \neq 0$	$d\psi_{sq(d)}/dt = 0$	$d\psi_{sq(d)}/dt = 0$
$d\psi_{rq(d)}/dt \neq 0$	$d\psi_{rq(d)}/dt \neq 0$	$d\psi_{rq(d)}/dt = 0$
$d\omega_m/dt \neq 0$	$d\omega_m/dt \neq 0$	$d\omega_m/dt \neq 0$

Table 1: Simplifications employed in various modeling orders

DFIG System Modeling

DFIGis basically has a construction of an induction generator having a wound rotor. The stationary windings are directly grid connected through a transformer. The rotating windings are connected to rotor side and grid side converters as shown in Fig. 1. They govern DFIG's behaviour and the operation of the controllers during all healthy and faulty conditions. Rotor side converter operated to alter the magnitude and phase angle of the rotor voltage and hence achieve control of real and reactive power.

DFIGs are gaining more attention due to its various desirable features like the generation at variable speed, enhanced power quality, individual real and reactive power control.

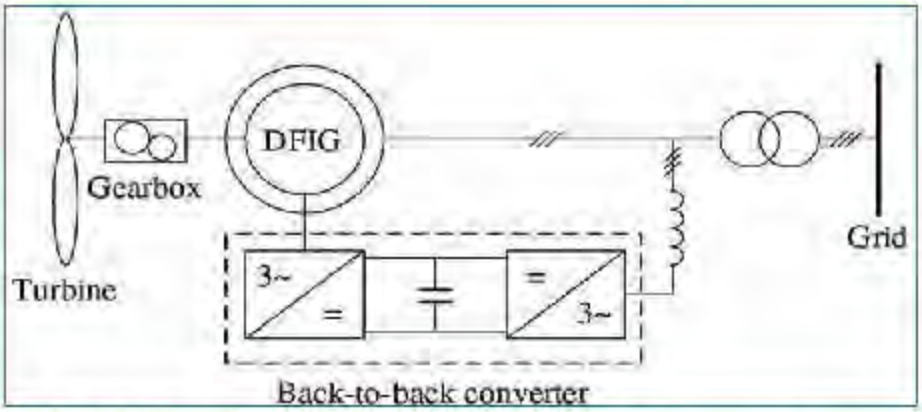


Fig. 1: Block diagram of DFIG based WECS

Generator Model

The modelling of DFIG can be in terms of direct d and q axes. Voltage equations can be represented in terms of d and q axes using various models as per the application.

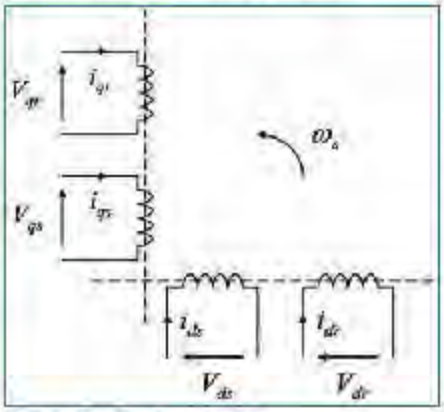


Fig. 2: d and q axes of DFIG

Reference Frame Analysis

The choice of the reference frame depends on the problem to be solved and the computational abilities of the machine. Three phase stator and rotor windings of an induction machine are represented by two sets of orthogonal fictitious coils. Rotation of the d-q axis can be arbitrary or at any of the three reference speeds as follows.

- The stationary reference frame where the d-q axes are stationary;
- The synchronously rotating reference frame where the d-q axes rotate at synchronous speed;
- The rotor reference frame where the d-q axes rotate at rotor speed.

Various Types of DFIG Models

The choice of appropriate model depends upon the application of the system and the computational abilities of the computer. Following section comprises of various DFIG models along with their results in different transient conditions. The bus bar voltages are written as:

$$v_a = V_\alpha \cos(\omega_s + \gamma)$$
$$v_b = V_\alpha \cos(\omega_s + \gamma - \lambda) \qquad (1)$$
$$v_b = V_\alpha \cos(\omega_s + \gamma + \lambda)$$

Fifth Order Model

Three-phase stator and rotor windings are represented by two sets of orthogonal fictitious coils along the direct and quadrature axes. A generalized fifth order model bears following assumptions:

- The stator current is positive towards the machine.
- Derivation of equations is on synchronous reference.
- The q-axis is 90 ahead of the d-axis along the direction of rotation.
- The q component of the stator voltage is the real part and d component is imaginary.

Reference frame	Stationary reference frame	Synchronously rotating reference frame	Rotor reference frame
Assumptions made	θ = 0; d, q axes do not rotate d-axis is chosen to coincide with the stator phase a axis.	θ=ω st; d, q axes rotate at synchronous speed	θ=ω r dt ; d, q reference frame rotate at rotor speed. d-axis position coincides with the rotor phase a axis.
Stator voltages	$v_{ds} = V_m \cos(\omega_{st} + \gamma)$ $v_{qs} = -V_m \sin(\omega_{st} + \gamma)$	$v_{ds} = V_m \cos\gamma$ $v_{qs} = -V_m \sin\gamma$	$v_{ds} = V_m \cos(s\omega_{st} + \gamma)$ $v_{ds} = -V_m \sin(s\omega_{st} + \gamma)$
Inference	$v_{as} = v_{ds}$ & $I_d = I_{as}$ hence lesser number of parameters are to be calculated.	stator voltages are DC quantities	the d, q voltages are of slip frequency and $I_d = I_{as}$
Advantages	Reduced computational time	larger step length can be used while digital integration	Reduced computational time

Table II: Comparison of various reference frames

The voltage equations for the induction generator are given below, where all quantities except the synchronous speed are in pu:

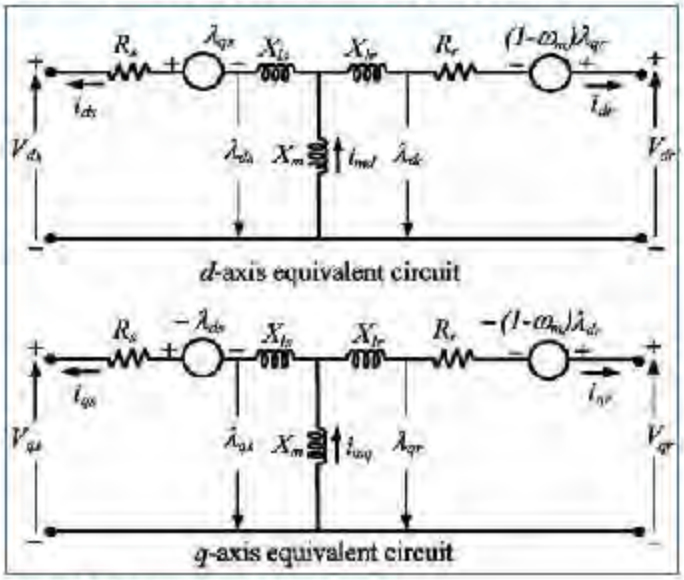


Fig. 3: DFIG equivalent circuits

$$\begin{cases} v_{ds} = R_s \times I_{ds} - \lambda_{qs} + \frac{1}{\omega_s}\frac{d}{dt}\lambda_{ds} \\ v_{qs} = R_s \times I_{qs} + \lambda_{ds} + \frac{1}{\omega_s}\frac{d}{dt}\lambda_{qs} \end{cases} \quad (2)$$

$$\begin{cases} v_{ds} = R_s \times I_{ds} - s \times \lambda_{qs} + \frac{1}{\omega_s}\frac{d}{dt}\lambda_{ds} \\ v_{qs} = R_s \times I_{qs} + s \times \lambda_{ds} + \frac{1}{\omega_s}\frac{d}{dt}\lambda_{qs} \end{cases} \quad (3)$$

where,

$$\begin{cases} \lambda_{ds} = L_{ss} \times I_{ds} + L_m \times I_{dr} \\ \lambda_{qs} = L_{ss} \times I_{qs} + L_m \times I_{qr} \end{cases} \quad (4)$$

$$\begin{cases} \lambda_{dr} = L_{rr} \times I_{dr} + L_m \times I_{ds} \\ \lambda_{qr} = L_{rr} \times I_{qr} + L_m \times I_{qs} \end{cases} \quad (5)$$

equation (4) implies,

$$I_{ds}\left(\frac{\lambda_{ds} - L_{ss} \times I_{ds}}{L_m}\right) \quad (6)$$

$$I_{qs}\left(\frac{\lambda_{qs} - L_{ss} \times I_{qs}}{L_m}\right)$$

substitution of eq.(5) in(3) with $X_1 = \left(L_{ss} - \frac{L_{ss}^2}{L_{rr}^2}\right)$ *gives,*

$$\begin{cases} \lambda_{ds} = X_1 \times I_{ds} + \frac{L_{ss}}{L_{rr}} \times \lambda_{dr} \\ \lambda_{qs} = X_1 \times I_{qs} + \frac{L_{ss}}{L_{rr}} \times \lambda_{qr} \end{cases} \quad (7)$$

Voltage behind a transient model for the DFIG can be calculated by the following two voltage components

$$e_d = -\frac{L_{ss}}{L_m} \times \lambda_{qr};\ e_q = -\frac{L_{ss}}{L_m} \times \lambda_{ds} \quad (8)$$

substituting eq.(8) in (7)

$$\lambda_{ds} = X_1 \times I_{ds} + e_q;\ \lambda_{qs} = X_1 \times I_{qs} + e_d \quad (9)$$

by substituting eq. (9) in (2)

$$\begin{cases} v_{ds} = R_s \times I_{ds} - X_1 \times I_{qs} + e_d + \frac{X_1}{\omega_s}\frac{d}{dt}I_{ds} + \frac{1}{\omega_s}\frac{d}{dt}e_q \\ v_{qs} = R_s \times I_{qs} + X_1 \times I_{ds} + e_q + \frac{X_1}{\omega_s}\frac{d}{dt}I_{qs} - \frac{1}{\omega_s}\frac{d}{dt}e_d \end{cases} \quad (10)$$

using eq. (6),(3),(8)in(10) & substituting substituting $\frac{L_m}{\omega_s R_r} = T_o$ gives,

$$\begin{cases} \frac{de_d}{dt} = -\frac{1}{T_o}\left[e_d + \frac{L_m^2}{L_{rr}} \times I_{qs}\right] + s \times \omega_s \times e_q - \omega_s \frac{L_m}{L_{rr}} \times v_{qs} \\ \frac{de_q}{dt} = -\frac{1}{T_o}\left[e_q - \frac{L_m^2}{L_{rr}} \times I_{ds}\right] + s \times \omega_s \times e_d - \omega_s \frac{L_m}{L_{rr}} \times v_{ds} \end{cases} \quad (11)$$

$$I_{ds} = \left(\frac{\lambda_{ds} - L_{ss} \times I_{ds}}{L_{rr}}\right) = \frac{1}{L_{ss}} \times e_q - \frac{L_{ss}}{L_{rr}} \times I_{ds}$$

$$I_{qs} = \left(\frac{\lambda_{qs} - L_{ss} \times I_{qs}}{L_{rr}}\right) = \frac{1}{L_{ss}} \times e_d - \frac{L_{ss}}{L_{rr}} \times I_{qs} \quad (12)$$

sudhir

One power....many roles !

Metros

Highways

Buildings

Hospitals

Diesel & Gas Gensets 7.5 - 3000 KVA

India's largest producers of Generating sets, powered by Cummins engines.

Our complete range of Generators are extremely useful in providing Power in areas where conventional power supply infrastructure is unreliable. Our product line includes the widest range of Gensets ranging from 7.5KVA to 3000KVA, with a fuel option of Diesel or gas, a complete range of intelligent switchboards, design & build end to end power solutions for your Captive Power Plants

Backed by Cutting edge technology & innovation, our generators are rugged, energy efficient & low noise machines

Committing to latest CPCB Norms

Sudhir Gensets Limited

Corporate Office : Plot No-1, Sector-34, EHTP, Gurgaon-122001, Haryana Tel.: +91-124-4156000(30 lines), E-mail : info@sudhirgensets.com
Marketing Office : 507, International Trade Tower, Nehru Place, New Delhi-110019, Tel.: +91-11-41606000(10 lines)
Branches : Chandigarh, Baddi, Ludhiana, Amritsar, Karnal, Jaipur, Jodhpur, Udaipur, Mumbai, Ahmedabad, Surat, Silvassa, Bangalore

Toll Free: 1800 102 7475

www.sudhirgensets.com

electromagnetic torque is calculated as

$$T_e = \bar{\lambda}_{sa} \times \bar{I}_{ra} - \bar{\lambda}_{sa} \times \bar{I}_{sa} \quad (13)$$

substituting eq.(9) in(13)

$$T_e = (\bar{X}_1 \times \bar{I}_{sa} + \bar{e}_q) \times \bar{I}_{ra} - (\bar{X}_1 \times \bar{I}_{ra} + \bar{e}_d) \times \bar{I}_{sa}$$
$$= \bar{e}_q \times \bar{I}_{ra} + \bar{e}_d \times \bar{I}_{sa} \quad (14)$$

substituting the values of $\bar{e}_d$ and $\bar{e}_q$ in (14)

$$T_e = \frac{\bar{L}_m}{\bar{L}_r}(\bar{\lambda}_{rd} \times \bar{I}_{ra} - \bar{\lambda}_{rq} \times \bar{I}_{sa}) \quad (15)$$

from eq.(5) and (15)

$$T_e = \bar{L}_m(\bar{I}_{sd} \times \bar{I}_{ra} - \bar{I}_{rq} \times \bar{I}_{sa}) \quad (16)$$

the mechanical torque T_m is given by

$$\frac{d\omega_r}{dt} = \frac{1}{j} \times (T_m - T_e) \quad (17)$$

Third Order Model

If we take into account the transients produced by the network and the stator, the resultant model is of higher order which puts constraints over the size of the system and the computational time increases. This enhances the scope of reduced order model. The voltage equation with a reduced order in per unit are

$$\begin{cases} v_{sd} = \bar{R}_s \times \bar{I}_{sd} - \bar{\lambda}_{sq} \\ v_{sq} = \bar{R}_s \times \bar{I}_{sq} + \bar{\lambda}_{sd} \end{cases} \quad (18)$$

$$\begin{cases} v_{rd} = \bar{R}_r \times \bar{I}_{rd} - s \times \bar{\lambda}_{rq} + \frac{1}{\omega_b} \frac{d}{dt} \bar{\lambda}_{rd} \\ v_{rq} = \bar{R}_r \times \bar{I}_{rq} + s \times \bar{\lambda}_{rd} + \frac{1}{\omega_b} \frac{d}{dt} \bar{\lambda}_{rq} \end{cases} \quad (19)$$

Since the stator transients are neglected

$$\begin{cases} \bar{v}_{sd} = \bar{R}_s \times \bar{I}_{sd} - \bar{X}_1 \times \bar{I}_{sq} + \bar{e}_d \\ \bar{v}_{sq} = \bar{R}_s \times \bar{I}_{sq} + \bar{X}_1 \times \bar{I}_{sd} + \bar{e}_q \end{cases} \quad (20)$$

$$\begin{cases} \frac{d\bar{e}_d}{dt} = -\frac{1}{T_0}\left[\bar{e}_d + \frac{\bar{L}_m - \bar{L}_r}{\bar{L}_r} \times \bar{I}_{sq}\right] + s \times \omega_r \times \bar{e}_q - \omega_r \times \frac{\bar{L}_m}{\bar{L}_r} \times \bar{v}_q \\ \frac{d\bar{e}_q}{dt} = -\frac{1}{T_0}\left[\bar{e}_q - \frac{\bar{L}_m - \bar{L}_r}{\bar{L}_r} \times \bar{I}_{sd}\right] + s \times \omega_r \times \bar{e}_d - \omega_r \times \frac{\bar{L}_m}{\bar{L}_r} \times \bar{v}_d \end{cases} \quad (21)$$

where $\bar{T}_0 = \frac{\bar{L}_r}{\omega_b \bar{R}_r}$

electro- magnetic torque according to eq. (16) is reduced by below mentioned procedure (a) with the help of eq. (4) and (18) and neglecting resistance term

$$\begin{cases} I_{sd} = \frac{1}{\bar{L}_m} \psi_{sq} - \frac{\bar{L}_r}{\bar{L}_m} I_{rd} \\ I_{sq} = \frac{1}{\bar{L}_m} \psi_{sd} - \frac{\bar{L}_r}{\bar{L}_m} I_{rq} \end{cases} \quad (22)$$

(b) substituting in(16)

$$T_e = -\frac{\bar{L}_m}{\bar{L}_r}(I_{rd} \times \psi_{sd} - I_{rq} \times \psi_{sq}) \quad (23)$$

Harmonic Model

Static loads are modelled as constant impedances and are calculated from power consumption at fundamental frequency and from the resistance and inductance values of the fundamental impedance at the harmonic frequencies is obtained. But slip of dynamic loads depend on the harmonic frequency. Therefore a harmonic model must be considered separately. Development of a harmonic model must include the considerations of unbalanced or balanced conditions of the power system.

Unbalanced three-phase systems

Sequence or phase components can be used to develop harmonic model. The prerequisite required for harmonic modeling are positive & negative sequence equivalent circuits at each harmonic. From these, the motor sequence admittance matrix Y_{Fk} can be derived.

$$I_m = Y_m V_m$$

$$\begin{bmatrix} I_0 \\ I_p \\ I_n \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ 0 & Y_p & 0 \\ 0 & 0 & I_n \end{bmatrix} = \begin{bmatrix} V_0 \\ V_p \\ V_n \end{bmatrix} \text{ where, } (k = 1, 3, 5) \quad (24)$$

Where Y_{pk} & Y_{nk} are the respective positive and negative sequence admittances. The zero-sequence component is null for Delta or isolated Wye connected. Modeling with phase components requires the three-phase admittance matrix Y_k at each harmonic using the symmetrical component transformation:

$$\underline{F}\, I_m = \underline{F} Y_m \underline{F}^{-1} \underline{F} V_m$$

$$\underline{I}_y = \underline{Y}_y \underline{Y} \underline{V}_y$$

$$\begin{bmatrix} I_0 \\ I_p \\ I_n \end{bmatrix}_k = \begin{bmatrix} \underline{Y}_0 & \underline{Y}_0 & \underline{Y}_0 \\ \underline{Y}_p & \underline{Y}_p & \underline{Y}_p \\ \underline{Y}_n & \underline{Y}_n & \underline{Y}_n \end{bmatrix}_k = \begin{bmatrix} V_0 \\ V_p \\ V_n \end{bmatrix}_k \quad (25)$$

where

$$\underline{F} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix}_k \quad F^{-1} = \frac{1}{3} \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix}_k \quad a = e^{j\frac{2\pi}{3}} \quad (26)$$

Thus from (25) and (26) elements of $\underline{Y}_y$ *are obtained from* $\underline{Y}_m$

$$\underline{Y}_y = \underline{F} \underline{Y}_m \underline{F}^{-1}$$

$$= \begin{cases} \underline{Y}_{ss} = (\underline{Y}_{aa} + \underline{Y}_{ab})/3 \\ \underline{Y}_{sn} = (a\underline{Y}_{ga} + a^2 \underline{Y}_{ab})/3 \\ \underline{Y}_{ns} = (a^2 \underline{Y}_{ga} + a\underline{Y}_{ab})/3 \end{cases} \quad (27)$$

Balanced three-phase systems

Balanced three phase system consists of positive sequence harmonics (V_{bk}=a2V_{ak} and V_{ck}=aV_{ak} for k=1, 7, . . .), set of negative-sequence harmonics (Vbk= aVakand V_{ck}= a2V_{ak} for k=5, . . .) & triplen harmonic voltages are zero. Hence considering this with equations (24) & (26) the relations between the harmonic phasors of the three-phase voltages & currents are obtained:

$$I_{ak} = Y_{pk} V_{ak} (k = 1, 7, ..),$$
$$I_{ak} = Y_{nk} V_{ak} (k = 5, ...) \quad (28)$$

Where g = a, b, c. Thus it is concluded that the knowledge of admittances of the induction motor, Y_{pk} and Y_{nk} is sufficient to develop harmonic studies on balanced three-phase systems.

Saturation Model

In order to increase the accuracy of performance prediction, the influence of main and leakage flux saturation has to be taken in account.

Main flux saturation

The magnetic saturation caused by the main field in DFIG does not depend on the direction of field and is affected only by its absolute value. The magnetizing flux is denoted as

$$\frac{d}{dx}\psi_m = \frac{d}{dx} L_m i_m = \frac{d}{di_m} L_m i_m \frac{d}{dt} i_m$$

$$i_m = \sqrt{i_{md}^2 + i_{mq}^2} \quad (29)$$

where $i_{md} = i_{sd} + i_{rd}, i_{mq} = i_{sq} + i_{rq}$

i_m affected by the operating region in the magnetization curve. According to the magnetization characteristics depicted in Fig. 5 the value of inductances is obtained from the following equations:

$$L_m = \frac{\psi_m}{i_m}, L_{md} \frac{d\psi_m}{di_m} \quad (30)$$

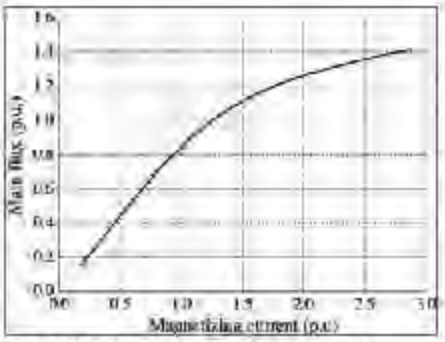


Fig. 4: Relationship between magnetizing current and main flux

the voltage equations of DFIG by considering magnetizing saturation of the flux are as follows

$$v_{sq} = R_s i_{sq} + L_{ls} \frac{d}{dt} i_{sq}$$
$$+ L_{sm} \frac{d}{dt} i_{sq} + \omega_s (L_{ss} i_{sd} + L_{sm} i_{sm})$$
$$v_{sd} = R_s i_{sd} + L_{ls} \frac{d}{dt} i_{sd}$$
$$+ L_{sm} \frac{d}{dt} i_{sm} - \omega_s (L_{ss} i_{sq} + L_{sm} i_{sm}) \quad (31)$$

$$v_{rq} = R_r i_{rq} + L_{lr} \frac{d}{dt} i_{rq} + L_{sm} \frac{d}{dt} i_{sm}$$
$$+ (\omega_s - \omega_r)(L_{rr} i_{rd} + L_{sm} i_{sm})$$
$$v_{rd} = R_r i_{rd} + L_{lr} \frac{d}{dt} i_{rd} + L_{sm} \frac{d}{dt} i_{sm}$$
$$- (\omega_s - \omega_r)(L_{rr} i_{rq} + L_{sm} i_{sm}) \quad (32)$$

Saturation of flux of DFIG in the event transients response during fault conditions is influenced by the operating region in

Smart solution for Smart Metering

... in design, functionality, and safety

Phoenix Contact offers application-specific innovative product range - connection solutions with IP20 and IP67 protection and electronic enclosure for your smart device for all kind of industrial application.

Signals

In measuring and control technology.

Data

Seamless for all established fieldbuses, Ethernet, Profinet, FireWire, and USB.

Power

For drive technology and all areas of modern power electronics.

PHOENIX CONTACT
INSPIRING INNOVATIONS

HEAD OFFICE
Phoenix Contact (India) Pvt. Ltd.
F-2/2, Okhla Industrial Area, Phase-II
New Delhi 110 020 INDIA
Tel: +91-11-30627700/800
Fax: +91-11-41611070/71
E-mail: adverts@phoenixcontact.co.in
Website: www.phoenixcontact.co.in

SOUTHERN INDIA OFFICE
411, Barton Centre
84, M.G. Road, Bangalore 560 001
Tel: +91-80-30577399 to 406
Telefax: +91-80-25581312

WESTERN INDIA OFFICES
36, Shamrao Bungalow, 1st Floor
Cooper Road, Andheri
Andheri (W), Mumbai 400 058
Tel.: +91-22-31901500 / 2772 / 3334

404-405, City Point
Dhole Patil Road, Pune 411 001
Tel.: +91-20-30581234-33
Fax: +91-20-30523637

www.facebook.com/PhoenixContactIndia

magnetization curve as well as the value of i_m. The active power output P_s at the terminals of the stator

$$P_s = \frac{\omega_s}{L_s}|\overline{\psi}_s|^2 - \frac{\omega_s L_m}{L_s}|\overline{\psi}_s|^2$$
$$\approx \frac{\omega_s}{L_s}|\overline{\psi}_s|^2 - \omega_s i_{ss}|\overline{\psi}_s|^2 \quad (33)$$

Therefore, with the reduction of L_m and accordingly L_s, in order to reach the unity pf the reactive power required is higher along with some contribution of compensating devices. Present ratings of the RSC is and hence the cost is elevated.

Leakage flux saturation

Because of the phenomenon of deep bar the equivalent circuit R and X_L are influenced by the slip. The effective values of rotor resistance R_{0r} & leakage reactance as well as the leakage reactance X_{0r} at the given operating region are formulated as follows

$$R_{0r} = \begin{cases} R_r & |s| \le S_{cr} \\ R_r\left[(K_x - 1)|s| + \dfrac{1 - K_g S_{cr}}{1 - S_{cr}}\right] & |s| > S_{cr} \end{cases}$$
$$X_{0r} = \begin{cases} X_{lr} & |s| \le S_{cr} \\ X_{lr}\left[(K_x - 1)|s| + \dfrac{1 - K_g S_{cr}}{1 - S_{cr}}\right] & |s| > S_{cr} \end{cases} \quad (34)$$

where s is the slip.

$$S_{cr} = R_r\sqrt{\frac{R_s^2 + X_s^2}{X_{cr}^2 - X_s X_r + R_s^2 + X_r^2}} \quad (35)$$

K_r and K_x are the respective leakage resistance & leakage reactance factors given by

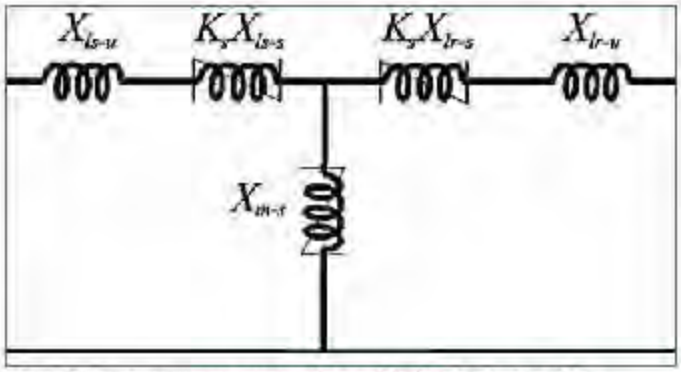


Fig. 5: Induction generators model considering the leakage flux saturation

$$K_r = \frac{1}{R_c}\left(\frac{U_n}{\gamma I_n}\sqrt{\frac{1}{1 + \tan^2\varphi_0}} - R_c\right)$$
$$K_x = \frac{1}{X_{lr}}[(R_c + K_r R_c).\tan\varphi_0 - X_{lr}] \quad (36)$$

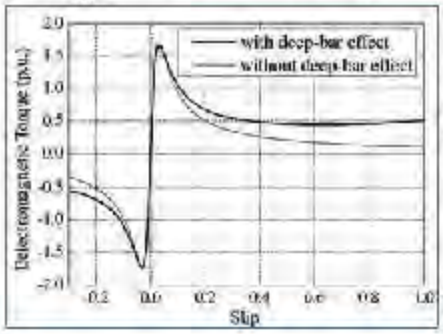


Fig. 6: Torque slip characteristics of the machine with short circuited rotor after considering and neglecting the effect of saturation

where, c denotes the relative starting current & φ 0 is the value of phase angle at standstill position. Electromagnetic torque fluctuations by considering and neglecting

Parameters	5th order model	3rd order model	Model with saturation effect considered
Stator voltage	$\begin{cases} v_{ds} = \overline{R}_s\overline{i}_{ds} - \overline{\lambda}_{qs} + \frac{1}{\omega_b}\frac{d}{dt}\overline{\lambda}_{ds} \\ v_{qs} = \overline{R}_s\overline{i}_{qs} + \overline{\lambda}_{ds} + \frac{1}{\omega_b}\frac{d}{dt}\overline{\lambda}_{qs} \end{cases}$	$\begin{cases} v_{ds} = \overline{R}_s \times \overline{i}_{ds} - \overline{\lambda}_{qs} \\ v_{qs} = \overline{R}_s \times \overline{i}_{qs} - \overline{\lambda}_{ds} \end{cases}$	$v_{ds} = R_s i_{ds} + L_{ls}\frac{d}{dt}i_{ds} + L_{sm}\frac{d}{dt}i_{sm} - \omega_s(L_{ls}i_{qs} + L_{sm}i_{qm})$ $v_{qs} = R_s i_{qs} + L_{ls}\frac{d}{dt}i_{ls} + L_{sm}\frac{d}{dt}i_{qm} + \omega_s(L_{ls}i_{ds} + L_{sm}i_{qm})$
Rotor voltage	$\begin{cases} v_{dr} = \overline{R}_r\overline{i}_{dr} - s\overline{\lambda}_{qr} + \frac{1}{\omega_b}\frac{d}{dt}\overline{\lambda}_{dr} \\ v_{qr} = \overline{R}_r\overline{i}_{qr} + s\overline{\lambda}_{dr} + \frac{1}{\omega_b}\frac{d}{dt}\overline{\lambda}_{qr} \end{cases}$	$\begin{cases} v_{dr} = \overline{R}_r\overline{i}_{dr} - s\overline{\lambda}_{qr} + \frac{1}{\omega_b}\frac{d}{dt}\overline{\lambda}_{dr} \\ v_{qr} = \overline{R}_r\overline{i}_{qr} + s\overline{\lambda}_{dr} + \frac{1}{\omega_b}\frac{d}{dt}\overline{\lambda}_{qr} \end{cases}$	$v_{dr} = R_r i_{qr} + L_{lr}\frac{d}{dt}i_{dr} + L_{sm}\frac{d}{dt}i_{sm} - (\omega_s - \omega_r)(L_{lr}i_{qr} + L_{sm}i_{qm})$ $v_{qr} = R_r i_{qr} + L_{lr}\frac{d}{dt}i_{dr} + L_{sm}\frac{d}{dt}i_{qm} + (\omega_s - \omega_r)(L_{lr}i_{dr} + L_{sm}i_{qm})$
Flux likages at the stator side	$\begin{cases} \overline{\lambda}_{ds} = \overline{L}_{ls}\overline{i}_{ds} + \overline{L}_{sm}\overline{i}_{dr} \\ \overline{\lambda}_{qs} = \overline{L}_{ls}\overline{i}_{qs} + \overline{L}_{sm}\overline{i}_{qr} \end{cases}$	stator transients neglected	Magnetizing flux $\frac{d}{dx}\psi_m = \frac{d}{dx}L_m i_m = \frac{d}{di_m}L_m i_m \frac{d}{dt}i_m$
Flux linkages at the rotor side	$\begin{cases} \overline{\lambda}_{dr} = \overline{L}_{sm}\overline{i}_{ds} + \overline{L}_{lr}\overline{i}_{dr} \\ \overline{\lambda}_{qr} = \overline{L}_{sm}\overline{i}_{qs} + \overline{L}_{lr}\overline{i}_{qr} \end{cases}$		
Other parameters			Resistance saturation factor and leakage reactance Saturation factor $K_r = \frac{1}{R_c}\left(\frac{U_n}{\gamma I_n}\sqrt{\frac{1}{1 + \tan^2\varphi_0}} - R_c\right)$ $K_x = \frac{1}{X_{lr}}[(R_c + K_r R_c).\tan\varphi_0 - X_{lr}]$

Table III: Comparison of 5th order, 3rd order and saturation models of DFIG

Since 1961

The Subscription In-charge
Electrical India
Chary Publications Pvt. Ltd.
201, Premalaya, Next to Café Coffee Day, Opp. Telecom Factory, Deonar, Mumbai - 400 088.
Email: sub@charypublications.in

If You are already a Subscriber
Enter the Subscription No. EI/SUB/ ☐

Yes, I would like to subscribe **Electrical India** for.....years at Rs..... (US $.....overseas subscribers)

Payment details :

Cheque / DD No.....Dated.....

Drawn on Bank.....Branch.....

In favour of **CHARY PUBLICATIONS PVT. LTD.**

Or charge my ☐ MasterCard ☐ VISA ☐ IndiaCard ☐ TajCard For Rs.....

CARD No. ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

CARD EXPIRY DATE: ☐☐ ☐☐☐☐ (M M Y Y Y Y) Date of Birth ☐☐ ☐☐ ☐☐☐☐ (D D M M Y Y Y Y)

Name.....

Designation..... Signature.....

Company.....

Department.....

Type of Business.....

Address.....

.....

City.....PIN ☐☐☐☐☐☐

Tel.....

Email.....

No. of Years	Amount	US $	Tick ✓
☐ 1 (12 issues)	1000	200	
☐ 2 (24 issues)	1750	350	
☐ 3 (36 issues)	2500	625	
☐ 5 (60 issues)	4000	990	

(Kindly add Rs. 50/- for Non-Mumbai Cheques)

EI \ July 2014

Lighting India
Bi Monthly

The Subscription In-charge
Lighting India
Chary Publications Pvt. Ltd.
201, Premalaya, Next to Café Coffee Day, Opp. Telecom Factory, Deonar, Mumbai - 400 088.
Email: sub@charypublications.in

If You are already a Subscriber
Enter the Subscription No. LI/SUB/ ☐

Yes, I would like to subscribe **Lighting India** for.....years at Rs..... (US $.....overseas subscribers)

Payment details :

Cheque / DD No.....Dated.....

Drawn on Bank.....Branch.....

In favour of **CHARY PUBLICATIONS PVT. LTD.**

Or charge my ☐ MasterCard ☐ VISA ☐ IndiaCard ☐ TajCard For Rs.....

CARD No. ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

CARD EXPIRY DATE: ☐☐ ☐☐☐☐ (M M Y Y Y Y) Date of Birth ☐☐ ☐☐ ☐☐☐☐ (D D M M Y Y Y Y)

Name.....

Designation..... Signature.....

Company.....

Department.....

Type of Business.....

Address.....

.....

City.....PIN ☐☐☐☐☐☐

Tel.....

Email.....

No. of Years	Amount	US $	Tick ✓
☐ 1 (6 issues)	700	150	
☐ 2 (12 issues)	1350	275	
☐ 3 (18 issues)	2000	500	
☐ 5 (30 issues)	3000	700	

(Kindly add Rs. 50/- for Non-Mumbai Cheques)

LI \ July 2014

RELIABLY CONNECTING TRANSPORT EQUIPMENT

Transport Equipment Sector plays a major role in the economic development of a country. Our comprehensive cabling solutions are apt for every application in the Transport Equipment Sector. Our cables, connectors, cable glands, conduits and accessories are perfect for diverse industry verticals like Mechanical and Systems Engineering, Automotive industry, MSR Technology, Electrical and Installations Engineering, EDC, Renewable Energy Applications and more.

We are Lapp India, a 100% subsidiary of Lapp Group-Germany. We are **RELIABLY CONNECTING INDIA** with our 'Total Solutions in Electrical Connectivity'.

Our International Brands:

ÖLFLEX® Power and control cables

UNITRONIC® Data communication systems

ETHERLINE® Data communication systems for Ethernet technology

HITRONIC® Optical transmission systems

EPIC® Industrial connectors

SKINTOP® Cable glands

SILVYN® Protective cable conduit and cable carrier systems

FLEXIMARK® Cable marking products

www.offer-lappindia.in

/lappindia

Lapp India Private Limited
Plot No. 96 J & K, Jigani Industrial Area,
Phase II Anekal Taluk, Bangalore South - 560 105.
Customer Service No.: 9243360000
Email : info@lappindia.com, Website : www.lappindia.com

LAPP INDIA

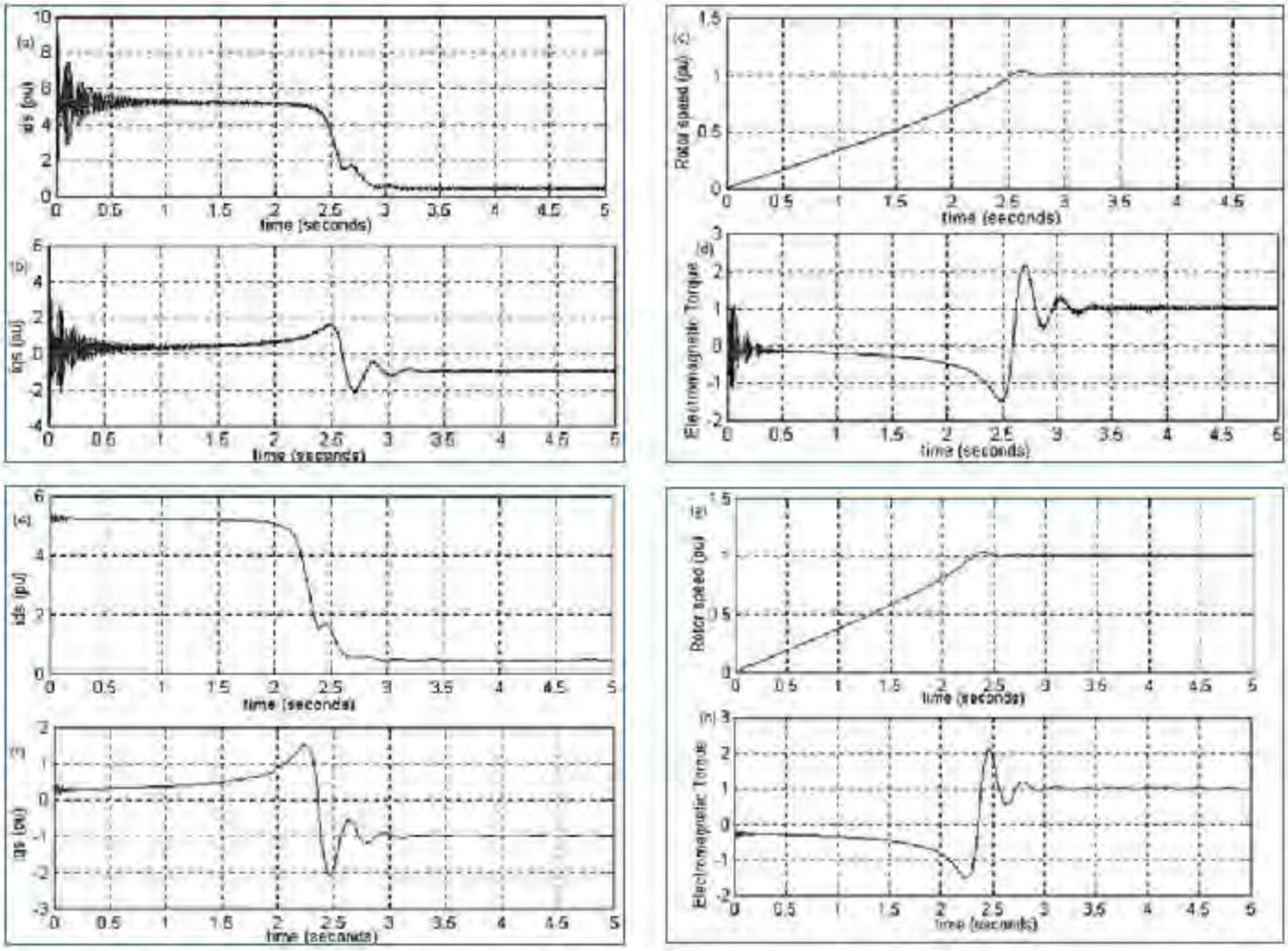


Fig. 7: 5th order and 3rd order DFIG startup with zero rotor injection (a) 5th order stator current in pu (b) 5th order rotor current in pu (c) 5th order rotor speed in pu (d) 5th order electromagnetic torque in pu (e) 3rd order stator current in pu (f) 3rd order rotor current in pu (g) 3rd order rotor speed in pu (h) 3rd order electromagnetic torque in pu

saturation of the said machine after short circuiting the rotor are depicted in Fig. 3.

Performance Characteristics

The starting condition of an induction machine in motoring mode was simulated to compare the performance of the 5th as well as the 3rd order models as shown in fig 4. The effect of the transients at the stator side on the 5th order model's characteristics can be prominently seen as compared to the 3rd order model.

A grid connected DFIG is simulated under voltage sag. The transient performances have been calculated with and without considering the main flux as well as the leakage flux alternately. The value of saturated machine magnetizing reactance X misdependant on the value of imas follows-

$$X_{ms} = f(x) = \begin{cases} X_{ms}, i_m < 0.5pu \\ K_m X_{ms}, 0.5 \le i_m \le 5pu \end{cases} \quad (37)$$

Comments

The results of simulation of both 5th order and 3rd order models for induction generator startup and running are shown in fig 4. It can be seen from graphical representations that the transients at startup are not indicated accurately. Simulation of a three-phase short circuit at the generating end is shown in fig 5; during the initiation of voltage dip and restoration of voltage level the 5th order model gives a more intense behaviour and includes the stator current transients. On the other hand, the 3rd order model as a similar mean value of the stator current but nature of the transient is unseen.

The effect of saturation on a DFIG are analysed by considering a grid connected DFIG under various power system transients conditions like voltage sag and short-circuit. The transient performances are observed for four saturation cases. In the first case effect of main flux as well as leakage flux saturation are ignored. Second and third cases consider the effect of main flux saturation and leakage flux saturation alternately. The fourth case considers saturation of both the fluxes. The effect of the saturation especially the effect of the leakage flux saturation is the highest during the transient stage of the machine while the saturation has a very small effect on the final steady-state values. This is why it is crucial to incorporate the

CONNECTED *with* NOMEX®

CONNECT WITH 50 YEARS OF INDUSTRY LEADING INNOVATION

Connect with DuPont™ Nomex® and you're plugged in to more than just electrical insulation with superior performance. You're also connected with 50 years of industry leading knowledge, innovative products and a commitment to collaboration. Because there's only one company that can offer you hundreds of scientists and engineers working to make sure your toughest projects have the electrical products that meet your budget and your unique needs.

CONNECT WITH THE SOLUTIONS THAT ENERGIZE THE FUTURE

Today, cities across the world are benefiting from safer & reliable dry type transformer options that Nomex® provides. DuPont is working not only with global utilities but also with leading utilities in India catering to the busiest & densely populated cities to provide fire-safe & reliable power supplies.

CONNECT WITH THE PEOPLE WHO HELP THE TRAINS RUN ON TIME

DuPont works closely with engineers across the world to enhance the life of traction transformers thereby improving the performance of the train. Nomex® paper and pressboard help reduce several tonnes of weight thus saving precious space at the same time reducing the maintenance requirements.

CONNECT WITH DUPONT GLOBAL COLLABORATORY NETWORK

Global collaboration with leading transformer manufacturers is helping many countries generate power with Nomex® engineered power transformers. Nomex® provides longer service life with higher reliability, reduced vulnerability, more overload capacity with operational flexibility, reduced load and no-load losses and increased power for a given unit size or available space.

To connect with DuPont™ Nomex®, please contact
Tel.: +91 2267561600
Fax: +91 2267101836

Nomex.

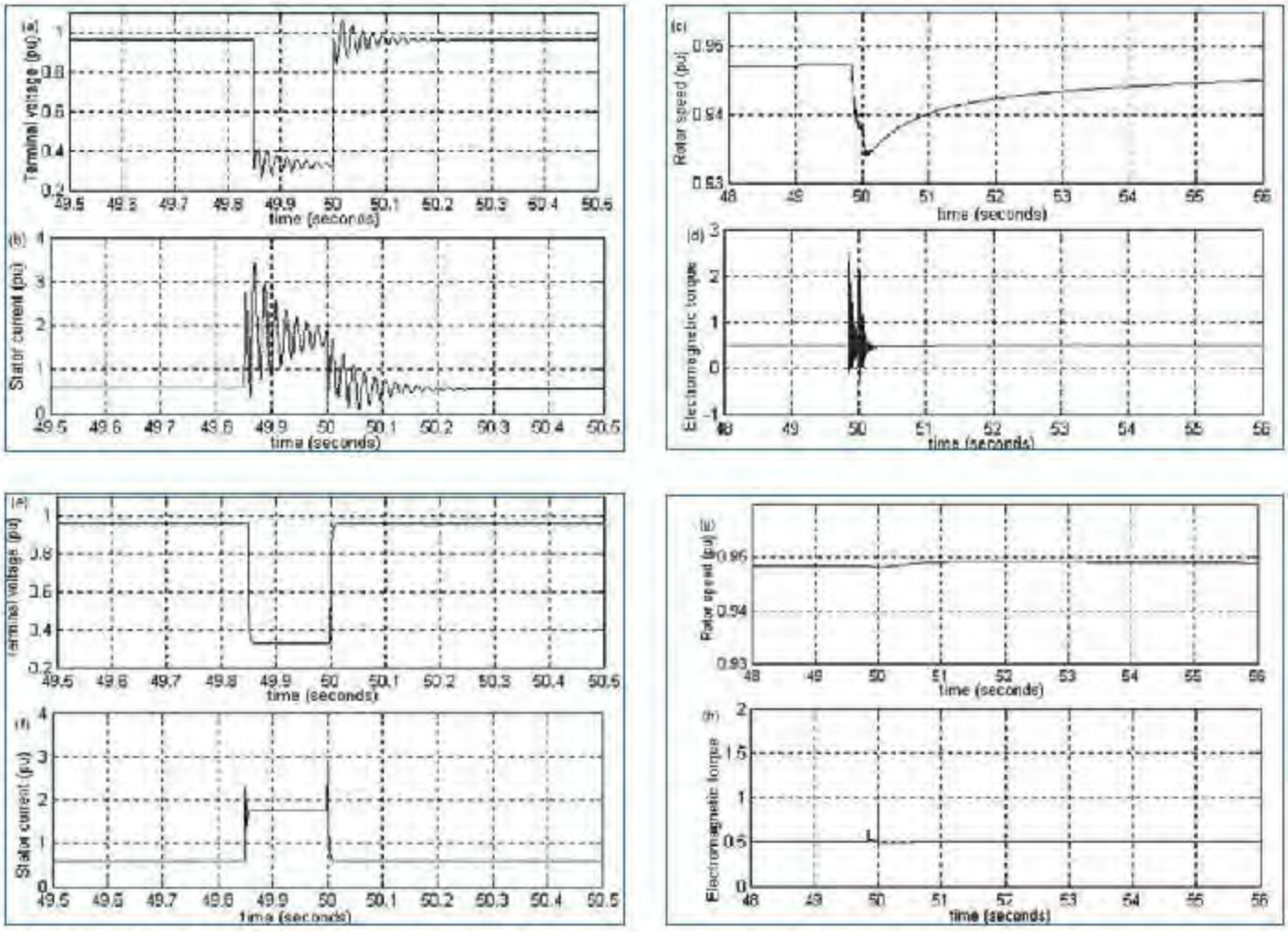


Fig. 8: 5th order and 3rd order response to a system fault at generator terminals (a) 5th order stator current in pu (b) 5th order rotor current in pu (c) 5th order rotor speed in pu (d) 5th order electromagnetic torque in pu (e) 3rd order stator current in pu (f) 3rd order rotor current in pu (g) 3rd order rotor speed in pu (h) 3rd order electromagnetic torque in pu

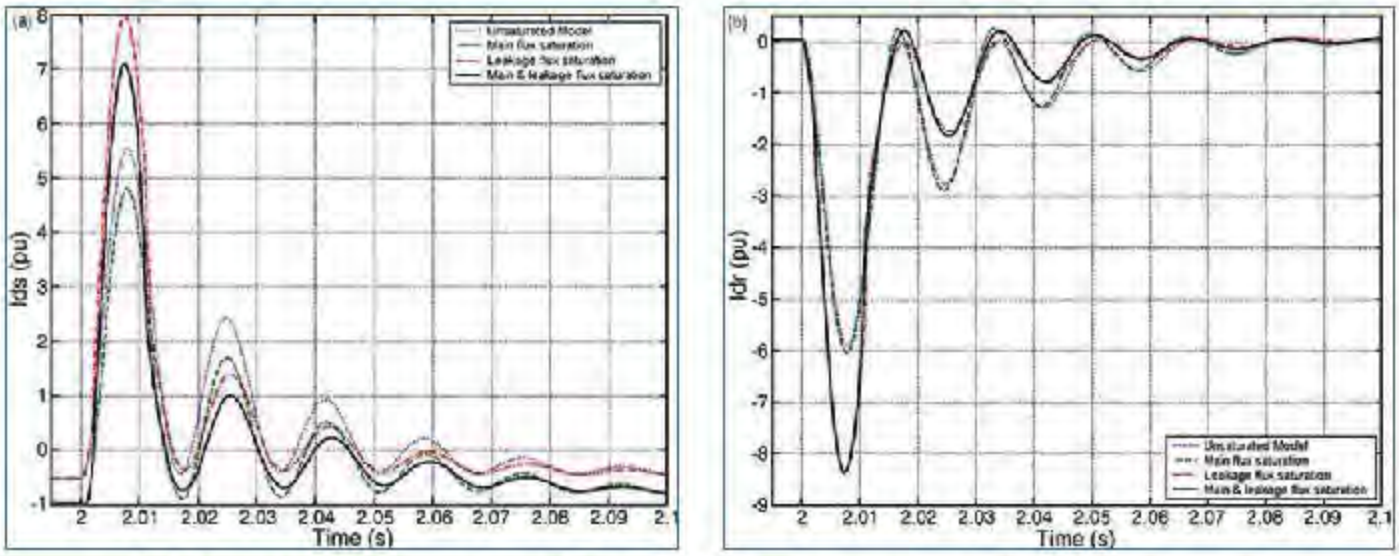


Fig. 9: Generator transient response due to voltage sag. (a) ids at voltage sag occurrence, (b) idr at voltage sag occurrence

HPL

POWER OF TECHNOLOGY

Technology of Measurement... defined

Our Metering Product Range

- Digital Panel Meters
- Multi Function Meters
- Load Managers & Demand Controllers
- Single / Three Phase, Whole current counter/LCD type meters
- LT Trivector Meters
- Prepaid Metering Solution
- LPR (Zigbee) Metering Solution
- Data Acquisition & Billing Solutions

HPL serves complete metering solution with the commitment to The State of The Art Technology. Offers the complete basket with its Digital Panel Meters, Digital Energy meters, Multifunction Meters, Load Managers, Demand Controllers, Power Quality Meters with Metering solutions based on the wired and wireless technology such as Zigbee, GSM/GPRS etc.

Other Product Range


4digit Range of Digital Panel Meter


Dual Source Multi-function Load Manager


Emfis range of Multi-function Meter


Dinis-A40 Multi-function Meter


Power Factor Control Relays


Prepaid Meter

HPL Electric & Power Pvt. Ltd.

1/21, Asaf Ali Road, New Delhi-110 002 INDIA

Ph.: 011-23234411, Fax : 011-23232639 E-mail : hpl@hplindia.com

www.hplindia.com

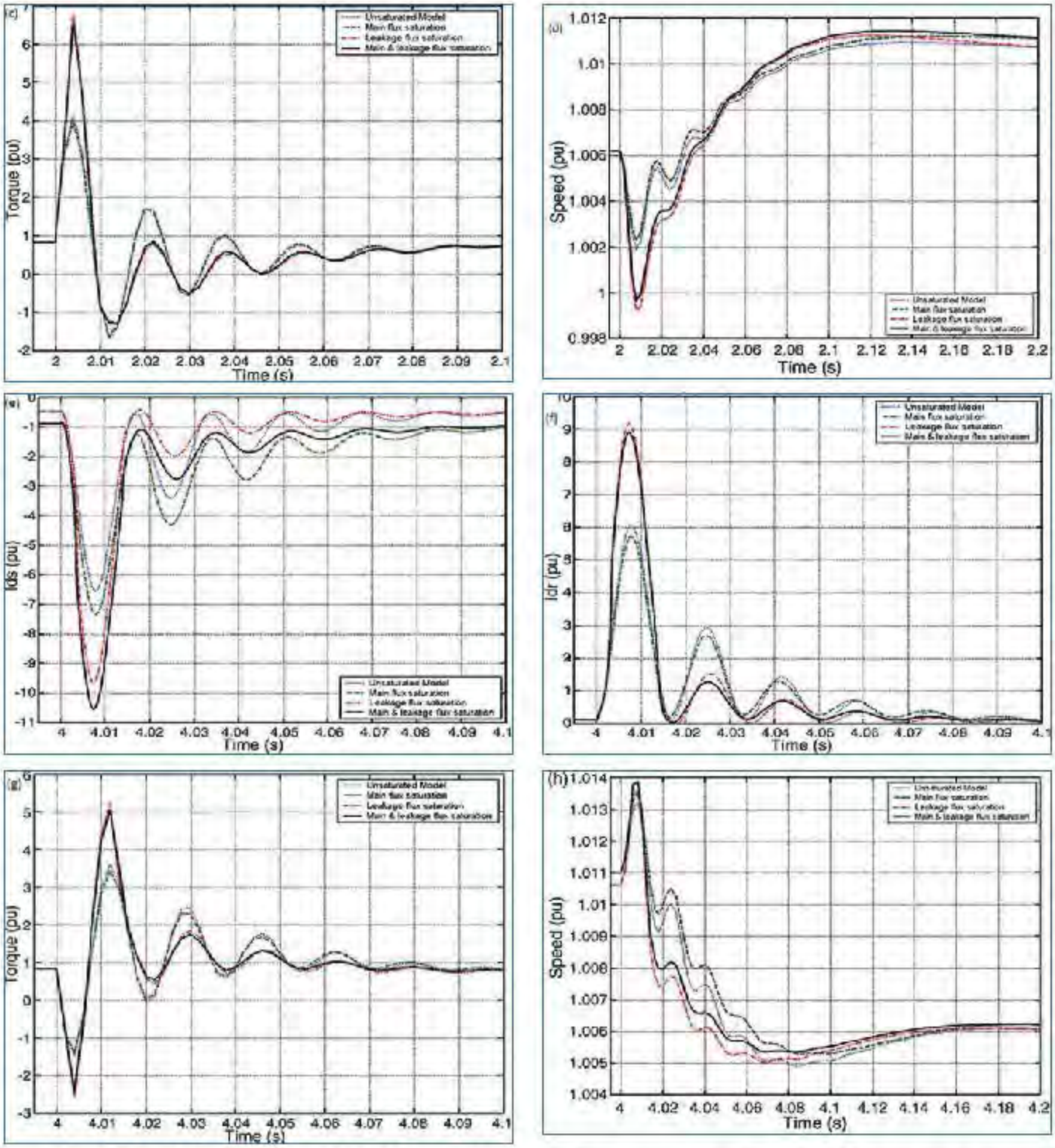
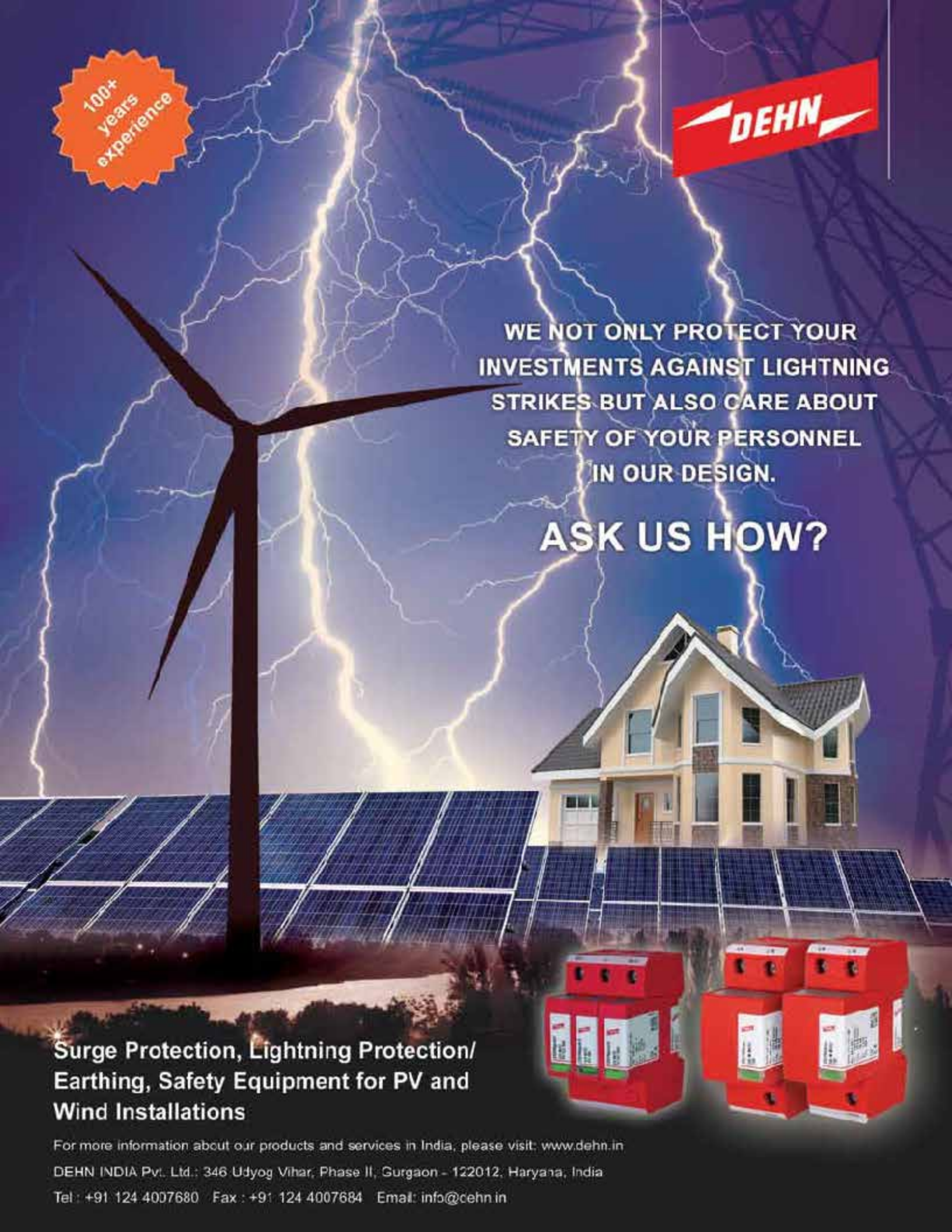


Fig. 9: Generator transient response due to voltage sag. (c) torque at voltage sag occurrence,, (d) speed at voltage sag occurrence, (e) ids at voltage restoration, (f) idr at voltage restoration, (g) torque at voltage restoration, (h) speed at voltage restoration.

effect of both the main and the leakage flux saturation in the models developed to study the transient performance of doubly-fed induction generators.

In case of voltage sag as shown in fig 6, the machine currents raise upto 3 pu due to the effect of leakage flux saturation as compared those with only main flux saturation. It is also observed that the effect of saturation on the generator speed is very small and of the order of 0.002 pu. A short-circuit can be considered as a severe voltage sag in which the voltage


100+ years experience
DEHN
WE NOT ONLY PROTECT YOUR INVESTMENTS AGAINST LIGHTNING STRIKES BUT ALSO CARE ABOUT SAFETY OF YOUR PERSONNEL IN OUR DESIGN.
ASK US HOW?
Surge Protection, Lightning Protection/ Earthing, Safety Equipment for PV and Wind Installations
For more information about our products and services in India, please visit: www.dehn.in
DEHN INDIA Pvt. Ltd.: 346 Udyog Vihar, Phase II, Gurgaon - 122012, Haryana, India
Tel : +91 124 4007680 Fax : +91 124 4007684 Email: info@dehn.in

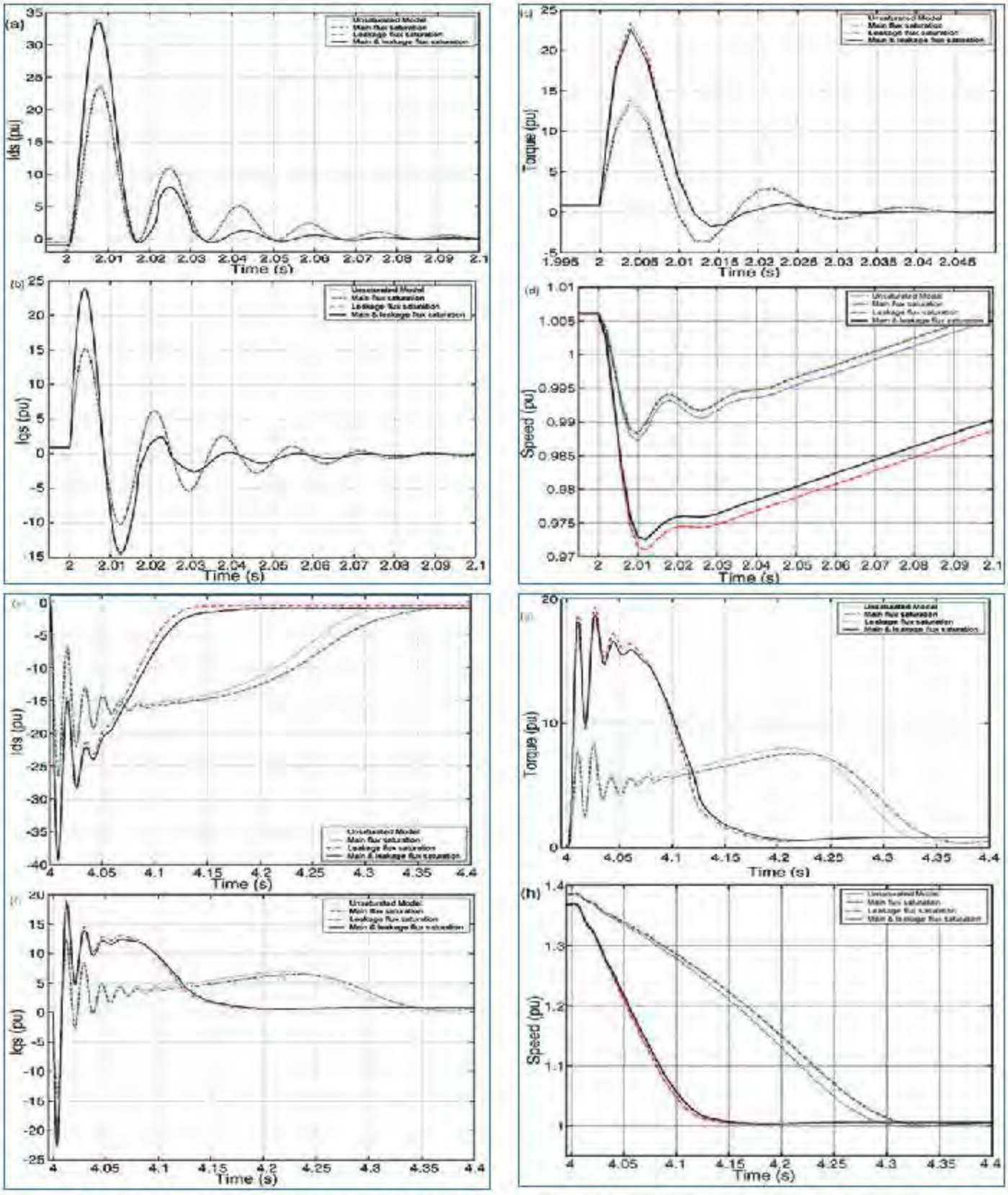


Fig. 10: Generator transient response due to short-circuit. (a) ids at short-circuit occurrence, (b) iqs at short-circuit occurrence, (c) torque at short-circuit occurrence, (d) speed at short-circuit occurrence, (e) i_{ds} at voltage restoration, (f) i_{qs} at voltage restoration, (g) torque at voltage restoration (h) speed at voltage restoration

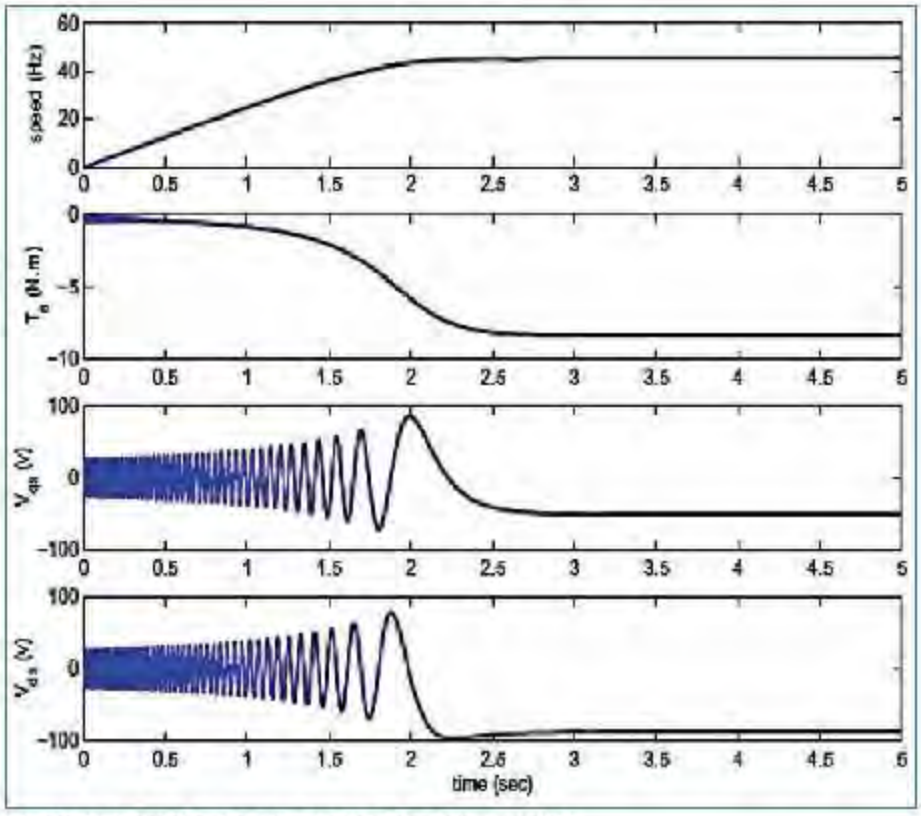


Fig. 11: DFIG acceleration with rotor injection torque applied

drops to 0 pu. In this case, the leakage flux saturation increases machine currents by 10–15 pu compared to those calculated by considering only the main flux saturation. In case of torque, the increase is in the range of 10 pu.

Hybrid Model

DFIG modeling is done in synchronous reference frame with slip control implemented at the rotor-side converters to ensures that the injected rotor voltage at slip frequency gives a constant stator frequency but in absence of slip control, the above modeling is not applicable. The frequency and amplitude of the injected rotor voltage are considered as inputs. Fig. 8 shows results of a DFIG acceleration to have a rotating speed equivalent to 45 Hz when applied with a suitable mechanical torque. The stator of the DFIG is connected to a wye connected resistive load.

Conclusion

Modelling is performed to study the behaviour of machine during various normal and abnormal operating conditions. Order of model and the assumptions made during modelling are chosen based on the accuracy required in results. To simplify the model and to increase speed of simulation, lower order models are implemented by neglecting some non- critical parameters. Consideration of operating environment and properties of material like saturation, if considered, gives more accurate results but their effects are often ignored for the sake of simplicity.

Profile

Sneha Patil

MTech (Power System)pursuer, Bharati Vidyapeeth University College of Engineering Pune.

Prof D S Bankar

Associate Professor in Electrical Engineering Department,Bharati Vidyapeeth University College of Engineering Pune.

Dr D B Talange

PhD IIT Bombay, Specialization in Systems and Control Engineering, currently working as Professor in Electrical Engineering Department of Govt. College of Engineering, Pune.

High Voltage Test Expert

SAMGOR TECHNOLOGY

We provide professional solutions:

- Impulse Voltage Testing
- Withstanding Voltage Testing
- C& tanδ Testing
- PD Testing
- Turn-key HV Test Lab
- Onsite Testing Service

CONIN iTesT Solutions Inc.

Mktd by:
iTest Solutions Inc.
2DLF Industrial Area, Moti Nagar,
New Delhi-110015
Email: sales@coninitest.com
Tele: +91-11-25433311

Mfd by:
Samgor Technology
Http://www.samgor.com
Email: info@samgor.com

Interview

"Products are in compliance with global electrical regulations"

Derik Lhundup, Bussiness Unit Head - India
Giantlok India Private Ltd

Giantlok is the professional brand of cable ties and wire accessories. Its products are sold all over the world with strategic branches in Taiwan, China, Thailand, Korea, India, and Hong Kong and so on. Giantlok® provides full line of cable management products, that improve production efficiency and reduce assembling costs. Giantlok has one-stop shop products lines. Giantlok's high quality cable ties and wiring accessories, are UL, CE, CSA, GL and ABS accreditation and complied EU RoHS and REACH environmental regulations. In an exclusive interview to **Electrical India, Derik Lhundup** states, Giantlok India's vision is to be the best preferred cable ties and wire accessories company.

➢ **What is your perception about cable and wire market in India and other eastern countries where you have offices?**

If we compare the overall cable and wire market for eastern countries where we have our offices the cable and wire market in India is significantly having a huge difference, of course the geographical area it covers is natural difference apart from China. In countries like Hong Kong, Korea, Taiwan the infrastructure is almost stagnant, with the developed market; it is sort of saturated with limited opportunities of slow demand unless you have a cutting edge innovative product mostly focusing on government projects in energy infrastructure or grid reinforcements. Another factor in these markets is that the industry's market structure remains for the main export in comparison to domestic market. Resulting in cases of oversupply and hence in the price competition. Similarly in countries like China & Thailand the opportunity of constant demand is narrowing down to few selected sectors and their developing plans. However while looking at India it's a very large and developing market which still remains a lot to be fully explored. Especially with recent new government policy improving and looking forward for a vast investment plans in almost all the sectors, it seems to play a vital role for cable and wire market which comprises to focus on electrical, automotive, infrastructure, metro railways, telecom and power segments. Out of which automotive, telecommunication and construction seems to have vast and rapid expansions. There exist vast opportunity to be looking forward to with government plans of development budget being proposed in mostly all the segment.

➢ **What is the range of products of the company in general and would you share more information on wire accessories market?**

In general our company's product range can be put in below categories:

Fastening System

- Full range of Cable Ties from standard, industrial, heat resistant, flame

retardant, UV resistant, Heavy Duty, Releasable, Mountable, Marker and special purpose
- Stainless Steel Ties ranging from Ball lock type, ladder, free end type.
- Engineering Fasteners ranging from Fir-Tree mount, Push mount, Metal clip, Weld Stud/screw fixtures, Non-fixed
- Fasteners applied in materials & application table ranging from self adhesive, screw fixed, push mount, steel nail fixed, twist locking, wall mounting
- PCB Support series ranging from Dual Locking, Single locking, locking+ adhesive, Locking + screw fixed.
- Tools for all required applications.

Cable Protection
- Wiring Ducts
- Wrapping Bands
- Bushings
- Conduits and conduit fittings.

Wire Connectors & Terminals
- Wire Connectors
- Terminals
- Tools.

The best possible example of giving comparison on wire accessories market would be looking into the entire possibility of usage ranging from panel builders, a machinery manufacturer, an automatic control system supplier or even a system integrator. Further, down the line if we look deeper into the circle we can find these products being commonly used in various automatic controlling units including motor control centre, automatic manufacturing control system, SPC control system, temperature monitoring system, PLC control system etc. In addition from domestic houses to power plants and various industries such as logistics, IT, telecommunication and machinery. The market is huge and variance and to give the exact calculation would be limiting my imagination on broad market.

How do you consider Indian market as against Taiwan with respect to your products offering and which of your products command considerable share in Indian market?

Like mentioned earlier, Taiwan seems quite a saturated market to us in relation to the products we have to offer against India. The market now mainly is more focused on export. However saying so the wide range of product is also being sold in equal distribution in Taiwan as compared to India. For our India operations we presently command a majority of sale through Cable Ties. The reason being we have been a little late comer in the market and we are focused with one type of product to give a better end support and commitment to customer. Our success has been tremendous and brand recognition and acceptance amongst the customer has been exceptional. Our growth compared to previous year has been double fold with a clear satisfaction of our customer and approval on our quality and after sales service.

Giantlok provides full line of cable management products, which improve production efficiency and reduce assembling costs. Could you share cutting edge technology behind your products?

Giantlok products specifically the Cable Tie, which presently holds approximately 70% of our overall India turnover, is specially manufactured with curved tip which makes it easy to be picked up from the flat surface and accelerates initial threading to decrease installation cost. The tapered and skid proof design on tip allows faster threading into the head and prevents slipping during threading. It is design as such that minimum threading force is required for insertion and reduces operator fatigue. The minimum-loop tensile strengths comply with industrial standards, with consistent and reliable quality. We also employ Computer-Aided Engineering (CAE) to accelerate the period of product development. Our in-house mould making capability allows great flexibility in our production and enables us to develop products jointly with our customers. Our core Technology relies on advanced moulding facility which provides precise stamping and precise moulding injection with engineering plastic Polyamide 6,6.

What measures would you suggest about cable protection?

Cable protection product would mean about protective tubing system which basically would protect anything from outer substances like electromagnetic impacts away from data lines, protect laser light guides against physical impacts and simultaneously guarantee easy stability for tools and instruments used in any field of mechanical engineering sector, wind power stations, automotives or in the medical sector. One of our second best selling products presently in India market would be our PA 6, Conduits. Our conduit and fitting series are applicable for temperature between -40 C up to 85 C, resistant to solvents, liquid-tight or with silicone cover. It is applicable on electrical, machinery and building harness wiring and has the flexibility for installation while providing protection to cables. All our PA 6 conduits are Fluid resistance with UL94 certification, V2 flammability standards.

Could you share information about accreditation and environmental regulations standards that your company complies with products?

Giantlok has gained ISO:14001 environment quality management to design, manage, train, and audit our environmental effect. Besides abiding environmental regulation, we reinforce environment friendly attempt and continue to reduce pollutions/wastes. We replace with new pattern machines to save on electricity. The full product range of Giantlok is compliant to EU RoHS and REACH regulations. 99.9% of our products are made of recyclable and reusable engineering plastic and metal and over 85% of them are made by Polyamide 6,6 which is low smoke and halogen free.

What are the R&D concepts and quality behind product engineering at Giantlok?

Giantlok employ computer-aid engineering

analysis in R&D process to prevent development failure of product in early period and to raise the efficiency and success rate of new product design and development. Giantlok also continues improving the function of existing products and by means of outstanding design, Giantlok supports customers with high quality cable ties and wiring accessories, which are UL, CE, CSA, GL and ABS accreditation. Our products are in compliance with global electrical regulations. They are technically reliable and qualified for purposes of wiring fixture and electrical connection. Apart from that, our experienced R&D team consistently develops new products and upgrades renovated production technology in responses to the market needs; meanwhile, the existing products are continuously being improved for better performance.

➢ Giantlok India Pvt Ltd is meeting the high ethical standards of Giantlok, Taiwan and conforming to the Indian laws. How do you substantiate the statement?

Today, one of the biggest problems a corporation suffers, would be relating to issues from many types of illegal and unethical behaviour, such as insider trading, illicit accounting practices, looting of company assets, no proper communication etc. Many executives, administrators and social scientists are concerned about the lack of ethics and see unethical behaviour as pervasive in society. Giantlok, Taiwan on the other hand in order to reduce numerous business-related scandals and to enhance corporate ethics, many surveys, discussions and programs are addressed to improve the quality in business conduct and proper development of the corporate citizens. Many of such outcomes are focused on the development and implementation of corporate codes of ethics. Similarly in such fashion Giantlok, India, we conduct various surveys and implement and adopt written codes of conduct. 99% of our company policy is to address ethics and conduct issues in various kinds of formal documents and the remaining 1% we keep working on getting this newly formed policy to do better improvement for the betterment of our corporate citizens. With regular policy manuals, we strive to implement and take the multi-faceted approach to setting forth our standards of appropriate conduct, which also meets the ethical standards and law and order subjugated by Indian Govt. However, one very important factor we keep in mind is with the globalization of the business environment, we understand the difference of culture and language and constantly try to address to match the difference in working society from India to that of Taiwan and come to a common ground of understanding, which is why we also implement a totally separate team which understands more clearly of the culture difference and smoothen the communication barrier within this culturally pluralistic business environment. Important question we always keep in mind and stress to work upon is, "What is the core difference of corporate managers in Taiwan vs India and the need for a formal code of ethics in the business operations to manage".

➢ Could you share strategy of the company in marketing products when faced with challenges?

Anybody, who has shown interest to do business in India knows that it comes with its challenges. India is huge market with immense potential to offer to any field of business in present times. It is the second most populous country in the world, which is undergoing a tremendous phase of transition, both in terms of investor and the market potential. The number of people in the Indian middle class is set to grow almost 3 times over the next 15 years, implying a significant impact on disposable income. Saying so, the challenges faced in such market is equally daunting. The business culture seems a major difference between Taiwan and India; hence for anyone who is planning for marketing their product in India I would suggest-

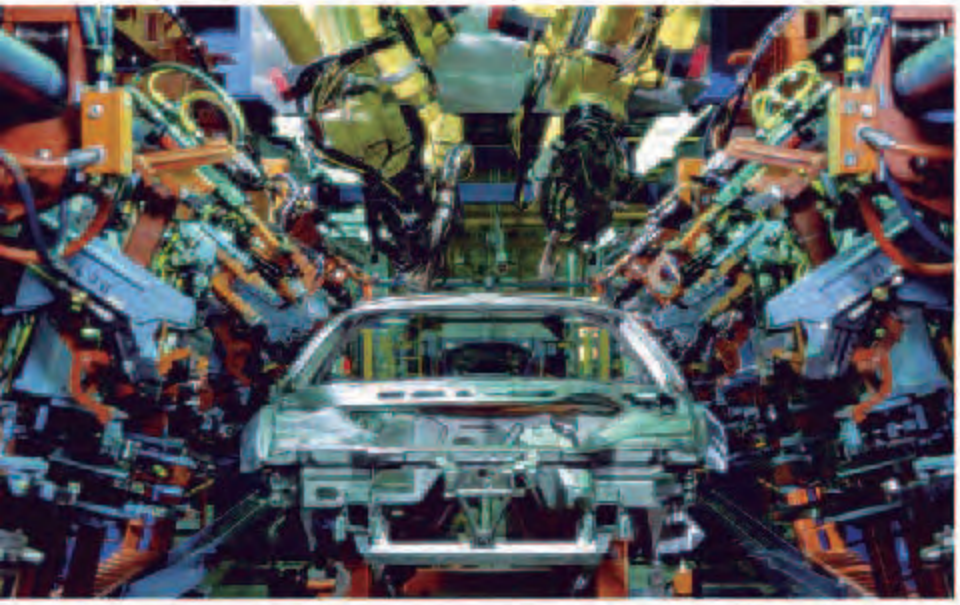
- The people are very friendly and before doing any business creating a trust is must. Which means creating a bond & relationship is must with your customer. Once the trust is there the relationship last much longer.
- Need to be thorough of what business type you are in and relating to its operation the Indian rules & regulations. Which is quite complex and to be sure of where you are will give a better and easier phase of challenge in future.
- Besides the taxes levied by central govt. you need to be thorough of all the other taxes relating to your product from different state government.

Besides the common challenges which are normally faced as above, others strategy relating to the Indian market is towards being extremely price sensitive. Being sure of your product and identifying appropriate markets and segments forms a core element of the entire strategy. A very unique and customized approach to each customer specially being divided in different regions is required and also depending on the business sectors and target markets.

➢ What are your plans for expansion in the next two years?

Giantlok India's vision is to be the best preferred cable ties and wire accessories company in India meeting the requirements of the customer and ensuring customer satisfaction by providing excellent customer service. In the next two years our first and foremost target of expansion is to be able to source each and every sector of market in supplying our Cable Tie product. More over once being supplied having further strength in identifying our major customers, support them with appropriate distribution channels. There on we want to focus more into our Non-Cable Tie items in wiring accessories. Strategically analyse the right product with right price market as per the market requirement and then move ahead case-by-case basis. And finally, by the end of second year plan we hope to finish setting up a suitable location for manufacturing unit/units.

GIANTLOK



Total Wiring Solution for Industrial and extreme environment

GIANTLOK INDIA PVT. LTD.
43 Community Center, 2nd Floor, Naraina Industrial Area, Phase - I, New Delhi - 110 028
Phone: +91 11 47001525, 47001540, ***http://www.giantlok.com***

Systematic assessment and improvement of protection systems

Conventional methods of assessing the performance of protection systems frequently reach the limits of their applicability in electrical power systems with distributed generating plants or meshed structures. Too many combinations of system configurations, operation and fault scenarios have to be taken into account. But how can complex protection systems be assessed automatically and systematically? Siemens has developed the SIGUARD PSA (Protection Security Assessment) system for the integrated simulation, evaluation and assessment of protection system performance.

Dinesh Pawar and Dr Thomas Bopp

Since power supply systems are constantly evolving, their protection systems also have to be reviewed regularly to ensure that they still meet the new requirements. Typical changes that trigger a review and possibly an adaptation of the protection setting values or the protection schemes are system restructuring measures, new system configurations, and changing operating states, for example as the result of the connection of distributed generating plants.

Problems and motivation

In radial systems without distributed generating plants, the protection system can be assessed at reasonable expense. However, conventional methods of assessing the performance of protection systems soon reach the limits of their applicability in electrical power systems with distributed power infeed points or meshed structures. Too many combinations of system configuration, operation and fault scenarios have to be taken into account. If only a few, subjectively selected fault scenarios are considered, there is a danger of overlooking operating states in which the current protection system does not work perfectly.

Error cause analyses have shown that the conventional methods for the calculation and checking of protection setting values can only be applied conditionally. The causes of many failures frequently could have been detected in advance by means of a comprehensive protection security assessment. Often better protection settings, modified protection schemes or new protection devices also could have prevented a disturbance from occurring or at least could have reduced the related damage. But such analyses were always very time-consuming because no automated solution has been available up till now. In many instances, hidden faults, such as in the backup protection, could only be detected if the entire system was taken into consideration. Compared to the evaluation of single protection objects, for example, this work is relatively time-consuming.

Thanks to technical progress, however, it is now possible to analyze complex protection systems automatically and systematically and, consequently, even make preventive protection performance assessments. Some examples of practical application are:

- The assessment of the protection system for all phases of a system restructuring measure;
- New switching states;
- Connection of new generation;
- Assessment of the protection in third-party systems in case of the acquisition of concessions;
- Error cause analyses.

The conventional method of assessing protection parameters is based on the graphical representation of setting values. However, every

The causes of many failures frequently could have been detected in advance by means of a comprehensive protection security assessment.

graphical representation used is incomplete from the system point of view. As an example, Fig. 1 shows the line impedances and the associated distance protection zone reaches.

This representation is only valid for one switching state. It does not show the effects of variable intermediate infeeds or the fault resistance on the protection function. Fig. 2 shows a typical current/time grading diagram of overcurrent protection devices. Here again, this diagram is only applicable to one system connection, so a new diagram has to be created for each possible grading path.

Another constraint of both diagrams is that they only show one protection device function, for example the distance protection or the overcurrent protection. This means that the selectivity, sensitivity and speed of mixed

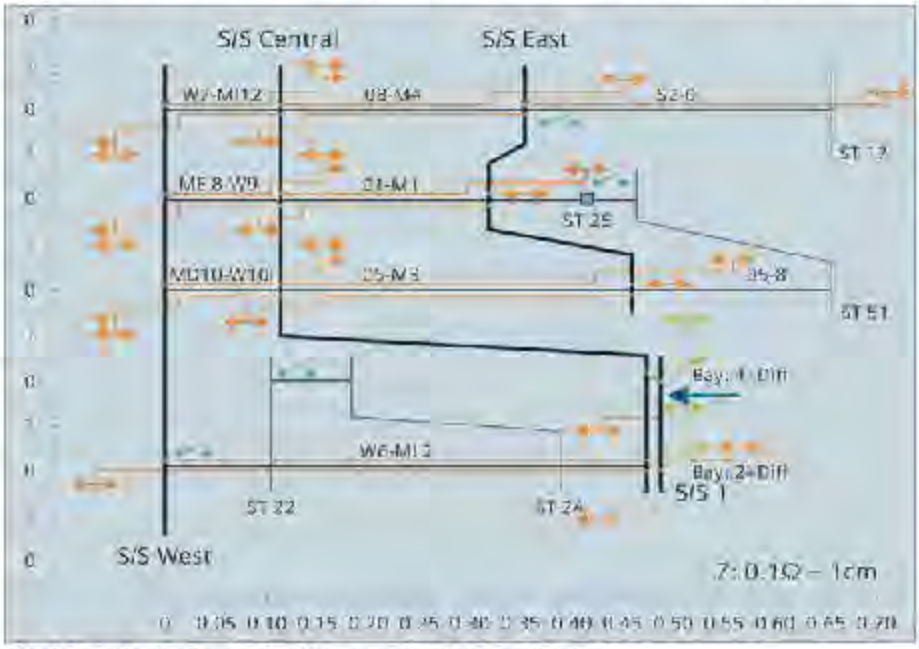


Fig. 1: Impedance diagram for distance protection coordination

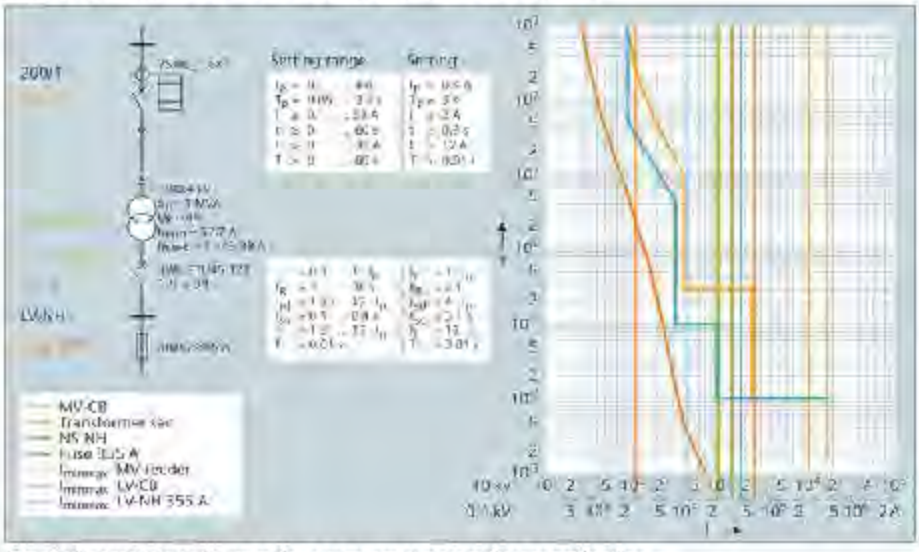


Fig. 2: Current-time diagram for overcurrent protection coordination

protection systems cannot be analyzed together in one single diagram. Furthermore, static diagrams do not show all states of the fault clearance sequence, and cannot reveal cascading disconnections. The multitude of system operating states that have to be considered results in a very large number of diagrams to be analyzed and, consequently, in high costs. This is frequently a reason why protection system assessments are not carried out regularly and thoroughly.

The conventional approach to protection coordination, which only shows the protection device setting values, can be significantly improved by showing the selectivity instead of the setting values. However, this calls for simulation of the power system, including its protection system, and for assessment of the response of the protection system to fault events. This in turn also makes the response of time-graded protection transparent and understandable – also for cascading events through to a blackout.

The approach to the solution: automated fault simulation

As a solution to the above-mentioned constraints of the conventional method, Siemens has developed the SIGUARD PSA (Protection Security Assessment) system for the integrated simulation and evaluation of protection performance assessments. It analyzes the selectivity, sensitivity and speed of the entire protection system, and facilitates a comprehensive consideration of the main and backup protection. Consequently, it can analyze all possible system and fault scenarios and, through its systematic approach, even reveal hidden faults.

For a fast, structured analysis of extensive systems, users can define the system areas and issues that are to be analyzed & assessed. This offers the advantages of scalability and parallelization of the calculations, while improving clarity & shortening calculation times.

After selecting the system areas that are to be examined, the user can define the relevant operating and fault scenarios. Then the protected objects are determined. In the next step, user-specified variations of fault types, locations and additional fault resistances are automatically simulated for all protected objects

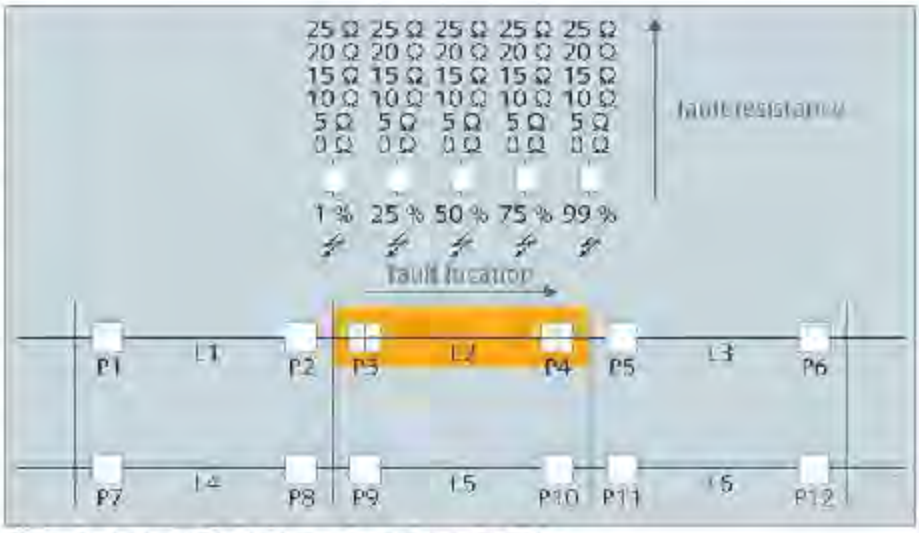


Fig. 3: Definition of the fault cases under consideration

in the selected system areas. Fig. 3 shows the definition of a fault scenario for a protection object – in this case for the yellow-colored line L2, which is defined by protection devices P3 and P4. Fault points from 1 to 99% of the length of the line are defined along the line L2, and calculated with a fault resistance varying from 0 to 25 ohms, for example.

All fault scenarios are simulated and assessed systematically. Fig. 4 shows the response of the protection system to a single-phase fault at the start of the yellow-colored line. The green squares symbolize picked-up protection devices, the red squares tripped protection devices. Selective trippings are indicated by a plus (+) and unselective trippings by a cross (x). This information can now be assessed to establish whether or not the protection system disconnects faults successfully and selectively.

An overview of the complete system area is created so that even systems with a large number of lines, protection devices and fault cases can be checked easily.

Interactive view for identifying weak points

Fig. 5 shows a system area with around 80

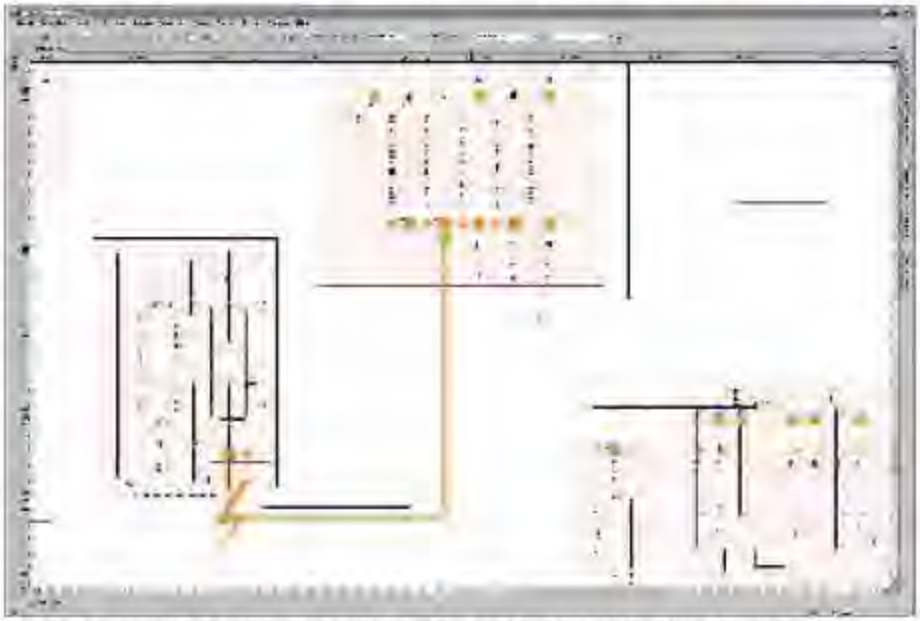


Fig. 4: Response of the protection system: selective trippings are indicated by a plus (+) and unselective trippings by a cross (x)

KMB SYSTEMS

Power Quality Analysers

Energy Management Systems

Power Factor Controllers NOVAR

KMB SYSTEMS

APS

KMB SYSTEMS, s.r.o
Tr. Dr. M. Horakove 559
460 06 Liberec 7
Czech Republic
Tel: +420 485 130 314
Fax: +420 482 736 896
Email: kmb@kmb.cz
Web: www.kmb.cz

ALLIED POWER SOLUTIONS
(ISO 9001:2008 & UL listed LPS installer)
C - 301, Delhi Rajdhani Apts
80, I.P. Extn. Patparganj
Delhi - 110 092 (INDIA)
Tel: + 91 11 2223 6074, 4303 6907
Email: info@alliedpowersolutions.com
Web: www.alliedpowersolutions.com

DEALERS ENQUIRY SOLICITED

lines and 300 protection devices. Each line corresponds to one column, a protection device is assigned to one row. On the left is a protection system that worked perfectly for all tested operating and fault cases. The flawless protection function is shown in green. On the right is a system in which the protection system has weaknesses. In this example, protection underfunctions are shown red and over functions yellow. The complete results of the simulation can be called for each identified weak point. This enables the causes to be diagnosed quickly.

The graphic evaluation is thus an important tool for assessing the protection performance. It is like a fingerprint – it facilitates the interactive optimization of the protection system.

New setting values can be calculated and their suitability checked immediately. The same procedure can be used to verify that the protection system is functioning correctly before a switching operation.

The solution described here ensures quick and reliable assessment of both the functioning and the quality of the protection system. The automated approach to the comprehensive testing of all expected operating states for relevant existing and future network configurations enables comprehensive, systematic and efficient checking of the protection system performance at regular intervals at comparably low cost. The user is therefore able to see immediately whether or not new protection coordination is required. The user can also assess whether a piece of equipment is adequately protected or whether there are operating and fault cases in which the protection task is not adequately fulfilled. It can be derived from the results whether new, improved protection device setting values are enough to eliminate the weak points or whether the protection system needs to be adapted.

Integrating SIGUARD PSA into the operating process

The assessment of complete system areas, while simultaneously focusing on critical cases, greatly simplifies the targeted improvement and efficient further development of the protection system. The solution can be used for all voltage levels and types of system and is suitable for transmission, distribution & industrial systems.

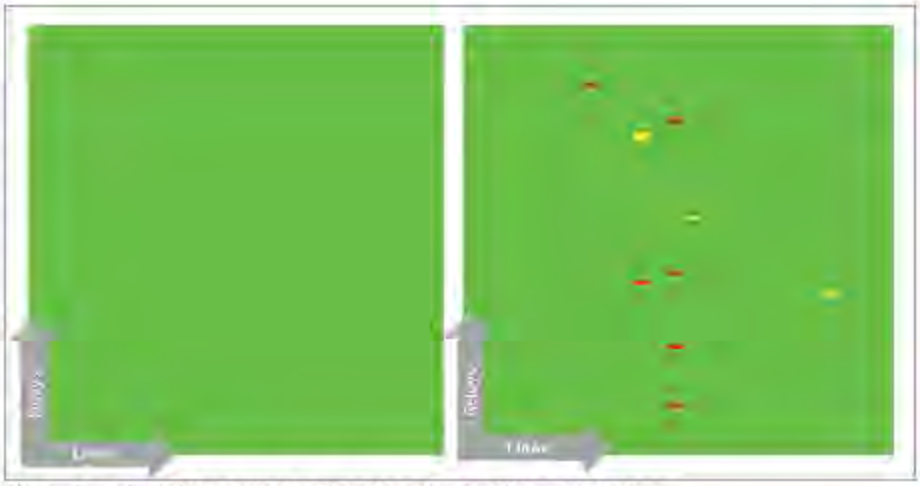


Fig. 5: Overview of the protection function of a complete system area
Left: Protection system functioning perfectly, Right: Protection system showing weaknesses

The following example illustrates the process for using SIGUARD PSA to improve a protection system and as a preventive measure to avoid interruptions of supply. As protection security checks are to be performed on a regular basis, the workflow can be shown as a cycle (Fig. 6). The cycle starts with data collection and modeling. In practice, there is hardly ever a validated calculation model that covers both the system and protection data. Electronically available system and protection data can be used directly, missing data can be acquired with a data collection tool. Possible data sources are geographic information systems (GIS), control center and system calculation applications, and protection

Fig. 6: Continuous improvement of the protection system

www.Lntecc.com

Synergy of Strengths to Transmit, Transform and Deliver

Larsen & Toubro (L&T), the US$ 14 billion technology, engineering, construction and manufacturing conglomerate is one among the very few companies in India providing integrated EPC solutions for a wide spectrum of power infrastructure projects.

From Electrical Balance of Plant (E-BoP) solutions for power plants to ultra-high voltage transmission lines, testing of transmission towers, extra high voltage substations (Gas and Air Insulated), from rural and urban power quality improvement to plant electricals and instrumentation, L&T offers end-to-end solutions for power transmission, distribution and improvement.

L&T has achieved an impressive track record that features nearly 19000 CKM of transmission lines of various voltage levels upto 765/800 kV, more than 475 substations including AIS and GIS upto 1200 kV voltage level and 15000 MW of E-BoP for thermal power plants.

Today, L&T, through its synergy of strengths in transmission and distribution, provides total solutions to complex power projects and remains at the forefront in constructing high quality transmission and distribution utility networks.

Regd. Office: L&T House, N. M. Marg, Ballard Estate
Mumbai – 400 001, INDIA, Tel.: +91 22 6752 5752 / 841
CIN: L99999MH1946PLC004768

L&T Construction
Power Transmission & Distribution

A brand of Larsen & Toubro Limited

Fig. 7: Simulation scenario building and in-depth result analysis

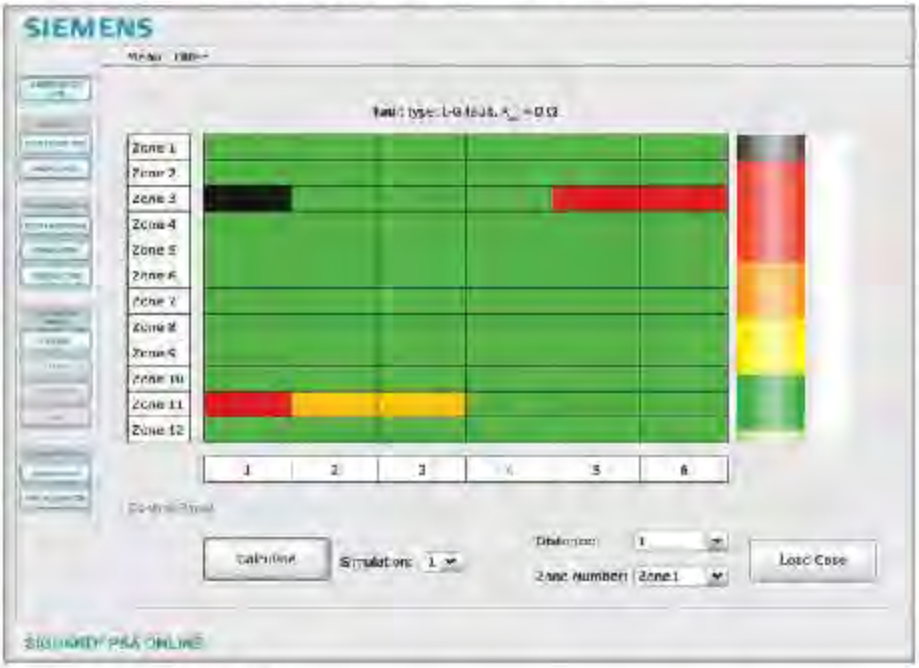


Fig. 8: Selectivity evaluation

databases. During data collection and modeling, the quality of this data is monitored by multi-level plausibility checks. The rigorous correction of data errors ensures high-quality system and protection data, thus creating the basis for the production of reliable protection simulation results. The completed model then covers both the primary and secondary systems, including current and voltage transformers, circuit breakers and protection devices. Figure 7 outlines the scenario building process and the in-depth result analysis and visualization.

Fig. 8 shows the assessment of a protection function in a complete network region. The color coding shows selective fault clarifications in green, protection overfunction in yellow, under function in orange, and uncleared fault cases in red. Critical fault scenarios such as cascading events and blackouts are indicated in black.

The graphic evaluation is an important tool for assessing the protection performance. It is like a fingerprint – it facilitates the interactive optimization of the protection system.

In a practical application, the solution shown can be used to find and correct incorrectly set overcurrent protection pickup values, distance protection zones and time delays. In this actual case, incorrect residual compensation factors, among other things, were detected in distance protections that would have led to under-reaching and over-reaching effects. It would have been difficult to detect them without a simulation. The protection function for taking mutual inductive line couplings and the ohmic reserve into account was also improved. Non-selectivities of the main protection and backup protection were also identified, which had been caused not only by incorrect settings but also by weaknesses in the protection concept, such as the lack of a directional decision.

The detection of errors and weaknesses not only enabled the individual setting values to be improved but also new, improved setting rules to be defined & verified. The effectiveness of the proposed measures for improvement were tested by simulation in every case.

The protection security assessment process presented here is intended for regular application. It can contribute toward improved coordination and functioning of the entire protection system in the short term and toward efficient further development in the long term.

Profile

Dinesh Pawar

Division Smart Grid, Power Technologies International (PTI), Siemens Ltd.

Dr Thomas Bopp

Division Smart Grid, Power Technologies International (PTI), Siemens AG, Erlangen, Germany.

KINGSINE

Specialize in Electric Power Testing

K6063Si *(Most Powerful)*
Universal Relay Test set

- Current Sources:6x60A / 900VA each
- Votage Sources: 4x300V / 120VA each
- Light weight in 19kg
- Inbuilt 9.7" color display & control board

K3063I
Universal Relay Test Set

- Current Sources:6x30A / 450VA each
- Votage Sources: 4x300V / 120VA each
- Light weight in 17.5kg

Features:

- Able for all kinds of relay testing
- Graphical test modules and templates for testing of various relays
- Quick relay testing facility in Manual mode
- Shot/Search/Check, Point & Click testing
- RIO/XRIO import and export facility
- Switch on to fault (SOTF)
- Power system model for dynamic testing
- GPS sync end-to-end testing
- Online vector display
- Automatic compare actual characteristic with expected characteristic
- Independent variable battery simulator(DC 0~300V)
- Automatic test report creation
- Fully functions PC software with advance distance, differential, overcurrent etc.
- All in one solution for Energy Metering, Transducer calibration, AC V/I measuring and Transient recorder *(Optional)*
- IEC61850 function compiled, GOOSE /SMV, IEC61850-8-1, IEC61850-9-1/2, IEC60044-7/8. *(Optional)*

3-years Standard Warranty, Supported by Kingsine's Service Center in Bangalore

K10 Series
Universal relay test set

K68i Series
Basic Three Phase relay test set

KF910
Fiber Digital relay test set IEC61850 Compiled

KS833
AC/DC Standard Power Source

Kingsine Electric Automation Co.,Ltd.

South India:
Kingsine office (Bangalore)
#888, 1/F, 3rd 'A' Main Road, 'D' Block,Rajajinagar, 2nd Stage,Bangalore-560010, India
Mob: +91-98454 71104, +91-94822 19051
Email: tone@kingsine.net India@kingsine.net
URL: www.kingsine.com.cn

North India:
Green-Watt Techno Solutions Pvt.Ltd.
Address: C32,3rd floor,Palam Vyapar, Kendra,Palam Vihar,Gurgaon Haryana 122001
Mob/Tel: +91-9999671988 0124-4006408
Email: sales@green-watt.co.in

KINGSINE

Green watt Techno Solutions Pvt. Ltd.

Interview

"We have models like the Smart Grid"

Dr Satish Kumar, Energy Efficiency Ambassador and Vice President
Schneider Electric India Pvt Ltd

Schneider Electric offers integrated solutions across multiple market segments, including leadership positions in Utilities & Infrastructure, Industries & Machines Manufacturers, Non-residential Buildings, Data Centers & Networks and in Residential. Focused on making energy safe, reliable, efficient, productive and green, it helps individuals and organizations make the most of their energy. In an exclusive interview to **Electrical India, Dr Satish Kumar** states, we would like to believe that the pace of execution can be faster, and planning can be better.

➢ What is the scope of the energy or the power sector in India?

At Schneider Electric, we provide solutions to make energy safe, reliable, efficient and productive from plant to plug. So, two things are there. We are not an electricity generation company and we are not an electricity device making company. Schneider Electric comes in between from transmission to distribution, to control, monitoring, automation and a lot of places where energy consumption is happening like switches, breakers and the entire electrical infrastructure. If you look at India's per capita electricity consumption and compare it with other countries then we will see that the per capita energy consumption in India is quite low. The per capita energy consumption in India is 5% of what US consumes and 20% of what China consumes.

Hence from a global perspective, I would say that India has a long way to go right now and this is something that the government realizes and it is reflected in the total installed capacity. So we have around 200 GW to 250 GW installed capacities as compared to China where it's about 800 GW. There are about 300 million people in India who do not have access to electricity and there are another 300 million people who only have access to electricity 3-4 hours a day. I think a lot of work needs to happen but the good news is that the government realizes this. In fact there is a lot of pressure on the government as we need to provide basic electricity access to all. From a business perspective, I would say that we would like to believe that the pace of execution can be faster, and planning can be better.

➢ Could you tell us what challenges you face for energy efficiency?

I think when it comes to energy efficiency, two things are very essential to understand in the energy world. One is the supply side i.e. do we have electricity? Is the cost of electricity competitive? To this I would say that the cost of electricity is very high in India and we also face problems related to electricity shortage. So the efficiency that needs to be there right from generation to transmission to distribution is lacking. I think a lot of businesses rely on DG sets which are not only expensive but highly polluting as well. So, definitely those are the things that we would like to eliminate very quickly. Now we consider the demand side. When you are at your home, let's say it is a 1500 to 2000 sq ft house, you will say that my electricity

bill is 2,500 to 3000 per month on an average and also you will think about how much my neighbour is consuming. So you will try to benchmark yourself in the economic strata that you are living in. You will say that I am actually in the top 25 % of the electricity cost and you will say I need to do something to bring down the cost. But if somebody says that I am in the bottom line of that 25% then of course they are doing something that other people are not doing and this can be having efficient appliances, efficient bulbs or an efficient air conditioner. Similarly when you are talking about a commercial building, it will have lighting, air conditioning, power equipment and AT equipment. You can benchmark the energy consumption in commercial buildings as well. You will say that am I consuming 200 kw per sq mtr per year or am I consuming 60 kw hour, it's a three times difference. And that's what we see in India that some of the enterprises are at least three times more energy efficient. So there is a big variation and that depends on what the thinking of the customer is, what kind of solutions they are deploying and what kind of engagement they are in with companies like Schneider Electric.

Similarly, with factories you have various programmers so you will say that I am producing 1 ton of cement and how much kW hour I am consuming in order to produce that 1 ton of cement. So this is the approach from the demand side. If you want to do it in a systematic fashion you will analyse whether you are in top / bottom 25 and what do you need to achieve to become more energy efficient and that's where Schneider Electric (SE) comes in. So you say that my energy costs are high and I want to reduce the cost and increase energy efficiency, what are the technologies available?

Whether we are talking industry, residential, commercial or at utility level, at SE we deal with everything. Because of our diverse businesses, we deal with all these customers and provide energy efficient solutions to them. We see a lot of potential for energy efficiency. We believe things can be better with policies and regulations, government is bringing which is an important consideration in driving energy efficiency.

➢ **Do you have any plans to provide energy efficient solutions to rural areas?**

There are a couple of things that Schneider Electric is doing. We have a rural business unit focused to address the same thing. Apart from this, we have Schneider Electric Foundation as well which does a lot of CSR work. But there is just so much you can do through charity and so Schneider Electric has taken a very clear approach. We want to make a business case out of it and want to do it in a way that is cost effective.

I think electricity is a big thing for everybody in remote areas so we are looking at it in that perspective. For example in a condition where there is no grid, wires etc, then you can generate electricity through solar photovoltaic and then you will have solutions which will light up your home LED lamps and other things or you can have a DC powered phone or you can have charging infrastructure. These are some of the basic necessities that will make a tremendous difference in the life of village people. The other thing that we have done is that Luminous, which is a part of Schneider Electric, is trying to come out with renewable solutions for rural areas. So we have a solar entrepreneur where there is a central charging station which is getting charged through photovoltaic and a battery bank. These solar entrepreneurs will have 20 batteries in a small village. By the time the customer brings the battery back, the solar entrepreneur will have the other battery fully charged. So these are the type of innovations which are happening.

➢ **Could you share something on the major energy efficiency project accomplished by your company?**

Energy Efficiency projects are taking place with utilities and are part of the ministry of power program. They want to reduce the losses that happen between the transmission and distribution process. Lesser the losses you have, the more you get electricity to consume.

➢ **Does Schneider Electric have any collaboration with other company?**

Sometimes, when you are trying to do a utility project, say a large electricity project, it's quite possible that electrical distribution can come from Schneider Electric while automation and other things can be provided by our partners. So we have such partnerships.

➢ **What product range did you display at Elecrama 2014?**

Elecrama is one of the expo where we really want to stand out from others. We want to give a feel to our customers that if they install our products and solutions then how these will really work. So you have real product displayed here. We have models like the Smart Grid which display how electricity gets generated, how it gets transported, and if there is a fault in the distribution network then how that information gets passed on to the network control centers etc. All this has been displayed in a real time here at Elecrama by us.

➢ **Can you share with us about your plan for updations of new technology in the facility?**

We have more than 19,000 people in India and we have 32 factories here in India. We are trying to deploy our own solutions in our factories. We have seven or eight facilities in India which are ISO: 5001 certified now. It's a standard protocol that all our facilities will be ISO 9001, 4001, 5001 and then on top of that we are deploying our own solutions whether its electrical distribution switches, protection systems or energy management systems. What we do is that we show them to our customers and tell them this is what we are doing at our own factory. This gives them the confidence that Schneider Electric is not just coming and selling something but they believe in their solutions and products.

➢ **What did you anticipate from the business visitors?**

We expect at least 3000 visitors during the four or five days of the exhibition. We have a good crowd and hope to have a good attendance at our stall.

Power Supply Design for Home Appliance with Consideration of Power Quality

Both electric utilities and end users of electric power are becoming increasingly concerned about the quality of electric power. Newer-generation load equipment, with microprocessor-based controls and power electronic devices, is more sensitive to power quality variations than was equipment used in the past. So, nowadays study of the power quality events while designing the power supply board is most important.

Amruta Balasaheb Jamdade

Power quality monitoring is the process of gathering, analyzing and interpreting raw measurement data into useful information. The process of gathering data is usually carried out by continuous measurement of voltage and current over an extended period. The process of analysis and interpretation has been traditionally performed manually, but recent advances in signal processing and artificial intelligence fields have made it possible to design and implement intelligent systems to automatically analyze and interpret raw data into useful information with minimum human intervention.

Study of Power quality events done in following steps –

- Decide objective -Monitoring as part of an enhanced power quality service.
- Determining what to monitor.
- Choosing monitoring locations.
- Setting monitor thresholds.
- Quantities and duration to measure
- Define Power quality Measurement equipment Power quality data analysis using standards.
- Last step is use of Data analysis for enhancing the power quality of latest equipment This paper gives you idea about the enhancing the power quality of power supply board of Home appliance with the suggestion of equipments to be used to get better quality of Power supply board.

Power Quality in Power Distribution System- Most of the more important international standards define power quality as the physical characteristics of the electrical supply provided under normal operating conditions that do not disrupt or disturb the customer's processes. Therefore, a power quality problem exists if any voltage, current or frequency deviation results in a failure or in a bad operation of customer's equipment. However, it is important to notice that the quality of power supply implies basically voltage quality and supply reliability.

A voltage quality problem relates to any failure of equipment due to deviations of the line voltage from its nominal characteristics, and the supply reliability is characterized by its adequacy (ability to supply the load), security (ability to withstand sudden disturbances such as system faults) and availability (focusing especially on long interruptions).

Power Quality From Design Side - The performance of each & every electronic system or electronic circuit depends upon the power supply that energizes the circuit or system. It

provides required current to the circuit. Any disturbance noise in this power supply can cause problem in working or operation of circuit. If there is any deviation in this power supply level the circuit may not work properly. The accuracy and precision of circuit operation depends upon it. In some of the circuits all the calibration are done at this voltage level.

There are two approaches to the mitigation of power quality problems. The first approach is called load conditioning, which ensures, equipment is less sensitive to power disturbances.

So all these calibrations becomes false if there is fluctuation in supply level.

There are two types of power supplies

- Unregulated power supply
- Regulated power supply.

Unregulated supply is used in some circuits where there is no much change in required load current. The load current remains fixed or deviation is very less. Because in such supply

- The output voltage reduces as load current increases
- The ripple in output voltage increases as load current increases.

So this kind of supply can not be used where there is noticeable change in load current frequently. But although many circuits works on unregulated supply because it requires very few components and design is also very simple. Also some fluctuation in supply level can be tolerated due to load current change. The regulated power supply is required in digital circuits, the circuits in which the components cannot tolerate even 1% change in supply level like micro controller, micro processor etc.

Solutions to Power Quality Problem

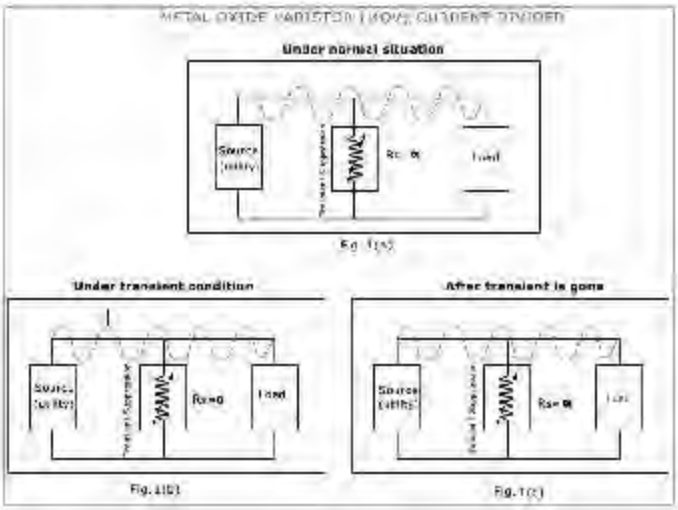
There are two approaches to the mitigation of power quality problems. The first approach is called load conditioning, which ensures that the equipment is less sensitive to power disturbances, allowing the operation even under significant voltage distortion. The other solution is to install line conditioning systems that suppress or counteracts the power system disturbances. Solutions for load conditioning approach by selecting proper components used in power supply design

Protection From Surges – Metal Oxide Varistor

A varistor is an electronic component with a 'diode-like' nonlinear current–voltage characteristic. The name is a portmanteau of variable resistor. Varistors are often used to protect circuits against excessive transient voltages by incorporating them into the circuit in such a way that, when triggered, they will shunt the current created by the high voltage away from sensitive components. A varistor is also known as voltage-dependent resistor (VDR). A varistor's function is to conduct significantly increased current when voltage is excessive.

The working of a MOV is shown in the Figure herein.

The resistance of the MOV is very high. First, let us consider the component to have an open-circuit as shown in Figure 1(a). The component starts conducting as soon as the voltage across it reaches the threshold voltage. When it exceeds the threshold voltage, the resistance in the MOV makes a huge drop and reaches zero. This is shown in the Figure 1(b). As the device has very small impedance at this time due to the heavy voltage across it, all the current will pass through the metal oxide varistor itself. The component has to be connected in parallel to the load. The maximum voltage that will pass through the load will be the sum of the voltage that appears across the wiring and disconnect given for the device. The clamp voltage across the MOV will also be added. After the transient voltage passes through the component, the MOV will again wait for the next transient voltage. This is shown in the Figure 1(c).



EMI Suppression Capacitors

EMI suppression capacitors, as the name implies, are used to reduce electromagnetic interference. They are connected directly to line and are therefore exposed to overvoltages and transients, which could damage the capacitors. For this reason, EMI suppression capacitors must comply with the requirements of the following safety standards like- EN 60384-14/ IEC 60384-14, 2nd edition, UL 1414 (across the line and line bypass application), UL1283 (electromagnetic interference filters), CSA C22.2,No.1 and CSA C22.2, No.8 , CQC (GB/T 14472-1998).

Classification of EMI suppression capacitors EN 60384-14 and IEC 60384-14 divide EMI suppression capacitors into two groups.

Subclass	Peak pulse voltage Vp in operation	Application	Peak values of surge voltage Vp (before endurance test)
X1	2.5 KV < Vp < 4.0 KV	High pulse application	CR < 1.0 mF: Vp = 4.0 KV
			CR > 1.0 mF: Vp = 4.0/√ CR KV (enter CR in mF)
X2	Vp < 2.5 KV	General purpose	CR < 1.0 mF: Vp = 2.5 KV
			CR > 1.0 mF: (enter CR in mF) Vp = 2.5/√ CR KV
X3	Vp < 1.2 KV	General purpose	No test

Table 1: For X Capacitors

X capacitors (for line-to-line or line-to-neutral connection)

These are capacitors for applications in which failure of the capacitor will not lead to a dangerous electrical shock. EN 60384-14 divides X capacitors into 3 subclasses according to the peak pulse voltage to which they are exposed in operation, in addition to the rated voltage. This kind of impulse can be caused by lightning in overhead cables, switching surges in neighbouring equipment or in the device in which the capacitor is used to suppress interferences.

Y capacitor (line-to-ground or neutral-to-ground connection).

These capacitors are intended for use where failure of the capacitor could result in a dangerous Electrical shock. Y capacitors are capacitors of enhanced electrical and mechanical reliability and Limited capacitance. The enhanced electrical and mechanical reliability are intended to eliminate short-circuits in the capacitor. Limitation of the capacitance is intended to reduce the current passing through the capacitor when AC voltage is applied and to reduce the energy content of the capacitor to a limit that is not dangerous when DC voltage is applied. Y capacitors are used in electrical equipment and machines to bridge operational insulation that provides safety, in connection with additional protective measures, in order to avert danger to humans and animals. EN 60384-14 divides Y capacitors into the following sub-classes:

Sub-class	Type of required insulation	Rated AC voltage	Test voltage of impulse voltage V_p (before endurance test)
Y1	Double or reinforced insulation	VR ≤ 250 V	8.0 kV
Y2	Basic or supplementary insulation	150 V < VR ≤ 250 V	5.0 kV
Y3	Basic or supplementary insulation	150 V < VR ≤ 250 V	No test
Y4	Basic or supplementary insulation	VR ≤ 150 V	2.5 kV

Table 2

Some important tests to IEC/EN 60384-14

- Impulse Voltage Test
- Endurance Test.

Capacitors are tested with a voltage of 1.25 times the rated voltage for class X2 and 1.7 times for class Y2 at the upper category temperature for 1000 h. Each hour the test voltage is increased to 1000 VRMS, 50 Hz for a period of 0.1 s.

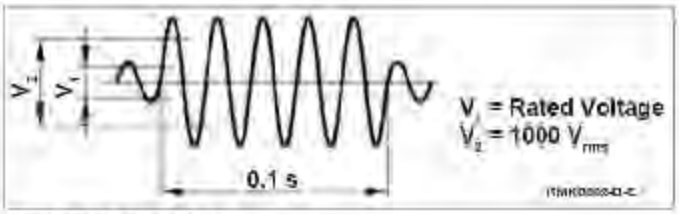


Fig. 2: Endurance Test

- Active Flammability Test

This test is to ensure that capacitors do not ignite at a defined electrical overload. Capacitors are applied the rated voltage at 50 Hz with 20 superimposed pulses of 2.5 kV for class X2 and 5 kV for class Y2.

The rated voltage is maintained for 2 min. after the last discharge. This is a destructive test, and the failure condition is that cheesecloth around the capacitor shall not burn with a flame. No electrical measurements are required.

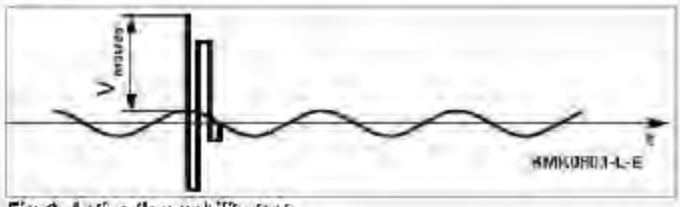


Fig. 3: Active flammability test

- Typical Application.

Depending on how they are connected, X and Y capacitors are effective against different kinds of electromagnetic interference. X capacitors connected between the line phases are effective against symmetrical interference (differential mode). Y capacitors connected between a phase and neutral (zero potential) are effective against asymmetrical interference (common mode).

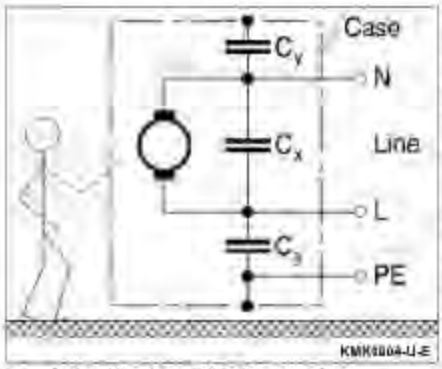


Fig. 4: Application of X & Y capacitor

Overload Protection From Design & Load Connected - Fuse

Although care is taken to properly design electrical and electronic circuits; overcurrents in the form of short-circuits and overload can occur. The sole purpose of fuses and circuit breakers is to protect personnel and/or equipment from serious harm when an overcurrent condition arises. This guide is intended to help create a better understanding the various parameters of overcurrent protection and the proper application of circuit protective devices. This guide creates a basic understanding of overcurrent principles and applications but is not intended to supplant sound engineering principles or replace specific application testing.

Features

- Lead Free
- Reduced PCB space requirements
- Direct solderable or plug-in versions
- Internationally approved
- Low internal resistance
- Shocksafe casing
- Halogen free.

Noise/ Harmonics Suppression - Filters

Harmonic filters can be used to reduce the amplitude of one or more harmonic currents or voltages. Filters may either be used to

protect specific pieces of equipment, or to eliminate harmonics at the source. Since harmonic filters are relatively large, space requirements may have to be budgeted for. In some situations, improperly tuned filters may shift the resonant frequencies close to the characteristic harmonics of the source.

The current of the high-harmonics could excite the resonant circuit & produce excessive voltages and attract high oscillating harmonic currents from elsewhere in the system. Capacitors Harmonic amplification due to resonance associated with capacitor banks can be prevented by using converters with high pulse numbers, such as twelve pulse units, thereby reducing high-amplitude low order harmonics. A similar effect occurs with pulse width modulated converters.

Linear Passive Filter Design & Operation - A linear filter is composed of linear components, such as inductors and capacitors. It passes the basic power frequency (60 Hz) and attenuates other frequencies which are in the form of electrical noise and harmonics. Some filters are tuned circuits, which means they address a small range of frequencies. Examples of filters that are not tuned are the simple low pass filter, and the simple high pass filter. Simple low pass filters attenuate high frequencies, and have the general characteristics most desired in filters for improved power quality and noise attenuation. Simple high pass filters attenuate low frequencies.

Tuned shunt filters are not used for general power quality applications. Special designs are used to attenuate harmonics. A shunt connected tuned filter, which consists of an inductor, a capacitor and a resistor, is tuned to eliminate a specific harmonic order by providing a low impedance to the harmonic frequency and shunting the harmonic energy to ground. A number of these filters may be arranged in stages, with each stage selectively filtering a given harmonic frequency.

Equipment which is either sensitive to electrical noise, or which creates it, is often designed with linear filters for protection of equipment. For instance, all power supplies contain electrical filters. For harmonics, multi-staged shunt filters are most effective for mitigation of lower order harmonics.

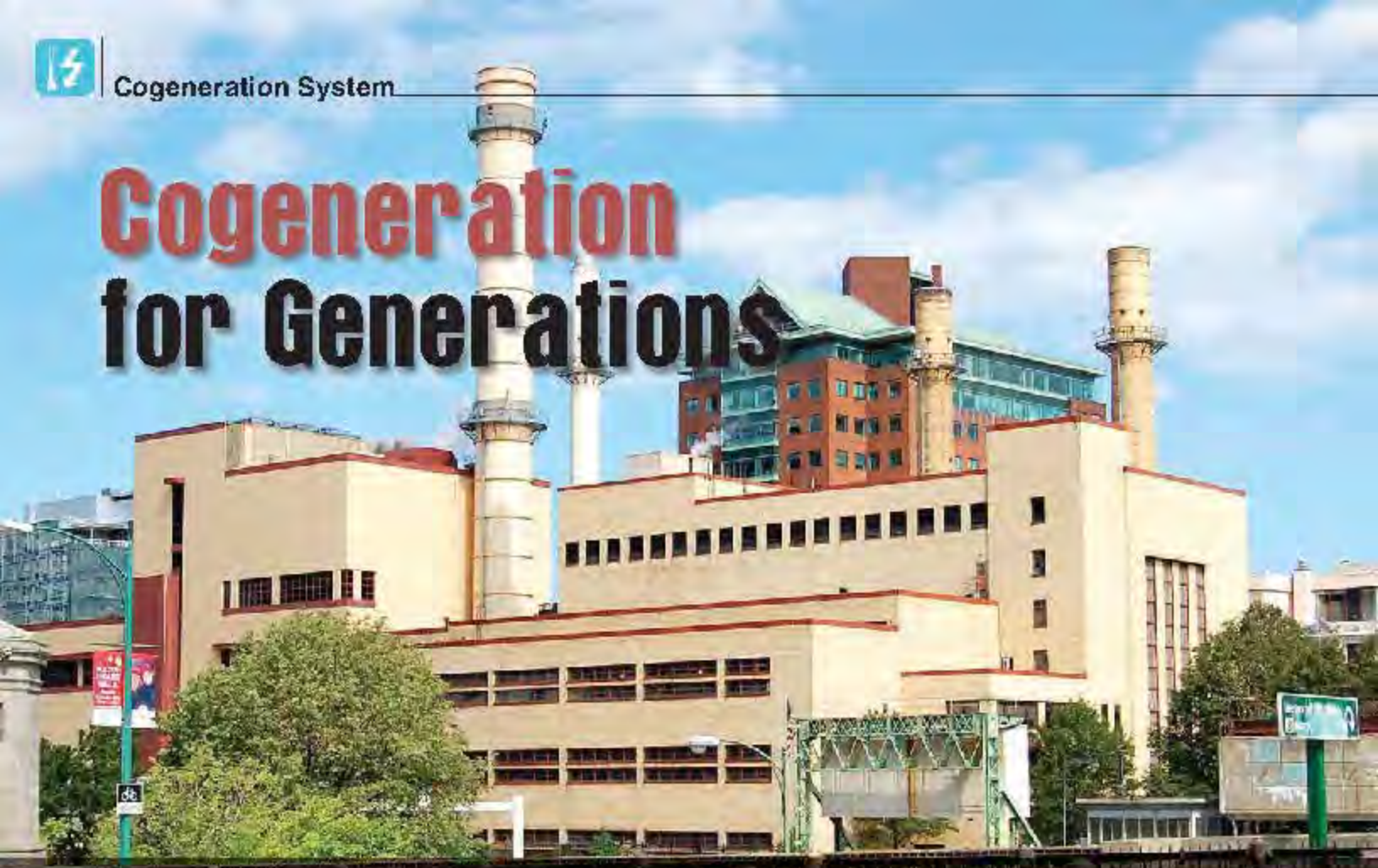
Acknowledgment

I am extremely thankful to Prof S S More, HOD of Electrical Department, Bharati Vidyapeeth deemed University, College of Engineering Pune, for support during the project. I am also highly obliged to Whirlpool of India Ltd, for the provision of necessary data.

Profile

Amruta Jamdade
MTech – Power System, BHDU's College of Engineering Pune, and Design Engineer at Whirlpool corporation Ltd.

Cogeneration for Generations



Shortage of power is to stay in the country, due to lack of planning and non-conserving habits, for coming generations. Policies, non-commitments and non-accountabilities hinder to tap all the sources to supplement the grid power and lower down the demand from state grids to help in reducing the gulf between demand and supply. In this perspective 'Cogeneration' should be the first choice of states to extend the attractive facilities/ incentives as well as, of industrialists.

P N Khare

Cogeneration is defined as the combined and simultaneous generation of Heat and Power from a single primary source. That is why a cogeneration plant is termed as CHP plant.

Advantages

Cogeneration system has the following advantages :

- Increase in the system efficiency.
- Reduction in fuel consumption and
- Reduction in Green House Gas (GHG) emission.

Prime Consumers

Total energy systems are particularly suitable, where large quantities of heat are required for the various process. Simple and innovative schemes can suitably be designed to suit each of the requirements. Following are some energy intensive industries/plants.

- Sugar factories
- Steel plants
- Petro-chemical plants
- Breweries
- Pharmaceutical plants
- Fertilizer industries
- Pulp & paper industries
- Textiles
- Process industries.

Economics

The main advantages of the cogeneration is that a big share of industrial power and process-steam needs are met from the cogeneration plants. The critical factors for cogeneration economic merits are effective heat-rate for cogeneration, by product power yield and characteristics of thermal heat load. The additional financial requirements to a new plant or existing one, is generally written off within a reasonable payback period, say five years, due to better efficiency, as high as 90%. The running costs of cogeneration plants should be kept to a long way in maintaining efficiency on higher side. Cogeneration system can be more meaningful if energy consuming facility has the following characteristics.

- Utilization of higher thermal energy than electricity.
- Quite stable heat-load pattern.

Many industries are unaware of the potential for energy efficiency and its conservation Energy manager must be a person of calibre to be responsible not only for reducing the energy cost.

- Reliable power requirements
- Long operation hours and
- High price and/or scarcity of grid power

Pricing

There can be only two methods of pricing the CHP generation:

- The entire annual costs worked out less the financial credit for production of heat supply designed to the electricity production.
- The value of electricity bought or sold is worked out and the balance annual costs are assigned to the heat supply.

Energy Management

Energy Consumers ought to have systematic approach towards present trend of energy consumption through energy auditing, modern techniques and avoiding energy wastage.

Many industries are unaware of the potential for energy efficiency and its conservation Energy manager must be a person of calibre to be responsible not only for reducing the energy cost but assuming a wider role as keeper of the company's conscience on all matters affecting the use of energy.

Fuel saving (qs, kg/hr)

A) By increasing efficiency of Boiler

$q_1 \times \eta_1 = q_2 \times \eta_2$ or $q_2 = q_1 \times (\eta_1/\eta_2)$

Where,

q_1 = initial fuel rate

η_1 = intial efficiency of boiler

η_2 = increased efficiency of boiler

q_2 = fuel rate after increased efficiency

Saving in fuel, $qs = q_1 - q_2$

B) By increasing efficiency of Turbine

$Q_1 * \eta_1 = Q_2 * \eta_2$ or $Q_2 = Q_2 * Q_1 (\eta_1/\eta_2)$

Where

Q_1 = initial mass flow of steam at turbine inlet, kg./hr

η_1 = intial efficiency of turbine

η_2 = increased efficiency of turbine

Q_2 = mass flow of steam after increased efficiency, kg/hr.

Also, $q_2/Q_2 = q_1/Q_1$ or $q_2 = q_1 * (Q_2/Q_1)$

Payback period

Power saved (Us) is given by the equation:

$Us = Ur\ (1/Ec - 1/Ee)$ ..... (i)

Where,

Ur = rated Power of an equipments, kw

Ec = efficiency of conventional equipment

Ee = efficiency of efficient equipment

Hence Saving in consumption per year (Sy) will be as below:

$Sy = Us * Hw * Cu$ .....(ii)

Where,

Hw = working hours per year

Cu = Cost per unit of energy

Now payback period (Pb) in year is worked out by:

$Pb = (Ce-Cc)/Sy$ ..... (iii)

Where,

Ce = Cost of efficient equipment

Cc = Cost of conventional equipment.

Technical Parameters

For making a choice of cogeneration systems, some technical parameters assist in defining the type and operating scheme of different alternative cogeneration systems to be selected, such as :

- Heat to Power Ratio,
- Quality of thermal energy needed,
- Load Pattern,
- Fuels availability,
- System Reliability,
- Grid dependent or independent system,
- Retrofit versus new installation,
- Electricity buy-back and,
- Local Environmental Regulations.

Heat to power Ratio (H/P)

Heat to power ratio is one of the most important parameters influencing the selection of the type of cogeneration. It is defined as the ratio of thermal energy (KWth) to electrical energy (KWe), where one KWth is equal to 860 Kcal or 3600 KJ. H/P required by a site may vary during different times of the day and seasons of the year. Many large cogeneration units utilize auxiliary, supplementary or boost firing of the exhaust gases in order to modify the H/P of the system to match the site loads. The H/P is normally high (say 4 to 12), unless the evaporators are designed for low steam pressure. Flexibility in this ratio can be obtained by using turbines with regulated extractions.

Load Matching

The selection and operating schemes of a cogeneration system is site specific and depends on various factors matching the loads of the plant.

Base Electrical Load matching: Minimum electricity demand of the site, is

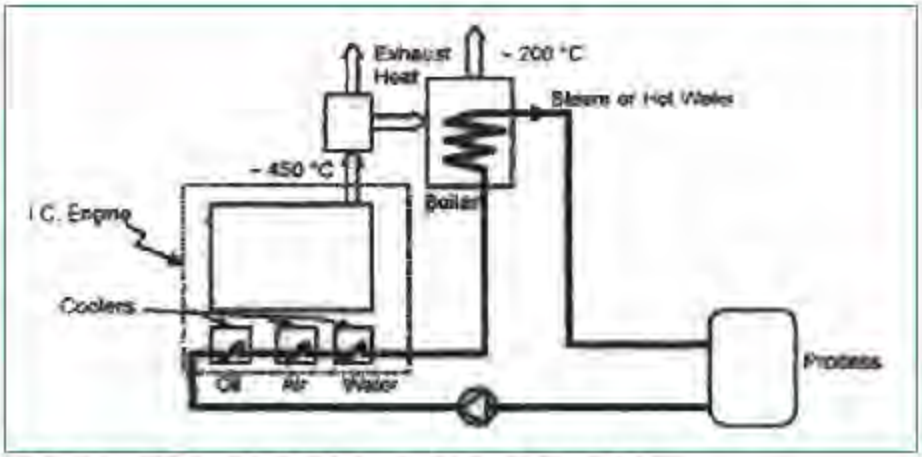


Fig. 1: Schematic Diagram of Reciprocating Engine Cogeneration

based on historical curve. Additional power is purchased from the grid or surplus power may be sold to power grid. Onsite generation equipments are connected to the Utility system inside the user's plant. Thermal energy requirement could be met by the cogeneration system alone or by additional boilers. Excess thermal energy can be exported to neighboring customers.

Base Thermal load matching: It is sized to supply the minimum thermal energy required; additional could be met with the auxiliary boilers or may be imported from neighboring plants. Additional electrical energy than that provided by the prime movers can be purchased from grid.

Stand Alone Electrical Load Matching: In this option, the facility is totally independent of the power utility grid. Higher thermal energy demand can be met with auxiliary boilers. Grid-independent system is adopted to increase the reliability of plant's critical loads.

Stand Alone Thermal Load Matching: The cogeneration system is designed to meet the thermal energy demand at any time. The deficit of electricity requirement can be compensated by power purchase from the grid or excess electricity generated may be sold to the utility.

Classification

Cogeneration systems are classified according to the sequence of the energy use and the operating schemes adopted i.e. topping or bottoming cycle.

Topping Cycle

In a topping cycle, fuel is supplied to first produce power and then thermal energy which is the by-product of the cycle and is used to satisfy process heat or other thermal requirements.

Steam Turbine Topping: Any type of fuel is burnt to produce high pressure steam, which processes through a steam turbine to produce power and the exhaust provides the low pressure steam.

Combined Topping: A Gas Turbine or Reciprocating (I.C.) Engine produces electrical or mechanical power followed by a heat recovery boiler to make process steam and process heat This cycle has over all efficiency as 69 to 83%.

Bottoming Cycle

In a bottoming cycle, the primary fuel produces high temperature thermal energy and the heat rejected from the process is used to generate power through a recovery boiler.

Prime Movers

For correct choice of a prime mover it is essential to know H/P of a plant. For some plants more than one type of prime mover may be suitable and final selection is done on optimization. There are mainly three type of prime movers used in a cogeneration system:

- Reciprocating (Internal Combustion) Engines,
- Gas Turbines, and
- Steam Turbines.

Reciprocating Engine C.G. Systems

These systems have high power generation efficiencies in comparison with other prime movers (Figure 1)

There are two sources of heat recovery.

- Exhaust gas at high temperature and
- Cooler, for air water and Oil, at low temperature. These systems are more popular in the non-process industries. Heavy Furnace Oil (HFO), Regular Furnace Oil (RFO), Light Diesel Oil (LDO) and High Speed Diesel (HSD)are the fuels in use. Overall efficiency of such a system is 75 to 85%.

Gas Turbine C.G. Systems

Gas Turbine cogeneration systems can produce all or part of the energy requirement of the site and the energy released at high temperature in the exhaust stack can be recovered for various heating and cooling applications. (Figure 2) :

Gas turbine has a short start-up time and provides the flexibility of intermittent operation. Natural gas, Gas oil, Low pressure gas, Naphtha etc. are the possible fuels. The overall efficiency of the system is 70 to 85%

Steam Turbine C.G. System

Steam turbines are the most commonly employed prime movers for cogeneration application. (Figure 3):

These systems involve different types of configuration with respect to mode of power generation and process steam, such as back pressure (η = 84-92%) and condensing turbines (η = 60-80%) with extractions as per need of the plants.

Extraction condensing C.G. systems have higher electricity generation efficiencies. Back pressure turbine is suited for constant demand of steam. The mollier Diagram, a chart with Enthalpy (H) and Entropy (S) is used in estimation of heat extraction from a turbine.

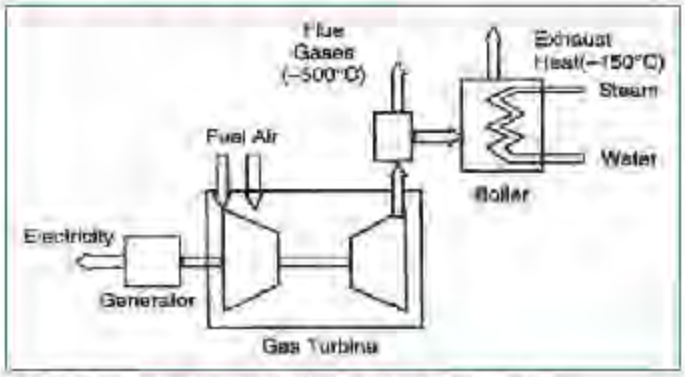


Fig. 2: Schematic Diagram of Gas Turbine Cogeneration

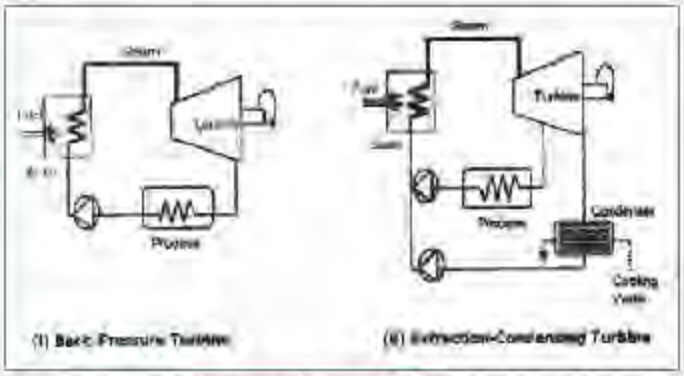


Fig. 3: Schematic Diagrams of Steam Turbine Cogeneration Systems

ENERGY EFFICIENT LIGHTING SOLUTION

Bright Ideas Bold Innovation

Innovative RIO system with Superior Optics

Insurance Energy saving further enhanced by cost saving on reusing existing fixture.
As a case 140W RIO system delivers equal light level as a 250W HPSV street light with 45% energy saving

Long Life Series Twin arc Metal Halide Lamp

Delivers the Twice the rated life
Reduces investment through replacing the lamp with the existing fixture
Cut maintenance cost

Energy Saving Lamps & Dimmable Ballasts

High Luminous & standard designs
Exceptionally low power consumed
Compact & Light weight
Smart & Intelligent

VENTURE LIGHTING

An Advanced Lighting Technologies Company. USA

Venture Lighting India Ltd.
Plot No A30 D5 Phase II Zone B,
MEPZ Tambaram, Chennai-600045
Email: marketing@vlindia.com
Tel: +91 44 22625567 / 22623094

www.venturelighting.in
www.venturelighting.com

LED Street Lights

Driver less LED street lights
Compact Design
Improved Life

Wireless Lighting Automation

Energy savings through dimming
24/7 Control and Programming
Lamp/Ballast condition reporting
Energy reporting per fixture

Ultra Efficient Magnetic Ballasts

95% Efficient Magnetic Ballasts for Street Lights
Exceeds / Matches Electronic Ballasts
Costs lower than Electronic Ballast
Longer life
Can be replaced in the existing Fixtures

Plant Performance

The overall efficiency of energy use in cogeneration mode can be in the range of 85 to 90%, A plant performance assessment would yield valuable insights into cogeneration system performance. The plant performance needs to be compared with the base line values arrived at for the plant operating conditions rather than the design values. Performance Test determines the power output and plant heat-rate. In certain cases the efficiency of individual components is addressed. It also shows the maintenance accomplishment after a major overhaul. In some cases the purpose of evaluation could even be for total plant revamp.

Measurements

The suggested instrumentation (Online/field instruments) for the performance measurement is as under :

Steam flow measurement	Orifice flow meters
Fuel flow measurements	Volumetric measurements/Mass flow meters
Air flow/Flue gas flow	Venturi / Orifice flow meter/Ion gun/ Pitot tubes
Flue gas Analysis	Zirconium Probe Oxygen analyzer
Unburnt Analysis	Gravimetric Analysis
Temperature	Thermocouple
Cooling water flow	Orifice flow meter/weir/channel flow/ non-Contact flow meters
Pressure	Bourdon Pressure Gauges
Power	Tri-vector meter / Energy meter
Condensate	Orifice flow meter

Data Collection

It is essential to ensure that the data is collected during steady state plant running conditions. Among others, the following are essential details to be collected for cogeneration plant performance evaluation.

Electrical Energy

- Total power generation for the trial period from individual turbines.
- Hourly average power generation
- Quantity of power import from utility (Grid)*
- Quantity of power generation from DG sets.*
- Auxiliaries power consumption

*Necessary only when overall cogeneration plant adequacy and system optimization / up gradation are the objectives of the study.

Boiler Efficiency, ηb

= Q (hs-hw) / (q*GCV)

Where

Q= mass flow rate of steam, kg/h

hs = Enthalpy of produced steam, kcal/kg

hw = Enthalpy of feed water, kcal/kg = tw ^{0}c

q = Fuel rate, Kg/hr

GCV = Gross calorific value of fuel, kcal/kg

Thermal Energy

S. No.	Energy	Flow	Pressure	Temperature
1	Steam inlet to turbine	✓	✓	✓
2	Fuel input to Boiler / Gas turbine	✓	-	-
3	Combustion air	✓	✓	✓
4	Extraction steam to process	✓	✓	✓
5	Back Pressure Steam to Process	✓	✓	✓
6	Condensing steam	✓	✓	✓
7	Condensate from turbine	✓	-	-
8	Turbine bypass steam	✓	-	-
9	Flue gas to HRSG	-	✓	✓
10	Exit flue gas	-	-	✓ + composition
11	Cooling water to condenser	✓	✓	✓

Overall Plant Performance

Overall plant heat rate (Phr), kcal/kwh:

= Q (h-hw)/kw

Where,

Q = mass flow rate of steam, Kg/hr

h = Enthalpy of steam generated, Kcal/kg

hw = Enthalpy of feed water, Kcal/kg = tw ^{0}c

kw = Power out put

Overall plant fuel rate (Pfr), kg/kwh

= Total fuel consumption (q) / Power Out put, (in kw)

Where,

q = fuel consumption rate, kg/hr

= Q/Evaporation ratio of boiler

Q = mass flow rate of steam, Kg/hr

Steam Turbine Performance

Turbine cylinder efficiency (ηtc), %

$$= \frac{Actual\ enthalpy\ drop\ across\ the\ turbine, Kcal/kg}{Theoretical\ enthalpy\ drop\ across\ the\ turbine\ Kcal/kg} * 100$$

Turbo- alternator efficiency (ηta), %

$$= \frac{Heat\ generated, kcal/hr}{Heat\ available\ for\ generation, Kcal/hr} * 100 = \frac{KW X 860}{Hg} * 100$$

Where,

KW = Power Output

Hg = Heat available for generation Kcal/hr = Hi-Ho

Hi = Heat input to turbine, Kcal/hr = Qi X hi

Qi = Mass flow rate of steam at turbine inlet, Kg/hr

hi = Enthalpy of input steam, Kcal/kg

Ho = Heat extracted/exhausted from turbine, kcal/hr
= Q1 X h1 + Q2 X h2 +-----

Q1, Q2 = Flow of extracted /exhausted steam, Kg/hr

h1, h2 = Enthalpy of respective extrated/exhausted steam, Kcal/kg

Turbine efficiency ηtu, %

= (ηta/ηgt*ηa) * 100

Where,

ηta = Efficiency of turbo alternator

ηgt = Efficiency of gear transmission

ηa = Efficiency of alternator

Gas Turbine Performance

Air Compressor Efficiency (ηgc), %

$$= \frac{\text{Theoretical temperature rise across the compressor°c}}{\text{Actual temperature rise across the compressor°c}} * 100$$

Overall gas turbine efficiency (Compressor + gas turbine). (ηct), %

$$= \frac{KW * 860}{q * GCV} * 100$$

Where,

KW = power output

q = fuel rate, kg/hr

GCV = gross calorific value, Kcal/kg

Heat Recovery steam Generator (HRSG) Performance

HRSG efficiency, %

$$= \frac{Q\ (h - hw)}{q * Cp * (Tin - Tou) + qau * GCV} * 100$$

Where

Q = Steam generated, Kg/hr

h = Enthalpy of steam generated, Kcal/kg

hw = Enthalpy of feed water, Kcal/kg = tw, °c

q = mass flow of flue gas kg/hr

Cp = Specific heat of flue gas, Kcal/k/ c

Tin = Inlet temperature of flue gas c

Tou = Out let temperature of flue gas c

qau = Auxiliary fuel consumption, kg/hr

Cogeneration efficiency

$$\text{(i) } \textit{Thermal efficiency } (hth) = \frac{Qo * ho}{Qi * hi}$$

$$\text{(ii) } \textit{Electrical efficiency } (hel) = \frac{KW * 860}{Qi * hi - Qo * ho}$$

Hence,

Cogeneration efficiency (ηcg), % = (ηth * ηet)*100

Conclusion

Many options are available to harness the energy in fuels. Very high efficiency, as high as 90%, of the cogeneration plants results in lesser fuel consumption and hence awards conservation of indigenous energy sources. Besides, C.G. plants share in reduced emission of green house gases. CG system allows a part of the financial burden of the National Power Utilities to be shared by the Private Sectors as well as, eliminates the transmission line losses. With the requirements of constant magnitude of Heat and Power in industries and large commercial/ residential complexes, C.G. system ought to be successful in the interest of Nation and Generations to come.

Profile

P N Khare

BE (Hons.) Electrical; Chartered Engineer; Energy Auditor
Manager, Chitransh Electrical, BORL Bins.

Natural gas requirements for Indian Power Sector

The world wise use of natural gas has increased in preference to coal and has recorded a consistent CAGR of 9-10% for past 5 years. The same trends are seen in the Indian market and the growth is occurring due to expansion of the power generating sector (through public and private sector routes), deterioration in coal quality and uneven growth in the coal supply sector which has been the traditional source for power sector growth. Major fraction of the natural gas goes towards power generation. As on date the indigenous production has not been able to keep pace with the growth and increased import of natural gas is inevitable. However, the open market cost of imported gas is going beyond the normal supply-demand dynamics because of the continuously widening market and superiority over coal as an environmentally friendly fuel. The domestic prices are around Rs 25-38/kg for R-LNG as compared to Rs 49-58/kg for LNG in the international market. The exploration of alternatives such as biogas and coal bed methanization is becoming inevitable in the near future.

M Siddhartha Bhatt

Among the fossil energy sources, natural gas is the most environmentally friendly and least polluting of the fuels as compared to coal, fuel oil, etc. Wide scale use of natural gas is prevalent in America and Europe. As proof of this transition, natural gas is catering to 24% of the global primary energy supply and is consistently growing at a CAGR of 9% for the last 5 years primed by the Asian markets. The present global consumption is around 3300 billion m^3.

The Asian Pacific Region is accounting for nearly 700 billion m^3/year of which India imports are around 70 billion m^3/year. Major problem which is affecting international purchase of LNG is the price volatility beyond the supply-demand dynamics to $16-19 per MMBTUof LNG (Rs 49-58/ kg of LNG) such as seasonal requirements in winter due to room heating loads, etc.

The gas prices in India are fixed at $4.8 per MMBTU (Rs 12.8/kg of LNG) for indigenous production which is likely to be increased to $8.4 per MMBTU (Rs 25.8/kg of LNG). The cost of CNG and PNG are Rs 38/kg and Rs 24/ kg respectively. With the exemption of vat the cost is reduced by Rs 6/kg. These costs refer to domestic costs. Open market international costs are much higher.

Natural Gas as an Energy Source

Natural gas in a gas/oil well is found in three physical states:

- Non oil associated-no oil contact
- gas cap, where it is overlying an oil reserve
- Associated gas-dissolved in the oil.

Natural gas resources are located onshore or offshore often in remote and difficult locations as far as 5000 km

away from the point of actual usage necessitating the efficient transfer for which it is converted to different forms such as:

- Compressed natural gas (CNG) - Natural Gas compressed to a pressure of 20.0-25.0 MPa and transported through containers (compression ratio: 200 to 250:1).
- Liquefied natural gas (LNG) - liquefied at –160°C and transported in containers (compression ratio: 600:1).
- Re-gasified liquefied natural gas (RLNG) – Re-gasified and transported through Pipelines.

Typical piped natural gas (PNG) is quantified in units of:

- Billion cubic metres (BCM)
- Metric million standard cubic meters per day (MMSCMD)
- Million British thermal units (MMBTU).

Sl No	Natural Gas Equivalents
1	1 BTU = 0.252 kcal
2	1 metric tonne = 48 to 52 MMBTU
3	1 MMBTU = 19.2 to 20.8 kg
4	1 metric tonne = 1300 to 1450 m^3
5	1 m^3 = 0.69 to 0.77 kg
6	1 BCM/year = 2.74 MMSCMD
7	1 BCM/year = 0.7 million tonnes/year
8	1 million tonnes/year = 3.91 MMSCMD

Nearly 25-30% of the world's natural gas is transported through the LNG route while the rest is through the CNG route. LNG involves liquefaction of the piped natural gas (PNG) which in its natural state of extraction in the form of superheated vapour well above the critical points of the component fuels.

Natural gas which mainly contains methane is liquefied by lowering the temperature of the hydrocarbon to approximately -160°C (range: -120 to -170°C). This temperature drop liquefies the methane present in the natural gas enabling storage and transportation at atmospheric pressure. LNG has no chance of igniting or exploding either in a spill or in an open environment. LNG is maintained in its liquid form through auto refrigeration. This is a process in which the fuel is kept at its boiling point. In the auto refrigeration processes heat additions are offset by the energy lost from the LNG vapor, vented out of the storage and used to power the system.

Concept of Liquefied Natural Gas (LNG) in a cryogenic storage system (with energy density on par with petrol and diesel fuels) was developed commercially in 1964 to compact the gas though the idea was known as early as 1870s.

LNG has transformed the natural gas market, rendering economic viability into previously unrecoverable, inaccessible and far located natural gas reserves. The concept of Liquefied Natural Gas (LNG) in a cryogenic storage system (with energy density on par with petrol and diesel fuels) was developed commercially in 1964 to compact the gas though the idea was known as early as 1870s. A compression ratio of 600 is achieved with LNG. Natural gas from the oil/gas wells undergoes separation processes to remove water, acid gases and fractionation of heavy hydrocarbons from the gas before liquefaction. Natural gas is then liquefied and transported in cryogenic tankers or ships and at the end point re-gasified into its original state for distribution. After regasification the gas is pumped directing into the pipelines of the distribution network.

In many African countries, the natural gas produced in oil wells has been flared for want of gas demand and storage facilities. In such circumstances, storage through the LNG route is appropriate.

Most natural gas locations are stranded and gas has to be piped to load centres required conversion into more compact forms such as CNG (compaction ratio: 200-250; density 175 kg/m^3 at 20.0 MPa) or LNG (compaction ratio: 600, density in liquid form: 435 kg/m^3). In other words, the sources and locations of gas both onshore and offshore are such that they cannot be economically transferred to end user locations without going through CNG or LNG routes.

Figure 1 gives a schematic of the process of gas handling from well to its end use.

The basic requirements for liquefaction are:

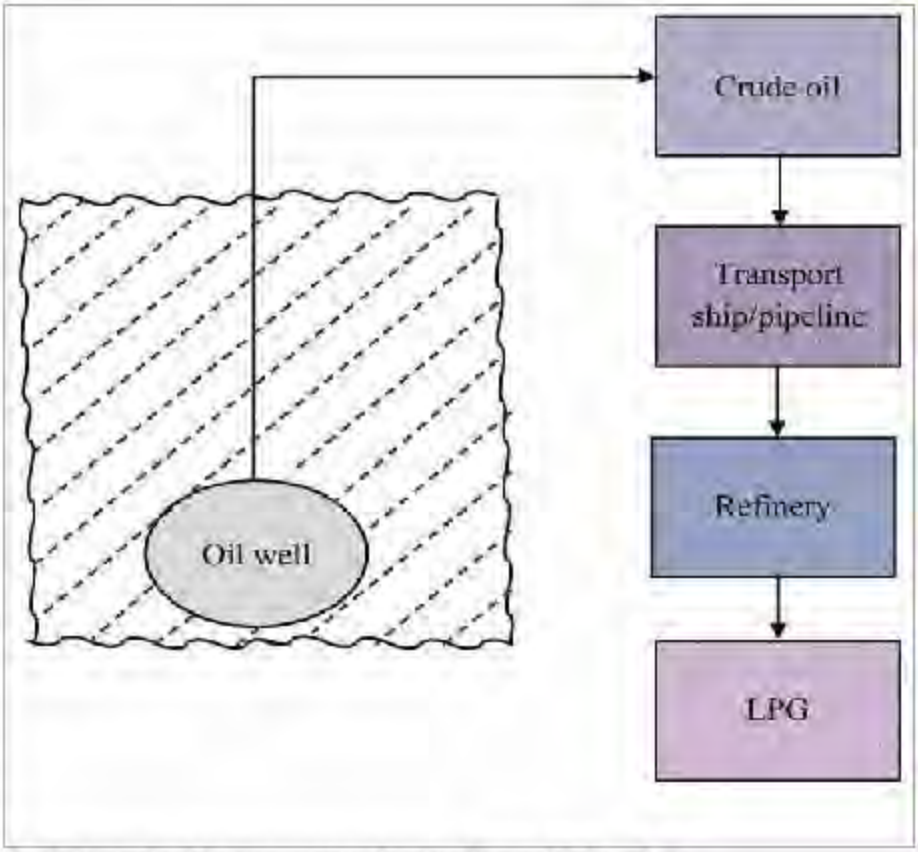


Fig. 1: Schematic of the process of gas handling from well to its end use

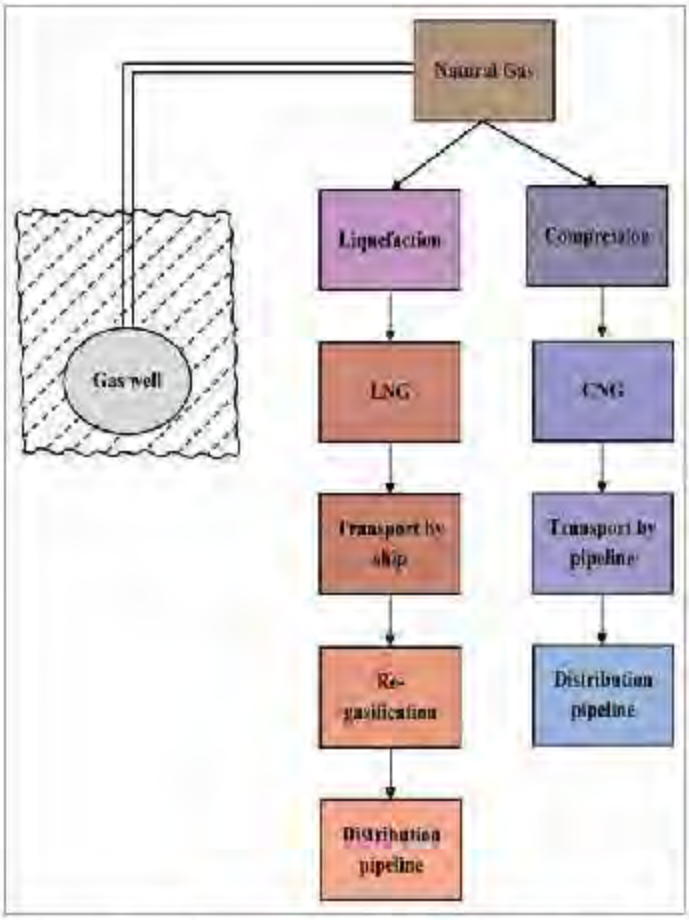


Fig. 2: Schematic of various production processes for conversion of PNG into LNG

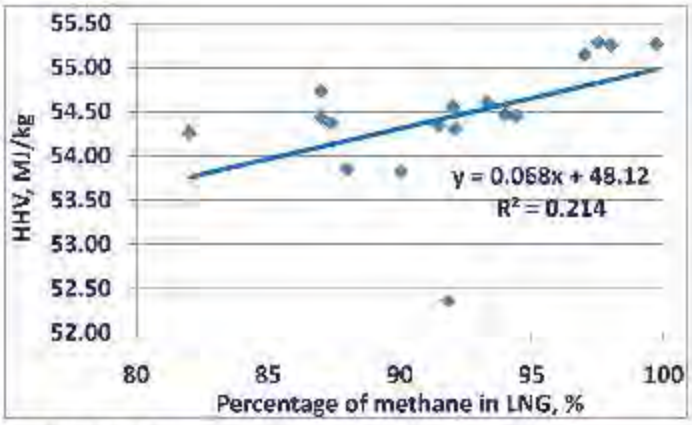


Fig. 3: HHV of gas as a percentage of methane (C1) content

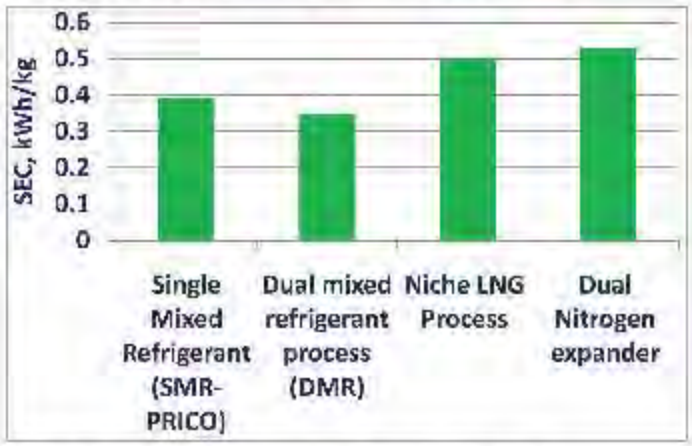


Fig. 4: Various production processes along with their SEC

Gas composition	Formula	Gas Composition (Mole %)	Molecular wt	Weight, gm	weight %
Carbon dioxide (CO_2)	CO_2	0.21688	44.0	0.095427	0.57
Nitrogen (N_2)	N_2	0.23101	28.0	0.064683	0.39
Methane (C_1)	CH_4	96.41632	16.0	15.426611	92.11
Ethane (C_2)	C_2H_6	2.07352	30.0	0.622056	3.71
Propane (C_3)	C_3H_8	0.67383	44.0	0.296485	1.77
I - Butane (IC_4)	C_4H_{10}	0.12204	58.0	0.070783	0.42
N - Butane (NC_4)	C_4H_{10}	0.17506	58.0	0.101535	0.61
I - Pentane (IC_5)	C_5H_{12}	0.02908	72.0	0.020938	0.13
N - Pentane (NC_5)	C_5H_{12}	0.02470	72.0	0.017784	0.11
Hexane (C_6+)	C_6H_{14}	0.03764	86.0	0.032370	0.19
Total		**100.00**	**508.00**	**16.749**	**100.00**

Table 1: Typical composition of gas

- Pre-cooling
- Liquefaction.

Figure 2 gives the various production processes for conversion of PNG into LNG.

Gas Composition & Energy Efficiency

Typically PNG consists of over 80% methane (C1) and small percentages of C2 (Ethane), C3 (Propane), nC4 (nButane), iC4 (iButane), nC5 (nPentane), iC5 (iPentane) along with contaminants like CO_2, nitrogen and moisture. Table 1 gives typical composition of gas. Natural gas which mainly contains primarily (C1) is liquefied by lowering the temperature of the hydrocarbon to approximately -160°C (range: -120 to -170°C). The higher heating value of LNG increases with increased C1 content. Figure 3 gives the HHV of gas as a percentage of methane (C1) content.

The energy efficiency is represented as either energy efficiency (as the compliment of the energy consumed for the liquefaction process to the total heating value in the gas expressed as %) or as Specific Energy Consumption (SEC) which is the energy consumption in kWh per kg of LNG produced. Figure 4 gives the SEC of various production processes for conversion of natural gas at STP into LNG. The conversion between Energy efficiency (%) and SEC is given by -

Energy efficiency (%) = (100- (6.7 xSEC))

The process Coefficient of performance (COP) is given by -

COP= (0.1672/SEC).

Indian Facilities

With India going in for a large number of LNG terminals on the costal belts as well as in offshore locations, efficient cooling technology for production and maintenance of LNG are required. Figure 5 gives the capital cost break up for the LNG transfer. It is seen that the capital cost for liquefaction is 28% and the refrigeration capital cost is 14% which together accounts for 42% of the total capital cost.

Figure 6 & 7 gives the break even cost for transportation through the LNG route. Since conversion to LNG requires high capital investment, the present break even distance for offshore transfer is 400 km and for onshore it is 1300 km.

Some of the planned gas pipelines are as follows:

- Dahej–Uran Pipeline (DUPL)
- Vijaipur–Kota Pipeline (VKPL)
- Jagoti–Pitampur Pipeline (JPPL)
- Dabhol–Panvel Pipeline (DPPL)
- Jagdispur–Haldia Pipeline (JHPL)
- Dadri–Nangal Pipeline (DNPL),
- Kochi–Coimbatore–Bangalore Pipeline
- Mangalore–Bangalore–Chennai Pipeline
- Kakinada–Uran–Ahmedabad Pipeline
- Hyderabad–Goa Pipeline
- Kakinada–Bhopal–Jamnagar Pipeline
- Kakinada–Cuttack–Haldia Pipeline
- Vijaywada–Chennai Pipeline.

Some of the planned gas storage facilities are as follows:

- Vishakapatnam
- Mangalore
- Padu near Mangalore.

Some of the planned re-gasification facilities are as follows:

- Dahej
- Dabhol
- Kochi
- Mangalore.

Fig. 5: Capital cost break up for the LNG route

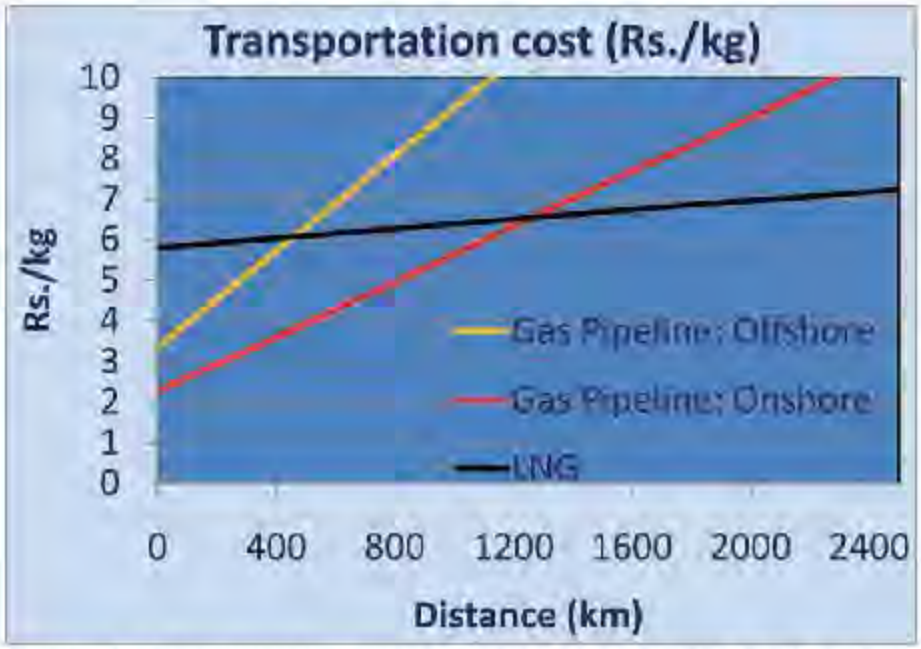


Fig. 6 & 7: Break even transportation costs (Rs./kg) for various modes of transfer of natural gas

Consumption & Demand of Natural Gas in India

Figure 8 gives the gas demand in India and Figure 9 gives the total consumption. The consumption is divided into power generation applications & process applications. Figure 10 gives the gas consumption for power generation purposes. Figure 11 gives the gap between demand and generation. Figure 12 gives the distribution of gas consumption for power processes and Figure 13 gives the distribution of gas consumption for Energy purposes and Figure 14 gives the distribution of gas consumption for Non-Energy purposes.

Future Options

Going by the present priceper unit thermal energy generated (Rs./Gcal) (Jan 2014) gas is in-between coal & fuel oil as seen in Figure 15.

While fuel oil is never used in the utility power generating sector except for combustion support and stabilization, coal is the bulk fuel. The gas cost is in-between the coal and oil cost.

The immediate future options are:

Enhancing the accessibility of natural gas to different power plant locations through establishment of transportation infrastructure.

Facilities required for gas grid are:

- Gas handling
- Processing
- Extraction of value added products
- Transportation pipeline
- Distribution pipeline

Cooling India

Monthly

The Subscription In-charge
Cooling India
Chary Publications Pvt. Ltd.
201, Premalaya, Next to Café Coffee Day, Opp. Telecom Factory, Deonar, Mumbai - 400 088.
Email: sub@charypublications.in

If You are already a Subscriber
Enter the Subscription No. CI/SUB/

Yes, I would like to subscribe **Cooling India** for.....years at Rs..... (US $.....overseas subscribers)

Payment details :
Cheque / DD No.....Dated.....
Drawn on Bank.....Branch.....
In favour of **CHARY PUBLICATIONS PVT. LTD.**

Or charge my ☐ MasterCard ☐ VISA ☐ IndiaCard ☐ TajCard For Rs.....

CARD No. ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

CARD EXPIRY DATE: ☐☐ ☐☐☐☐ (M M Y Y Y Y)

Date of Birth ☐☐ ☐☐ ☐☐☐☐ (D D M M Y Y Y Y)

Name.....
Designation.....
Company.....
Department.....
Type of Business.....
Address.....
.....
City.....PIN ☐☐☐☐☐☐
Tel.....
Email.....

Signature.....

No. of Years	Amount	US $	Tick✓
☐ 1 (12 issues)	800	160	
☐ 2 (24 issues)	1500	275	
☐ 3 (36 issues)	2100	500	
☐ 5 (60 issues)	3500	700	

(Kindly add Rs. 50/- for Non-Mumbai Cheques)

EI \ July 2014

Medical Equipment & Automation

India's Premium magazine on diagnostic, medical equipment and technology

Bi Monthly

The Subscription In-charge
Medical Equipment & Automation
Chary Publications Pvt. Ltd.
201, Premalaya, Next to Café Coffee Day, Opp. Telecom Factory, Deonar, Mumbai - 400 088.
Email: sub@charypublications.in

If You are already a Subscriber
Enter the Subscription No. MEA/SUB/

Yes, I would like to subscribe **Medical Equipment & Automation** for.....years at Rs.....
(US $.....overseas subscribers)

Payment details :
Cheque / DD No.....Dated.....
Drawn on Bank.....Branch.....
In favour of **CHARY PUBLICATIONS PVT. LTD.**

Or charge my ☐ MasterCard ☐ VISA ☐ IndiaCard ☐ TajCard For Rs.....

CARD No. ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

CARD EXPIRY DATE: ☐☐ ☐☐☐☐ (M M Y Y Y Y)

Date of Birth ☐☐ ☐☐ ☐☐☐☐ (D D M M Y Y Y Y)

Name.....
Designation.....
Company.....
Department.....
Address.....
.....
City.....PIN ☐☐☐☐☐☐
Tel.....
Email.....

Signature.....

No. of Years	Amount	US $	Tick✓
☐ 1 (6 issues)	750	150	
☐ 3 (18 issues)	2000	500	
☐ 5 (30 issues)	3000	700	

(Kindly add Rs. 50/- for Non-Mumbai Cheques)

EI \ July 2014

Fig. 8: Gas demand in India

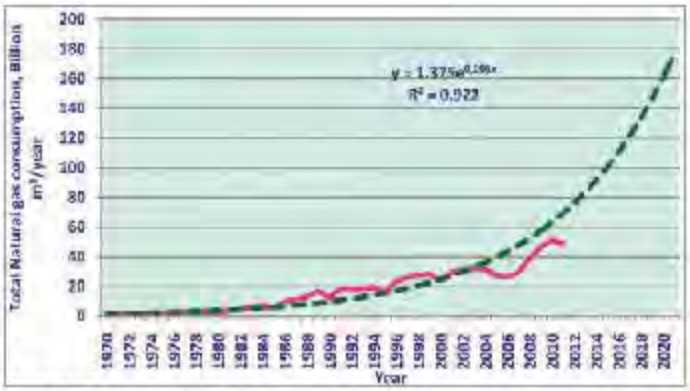


Fig. 9: Total consumption of gas in India

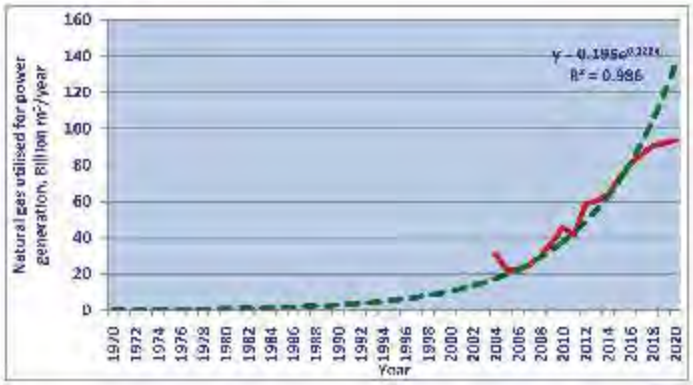


Fig. 10: Gas consumption for power generation purposes in India

Fig. 11: Gap between the demand and generation (import of gas) in India

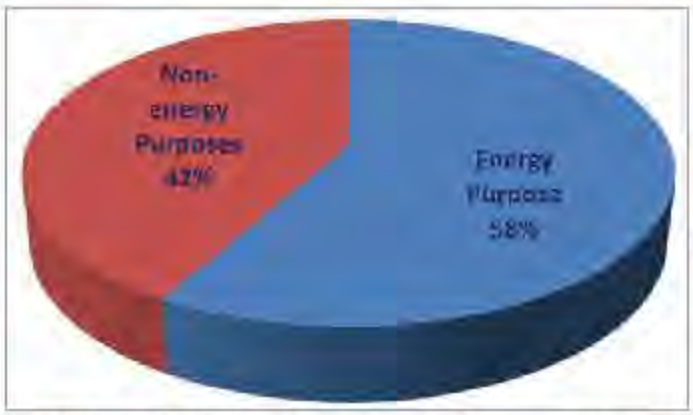


Fig. 12: Overall distribution of gas consumption for power and non-power processes

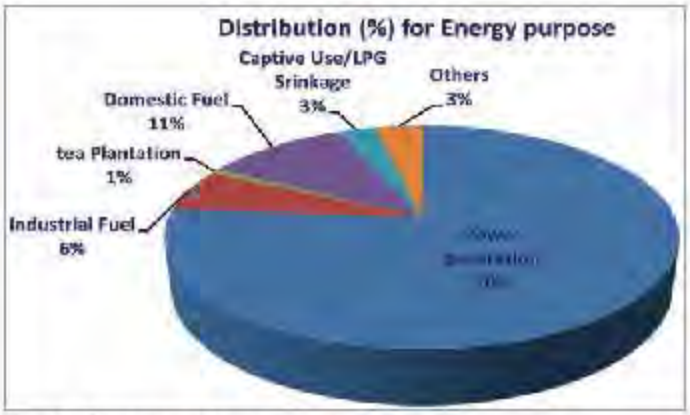


Fig. 13: Distribution of gas consumption for Energy purpose

- Utilization system.

Conversion of conventional coal burning boilers for accommodation of gas burning.

Even though conversion of coal fired boilers to accommodate is a well known and proven technology there could arise problems in large scale conversion of coal plants. Since, gas-air mixing is non-optimal during the combustion process probably because of the temperature of the injected gas which is cooled because of Joule-Thomson throttling. Propagation of the combustion/oxidation zone upwards is noticed with the result of offset of heat pick up in the radiant and convective zones. The heat pick up in the convective zones above goose neck and in the second pass are higher than design while the heat pick up in the furnace radiant zone is deficient. This could also because of the lower emissivity of the gas flames as compared to oil flames since the radiant heat transfer is through the Stefan-Boltzmann mechanism as compared to convection which is velocity dependent. Considering these facts, it is recommended to re-design burner configuration with pre-heating of fuel gas. Tilting of the burner downwards can give temporary relief but the re-design of the gas burner injection configuration and temperature are essential for the containment of the flame in the radiation zone below the

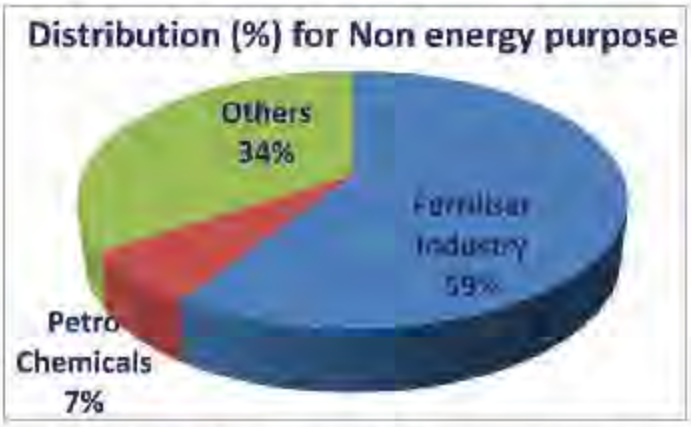


Fig. 14: Distribution of gas consumption for Non-energy purpose

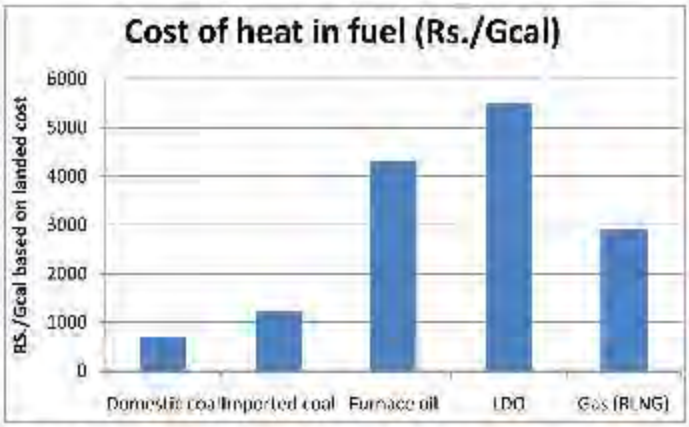


Fig. 15: Comparison of Rs./Gcal for coal, oil and gas

Considering all the above the natural gas trends are likely to be as follows				
Sl. No.	Particulars	2014	2016	2020
01	Total gas consumption (million tonnes/year)	43.8	93.2	106.4
02	Total gas demand (million tonnes/year)	73.0	119.0	130.0
03	Demand –supply gap (%)	40.0	21.7	17.9
04	Gas consumption for power generation (% of total consumption)	35.6	42.0	44.5
05	Total indigenous gas production (% of total consumption)	69	48	55
06	Total import of gas (% of total consumption)	31	52	45
07	Share of natural gas based power in overall power generation capacity (% of total national installed capacity)	11	16	20
08	Demand in the Southern region (% of the total demand)	14.0	21.0	32.0
09	Pipeline infrastructure (km)	12,500	28,072	31,432
10	Pipeline infrastructure (million tonnes/year)	78.2	184.6	200.0

Typical comparison of coal, gas and supporting fuel oil is as follows					
Sl. No.	Fuel type		Coal	Oil	Gas*
01	Unit capacity	MW	500	500	500
02	Steam to fuel ratio	t/t	6.9	14.6	15.6
03	SSC	t/MWh	3.216	3.216	3.076
04	DHR	Kcal/kWh	2370.571	2334.741	2437.689

goose neck and restoration of the proportioning of the heat pick up. This implies re-engineering of coal fired boiler main pass burner zones for accommodating gas burners.

Medium term alternatives to conventional natural gas

Alternatives to natural gas (in the medium term) for minimization of import of gas are:

- Coal bed methanization
- Underground coal gasification
- Gas hydrates
- Coal liquefaction
- Bio-gasification in rural areas.

Concentrated efforts are required to realize these options which are available on commercialization scales today.

Concluding Remarks

- The cost of imported LNG is around Rs 58/ kg as compared to local rates of Rs 25-38/ kg. Even though imported LNG costs are likely to increase, import is likely to increase steadily. The import of gas is likely go up to 52% of the total consumption.
- The natural gas consumption is likely to more than double by 2016 in comparison to 2014 partly because of its superiority and partly because of the deterioration in coal quality as well as its inelasticity to demand.
- The present cost of gas per unit heat generated (Rs/Gcal) for power generation purpose is Rs 2900/Gcal as compared to imported coal of Rs 1235/Gcal & Rs 5514/ Gcal of LDO.
- New options like rural bio-methanization and coal bed methanization need to be explored with concentrated efforts.

Profile

M Siddhartha Bhatt

is Additional Director and Divisional Head of Energy Efficiency & Renewable Energy Division of CPRI, Bangalore. He has published over 45 international papers in the area of energy efficiency and one book. He has developed several energy products and holds 5 patents and received many awards such as Award for Science and Technology, CBIP Best paper Award etc.

Cleantech India

Event to make way for Deployment of Renewable Energy Solutions

cleantech INDIA

September 10-12, 2014, Pragati Maidan, New Delhi.

messe frankfurt

Messe Frankfurt India, the organiser of the highly successful editions of Watertech India, have now expanded their portfolio of events addressing key environmental issues with the announcement of the launch of Cleantech India 2014.

There has been exponential growth in the renewable technology market, and the organiser feel it is the perfect time to raise the subject of depleting natural resources and bring technological advancements and clean business practices to the forefront of the Indian market. The launch of Cleantech India will be an ideal platform for a clean energy revolution. The show aims to boost the development & deployment of energy renewable technologies among Indian Industries.

Messe Frankfurt has a successful history of hosting global trade fairs such as Water Expo China, Canadian Waste & Recycling Expo, Eco Expo Asia and Building Solar China. The introduction of Cleantech India 2014 will further cement its position as the leading exhibition organiser for 'Green Industry' professionals. Cleantech India 2014 will be held from 10-12 September 2014 at Pragati Maidan, New Delhi.

India needs green solutions and energy renewable technologies to break the dependence on natural resources. Cleantech India's focus on alternative energy resources through solar power, hydro power and wind power, will provide technologies and solutions that can maximise use of resources and minimise environmental impact. Raj Manek, Managing Director, Messe Frankfurt Trade Fairs India stated: "Renewable energy technologies although available need to be accepted and intensely deployed across industries. Through Cleantech India 2014, we intend to provide the renewable energy sector players a platform to showcase their technologies while allowing the Indian market to access green solutions designed to optimise productivity and achieve sustainable development."

On extending support to the show, Dr. R. Harikumar, General Secretary, Society of Energy Engineers and Managers commented: "India must improve energy efficiency and promote renewable sources if it is to meet its growing energy demand over the next 10 – 15 years. An event like Cleantech will help bring energy efficient technologies to the forefront. I congratulate Messe Frankfurt for the launch of Cleantech India and hope it will act as a platform for the advancement of India's renewable energy sector."

Currently estimated at ₹ 102,000 crore (USD 17 billion), India's renewable energy market is growing at an annual average of 15%, indicating enormous opportunities and the untapped potential of the sector. Clean energy technologies that improve operational performance and optimise efficiency while reducing costs, energy consumption, waste, or environmental pollution is the need of the hour, and engineers, manufacturers and authorities are aware of the competitive edge it can provide to their businesses and more importantly to the economy. With the UN declaring 2014 to 2024 as the decade for 'Sustainable Energy for All', it is time for India to prove its leadership by making way for renewable energy resources.

Cleantech India will be held concurrently with three other shows including Wastetech India, Pollutech India and the highly anticipated 3rd edition of Watertech India 2014. Together these four shows will cover the complete chain of green technologies for Water, Waste, Pollution and Energy Management.

Messe Frankfurt is one of the world's leading trade show organisers with 543 million euros in sales and 2,026 employees worldwide. The Messe Frankfurt Group has a global network of 28 subsidiaries and approx. 50 international Sales Partners, giving it a presence for its customers in more than 150 countries. Messe Frankfurt's exhibition grounds, featuring 578,000 square metres, are currently home to ten exhibition halls and an adjacent Congress Center. The company is publicly owned, with the City of Frankfurt holding 60% and the State of Hesse 40%.

Mini Grids: a viable source of power for Energy Access

New Delhi based think-tank Centre for Science and Environment (CSE) discussed the role - mini grids have to play to eradicate energy poverty in the country, and proposed a model to ensure at least 12 hours of electricity to every household per day at a workshop on "Sustainable Mini-Grid for Energy Access" in Pune.

Energy access in rural India has been a development priority for the government for many decades. Presently, 45 percent of rural households still lack access to electricity, though its generation has grown at 7 per cent between 2002 and 2013. There are still around 77.5 million households in India who are dependent on kerosene for lighting. Out of these 93.6 per cent belong to rural India.

CSE organised a one-day workshop in Pune to deliberate on how to proliferate sustainable mini-grids for energy access. The deliberations included CSE recommendations on policy reforms and a mini-grid business model on which several stakeholders offered their views for future course of actions.

CSE emphasised on the need to scale up mini- grids development in the country. CSE demanded clarity in mini-grid definition and accordingly defined it in order to develop policies and regulations accordingly and build a sustainable model.

Coal based thermal power plants account for more than 60 per cent of the electricity produced in India. Though generation capacity is growing in the country at 7 per cent (mostly coal based), consumption is growing even faster due to rapid infrastructure growth in urban and semi-urban areas. Therefore, grid powers from lager scale coal based power plants (for that matter, other renewable energy based large scale power plants too) are unlikely to reach the rural India to provide energy on demand.

On the other hand, renewable energy based mini-grids can be a possible solution to meet the electricity demand of vast rural population of India which addresses the climate change issues also adequately. Various renewable based mini-grid models have emerged in India. They have been able to set examples of how mini-grids can bring an end to energy poverty in India.

But mini-grids developed so far in the country are facing several challenges due to high capital and operating costs, high tariff and inconsistent revenue collection, low demand in the villages, and bureaucratic delays etc.

Tariff mechanisms for mini-grids

"In order to make energy access through mini-grid a reality, we need a simple but robust model to provide reliable electricity for most of the time to villagers." said Nayanjyoti Goswami, Programme Director – Renewable Energy at CSE. Besides the policy changes suggested by CSE, it also proposed a business model to make the operation of mini grids sustainable.

CSE divided the energy poor into two categories:

- Grid connected rural areas (not receiving at least twelve hours of electricity in a day) and;
- Remote villages and hamlets not connected to the grids.

In the grid connected villages, the mini-grid has to co-exist with the main, so that villagers receive reliable power on demand. Mini-grids in such situations must act like a franchise to the DISCOM, or the electricity distributor. Using reverse bidding, renewable energy based mini-grids would be set up for a cluster of villages to ensure minimum supply of twelve hours of electricity. The developers will receive feed-in tariff (FIT) and the villagers will pay a minimal rate for the power they use. The choice of technology can be left to the developer. The idea is to develop a mini-grid of mega-watt scale that can be a tail end generator. It can export the surplus power back to the national grid.

Remote villages will not come under the purview of DISCOMs under normal circumstances. Generation based incentives (GBIs) on the basis of the number of units generated or capital subsidy has been suggested by CSE.

Guwahati Summit: GO North-East 2014

R L Barua, MD APDCL is addressing in the summit

Golap Kr. Das, MD AEGCL addressing the gathering

K N War, Director MePDCL addressing in summit

A summit with the theme GO NORTH-EAST 2014 was organised at Landmark Hotel, Guwahati on 6th June 2014. . Principal sponsor of the summit was Supreme & Co Pvt Ltd, Kolkata.

Golap Kr. Das, MD of AEGCL, Rathindra Lal Barua, MD, APDCL and K N War, Director of MePDCL highlighted about the opportunities in North-eastern states and welcome the idea of organising the summit. K. Haridoss of North Eastern Council informed that P K H Singh, Advisor, NEC is supposed to present in the summit but due to some emergency meeting at Delhi he could not attend the summit. Harish Agarwal, Chairman, organising Committee briefed about the reason for holding such summit.

A brochure GO NORTH EAST was released in the summit. Technical presentations on Compact Transmission Line, Emergency Restoration of Transmission Line by Harish Agarwal of Supreme & Co and Smart Grid by Gautam Agarwal of Supreme Gridtech are highly appreciated by the audience. Ajay Mahajan of IEEMA informed about iNTELECT 2015 at Mumbai, Ganesh Parker of Fairact informed about Power Elec-East Expo at Kolkata during February 2015, Yokogawa India Ltd on Process Automation and Anit Ghosh of Supreme & Co presented on Geo Energy.

Northeast of India is endowed with huge untapped natural resources and is rich biodiversity. It is acknowledged as the eastern gateway of India's Look-East Policy. It shares the international boundaries of India with China, Bangladesh, Bhutan, Nepal and Myanmar. Generously endowed with vast stretches of fertile land, rich expanse of forests and substantive mineral and hydrocarbon deposits, India's northeast is potentially one of the richest geographical units of the country. The present economic policy framework for the Northeast region is based on its political economy and a cultural approach, adjusted with a regional planning model. It is implemented mainly through the Planning Commission and the Northeast Council. Despite huge financial investments, this has failed to produce desired results. With Myanmar becoming a member of the Association of South East Asian Nations (ASEAN), a common market of 500 million consumers is at the doorstep of the Northeast.

The Summit has provided platform to different industries and utilities in Eastern and North Eastern States to exchange views and bring focus and attention to the potential of the Eastern and North Region in Power & other Sector. This summit had also bring together Industry stalwarts and key decision makers from various Government departments, Utilities and users from across the Eastern and North Eastern States.

Mexican Power Customer chooses MAN B&W again

Comisión Federal de Electricidad (CFE) – the Mexican state-owned electric utility – has awarded Spanish contractor, Acciona the turnkey contract for the extension of a diesel power plant at La Paz, Baja California Sur. The contract covers the installation of an MAN B&W 12K80MC-S9 engine at the plant. The order is significant for being the fifth two-stroke MAN B&W unit to be installed at the plant. CFE's La Paz plant already has a single 10K90MC-S and 3 12K80MC-S engines, offering a total current output of 172.5 MW. At 47.88 MW, the newer 12K80MC-S9 version's output will be 5 MW higher than its 12K80MC-S predecessor, while also possessing a lower heat rate.

MAN Diesel & Turbo's Korean licensee, Doosan Engine, will construct the new engine. The La Paz power plant will feature both a bottoming cycle steam turbine for utilisation of waste heat for power generation – as with the previous installations – and

high-pressure SCR (Selective Catalytic Reduction) for emission control in order to meet local legislation on-site. The four existing engines already operate on the same fuel and fulfil all local environmental regulations, as will the new addition.

Shivalic Power Control Pvt Ltd

Shivalic Power Control Pvt Ltd is one of the leading manufacturers of custom-built Electrical Panels and also executes Turnkey Projects. "Shivalic" works with an aim to provide human safety, product quality with technical competency and timely solutions to its customers, thus it enjoys an enviable market share in India and Abroad.

Shivalic was incorporated in the year 2004 by Amit Jindal (BTech - Electrical, Electronics & Power), the customer-oriented company is being managed by professionals with years of experience in the same industry & also one of the Director Naveen Khare (BTech - Electrical, Electronics & Power), having years of experience in companies like SIEMENS and L&T.

As we understand that Power System and its Distribution is a valuable asset for an Industry therefore, we provide various authentic solutions by adapting quality standards from ISO 9001:2008 and conducting various routine tests at CPRI for 100KA Short Circuit, 6000 AMP Temperature Rise.

Customized Solutions for Switchboards

- PCC & Main LT Panels
- PMCC & MCC Panels
- iMCC (INTELLIGENT MCC Panel)
- Main LT Double Busbar Panels
- PLC cum DG Synchronizing Panels
- Junction Boxes & Meter Boards
- VFD (Drive) Panel & Control Desks
- SDB, LDB & Feeder Pillars
- Capacitor with Reactor (APFC) Panel
- LPBS, ACDB & DCDB
- Drawout PCCs and MCCs
- HT Panels & HT Bus Duct up to 22KV
- Changeover Panels
- Bus Ducts & Cu/AL Flexibles.

Customized Solutions for Turn-Key Contract

- HVAC, FDV
- Air Conditioning Ducting with VRV
- Lighting Fixtures & Solar lights
- Bus Trunking
- Lightning Arresters
- Raceways & Cable Trays
- LT/HT Panels
- Industrial Air Piping
- Advanced Fire Protection System

Infrastructural abilities

Shivalic possesses a complete infrastructure meeting all its requirements to international standards. The company has a workspace of 26000 sq ft with latest working stations and all amenities for its back office staff.

Design & Engineering

We have a licensed AutoCAD Electrical - 2009 software to design any type of electrical custom-built solutions as required by our valued customers and to assist our team for designing of panels. We have adopted latest printer upto A0 size to give up clear appearance and proper layout to our customers.

Our designing team of Engineering Professionals are well experienced and qualified to take on assignments of any magnitude.

Machinery & Power Backup

We have state-of-the-art infrastructure which is well-equipped with sophisticated technology and modern machines to manufacture & supply innovative products in the market. We possess latest machines like TRUMPF (Germany), AMADA (JAPAN), LVD (Belgium), NAMSUNG (Korea), UNIPUNCH (Chennai), Cummins D.G. Sets and other Bending & Punching Machines etc., to manufacture our range of high power control systems. We also have a substantial Research and Development Department to make more convenient and user friendly products.

In view of shortage of power and heavy cut, we have 100% power back up with 3 nos. of full capacity D.G. Sets to get continuous power supply to comply with our commitment for timely job execution to our customers.

Manufacturing Facilities

- Sheet Metal
- Painting Pre-Tank Process
- Assembly
- Wiring
- Testing & Inspection

Range of Products include-

- Power Control Centers
- Main LT Panels
- Motor Control Centers
- Power cum Motor Control Centers
- APFC Panels
- Bus Trunking & Rising Mains
- Distribution Board Panels
- Main LT Double Busbar Panels
- DG Synchronizing Panels (PLC Based)
- Control & Relay Mimic Panels
- Control Desk Panels
- Changeover Panels
- HVAC Panels
- AC / DC Drive Panels
- Soft Starter & VFD Panels

They cater for Industries & Commercial Buildings.

Quality Policy & Objective

The vision of the company is to constantly provide customers with quality products by adapting latest technologies. Encouraging innovations and product diversifications to offer customers the best, safe, reliable and cost effective solutions, without compromising on quality and lack in commitments.

The objective of the company is to provide total customer satisfaction through teamwork, based on honesty and integrity, for delivering cost-effective quality products by acquiring skills and competency for continuous growth and development. To motivate all employees and build mutual co-operation and trust with appropriate participation of all concerned to meet the requirements of QMS.

It has always been an endeavour of Shivalic Power Control Pvt. Ltd. to continually improve and their switchboards have been successfully tested at Central Power Research Institute Bhopal for "Verification of Short Circuit Strength".

The company has in-house Quality Control & Design Department with qualified and experienced team of engineers along with CAD and Design facilities.

- In house facility for fabrication to ensure Monitoring of high quality
- Unique colour for DG and transformer, ensuring ease of identification and operation
- Adequate space for cabling in each vertical section
- Legends / Labels are engraved on black Anodized AL
- Bus Bars are insulated with Shrinkable PVC Sleeves, rested on SMC / DMC supports and all the live parts are shrouded to avoid accidental contact
- All covers and doors are very well gasketed so as to obtain dust proof enclosure

All the panels are totally enclosed, dust and vermin proof, fully compartmentalized, cubical design and modular construction which has a facility to extend for future expansion on either side. Our products are type tested for Degree of Protection IP Test. Our Bus Duct is manufactured with 2 mm thick CRCA Sheet Steel with louvered covers on both side of Bus Duct. This aids in proper heat dispensation and has top and bottom covers for visual inspection and maintenance.

For further details contact:
www.shivalic.com

Shan Solar Pvt Ltd

SHAN Solar
Power for Sure. SURE.

Shan Solar is based in headquartered in Bengaluru, India. The company is fully equipped with stat- of – the art fully automated manufacturing plant at SriCity SEZ, Chitoor District, Andhra Pradesh (near Chennai). The company is ISO 50001 standards and its silicon crystalline modules are tested and comply with the IEC 61215, IEC 61730, IEC61701; SEVERITY 1 and standards by VDE, Germany.

The company has alliances with independent solar consultants from Germany and Spain. SHAN Solar's business is structured to ensure customer gets end–to–end solution through the following strategic business unit: module division manufacturers 30 MW of high efficiency Mono Crystalline & Poly Crystalline Solar photovoltaic modules. Solar farm business unit specializes in setting up solar energy parks exclusively for clients and also on a consortium basis. This division also offers EPC and turnkey solutions.

Systems division focuses on offering innovative on-grid and off-grid power packs that runs on solar energy for industrial, commercial and residential applications.

For further details contact:
www.shansolar.com

Decade of Sustainable Energy for All: 'The future starts now'

During June, Secretary-General Ban Ki-moon hailed modern energy services as the source of profound and life-changing opportunities – for the poorest communities and the richest investors – and urged generating the innovative ideas and vital partnerships to wholly transform the global energy landscape.

"We are here because we understand civil society and business to make sustainable energy for all a reality by 2030. The Forum, which sets the stage for the

launch of the UN Decade (2014-2024), was also addressed by World Bank President Jim Yong Kim (by video) and John Ashe, President of the UN General Assembly, which designated the Decade as a vehicle to increase advocacy and action. "The Sustainable Energy for All initiative is maturing and bearing fruit –thanks to you," Ban told the Forum, noting that commitments worth many billions of dollars have been pledged and delivered.

More than 80 developing countries have joined the initiative. From India to Brazil a growing number of people have light and power where there was none before.

Pre-budget announcements on Union Budget

Union Budget is being announced on July 10, 2014. While Modi government is determined to bring all around policy shifts and focus on infrastructure and power sector, the corporate is keenly watching the development. We produce herewith the select quotes as pre-budget announcements.

Shekhar Sanyal
Director & Country Head
The IET

"The new government is showing concerns and devising action-oriented approaches to educate and skill our young people. We expect the budget to provide much needed boost to the education sector. With the HRD minister's nod for spending 6 per cent of GDP on education, the sector will experience result-driven initiatives. The immediate focus of the budget should be to deal with three challenges - faculty crunch, quality regulation and unemployability.

The budget should emphasize on:

- Enhanced focus on research and emphasis on teachers and teaching
- Government's major schemes like RUSA, RMSA and SSA should be strengthened and streamlined to be outcome based.
- Skill development to be given high priority
- Bringing together the public agencies (NSDC, HEC, UGC, AICTE) to work closely to tackle the issue of unemployability
- Incorporating professionalism and ethics in the course curriculum."

Ved Prakash Mahendru
Chairman & MD
Eon Electric Limited

"This particular budget is coming up at a very opportune time. Industry in general and Electrical / Electronic Industry in particular is confident, committed and upbeat now to expand their capacities substantially with more creative and energy efficient products not only for Indian market but also for the fast growing markets around India including Middle East and Africa.

- Extend the period of tax benefits for another 10 years for the special industrial zones created in Himachal Pradesh and Uttarakhand to ensure that the heavy investments already made and the experience gained which were lost in setting up the plants and in policy paralysis for effective implementation of the industrial growth can now be put to use. The Industry now wants to further modernize and expand these units. Help this fast growing industry with duty free import of critical raw materials unavailable in India.
- Organize a dry-port around Chandigarh to facilitate fast track growth of exports and ease import of critical components expeditiously to ensure growth from Northern India including Punjab, Haryana, Himachal Pradesh, Uttarakhand, Western UP etc.
- Encourage setting up cluster of similar Industries for 100% utilization of high quality common facilities such as import of raw materials, testing of products and convenient distribution of products all over the country and abroad thus creating millions of new job opportunities.
- Enforce companies to procure on priority power from Solar and Wind Energy sources and encourage use of LED Lights for home, domestic, industrial and commercial uses apart from Street Lights which account for 20% of the power generated by our Nation.
- Impose Anti Dumping Duty particularly on import of low tech fast growing demand products such as LED Indoor and Outdoor Lights including Bulbs, Tubes, Flood Lights and Street Lights etc. The technical Universities such as IIT Delhi, Roorkee, Pant etc. should be encouraged to take up research in LED Lights which have 60 - 80% higher efficiency than traditional lights. This will also provide LED Lighting Engineers to the fast growing LED Lighting Industry. These R&D Trained Engineers / skilled / semi-skilled workers will have great job opportunities in such Industries."

inter solar

connecting solar business | INDIA

NOV 18–20 2014

www.intersolar.in

India's Largest Exhibition and Conference for the Solar Industry
Bombay Exhibition Centre, Halls 5 and 6 Mumbai

Intersolar India is your gateway to one of the most promising solar markets in the world.

- Network with over 8,500 potential business contacts from the Indian solar industry
- Stay up to date with the latest trends and technological developments
- Boost your brand visibility with an established B2B event

ME PLC component housing by Phoenix Contact

The ME-PLC component housing permits application-specific device design for modular control systems. With the dimensions as 40mm X 180mm X 145mm, this housing offers plenty of space for ones complex electronics with an innovative high position bus connector as an option for customer specific bus PCBs. The housing base can be combined with various covers or the upper parts consist of connection technology carriers comprise of pre-mounted plug-in connectors FKCN 2,5 series which allows conductor cross sections up to 2.5 mm insert from front side with reliable and fast push-in spring-cage connection technology.

In addition, a connection technology carrier with RJ45-plugin connectors and a universal cover are available. The universal cover is especially suited for installing connection systems or display and operating elements. Due to the lever technology which enables customer to conveniently connect and disconnect the upper part.

There is also a generous display area is available which facilitates customer to provide an individual marking and processing. These innovative features make ME-PLC the ideal housing for complex controllers to cope up with future challenges as well.

The housings can be snapped onto an NS 105/20 DIN rail. They can be combined with a DIN rail connector to allow cross connection from device to device for reliable data and current transmission without the need for additional wiring. The bus connectors supplied un-mounted and can be equipped with customer specific PCBs as needed.

Bus connectors are available with the number of positions 50/40 and 10/10, i.e. 50-pos. in the DIN rail / 40-pos. into the device or otherwise 10-pos. in the DIN rail / 10-pos. into the device. Customer has the option to code the bus connector and the housing. This is required to prevent a housing being accidentally plugged onto the wrong bus connector.

Also in case customer wishes not to use a bus connector, customer can also fasten the housing onto two NS 35 DIN rails.

Advantages to use ME-PLC 40

- Flexibility in selection of connection technology
- Time-saving and convenient wiring, due to front-mounted connections
- Easy creation of modular device systems, due to the DIN rail connector
- Plenty of space for your electronics on the PCB
- High availability, due to particularly secure purchase on the DIN rail.

For further details contact:
adverts@phoenixcontact.co.in

Automatic Voltage Controller by Jindal

Automatic Voltage Controller by Jindal Electric and Machinery Corporation is an industrial robot which monitors the voltage variation around the clock and stabilizes the required Voltage in few seconds and will have following advantages:

- Reduction in Breakdown of Electrical equipment upto 80%.
- Reduction in Electricity Bill up to 15% on lighting load and up to 5% on Industrial load.
- Reduction in MDI up to 15%.

The capital & interest cost of AVC is just 1.5% per month and installation of AVC will save 4-8 times of capital & interest cost per month of AVC due to reduction in breakdown of electrical equipment and energy saving. They have tested the affect of voltage variation in fluorescent tube lights and found that with 10% increase in voltage power consumption increases by 20% and failure rate of electrical equipment increases by 40%. In case one has high breakdown in ones firm then they should check the voltage at their end.

For further details contact:
jemc@jindalelectric.com

Retrofit Integrated Optic by Venture

Super Pulse Start Ceramic (SPC) Metal Halide System

Venture RIO kits are Green Technology products upgrading outdoor lighting utilizing existing HPSV fixture. RIO kits are the most cost effective solution to upgrade road way lighting system. It save energy upto 50%; proven Ceramic Metal Halide technology; it is available in 45W/60W/90W/140W/210W.

RiO

Highest efficiency AUER Glass StreetLight optic featuring unique multi-faceted; design to deliver unrivalled performance and uniformity.

Venture RiO Ballast

Highly efficient electronic control gear with> 0.95 power factor, also available in Electro Magnetic Copper wound ballast option.

Easy to install

RiO kits install in minutes yet the savings will last a lifetime.Simply remove existing lamp and ballast. Install new Ventronic Screw in RiO. Adjust position of RiO for precise alignment.

For further details contact:
ldd@adit.com

ElMeasure brings 3 in 1 Prepaid Meter (Dual Source)

ElMeasure has developed a unique 3 in 1 Contactless Prepaid Energy Meter were in process parameters such as water, gas etc, can be integrated and its consumption can be monitored along with electrical parameters. Recovering electricity dues remain one of the major challenges in the power sector. Most distribution companies face serious problems in recovering electricity bills. Its 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. 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 & measures the energy consumption. When the purchased units are used up by the consumer the meter disconnects the power supply until the next recharge.

Features

Compact wall mounting design. 3 in 1 meter with option to integrate process parameters. Pre-paid metering system using contactless smart cards. Cost effective 'Pay as you use' three phase electricity metering.

Advantages

- Upfront payment for electricity and hence low over heads for service providers.
- Advanced RF card technology.
- 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 the system 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.
- Available in single phase and three phase system.

Application

It is applicable for shopping malls / multiplexes, residential townships / apartments, commercial buildings, employee quarters.

For further details contact:
marketing@elmeasure.com

Kusam-Meco brings 1000A AC True RMS Clamp Meter

Model KM-086 is a new AC True RMS Clamp Meter introduced by "KUSAM-MECO", an ISO 9001-2008 certified company. It has Three Phase Rotation indications, backlight function, MAX/MIN/AVG Recording mode (Auto ranging). It has a unique AmpTip™ function, not available in any other instrument in the market. This feature allows users to keep the current carrying conductor at the top end of the clampmeter & get accurate measurements whereas in other meters, the current carrying conductor has to be at the centre of the clamp which does not give the best accuracy. The conductor size is upto 51mm dia. KM 086 also has VFD-V & Hz function specially designed for Variable Frequency Drives. It can measure TRMS 1000A AC Current upto 400Hz frequency, TRMS AC voltage 1000V upto 400Hz frequency, DC 1000 Volts, Capacitance upto 2500 µF, Frequency, Continuity, Temperature upto 400°C / 752°F. It can measure DCµA current & has a special feature of Non-contact EF detection. It has Crest peak-RMS hold & data hold facility. It has highest safety levels having transient protection upto 8 KV lighting surge and meets the requirements for CAT III 1000V & CAT IV 600V AC & DC. It meets E.M.C. requirements and Double insulation per UL/IEC/EN61010-1 Ed. 3.0, IEC/EN61010-2-033 Ed. 1.0, CAN/CSA C22.2 No. 61010-1 Ed. 3.0, IEC/EN61010-2-032 Ed. 3.0 & IEC/EN61010-031 Ed. 1.1. It has a fire retarded casing. It is supplied with Soft Carrying Pouch, Operating Manual, Test lead set, Bkp60 banana plug K-type thermocouple, Alligator Clip set, BKB32 banana plug to type-K socket plug adaptor (for optional purchase).

For further details contact:
kusam_meco@vsnl.net

IT 51: 5kV Semi Diagnostic Digital Insulation Tester from Motwane

Motwane introduces another revolutionary product IT 51 in the 5 kV Insulation Testing. With introduction of the highly successful 5 kV Diagnostic Insulation Tester 5KPI two years back, Motwane has launched a series of High performance & high precision Digital Insulation Testers. The all new IT 51 is a microprocesor based compact and robust 5 kV Digital Insulation Tester with PI and Spot Insulation facility. It is ideal for Power Distribution and Transmission Companies, HT Motor mfgrs, Large EPC Contractors, Transformer testing, Switchgears, CT, PT and Insulator testing. The advanced features of PI help to undertake predictive maintenances of Electrical installations. It automatically performs Polarization Index test and helps to get the job done, quickly and safely. IT 51 comes with various distinctive features like Insulation resistance up to 1 T, covering large set of applications. It has a wide selectable voltage range of 250/500/1000V/2500/5000 VDC so as to fulfill different set of applications of Telecom, Power, Oil & Gas, Motors, Railways and Electrical Contractor sectors. The robust ABS housing and other safety features like live circuit detection, automatic discharge of capacitive load after insulation resistance test, accessories in accordance to IEC 61010-31, CE & CAT IV compliance, ensures the Safety of the User as well as Electrical installations. The equipment is powered by a powerful internal rechargeable battery and is provided with additional AC mains provision for battery charging thus keeping the recurring costs under control.

For further details contact:
sales@motwane.com

OBO introduces Under Floor Systems (UFS)

OBO BETTERMANN India is a subsidiary company of OBO BETTERMANN, Germany. OBO under floor systems are customer focused and future oriented. With their offering one can keep the option to be open for new future proof requirements and be flexible as these systems are developable and can be adapted accurately for ones needs.

Under floor system for carpeted floors where choice of colors, shapes, and number of compartments and with variable recess options. A range of Galvanized under floor trunking/ UPVC trapezoidal ducts with choice of compartments & thicknesses to choose from. Specialty dry and wet cleaned service outlets for marble, granite and tiled floors.

Floor outlet offering with traps made of Galvanized iron powder coated to suit various floor covering and type. Complete range tested and in conformance with the latest international norms.

OBO Bettermann under floor system solution adds value by providing-

High-quality design solutions which offer aesthetically pleasing complete solutions for customers. OBO product range comprises various design and equipping variants. Technically mature, user-friendly products for fast and uncomplicated installation make day-today work much easier.

For further details contact:
sales@oboindia.com

Index to Advertisers

K-Lite introduces LED Bollards

The photometric design of luminaires such as efficient and cost-effective LED bollards with rotationally symmetrical illumination for ground surfaces, is based on LED integrated with K-Lite's precision reflector module. These luminaires are characterised by their high luminous efficiency, extremely long service life and the uniformity of the degree of illuminance. These luminaires are available in Ø100 and Ø166, three different heights to suit the installation site.

K-Lite Advantages - Powerful Design Powerful light

Extruded aluminium alloy housing through homogenization for durability and thermal management. UV stabilized, non yellowing polycarbonate diffusers for better light transmission, vandal resistant and UV stabilization. Finished with 60 micron thick polyester based powder coating for uniform deposition and excellent finish. CREE / OSRAM / NICHIA make LEDs, which are internationally recognized brands with higher lumen output are used for better illumination and longevity.

Application

It is applicable for the illumination of footpaths, entrance areas, driveway, private and public areas.

For further details contact:
info@klite.in

Five taps in one trip.

MRCT
Relay and Current Transformer Tester

Reduce your ladder time. Make one connection and test all taps simultaneously with the new MRCT from Megger. Now you can measure saturation, ratio, polarity, winding resistance, burden and voltage simultaneously on all taps with no lead changes. With integrated insulation and single-phase relay testing, demagnetization functionality and automated test sequences, the MRCT is a small solution that creates big time savings.

About Megger:

For over 100 years Megger is the premier provider of electrical test and measuring equipment in Power applications.

Creating benchmarks and leading innovations, today Megger is sole provider of wide & diverse product offerings for Power, Industrial Electrical testing and measuring instruments range worldwide.

Visit our website to know more www.megger.com

E: Marcomms.India@megger.com

Megger

Megger
211 Crystal Paradise Mall
Off Veera Desai Road
Andheri (w) Mumbai 400053
T +91 22 26740400
F +91 22 26740425
E inquiry@megger.com

■ Cable Fault Location ■ Battery Testing ■ Earth Testing ■ Transformer testing ■ Insulation Testing ■ Switchgear Testing

IEX
INDIAN ENERGY EXCHANGE
India's No.1 Power Exchange

5 YEARS OF EMPOWERING INDIAN POWER MARKET

India's premier power trading platform promoting transparency and competition

96% Market Share* • 3100+ Participants • 2700+ Industrial Consumers • ~80,000 MWh Daily Average Volume*

Recipient of several accolades including Best Performing Trading Company/Power Exchange - Power Line Award 2012 & 2013

*FY 2013-14

INDIAN ENERGY EXCHANGE (IEX)

India's premier trading platform for electricity and renewable energy certificates, completes five successful years of modernization of electricity trade in the country.

As we continue our journey of shaping the Indian power market, we thank you for your valuable contribution and support.

PRODUCT PORTFOLIO

- **ELECTRICITY MARKET**
  - Day-Ahead Market
  - Term-Ahead Market
- **RENEWABLE ENERGY CERTIFICATES**
  - Solar & Non-solar Certificates
- **ENERGY EFFICIENCY CERTIFICATES** (soon to be launched)

DIVERSIFIED PARTICIPATION | LOW TRANSACTION COST | COMPETITION | TRANSPARENCY | ROBUST PRICE DISCOVERY

INDIAN ENERGY EXCHANGE LTD.
CORPORATE OFFICE: 100A/1 Ground Floor, Capital Court, Olof Palme Marg, Munirka, New Delhi - 110067
Tel: +91-11-4300 4000 | Fax: +91-11-4300 4015 | Email: info@iexindia.com
REGISTERED OFFICE: 1st Floor, Mahavir Chamber, Off Nehru Road, Vile Parle (East), Mumbai - 400099
www.iexindia.com

Approved and Regulated by Central Electricity Regulatory Commission (CERC)

RNI Reg. No. 6226/1961 Reg. No. MH/MR/North East/95/2012-2014 Posted at Mumbai Patrika Channel STG office, Mumbai 400001 on 5th of every month, Date of Publication 5th of every month