Vol 54 No 11 November 2014 ₹ 100

Since 1961

Electrical India

India's oldest magazine on power and electrical products industry

Fifty-fourth Year of Service to the Power Industry 54

Metering Systems, Policies and Tariffs for Distributed Renewable Systems

Articles

Scan the QR Code to know more about EI Website

A Diary Publication

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

LARSEN & TOUBRO

READY-TO-USE POWER DISTRIBUTION SOLUTION

ENERSYS-S

SUB-MAIN DISTRIBUTION BOARD

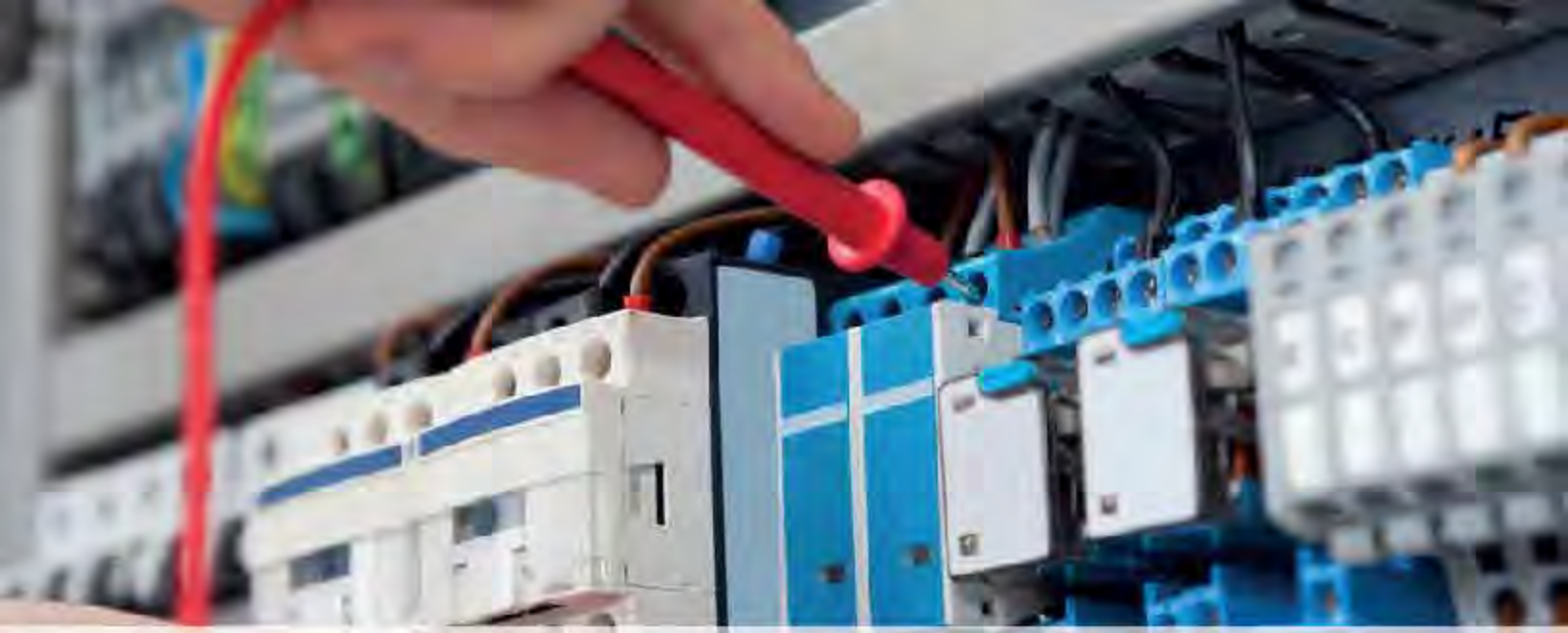
Enersys-S from L&T is design verified assembly that complies with IEC 61439-2 and certified by DEKRA. It is a design verified sub main distribution board for power distribution that is designed for easy handling and simple installation. It also offers safe, reliable and higher performance.

*SMS **LNT**<space>**12** 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 www.Lntebg.com

L&T SWITCHGEAR
SAFE & SURE

Regd. Office: L&T House, N. M. Marg, Ballard Estate, Mumbai - 400 001, INDIA Tel: +91 22 6752 5792 / 841. CIN: L99999MH1946PLC004768



Safe Testing and Measuring!

www.multi-contact.com w

Test & Measureline

Industrial Connectors

Test leads/probes of all Categories I to IV as per IEC/EN 61010-031

Multi-Contact test accessories are characterized by reliability, long lifespan and high insertion cycles. MC offers trusted probes and highly flexible test leads with insulation in PVC or Silicone.

CAT I (for special voltages: 30 VAC – 60 VDC)
- Current rating: 1 – 32 Amps
- Plug / Socket Ø 1,2 and 4 mm

CAT II (for experimenting, Testing, Repairing)
- Current rating: 1 – 32 Amps
- Plug / Socket Ø 2 and 4 mm

CAT III (for Electricians)
- Current rating: 1 – 32 Amps
- Plug / Socket Ø 4 mm

CAT IV (for Measurement at main supply source)
- Current rating: 1 – 24 Amps
- Plug / Socket Ø 4 mm

We also offer complete customised test leads (cable length, colour etc) suitable to your measuring instruments and special applications.

Contact us:
Multi-Contact India, c/o Stäubli Tec Systems India Pvt. Ltd.
Tel: 022-28239 343, 345, india@multi-contact.com

Advanced Contact Technology

Multi-Contact MC

STÄUBLI GROUP

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

Nowadays, distributed energy resource systems are playing an important role in modern electric power distribution system. These refer to small grid connected decentralized energy generators that typically use renewable energy sources such as biomass, solar and wind power.

The write-up 'Metering Systems, Policies and Tariffs for Distributed Renewable Systems' explores that in contrast to the conventional centralized coal-fired, hydro or nuclear power plants, DER systems are located close to the load and use flexible technologies.

In the context of renewable energy, for power production in remote areas double fed induction generators are good options. The article 'Controlled Operation of Doubly Fed Induction Generator under Isolated Conditions' discusses that for electrical stability, synchronous and induction generators, both can be used for wind energy conversion systems.

"Transformer life-time gets reduced because of deterioration of insulation"

In order to maintain stability in the electrical system, condition monitoring of the sensitivity equipment in power system is very essential. The article 'Testing of Transformer Oil for Fault Analysis' deliberates that the transformer life-time gets reduced because of deterioration of insulation, which may be solid or liquid insulation.

Moreover, do visit us at India Nuclear Energy 2014 from November 6-8, 2014, on our Stall No. S26 at Nehru Centre, Worli, Mumbai, as well as Inter Solar India, November 18-20, 2014, Hall No. 5&6, Stall No. A 561 at Mumbai Exhibition Centre.

Do send in your comments at miyer@charypublications.in

Mahadevan

Vol. 54 • No. 11 • November 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
Nafisa Kaisar
nafisa@charypublications.in

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

Design
Rakesh Sutar, Sandeep Amte

Subscription Department
Hemant Yelave
Nafisa Khan
sub@charypublications.in

Administration
Dattakumar Barge
Bharati Solanki

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

Printed, Published and owned by Mahadevan Iyer from 311, Ratkar 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

ACREX India 2015

26-28 FEBRUARY 2015
BIEC, BANGALORE

South Asia's largest exhibition on Air Conditioning, Ventilation, Refrigeration & Building Services

along with

Knowledge enhancing Workshops & Panel Discussions steered by Global Experts

DEDICATED PAVILIONS

Curtain Raiser Partner:

Platinum Partner: HITACHI Inspire the Next

Titanium Partner: BLUE STAR BREATHE EASY

Networking Dinner Partner:

Smart Homes Pavilion Partner: SOBHA

Silvan Innovation Labs

Silver Partners:

citizen industries ltd.

Silver Partners:

Fuji Electric

HUMIDIN

Organizer

www.acrex.in

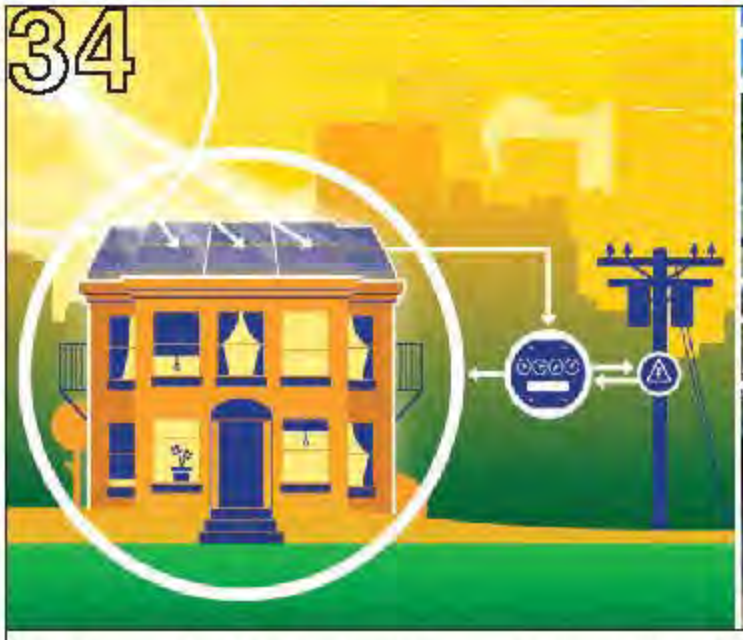
Endorsed by ASHRAE

Event Producer: NÜRNBERG MESSE

For more information please contact:
NürnbergMesse India Pvt. Ltd.
E: [illegible] / [illegible]
T: +91-11-[illegible]

CONTENTS

Vol 54 | No 11 | November 2014



Departments

Interview

92

Ashish Tandon
VP - Sales & Marketing
Landis+Gyr

96

Sam P Cherian
Chairman
Elecon Measurements Pvt Ltd

Benchmarking performance with feature rich and high accuracy meters

PowerSCADA Expert

- Demand Forecast and control: Using Upto 4DI/ 2DO and upto 2RO
- Power Quality analysis: THD, TDD, Individual Harmonics upto 63rd
- Multitariff: Billing flexibility and visualize load patterns upto 8 different tariffs
- WAGES: Integration of piped consumptions using upto 4DI
- Performance monitoring: For all electrical parameters as per IEC61557-12 [PMD]
- IEC Standards: Cost allocation with accuracy Class: 0.2S/0.5S as per IEC62053
- Alarms: Time Stamped configurable setpoint alarms for network reliability & diagnosis
- Direct connection: Upto 690VL-L without PT
- Communication: Variance of RS485 / Dual Ethernet ports with Onboard Webserver
- EMS-SCADA: Seamless integration into any modbus compatible EMS-SCADA system

For more information on **PM5000 Series** download our **FREE** MeterApp and enter here to stand a chance to **WIN a Samsung Galaxy Note 3!**

Visit **www.SEreply.com** Key code **53154Y**

MeterApp - complete metering catalogue download on AppleiOS and Android >>

Schneider Electric

Technology Innovations and power plant automation for positive change

> *Power utilities in energy sector require automation technology*

Gopal Krishna Anand

There is a great need for specialized, customized and updated software systems for power sector as information technology is empowering power supply utilities being automated progressively. Automation amounts to using control systems causing machinery to button varied operations. The major benefits of automation are majorly saving manpower and manual risks in power plants, however, it also improves quality, accuracy and precision. And the advantages in holding automation events are awareness of R&D and technology updates to improve existing products and processes and innovative controls.

Production is yet to catch up complete automation. To be in pace with competition, industrial manufacturers require resource-efficient production methods to meet growing demand for customization. Power utilities in energy sector require automation technology not only from accelerating process angle but also to get project information and make speedy decisions correctly in matter of time.

The issues related to power projects, expansion, and regulatory norms effect changes in operation and planning and integration in future grids for power management. IT and automation systems bring range of solutions, retrofitting existing solutions, transparency, and saves loss in T&D sector. Tasks from different domains have to be coordinated. However, selection of IT systems and tools should be based on long-term strategy and business goals.

Technology innovations certainly benefit the power sector. Mostly, power plants are located in remote places, and for the most part, the availability of reliable communication facilities at such locations is a huge challenge. Technology advancements in line with global trends have been instrumental for automation. The automatic metering through smart meters and steps from planning, execution, right up to commissioning of the facility are vital as future envisages growth of more solar PV systems too, renewable energy integration etc., and utility companies will have to handle complex tasks of monitoring in future times. Evidently, the changing priority is a paradigm shift in choosing an informed technology solution for power plant automation.

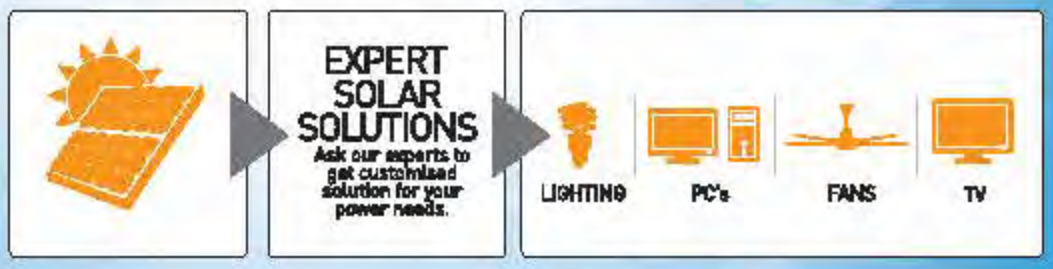
Ravin

EVOLVING TECHNOLOGY, ENERGIZING LIVES.

The only thing that'll stop electricity bills from shooting through the roof *is the roof.*

Use your roof to reduce your energy bills. Call us and we will install a solar power system that will generate enough power to run several electrical appliances through the day.

Get on top of rising electricity costs. **GET RAVIN SOLAR SOLUTIONS.**



Ravin Infraproject Pvt. Ltd. | **Qubic SunTrack Energy Systems Pvt. Ltd.**

- **Solar Systems - Fixed, Single and Dual Axis Tracker**
- Energy Cables upto 220 kV • EHV Installations & Accessories • Power Equipments • Projects & Services • Renewable Energy • Retail Energy Products

Head Office: B – 403, Akruti Trade Centre, Road No. 7, MIDC, Andheri (E), Mumbai – 400093. | T +91 22 30816444, 29215000 | F +91 22 30816441, 29215011
E: **sales@ravingroup.com** | W: **ravingroup.com**

BHEL wins order for 444 MW Hydro Electric Project in Uttarakhand

Bharat Heavy Electricals Limited (BHEL) has secured a contract for setting up a 444 MW Hydro Electric Project (HEP) in the state of Uttarakhand. Valued at Rs 4,220 Million, the order for setting up of Hydro Generating sets and associated Electro-Mechanical works for the 444 MW Vishnugad Pipalkoti HEP has been placed on BHEL by THDCIL (formerly known as Tehri Hydro Development Corporation Limited). Significantly, this is the second major order, bagged by BHEL, for a hydro electric project in Uttarakhand in 2014. Earlier, an order for the 2x60 MW Vyasi HEP was received from Uttarakhand Jal Vidyut Nigam Limited (UJVNL) in March, 2014. Located in Chamoli district of Uttarakhand, Vishnugad Pipalkoti HEP is a run of the river scheme on the river Alaknanda. The project comprises four hydro generating sets of 111 MW capacity each, with vertical Francis turbines and matching hydro generators. BHEL's scope of work in the contract envisages Engineering, Procurement and Construction of all hydro generating sets and associated electro mechanical works and is to be executed in a tight schedule of 48 months. While the hydro generating sets shall be supplied by BHEL's Bhopal unit, the transformers and Control & Monitoring system will be supplied by the company's Jhansi unit and Electronics Division, Bangalore, respectively. The erection & commissioning of the equipment shall be carried out by BHEL's Power Sector - Northern Region. BHEL has a long standing association with THDCIL. In the past,BHEL has carried out erection and commissioning of four units at the 1,000 MW Tehri Dam HEP of THDCIL, along with supply of generator transformers and busducts. The four units were commissioned by BHEL in 2006-07. BHEL has also supplied and installed Electro-Mechanical equipment for the 400 MW Koteshwar HEP of THDCIL, which was commissioned in 2011-12. BHEL's efforts in the commissioning of two units of Koteshwar HEP in less than 6 months after the power plant was flooded were highly appreciated by the customer. With this order, the customer has once again reposed confidence in BHEL's proven technological excellence and capability in executing hydro electric projects.

International Copper Association India organizes a session on Revised 'National Electrical Code India 2011'

International Copper Association India (ICAI) in support with Bureau of Indian Standards (BIS) organized a special session on the Revised 'National Electrical Code India' in Delhi. The objective of this seminar was to develop Electrical Safety amongst key constituents of building industry and industry stakeholders, through a nationwide awareness campaign which was accomplished successfully with this last session in Delhi. The seminar was inaugurated by A.P. Joshi, ADG (Border) Central Public Works Department along with other industry experts like Anil Kumar, Former DG, Central Public Works Department, Dinesh Kumar, E-in-C, Central Public Works Department Delhi, M.C. Chauhan Advisor, Railway Electrification, Sandeep Mehta, Chief Engineer, DDA.The event was attended by over 100 professionals including electrical engineers, Electrical Consultants, A grade Electrical Contractors, designers, manufacturing associations, policy makers, technical officers across various industrial sectors. Currently, Delhi is facing a constant problem of power crisis hampering the commercial and residential areas in the city. Additionally, there are a lot of places wherein the wiring is unfinished without proper wiring infrastructure that poses as a threat to property and lives of the people in those areas including offices, educational institutes and hospitals etc. The city suffers from frequent power blackouts and high electricity bills thereby causing disturbance in routine life of the consumers.

Suzlon to Build 2000 MW Wind Energy Projects over Next Five Years in Madhya Pradesh

Suzlon Group, the world's fifth largest* wind turbine maker expressed at the Global Investors Summit 2014 held in Indore, its intent to build 2000 MW of new wind energy projects in the state of Madhya Pradesh over the next five years and establish supporting manufacturing facilities. These wind energy projects established by Suzlon for SME sector and IPP producers will drive investments and create sustainable economic growth for the state. Suzlon Group has installed more than 50% of total wind capacity in the state. Tulsi Tanti, Chairman, Suzlon Group said, "The MP Government has an impressive track record of delivering 11 per cent all round economic growth in 2013-14.With a very impressive growth of 25% in the agriculture sector which is the highest in the world. This is indeed a testament of the state's progressive outlook and pro industry policies that offer a conducive business environment. MP has not only emerged as one of the fastest growing states in the country but is a power surplus state as well, with close to 14000 MW installed capacity. The achievements of the state are credited to the astute leadership under the aegis of Chief Minister, Shivraj Singh Chouhan. We are confident, the MP governments thrust on enhancing its clean energy portfolio and industry growth will ensure sustainable growth across the state." Suzlon is fully committed to convert chief minister's vision of affordable energy to all and to contribute towards building greener sustainable economy of Madhya Pradesh. Suzlon is committed to social, economic and ecological sustainable development across its areas of operations.

Siemens wins international recognition for its motors manufactured in India

Siemens India won the Super-Efficient Equipment Appliance Deployment (SEAD) Global Efficiency Medal for its 1LA2 series of Low Voltage IE3 induction motors, verified by testing of 3.7kW and 11kW models. The Super-efficient Equipment and Appliance Deployment (SEAD) initiative is an international collaboration of 16 countries and an initiative under the Clean Energy Ministerial, a global forum to share best practices and promote policies and programs that encourage and facilitate the transition to a clean energy economy across the world. The Swedish Ministry of Enterprise, Energy and Communications hosted the awards ceremony in Zurich, Switzerland. International dignitaries, including the Ambassador for India to Switzerland and the Honorary Consul of Australia, presented the awards at a ceremony on October 7, 2014. 'Improving the energy efficiency of electric motors is critical for the continued development of India's economy,' said the Ambassador for India in Switzerland, His Excellency M.K. Lokesh, who presented the two awards to Siemens Limited. 'The SEAD Awards help the market recognize the most efficient products currently available and encourage the development of new technologies.'Siemens' 1LA2 series of Low Voltage IE3 induction motors manufactured in India won in the IEC Induction Motor category for the India region as the most efficient motors thereby providing the fastest return on investments to the users.

First Renewable Energy Global Investment Promotion Meet & Expo

As a follow-up to the 'Make in India' initiative, Ministry of New and Renewable Energy announced organisation of the First Renewable Energy Global Investors Meet & Expo (RE - INVEST) on February 15-17, 2015 in New Delhi. The central theme of the meet is to attract large scale investments in the renewable energy sector in India. The event is proposed to be inaugurated by the Prime Minister, Narendra Modi. It will be the first major platform for investment promotion in the renewable energy sector at Government of India level to signal India's commitment to the development and up scaling of renewable energy for meeting its energy requirement in a sustainable manner. RE-INVEST will enable the global investment community to connect with renewable energy stakeholders in India. The event is expected be attended by over 200 investors, both domestic and international. Besides, representatives from State Governments, Public Sector enterprises, renewable power developers and manufacturers, state renewable energy nodal agencies and other related stakeholders will also play an important role. Over 1,000 delegates are expected to attend the Meet. Renewable Energy is contributing about 6.5% in the electricity mix of the country. It is proposed that this would be taken to about 12% in the next three year. Major initiatives by the Government including accelerated depreciation, generation based incentive, feed-in-tariff, viability gap funding is expected to add massive investments in the renewable energy sector. FDI up to 100% under the automatic route is permitted in Renewable Energy Sector.

ACME Group achieves 160 MW Projects as Largest Developer

ACME Group, India's leading solar power player in India announced that it has emerged as the largest Bidder for 160 MW solar PV power projects at the 500 MW tender opening ceremony event at Hyderabad under RFP floated by Southern Power Distribution Company Limited of Andhra Pradesh (APSPDCL). As per the terms and conditions of the bidding document, the selected developer would sign 25 year long PPA with AP Discom on bided tariff. Commenting on this momentous occasion, Manoj Kumar Upadhyay, Founder & Chairman, ACME Group said, "This win is the country's largest win by any private solar developer. It is a testimony to the prowess of ACME Group and further strengthens our emergence as the leading solar power producer in the country. With this addition, our solar power portfolio has reached 422.5 MW and we are on way to generate 1000 MW by year 2017. We thank the Andhra Pradesh Authorities for their initiatives and look forward for support from all stakeholders to help us in achieving the dream of bring power to every house by 2019." This project would entail an estimated investment of $ 210 mm/ Rs. 1250 crores. The 160 MW projects would be set-up in the three districts of Anantpur, Kurnool and Chittoor in Andhra Pradesh. Earlier this month ACME Group received final approval for credit facility of $100 mn loan from Asian Development Bank. US$ 50 mn shall be utilized in developing 100 MW projects in Rajasthan and the remaining amount of loan shall be used for its upcoming projects. Last month, ACME also sourced an investment from IFC in the form of an 'A' Loan of up to $34 million (Rs. 201.9 crores) for the 100 MW project in Rajasthan under the ambit of JNNSM. Earlier, IFC also funded Rs.73.10 crores for the 25 MW solar power project of the company in Madhya Pradesh which was commissioned early this year. The company had an existing portfolio of 262.5 MW including 100 MW JNNSM Phase II Projects, in the states of Gujarat, Madhya Pradesh, Rajasthan, Odisha and Chhattisgarh. The company aims to generate 1000 MW by the year 2017. The portfolio consists of 100 MW plants in Rajasthan, 25 MW plant in Madhya Pradesh, 25 MW plant in Odisha, 30 MW plant in Chhattisgarh, a 15 MW in Gujarat, 10 MW in Assam, 25 MW in Bihar, 30 MW in Uttar Pradesh and a 2.5 MW CSP plant in Rajasthan.

EXPERIENCE LIFE
IN ITS TRUE COLOURS WITH

Finolex

Finoglow

Eight Times Longer Life | 40% Extra Life*

Energy Saver | Eco Friendly | True Colour Lighting

Newly launched a wide range of LED Lights - FinoLED

/Finolexindia /Finolexindia YouTube /Finolexgroup /finolex-cables-ltd

Regd. Office : 26-27 Mumbai-Pune Road, Pimpri, Pune 411 018, India
Tel : 020-27475963 Fax : 020-27470344 Visit us at : www.finolex.com Email : sales@finolex.com

Schneider Electric engages discussion on Smart City project

Schneider Electric India hosted an engaging panel discussion with subject matter experts to deliberate on India's urban infrastructure and identify the building blocks for making the government's 'Smart Cities' project a reality. 'Changing India: A Smart City Revolution' put the spotlight on the socio-economic necessities that drive the Smart City objective, turning the table on the inadequacies of our country's infrastructure and administrative mechanisms, and the skills that will guide the city planners, administrators and proponents to build and manage Smart Cities. The contour of the discussion was shaped and led by Dr R K Misra, Founder Director, Center for Smart Cities and the panellists comprised an eclectic mix of eminent dignitaries. The inaugural speech was delivered by Leo Apothekar, Vice-

Chairman and Independent Lead Director, Schneider Electric. Apothekar said, "There are multiple components to a Smart City which need to be considered while planning such a project. These mainly include energy, mobility, water, public services and buildings & homes. India has embarked on a very exciting mission of creating Smart Cities and we are confident that contributions from all sections of the society, public and private, can make this dream a reality. Only cities can accommodate population growth and there is a need for Smart Cities." Mishra further said that Smart Cities use infrastructure more efficiently and its four main pillars should be mobility, safety, cleanliness and being green. Shivendra Nath, who will be the first overseer of India's first Smart City, said, "We need to keep consumer happiness at the core while ensuring that whatever we do is economically viable and gives the best output." Among discussions, talking about integrating technologies to achieve energy efficiency, Anil Chaudhry shared Schneider's experience as a developer of Smart Cities. He said, "Schneider is well positioned to contribute to the government's vision of creating 100 Smart Cities. We are already working on various Smart projects. The physical and virtual worlds now need to come together; integration is required."

French companies to present their expertise at Indian Nuclear Energy 2014

UBIFRANCE India in partnership with G.I.I.N and AIFEN (French Nuclear Industry Associations) is organising for the 5th consecutive year a French pavilion at the India Nuclear Energy (INE) exhibition, the leading event in the nuclear sector in India. The French delegation would represent almost 40% of the total participating companies like in the previous editions. French expertise in the nuclear sector is globally acknowledged. This expertise is the fruit of the constant commitment and investment of French industrial groups and SMEs for the past 60 years in the nuclear field. The French nuclear sector is currently the leader in the domain of the fuel cycle (manufacturing, processing and recycling) and in nuclear power plant construction and maintenance, with 2,500 companies which employ 220,000 persons and generate a 46 billion turnover, including 5.6 in exports. 58 nuclear reactors are currently in operation in France. India Nuclear Energy 2014 will serve as the platform for the civil nuclear energy industry to interact and work towards the fulfilment of the power and electricity requirements of the Indian economy. The French pavilion had brought under its banner 18 companies at INE 2013. Thus, the French Pavilion was the biggest country pavilion with the maximum number of participating companies. In addition to these 18 companies, 5 other French companies exhibited directly through their Indian subsidiaries and the French Pavilion at INE 2014 will be on the ground floor at Nehru Centre in Mumbai.

Eaton expands Market Presence through HCL Infosystem

Eaton announced its partnership with Digilife Distribution and Marketing Services (DDMS), a 100% subsidiary of HCL Infosystems. The partnership aims to expand market presence of Eaton's electrical power back-up solutions by leveraging HCL's distribution and retail infrastructure in the India. With this partnership, Eaton's reliable and efficient uninterruptible power systems (UPS), ranging from 600VA up to 40kVA, will now be available throughout HCL Infosystems' distribution and retail network. "Eaton's alliance with HCL Infosystems will help us expand our partner community and help maximize our market share," said Syed Sajjadh Ali, MD – India, Electrical Sector, Eaton. "The extensive network of HCL Infosystems will enable customers in distant towns & cities have access to Eaton's industry leading UPS systems that help manage power more efficiently, reliably, safely & sustainably." HCL Infosystems is India's premier distribution & IT services and solutions company. It has one of the largest sales and distribution networks in India that reaches more than 100,000 retail outlets, over 800 direct & micro distributors and over 12,400 channel partners across 15,000 towns and 664 districts in the country. Bimal Das, Joint-President, Enterprise Products Distribution, HCL Infosystems Ltd said, "We are excited about our partnership with Eaton. We see a great opportunity to create value by leveraging our distribution footprint across the country.

r Meters ● Clamp-On Current Transformers ● Calibrators ● Multifunction Panel Meters ● Digital Panel Meters ● M

MECO®
SINCE 1962

Digital Multimeters

DEALERSHIP ENQUIRIES INVITED

K Type Stick Probe

Test Leads

FEATURES / FUNCTIONS	63	603	45CF	9A09	9A06	801AUTO	450-TRMS
COUNTS	2000	2000	20000	2000	2000	4000	20000
AUTO RANGING	-	-	-	✓	✓	✓	-
TRMS	-	-	-	-	-	-	✓
A AC	-	20	20	10	10	20	10
A DC	10	20	20	10	10	20	10
V AC / DC	✓	✓	✓	✓	✓	✓	✓
RESISTANCE / CONTINUITY / DIODE TEST	✓	✓	✓	✓	✓	✓	✓
DUTY CYCLE (%)	-	-	-	-	-	✓	-
CAPACITANCE	-	-	✓	-	-	✓	✓
FREQUENCY	-	-	✓	-	-	✓	✓
TEMPERATURE	-	-	-	✓	✓	✓	-
AUTO POWER OFF	-	-	✓	✓	✓	✓	✓
hFE TEST	✓	✓	✓	-	-	-	-
Infrared Remote Control Check / Live Wire Check	-	-	✓	-	-	-	-

Meco Meters Private Limited

Plot No. EL-60, MIDC Electronic Zone, TTC Industrial Area, Mahape, Navi Mumbai - 400710 (IN
Tel : 0091-22-2767 3300 (Board), 2767 3311-16 (Sales) • Fax : 0091-22-27673310, 276733
Email : sales@mecoinst.com • Web : www.mecoinst.com

VER:180814

● Solar Analyzers ● Battery Capacity Testers ● Environmental Testers ● Power And Harmonic Analyzers ● Energy Auditors ● Sq / 1φ Clamp- On Powe

store ● Clamp - On earth / Ground Resistance Testers ● Leakage Current Testers ● Micro-Ohmmeters ● LCR Meter

OMRON Automation displays its best in Vision and Safety at Automation 2014

OMRON Automation, part of Omron Japan- a global leader in industrial automation displayed a wide spectrum of its cutting edge automation technology at the ongoing renowned B2B exhibition Automation 2014. This comprises of all key offerings in the field of high-end automation including Robotics. Recognised as 'Asia's Automation Torchbearer', the 9th edition of Automation 2014 brings together the best available technologically empowered machineries catering to Industrial Automation & Factory Automation. OM RON being a pioneer in factory automation is well poised to assist the Indian manufacturing sector with its 'total solutions' approach. Themed "We Automate!"- the OMRON exhibited the utility of OMRON's unique sensing & control technology helping crucial operations in the manufacturing industry to get automated. The major focus of the display was on the Vision and Safety solutions, the flagship range of Sysmac automation and Scara robotic platforms - which play an important role in varied industries like packaging, automotive, material handling, chemicals, pharmaceuticals, food & beverage and textile to name just a few. Select offerings from industrial components portfolio were also exhibited. Sameer Gandhi, MD, OMRON Automation India, remarked, relevant shows like Automation 2014 help a lot in portraying strengths as complete automation partners and strengthening the reach and connect with all key audience - OEMs, end users, system integrators and engineering distributors. .

Alstom T&D India wins second grid strengthening contract from Power Grid

Alstom T&D India secured a contract from Power Grid Corporation of India Limited (PGCIL), for approximately 17 million (INR 1380 million), to supply transformers and reactors for the expansion of 400/220 kV grid substations across southern India. The project is part of Power Grid's System Strengthening Scheme to boost power handling capacity of substations, and stabilise the transmission infrastructure in southern India. Under this new contract, Alstom will supply six units of 400/220kV, 500MVA transformers and two units of 420kV, 125MVAr shunt reactors. All equipment will be supplied from Alstom T&D India's manufacturing facilities across the country. This is Alstom's second win to strengthen the country's transmission infrastructure under the System Strengthening Scheme. The first power transmission reinforcement contract was awarded in July 2014 to expand 400/200 kV grid substations across eastern India. Rathin Basu, Managing Director of Alstom T&D India, said, "Winning a second project under the System Strengthening Scheme is a major achievement for Alstom, confirming our industrial expertise & leadership. We are delighted to continue contributing to the development of India's national grid infrastructure."

DSM inaugurates Solar Technologies Demonstration Center in India, showcases benefits of current and future solar technologies

Royal DSM, the global Life Sciences and Materials Sciences Company, inaugurated its Solar Technologies Demonstration Center at its DSM Engineering Plastics facility in Pune. This state-of-the-art solar technology center has been built to demonstrate and showcase the performance of DSM's innovations in solar technology and will also reduce the plant's CO_2 footprint by using the renewable energy generated by the solar plant to meet 25% of the site's electricity needs. Technology for solar energy will play a central role in a more renewable energy balance of the future – a role that will become even more critical and valuable as the technology becomes more efficient and competitive. DSM aims to help enable the penetration of solar energy by focusing on the development and commercialization of technologies and materials solutions that increase the efficiency and yield of solar modules, thereby increasing the energy generation and reducing the cost of solar electricity. KhepriCoat®, an anti-reflective coating developed by DSM Advanced Surfaces, significantly increases the efficiency of solar panels by enabling more light to enter a solar device. At the demonstration center, the coating is successfully applied to panels of different makes and models, validating its performance for the solar industry. The center will also test a new light trapping technology which DSM is developing, which gives solar panels a performance boost utilizing smart 3D structures in a thin plastic foil. Oscar Goddijn, VP, DSM Advanced Surfaces said, "We aspire to be a world leader in materials based solutions for solar photovoltaic technologies. Our newly commissioned solar energy plant in Pune is the first of our demonstration facilities to showcase our technologies to customers and stakeholders around the world. The demonstration center validates performance of KhepriCoat, DSM's best-performing anti-reflective coating technology as well as our new light trapping technology and will test and demonstrate future technologies from our stable." With demand for energy increasing around the world, DSM recognizes need to use alternative energy solutions for its own use.

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, Aurus Chamber, Annex - A,
S. S. Amrutwar Marg, Worli,
Mumbai 400 013, INDIA

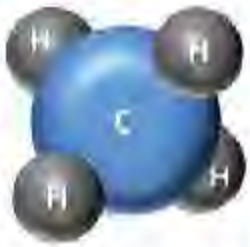
Phone : +91 22 4344 4244,
FAX : +91 22 4344 4242
e-mail: marketing@scopetnm.com,
Web site: www.scopetnm.com.

Solar energy: the largest source of electricity by mid-century

The sun could be the world's largest source of electricity by 2050, ahead of fossil fuels, wind, hydro and nuclear, according to reports issued by the International Energy Agency (IEA). The two IEA technology roadmaps show how solar PV systems could generate up to 16% of the world's electricity by 2050 while solar thermal electricity (STE) from concentrating solar power (CSP) plants could provide an additional 11%. Combined, these solar technologies could prevent the emission of more than 6 billion tonnes of carbon dioxide per year by 2050 – that is more than all current energy-related CO2 emissions from the United States or almost all of the direct emissions from the transport sector worldwide today."The rapid cost decrease of photovoltaic modules and systems in the last few years has opened new perspectives for using solar energy as a major source of electricity in the coming years and decades," said IEA Executive Director Maria van der Hoeven. "However, both

technologies are very capital intensive: almost all expenditures are made upfront. Lowering the cost of capital is thus of primary importance for achieving the vision in these roadmaps."The Executive Director also stressed that the two reports do not represent a forecast. As with other IEA technology roadmaps, they detail the expected technology improvement targets and the policy actions required to achieve that vision by 2050, highlighting priority actions and milestones for governments, research and industry stakeholders. A central message in both publications deals with the need for clear, credible and consistent signals from policy makers, which can lower deployment risks to investors and inspire confidence. "By contrast," Ms. Van der Hoeven said, "where there is a record of policy incoherence, confusing signals or stop-and-go policy cycles, investors end up paying more for their investment, consumers pays more for their energy, and some projects that are needed simply will not go ahead."The two documents underline the complementary role of the two technologies. With 137 GW of capacity installed worldwide at the end of 2013 and adding up to 100 MW each day, PV deployment so far has been much faster than that of STE, mainly thanks to massive cost reductions. Under the scenario described in the roadmaps, most of the growth of solar electricity comes from PV until 2030. However, the picture changes afterwards. When reaching shares between 5% and 15% of annual electricity generation, PV starts to lose value in wholesale markets.

Carbonate-hosted methanotrophy: A new methane sink in Deep Sea



A previously unrecognised biological sink for methane, a gas that contributes to climate change, has been reported recently in Nature Communications. The research shows that abundant microorganisms living in carbonate rocks in the deep sea use methane for respiration, removing methane from the ocean on a global scale. Methane is a significant contributor to greenhouse forcing, and determining its fluxes and reservoirs is important for understanding the methane cycle. Victoria Orphan and colleagues investigate carbonate rocks associated with three different cold seeps (areas of the ocean floor where methane and other hydrocarbon-rich fluid seepage occurs naturally). Carbonate rocks in these areas were previously thought to be passive recorders of methane oxidation over time; however, the authors find that microorganisms living within the rocks are actively utilising methane and consuming it. This is a previously-unrecognised ecological niche for these important methane consumers. The microorganisms were found to be capable of methane oxidation in both oxygenated and low oxygen conditions. The carbonate rocks hosting these microbial communities are difficult to sample, being at water depths of more than 500m, but it is likely that similar communities exist in many other parts of the ocean and may be a significant sink for methane globally.

New Zero 88 Bypass Cabinets powering mixed Lighting Installations

Power management company Eaton announced its theatrical and performance lighting controls Zero 88 product line now offers the new Chilli Pro Bypass lighting cabinet. These professional 24-channel, slim line cabinets feature 24 Eaton bypass switches for use when direct mains power is needed in place of theatrical dimming. Available in both 10A and 16A variants, individual channels can be set for dimming or to deliver mains power for intelligent lights, light-emitting diode (LED) light fittings and other stage specials. Chilli Pro Bypass cabinets save wiring and simplify set up to make it easier to connect lights exactly where they are needed. For peace of mind, the bypass switches, user interface and all breakers are also protected by a lockable, hinged cover with viewing window to check bypass status. Chilli™ lighting control cabinets are a comprehensive range of high density wall mounted convection cooled dimming & power control devices. Quick to install and set up, easy-to-operate & maintain, the 18-button user interface & backlit LCD screen on each cabinet ensure simple convenient set up for DMX patching, preheat, top set and dimmer curves. Responses to DMX failure, backup memories, built-in chases and an alarm input trigger complete this package.

In emergencies, how fast you restore power can mean how effectively you restore confidence.

Trust LINDSEY ERS: Fast. Versatile. Proven.

Transmission lines are vulnerable to mechanical failure during natural disasters or acts of sabotage. This has significant economic and political costs as well making it imperative to restore electrical power swiftly, effectively and efficiently. For nearly 65 years and with over 1000 Emergency Restoration Systems working reliably across 20 countries, Lindsey ERS are well-proven in addressing calamities and challenges. In India, Lindsey ERS is available through PCI Limited - the company that, in association with global technology major has brought hi-tech solutions for various sectors of the Indian economy for 25 years now.

Lindsey ERS are designed to be user-friendly especially during mission-critical situations and can be deployed swiftly - a complete tower can be erected within a matter of hours. All ERS tools and accessories such as insulators, hardware, anchors and gin poles, can be safely stored and transported in standard 20 foot containers. PCI can also provide the necessary orientation and training of your technical disaster management personnel.

These highly reliable and quick-to-deploy ERS have played a significant role in the restoration of normalcy of power supply in the aftermath of various natural calamities in India such as the 1998 cyclone in Gujarat, the 1999 Orissa cyclone and the severe floods that had paralyzed vast districts in Bihar and Assam during 2010.

• MODULAR STRUCTURE • NO SPECIAL FOUNDATION NEEDED • STANDARDIZED COMPONENTS • USABLE AT ANY VOLTAGE LEVEL FOR SUSPENSION, ANGLE OR TENSION STRUCTURES • PROOF-TESTED TO MEET IEEE STD.

TO ASSESS HOW QUICKLY & EFFICIENTLY, YOU CAN DEPLOY LINDSEY ERS ACROSS VARIOUS TERRAINS, CALL US!

PRIME GROUP
LOOKING BEYOND TOMORROW

PCI LTD. POWER & ENERGY DIVISION

Corporate Office: Prime Tower, 287-288, Udyog Vihar, Phase-II, Gurgaon-122 015 (India)
Tel: +91 124 4111999 (30 Lines), 6658999 (30 Lines), 2342686-87 **Fax:** +91 124 4671699 99, 2342688 **E-mail:** primegroup@vsnl.com pci@prime-pci.com **WEB:** www.primegroupindia.com
BRANCH OFFICES: • Delhi • Mumbai • Hyderabad • Bangalore • Chennai • Kolkata • Bhubhaneshwar • Cochin • Chandigarh • Vizag • Jaipur • Kanpur • Pune • Ahmedabad • NOIDA • Gurgaon • Manesar

LINDSEY

PCI offers state-of-the-art instruments 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

US anti-dumping, countervailing duties cast shadow over solar market

US International Trade Commission recently announced it would extend the final decision of countervailing duties on solar PV imports from China and change scope of the investigation to target modules and cells. However, a 2012 decision on Chinese cells prevails, so they will not be affected by the ITC's recent amendment. By contrast, duties will likely be slapped on Chinese modules, irrespective of where wafers or cells used in the modules are produced. Taiwan manufacturers, meanwhile, should expect for modules produced in Taiwan to be investigated as well as third-party module manufacturers who use Taiwan-made cells. The ITC's new amendment to the 2014 anti-dumping and countervailing duties simplified the criteria under which Chinese modules can be targeted, said Jason Huang, a research manager at EnergyTrend, a subsidiary of the Taiwan-based market intelligence firm TrendForce. As a result, it is now easier for the US to block imports of Chinese modules. Originally, if Chinese modules used silicon wafers produced outside of China and cells produced in Taiwan, they could avoid the duties, Huang said. But this new amendment is a game changer. Now if companies like Yingli, Suntech or Jinko choose to manufacture modules in China, they will produce cells themselves rather than using cells made in Taiwan.

ERDF selects CG to Supply Linky Meters

Avantha Group Company CG was selected by ERDF -Electricité Réseau Distribution France, the public electricity distribution company managing 95% of the electricity distribution network in continental France, as one of the six suppliers to manufacture the first three million of its new generation Linky smart meters. This contract is a very significant achievement for CG, a company that has built its competitive strategy in the development of smart grid solutions, under ZIV brand, based on its own technology and a unique mix of knowledge in protection and control, communications and metering technologies. The technological strength of ZIV smart meters backed by a large field experience on the behaviour and performance of powerline communication networks of different nature has proven to be a key factor, as it results in a direct benefit to the utilities by offering more flexibility when modifications or upgrades are requested. ZIV smart meters and data concentrator units from CG are gaining a strategic position in the Smart Grid European market where it has achieved key wins in 2014. Large-scale deployments are planned in the UK, Spain, the Netherlands and France. CG will face new challenges with agility, implementing new supply chain in France.

North America's largest Battery Energy Storage System

LG Chem has delivered and commissioned the largest battery system installed in North America, a 32 MWh battery energy storage system in Tehachapi, CA.In May 2013, Southern California Edison (SCE) selected LG Chem to deliver the turnkey 8 MW/32 MWh energy storage system for the Tehachapi Energy Storage Project, (TSP) funded by SCE and the Department of Energy as part of the American Recovery and Reinvestment Act (ARRA).As a complete energy storage system solution provider, LG Chem successfully delivered the turnkey project, the largest battery system in North America, including overall project and construction management, system engineering and design, and battery rack systems. Team members include ABB, Inc. for power conversion equipment and LG-affiliate LG CNS Corp. for construction services. The objective of TSP is to validate the capabilities of a utility-scale lithium-ion battery energy storage system in providing grid support, facilitating integration of renewable energy resources. Over a two-year period, SCE will perform extensive field testing to verify the battery system's capabilities for transmission, grid, and market applications under thirteen specific operational uses."Successful completion and commissioning of SCE's TSP battery system demonstrated LG's ability to deliver large-scale energy storage projects," said Young Soo Kwon, president of Energy Solution Company at LG Chem. "Our continued collaboration with SCE over the next two years will provide valuable feedback on utilities' integration and operation of grid-scale storage systems. This will reinforce LG Chem's position as a leading energy storage partner to utilities and project developers.""The Tehachapi Energy Storage Project is a significant milestone for SCE and for energy storage in California" said Doug Kim, director of Advanced Technology at Southern California Edison."Grid-scale energy storage is an integral part of our company's Storage Portfolio Development Framework that will contribute to optimizing grid performance and integrating more renewable energy resources. This demonstration project will give us insight into the operational capabilities of large-scale lithium-ion battery storage."LG Chem demonstrated its system engineering capabilities and the modularity and flexibility of its battery solutions by designing, engineering, and installing the utility-scale battery system to fit within a small footprint inside an existing 6,300 sq ft facility at SCE's Monolith Substation in Tehachapi. The large-scale battery system is comprised of a total of 604 battery racks, 10,872 battery modules, & 608,832 individual battery cells – the same lithium ion cells installed in commercially-available vehicles sold by leading automotive OEMs to customers worldwide.

Superconducting Fault Current Limiters- Application and Effects in Power System

Fault current limiters are the effective solution for most of the power system failures nowadays. Superconducting fault current limiters are used as effective way of fault current limiting. Most of the problems or failures in system are due to overloading of system lines thus flashover or fire hazards. This all will occur mostly at the time of fault because fault current will be of a large value than system can withstand. By expanding system, we have to increase the fault current level also. Otherwise system will collapse soon. The better way is to use current limiters. The fault current limiters limit current at the event of fault. Superconducting fault current limiters use superconducting material for current limiting. Here a study on superconducting fault current limiters, their usage, types etc., are included.

Avinash Babu K M and Prof (Dr) Vinayak N Shet

Electric power systems are designed such that the impedances between generation and loads are low. However, a significant drawback of the low interconnection impedance is that large fault currents (5 to 20 times nominal) can develop during power system disturbances. In addition, the maximum fault current in a system tends to increase over time for a variety of reasons, Main reasons are-

- Demand increases, so we have to expand system capacity, generation
- Parallel conducting paths are added to accommodate higher demand.
- Interconnections the grid increases.
- Sources of distributed generation are added to an already complex system.

We have to maximum prevent the damage to the system and customer blackout time. Nowadays fault detectors and isolators are used effectively in the system. But if we want

Proposed Fault current limiters are having capability of rapidly increasing impedance to fault current. These devices will control/limit current to the value which devices can withstand.

to expand our system, we have to make changes in whole equipment like we have to use high capacity lines, we have to use high capacity isolators etc.

In some cases, power system engineers using shunt reactors or inductors to reduce fault current. Here the problem is the fault current limiting reactor's impedance. This impedance will increase the total impedance of the system and thus may affect the stability. So we cannot use this type of limiters widely.

Here comes the role of FCL (Fault Current Limiters). Proposed Fault current limiters are having capability of rapidly increasing impedance to fault current. These devices will control/limit current to the value which devices can withstand. Proposed FCL is Superconducting Fault Current Limiter. It has the ability to be invisible (nil resistance/ impedance) during normal operation and can exert high impedance on the occasion of fault to reduce/limit fault current. This will go back to its nominal zero impedance condition automatically depend on the physical condition.

Superconducting FCL uses super conducting materials for conductors. Proposed is high temperature superconducting material. This is the future technology. This superconducting technology is in growing state. Many research studies are going on this subject.

Fault Current Limiters

What are fault current problems?

Fault-current problems are commonly faced when expanding existing buses. Larger transformers result in higher fault levels, this in turn needs the replacement of existing bus work and switchgear because of changed fault level. Alternatively, the existing bus can be broken and served by two or more smaller transformers. Another alternative is use of a single, large, high-impedance transformer, resulting in degraded voltage regulation for all the customers on the bus.

FCL Application

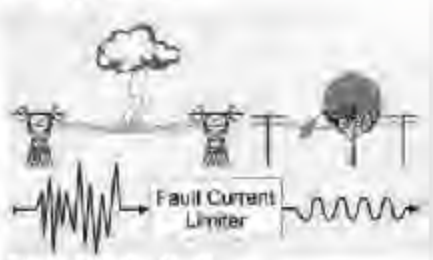


Fig. 1: FCL Application

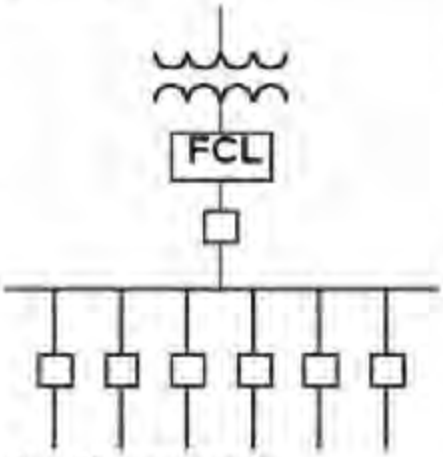


Fig. 2: FCL in main position

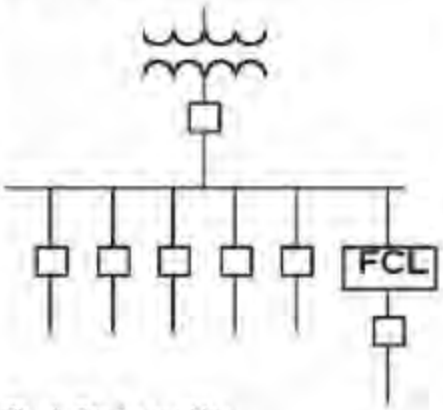


Fig. 3: Feeder position

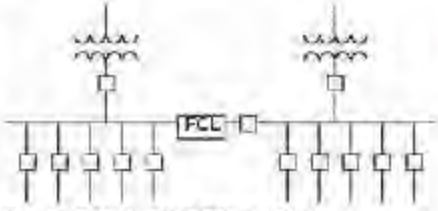


Fig. 4: FCL in BUS TIE position

Desirable Attributes of the "Ideal" FCL

The attributes of an ideal FCL in the power system may be listed as follows.

- Exhibit zero impedance during normal operation (i.e. no losses, no reactive voltage drop). This requirement is straightforward. It cannot be met completely by real FCL systems but they may come close to the ideal value.
- Provide immediate and "perfect" discrimination between a (temporary) overcurrent situation & a true fault event.
- In case of a fault, decrease the rate-of-rise of the current quickly within the first quarter cycle in order to reduce the fist current peak to an acceptable level.
- Perform the voltage build-up across the FCL such that the associated voltages do not exceed the dielectric insulation capability of the existing system.
- Allow a follow current to flow to enable downstream protection coordination to clear and isolate the fault.
- Immediate and automatic recover under full load current, or even under overcurrent conditions.
- Fail safe limiting operation. This indicates whether the FCL will still limit the fault current even if its primary mechanism fails.
- No or minimum impact on existing protection.
- Reliable operation (i.e. no false limiting action) which implies no degradation or aging of active elements (e.g. HTS elements in SCFCLs).
- Low maintenance.
- Low weight and small size.
- No or only few auxiliaries.

Superconducting FCL

Superconducting technology

The concept of using the superconductors to carry electric power and to limit peak currents has been around since the discovery of superconductors and the realization that they possess highly non-linear properties.

The current limiting behavior depends on their nonlinear response to temperature, current and magnetic field variations. Increasing any of these three parameters can cause a transition between the superconducting and the normal conducting regime. The curve in the lower half of Figure 5 is a normalized plot showing the non-linear relation between current flow in a superconductor and its resistance. The data for the curve was measured while the superconductor was in a constant magnetic field and a constant temperature. Similar curves can be produced for changes in temperature and magnetic field. The current increase can cause a section of superconductor to become so resistive that the heat generated cannot be removed locally. This excess heat is transferred along the conductor, causing the temperature of adjacent sections to increase. The combined current and temperature can cause these regions to become normal and also generate heat. The term "quench" is commonly used to describe the propagation of the normal zone through a superconductor. Once initiated, the quench process is often rapid and uncontrolled.

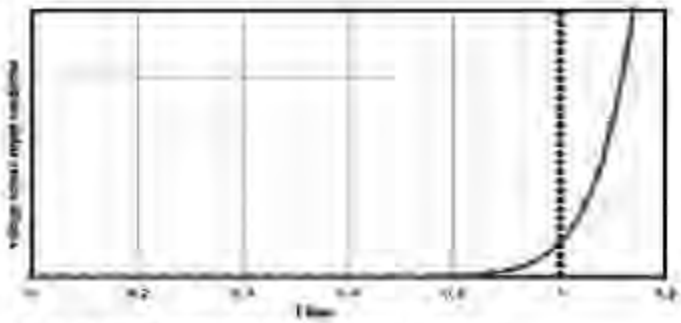


Fig. 5: voltage current relation in super conductor

Though once initiated the quench process is uncontrolled, the extent of the normal region and the temperature rise in the materials can be predicted. Thus, the quench process can be used in the design into a superconducting component. Several hundred patents exist showing theoretical ways in which this phenomenon might be used to control fault currents in the electric power grid. However, efforts to develop the concepts into commercially viable product have culminated in only a few practical designs and even fewer working prototypes. Many of these designs have shortcomings (e.g. size, performance, reliability, recovery under load, or cost) that hinder them from reaching full commercial potential. Most SFCL designs use the aforementioned quench behavior to limit fault currents within the first cycle. However, that is often where the similarities end as each SFCL design has its own methods of sustaining the limiting action once the superconductor becomes resistive.

Definition

- SFCL is a new power device to automatically limit a fault current to a safe level with the superconducting property
- When superconductor is cooled down to critical temperature (about -186°C) or less, the resistance becomes zero. However, superconductor loses superconductivity and resistance occurs rapidly (quench), when excessive current flows and exceeds certain value (critical current). SFCL device uses this property.

SFCLs are available today for application in the power grid and can serve to reduce fault current magnitudes, eliminate or defer the need to replace circuit breakers, reduce short current forces, and increase system reliability by allowing for tighter grid interconnection.

Operating Principle

Superconductor has a property that it loses superconductivity and resistance/impedance occurs rapidly when excessive current flows and exceeds certain critical current value. This property of superconductor made use for the production/usage of super conducting fault current limiters

Fig. 6: what will happen to super conductor material when fault

SFCL Characteristics

- First cycle peak current limiting: Fault currents above the SFCL's trip current level cause the superconductor element to undergo an almost step-function transition to its high impedance state, ensuring fault current limitation of the first cycle peak.
- Near-zero Insertion Impedance: Under normal conditions, the SFCL acts as a near perfect electrical conductor. It is practically invisible in the grid, essentially eliminating steady state losses, voltage drop and other operational limitations of current limiting reactors.
- Automatic, Fail-safe: Operation of the SFCL is based upon the physical properties of its superconductor element – no external controls are needed. The current is controlled for a predefined interval consistent with the power rating of downstream equipment and to enable fault identification before circuit breaker operation.
- Automatic Reinsertion: After a current-limiting operation, the SFCL automatically resets and is ready for the next operation. No external signals are necessary to reset the device and no elements need to be replaced after a fault.
- Continuous Limiting Option: If desired, an interruption-free, current-limited power flow in the grid can be provided by optional parallel-connected inductive or resistive shunts. These provide continuous current limiting while the SFCL is returning to its passive superconducting state.
- Minimal Voltage Distortion: Resistive SFCLs produce minimal voltage distortion while limiting fault currents. Only a reduction in current peaks, along with normal voltage waveforms, result from SFCL operation.
- Voltage and Current in Phase: Voltage and current remain in phase during current-limiting operation, making it easier for circuit breakers to interrupt the fault current.

- Modular Design: The internal modular design of the SFCL allows for customization of the device's ratings, including continuous current, trip current, available fault current, limited fault current and fault duration.

Types of SFCL

Mainly there are 2 types of SFCL are using,. they are i. Resistive SFCL and ii. Inductive SFCL

Resistive SFCL: The resistive FCL is based on the nonlinear characteristic of a SC element. An electric field only develops above the critical current.

The resistive SC FCL brings an innovative device in the electric grid, which need it to respond to new demands in terms of power quality and supply secularization. A FCL also enhances the operation of an electric grid and will play a part in the grids of the future.

SFCL uses a high temperature superconductor (HTS) element to carry normal load current. The HTS element has near-zero impedance under normal conditions and remains in the circuit when a fault occurs. During the fault, the current magnitude will exceed the HTS material's so-called critical current, causing the HTS material to transition to a very high resistance state.

This transition is immediate and reduces the first cycle and subsequent fault current peaks. In this case, the HTS element acts as what very fast (<2 msec) current-limiting switch. The introduction of resistance by the SFCL also reduces the system X/R ratio at that point, reducing any DC offset in the fault current waveform and further lowering the impact of the fault on downstream devices. A reactor or resistor can be paralleled with the SFCL for extended fault duration operation.

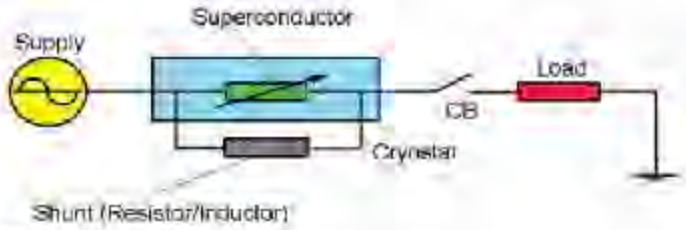


*Fig. 7: **Resistive SFCL***

- Superconductor connected in series with the line to be protected.
- To keep it superconducting, it is usually immersed in a physical condition which is chilled.
- In case of a fault the inrush of current and magnetic field take the super conductor into the transition region, thereby the increasing resistance limits the fault current.
- The behavior of resistive fault current limiter is largely determined by the length of the superconductor & the type of material used for it.

Before resistive SFCL designs experienced issues with "hot spots", or non-uniform heating of the superconductor during the quench/ transition. This is a potential failure mode that occurs when excessive heat damages the HTS material. Recent advances in procedures for manufacturing HTS materials coupled with some creative equipment designs like some coatings etc., have reduced the hot-spot issue.

Characteristic resistive SFCL after a quench is determined by the shunt element connected. Shunt is typically quite reactive, so a resistive SFCL typically introduces significant inductance into the power system during a fault.

During the transition period when current is being transferred from the superconductor to the shunt, the voltage across the parallel combination is typically higher than it is after the current has transitioned into the shunt. The dynamics of this process depend on the two elements and their mutual inductance.

We know the fault current inrush thus quench process will result in a high temperature in super conducting material. This heat we have to remove very quickly so we have to use coolant for that. And also its superconductivity has to be retained quickly. This time for restoring is called recovery time for SFCL.

Indictive SFCL: Inductive type superconducting FCL is of two types. They are FCL with saturated iron and FCL with shielded core.

- **Shielded Core Type SFCL:** This is a variation of the resistive type SFCL. Here the super conducting cool environment/cryogenic environment are mechanically isolated from other part of the circuit. And electrically coupled. Device looks like a transformer with secondary side shunted by high temperature super conductor element. At the time of fault, a high inrush of fault current occurs. This causes a high current flowing through secondary side. Now by action of high temperature superconductor, quenching occurs and thus voltage drop increases. This voltage drop will make a high voltage on the primary side/line. This will oppose the flow of fault current, thus current limiting takes place. Like in resistive type, we have to re cool the high temperature super conducting element after quenching occurs.

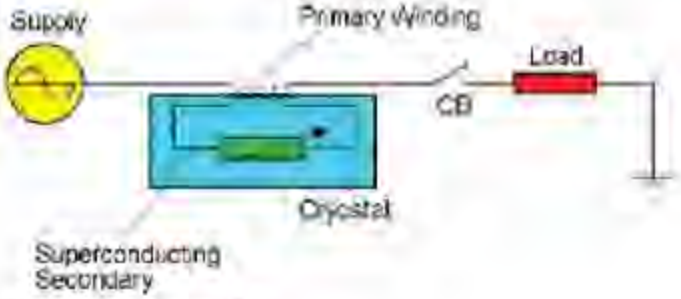


Fig. 8: Shielded core SFCL

- **Disadvantage of the shielded core type:** It will be approximately 4 time the size and weight of resistive type for the same rating. Because of this size and weight problem this type is not used as well.
- **Saturable Core Type SFCL:** saturable-core SFCLs utilize the dynamic behavior of the magnetic properties of iron to change the inductive reactance on the AC line. Arrangement shown in Figure 9. The line windings are made of conventional conductors that are wounded on core to form an inductance in series with the AC line. The iron core also has a superconductive winding that provides a magnetic bias.

Capacitor

PRESENTING REACTIVE POWER SOLUTIONS THAT YOU'LL LOVE, BUT YOUR ELECTRICITY PROVIDER WON'T.

Havells Capacitors are built to make sure your factory consumes lesser energy and saves more. The design and materials used to build them not only ensure safety from high voltage, current stress and the ability to withstand extreme temperatures, but also provide low electrical losses and help reduce energy consumption around 30%*. This means more saving for you and lower revenue for your electricity providers. So if you were in their place, would you love these capacitors?

*Condition apply.

HAVELLS

Customer Care no. for Product enquiry: 1800 11 0303 / 1800 103 1313 / 011-4166 0303
Corporate Office: Havells India Ltd., QRG Towers, 2D, Sector-126, Expressway, Noida-201304 (UP) India. Tel.: +91-120-3331000, E-mail: marketing@havells.com, www.havells.com | Join us on Facebook at www.facebook.com/havells and share your ways to save the planet

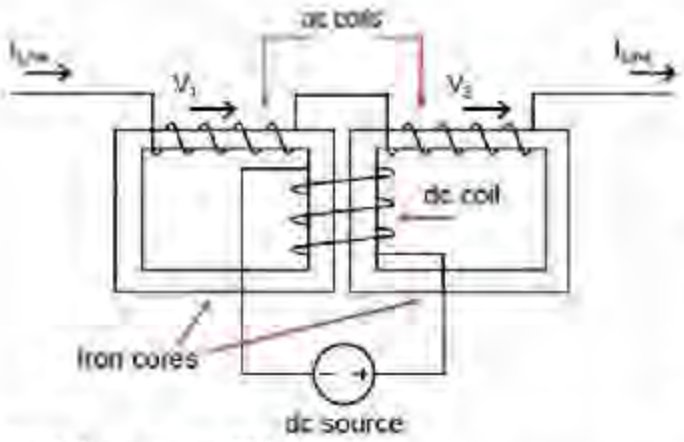


Fig. 9: Saturable core SFCL

Under nominal grid conditions (no fault), the HTS coil fully saturates the iron so that it has a relative permeability of one. To the AC coils, the iron acts like air, so the AC impedance (inductive reactance) is similar to that of an air-core reactor. Under fault conditions, the negative and positive current peaks force the core out of saturation, resulting in increased line impedance during part of each half cycle. The result is a considerable reduction in peak fault current. During a limiting action, the dynamic action of the core moving instantaneously in and out of saturation produces harmonics in the current waveform. Under normal conditions, the voltage and current waveforms are basically unaffected by the saturable-core SFCL.

Here quenching does not takes place. The saturable-core SFCL is a variable-inductance iron-core reactor that has the impedance of an air-core reactor under normal grid conditions and very high impedance during fault events. In resistive SFCLs because of quenching action, it require time between limiting actions to cool the superconducting components. The saturable core type approach can manage several actions in succession because the superconductor does not quench. In fact, the saturable-core FCL need not use a superconducting coil; however, the use of an HTS DC field winding reduces operating losses and makes the winding more compact.

Disadvantage is almost same as shielded core type. That is major disadvantage is its iron core weight because of the heavy iron core. Now researches are going on to make it more compact.

Design parameters of SFCL

- System voltage
- Continuous current rating
- Maximum 3-phase short circuit current or source impedance
- Fault clearing time; back-up clearing time, reclose sequence (if any)
- 1st cycle peak fault current desired to be limited to Follow through fault current desired to be limited to (i.e., through fault or overload levels where no limitation is desired)
- Per unit level of rated current for FCL transition

SFCL Application in power system

A fault condition may result in an electric power transmission system from events such as lightning striking a power line, or downed trees or utility poles shorting the power lines to ground. The fault creates a surge of current through the electric power system that can cause serious damage to grid equipment. Switchgears, such as circuit breakers, are deployed within transmission substations to protect substation equipment. When power delivery networks are upgraded or new generation is added, fault levels can increase beyond the capabilities of the existing equipment, with circuit breakers in an "over-duty" condition. This problem necessitates upgrades such as the modification of substations or replacement of multiple circuit breakers. Increased fault currents due to load growth and industry structural changes have become a significant factor in system planning and operation. Equipment and personnel safety, power quality, and overall system reliability are all at stake if techniques and tools are not found to mitigate the higher levels of fault current in today's grid. Here comes the role of fault current limiters. As we discussed early, there are many types of fault current limiters are used nowadays. Here in this part we can see the relative merits of superconducting FCL, how it behalves in a system etc. We will start with conventional methods. We listed most of these methods earlier. Conventional methods are-

- Construction of New Substations: Fault current over-duty coupled along with other factors may result in a utility selecting this solution, which will correct immediate problems, as well as providing for future growth. However, this is the most expensive of all the conventional solutions.
- Bus Splitting: This entails separation of sources that could possibly feed a fault by the opening of normally closed bus ties, or the splitting of existing busses. This effectively reduces the number of sources that can feed a fault, but also reduces the number of sources that supply load current during normal or contingency operating conditions. This may require additional changes in the operational philosophy and control methodology.
- Multiple Circuit Breaker Upgrades: When a fault duty problem occurs, usually more than one breaker will be affected. Upgrade of these breakers has the disadvantage of not reducing available fault currents and their associated hazards, as well as the often prohibitive expense of replacing the switchgear within a substation.
- Current Limiting Reactors And High Impedance Transformers: Fault current limiting reactors limit fault current due to the impedance across their terminals, which increase during the fault. However, current limiting reactors also have a voltage drop under normal loading conditions and present a constant source of losses. They can interact with other system components and cause instability
- Sequential Breaker Tripping: A sequential tripping scheme prevents circuit breakers from interrupting excessive fault currents. If a fault is detected, a breaker upstream to the source of fault current is tripped first. This reduces the fault current seen by the breaker within the zone of protection at the location of the fault. This breaker can then open safely. A disadvantage of the sequential tripping scheme is that it adds a delay of one breaker operation before final fault clearing. Also, opening the breaker upstream to the fault affects zones that were not originally impacted by the fault.

Our tools and critical components are manufactured in-house

This gives us a lead in building your trust.

We, at Havells have set up one of the most advanced production facilities in the world to produce switchgear and controlgear. By bringing the world's best machines, highest grade raw materials and the best production practices together under one roof, we produce an industrial range that is at par with the best in the world.

- Advanced in-house lab
- High degree of automation for greater accuracy
- Every product tested vigorously for quality
- Sophisticated and tooling and manufacturing machines
- Use of best available raw materials at every stage

HAVELLS

Customer care no for product enquiry: 1800 11 0303 / 1800 103 1313 / 011-4168 0303.
Corporate Office: Havells India Ltd., QRG Towers, 2D, Sector-126, Expressway, Noida-201304 (UP) India, Tel.: +91-120-3331000, E-mail: enquiry.f@havells.com, marketing@havells.com, www.havells.com, Join us on Facebook at www.facebook.com/havells and share your ways to save the planet!

Now as an effective alternative, we will discuss about application of SFCL for current limiting. Superconducting fault current limiters we already discussed their operation and all Under normal operating conditions, the peak of the AC current level of the power transmission network is always below the critical current level of the superconductor, therefore there is essentially not voltage drop across the device and there are no losses. The device is "invisible" to the grid. When the fault occurs, the fault current level exceeds the critical current level of the superconductor, creating a quench condition. The superconductor is forced to transition to the high resistive state and most of the fault current is shunted into the parallel inductor to introduce the current limiting impedance 'Zo' into the grid to limit the fault current.

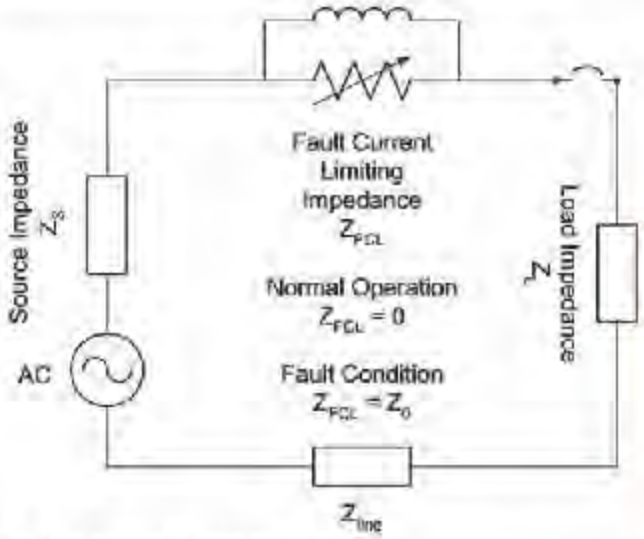


Fig. 10: Electrical equivalent of SFCL

The introduction of the new generator could result in breaker over-duty problems on multiple breakers shown in the ring bus in Fig. 10. Utilities are faced with extended outages and expense to upgrade all the affected breakers. An alternative approach is to use an SFCL to reduce the available fault current to a lower, safer level so the existing switchgear can still protect the grid. In the example of Fig. 11, the SFCL is placed in series with the generator to reduce its contribution of fault current, avoiding the cost of upgrading the four breakers in the ring bus.

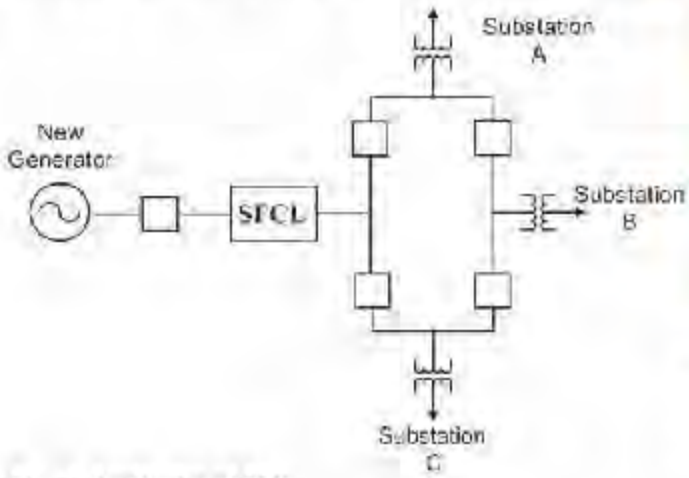


Fig. 11: Application of SFCL

Comparison of SFCL with Conventional Systems

Table 1 summarizes the conventional solutions SFCL. The expected cost of the SFCL relative to the conventional solutions is also shown. Here primarily considers the initial capital installation cost in the comparison. In the cases of multiple circuit breaker upgrades, the cost of bus work reinforcement must also be considered, since the level of fault current is not being reduced. This consideration makes the SFCL an attractive alternative, since it also minimizes the outage time. From table, the SFCL is expected to be cost-competitive with all of the conventional solutions with the exception of current limiting reactors and sequential breaker tripping. In these cases, a consideration of life-cycle costs and negative impact on system reliability may cause a utility consider the SFCL over these solutions. There is, furthermore, a limit to the effectiveness of adding current limiting reactors as more and more of these devices are added into the grid.

Solution/ method	Advantage	Disadvantage	Relative cost	Relative cost to SFCL
New sub station	Provides for future growth	Expensive and lengthy to install	Most expensive	SFCL is less expensive
Bus splitting	Separate sources of load current	Separate sources of load current from load centres and undermines system reliability	High if split bus is not installed	SFCL less expensive
Multiple circuit breaker upgrade	Most direct solution with no adverse side effects	Difficult to schedule outages; bus work reinforcement also needed	High to medium, depending on number of breakers	SFCL less expensive than most multiple breaker upgrades
Current limiting reactor	Easy to install	Voltage drop and power losses	Medium to low	SFCL cost higher
Sequential breaker tripping	No major hardware installation involved	Expands impact of fault to wider range of system	low	SFCL cost higher

Table 1

SFCL Application Example

The Figure next page shows the application of SFCL in a transmission network for controlling fault current problem. Figure shows an example of a substation in the American Electric Power (AEP) grid that currently employs a sequential tripping scheme to

"We cherish the strong relationships we have built with our

over the years, and we truly appreciate their loyalty"

Amit JINDAL

- ✓ **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, 971 838 8310
E-mail: sales@shivalic.com | Web : www.shivalic.com

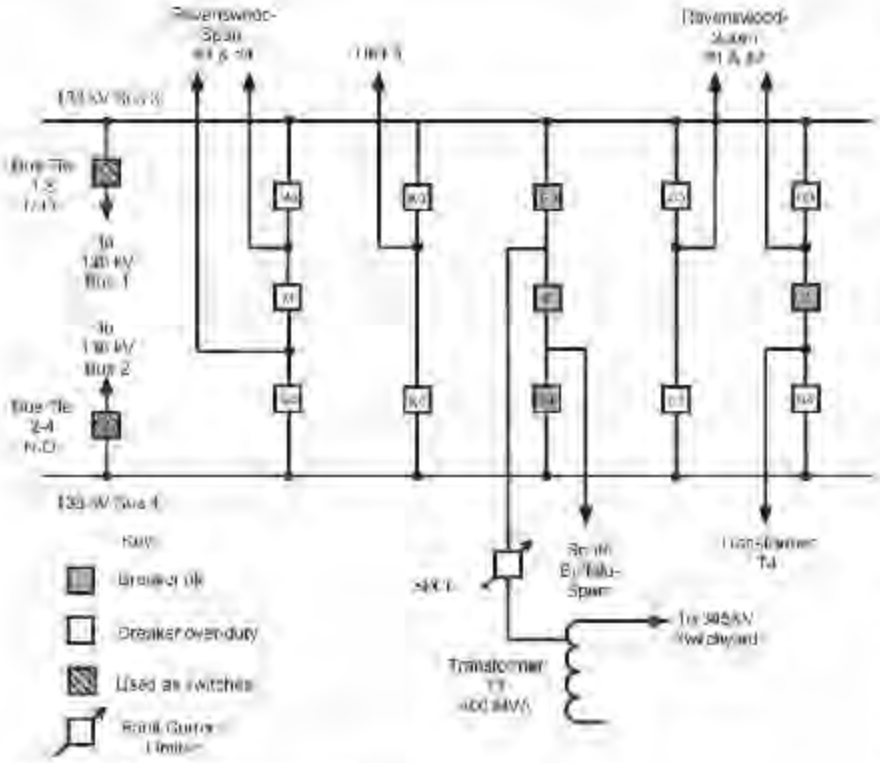


Fig. 12: SFCL application example

cope with high fault currents. Auto transformer T3 with a 400 MVA rating ties the 345 kV portion of the switchyard to the 138 kV portion of the switchyard. This tie is beneficial to the operation of the system during normal operation, but the transformer contributes an additional 13 kA at the 138 kV bus during fault conditions. This puts 9 breakers, as indicted in the Figure, in an over-duty/overloaded situation. To resolve this problem/to avoid this overload, breakers E3 and E, which have sufficient rating, are tripped first if a fault is detected on Line 1 to Line 4. This removes Transformer T3's contribution to the fault so that the affected over-duty breaker can safely open and isolate the fault. The sequential breaker scheme solves the problem, but has the disadvantage of delaying the fault clearing by the addition of E3 and E in the trip sequence. It also results in removing the normal T3 load current to portions of the system that were not affected by the fault.

Fig. shows how the addition of an SFCL in series with transformer T3 could resolve the problem without resorting to the sequential breaker trip scheme. During normal operation the SFCL is transparent to the system, and T3 supplies load current from the 345 kV systems to the 138 kV system. Under fault conditions, the SFCL transitions to the high impedance state to limit the contribution of T3 to the fault, allowing the existing breakers to clear the fault without opening E3 or E first. The appropriate SFCL requirements have to be determined by additional system studies to finalize the feasibility of using an SFCL in this application. This particular application also presents a good opportunity to study the response of the SFCL at the time of the fault. If the sequential breaker trip scheme is left in place with the SFCL installed in series with T3, then the response of the SFCL can be verified in the time before E3 and E are opened. This will help with the verification of the new SFCL technology before it is placed in a critical protection application.

Challenge for SFCL to be used in Transmission Level

Use of SFCL in transmission level is little more difficult and is having some challenges. This is under research. Many research studies are going on to overcome these challenges. The main challenges for SFCL to be used in transmission level are,

- Scale-Up to Transmission Voltage: The scale-up to transmission-level voltages is particularly challenging, since there is not much prior art on the application of high voltage components in a cryogenic environment. In support of the high voltage work, a Cooperative Research and Development Agreement (CRADA) is being conducted on the SFCL program with Oak Ridge National Laboratory (ORNL) to utilize the available experience in this area. This will include the development of new high voltage design tools. Experimental and mock-up tests will be employed to develop the empirical formulas to predict breakdown voltages and perform evaluations of materials suitable for high voltage application in cryogenic environment.
- Impact on Protection Schemes & Test Standards: The application of superconducting fault current limiters in the utility network will require new integration issues to be addressed. As devices like the SFCL come closer to commercial reality, these issues are now being considered by various industry groups. The characteristic of the SFCL impedance appearing only during the fault must be considered in the implementation of protective relay schemes. The development of testing standards and procedures also has to consider the variable impedance nature of the device. In particular, the method by which the BIL tests are applied to the terminals of the device must consider the variable impedance characteristic. These standards will be developed in conjunction with input from the utility industry.
- Recovery Requirements: During the fault, the HTS material heats up and must cool back down to return to a superconducting state before the device is invisible to the system again. The time to return to a super- conducting state is typically termed the "recovery" period. The cool-down period is proportional to the amount of time that the material was heating up during the fault, both in terms of the duration and the magnitude of fault current.

The length of the recovery period will also be a function of the conditions under which the recovery must take place. In some applications, the SFCL device will not be carrying any current

during the recovery, which will result in the fastest recovery period. In some applications, the device will have to carry nominal load current during the recovery, which will provide some constant level of background heat generation in the device that will lengthen the recovery period. This would be the case for both applications shown in Figures. SFCL Application and application example.

In this case, the HTS elements are not bypassing the parallel inductors, so the SFCL will present some impedance to the system during this recovery. As part of the future work, formal studies will be performed to determine acceptable recovery periods for the potential applications of the SFCL. Preliminary discussions with utilities have indicated that the presence of the SFCL impedance during the recovery may not be an issue of concern, since the device will typically be employed in strong systems, where the short circuit current level is high.

Conclusion

From all discussions in this article, we can see superconducting fault current limiter technology is a very much cost effective, clean, safe, reliable method of fault current limiting. Many researches are going on this topic. It has a very good future scope. In recent decades, all our systems will be of superconducting technology. It is one of the contributing component of smart grid technology. Only the limitation they are facing is that they cannot use for high voltages. Research studies are going on to overcome this difficulty.

Profile

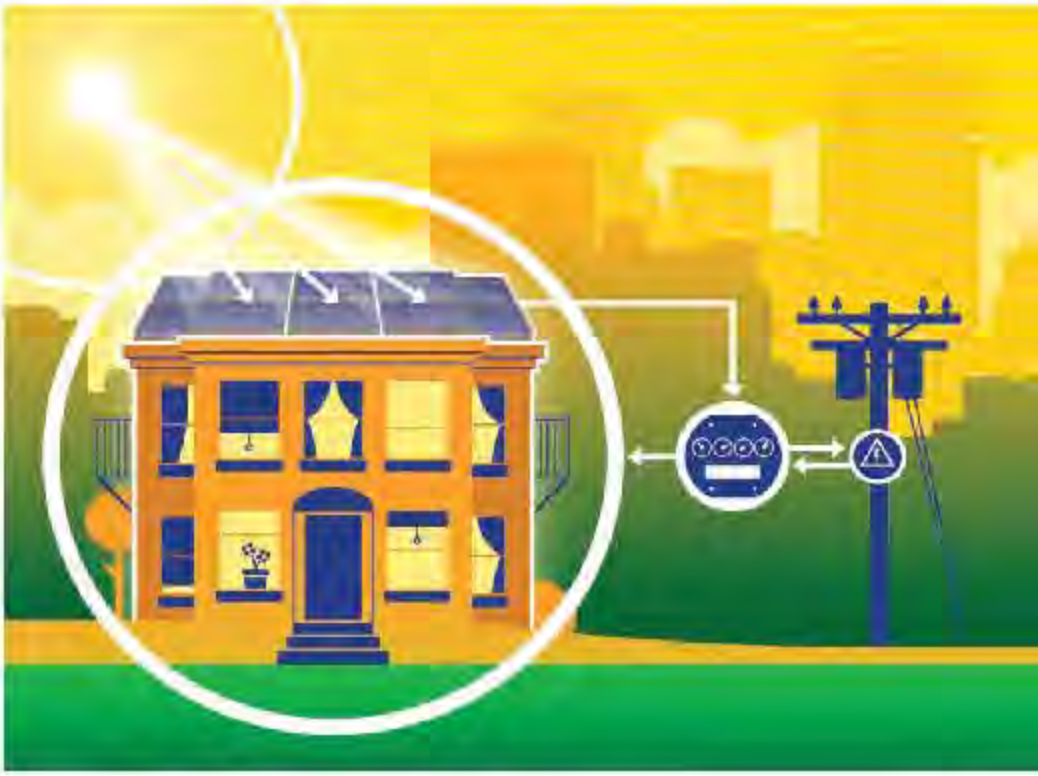
Currently pursuing ME from Goa College of Engineering, is BTech in Electrical and Electronics Engg. from Cochin University of Science and Technology, Kerala. He has Diploma in Electrical Engineering from Sreerama Govt. Polytechnic College Triprayar, under Technical Education Department, Kerala.

Avinash Babu KM

Currently working as Principal and Head of the department of Electrical and Electronics Department, Goa College of Engg. is PhD in power factor correction in converters from IIT Bombay. He is MTech in Power Electronics from IIT Bombay and BE from Karnataka University.

Prof (Dr) Vinayak N Shet

Metering Systems, Policies and Tariffs for Distributed Renewable Systems



Worldwide, there are three different tariff policies that are designed to foster private investment in distributed energy resource or renewable systems, namely, the Power Purchase Agreement (PPA), the Feed-in Tariff (FIT) and the Net Energy Metering (NM). Based on the experiences gathered in countries where implemented, this article attempts to identify a system that would be most appropriate for implementation in a diverse democratic country such as India.

Dr Vithal N Kamat

Distributed Energy Resource systems (DER) are increasingly playing an important role in modern electric power distribution system. They refer to small grid connected decentralized energy generators that typically use renewable energy sources such as biomass, solar and wind power. In sharp contrast to the conventional centralized coal-fired, hydro or nuclear power plants, DER systems are located close to the load and use modular, flexible technologies.

DER exploits small size for lower cost (possible to mass produce small systems), reduced T&D losses (due to local generation / less site specific), low pollution, lower maintenance, lesser complexity and cost of regulatory oversight, tariff administration & metering and billing.

Currently DER systems are reaching grid parity – a point at which the DER can generate electricity at a Levelized Cost of Electricity (LCOE) that is less than or equal to the end consumer's retail price (see Figure 1). Reaching grid parity is essential for an energy source to be a contender for widespread development without subsidies or government support. Since 2010, grid parity has been reached for solar and wind (see Table 1), and this has been a catalyst for growth of these DER systems in a number of markets such as Europe, Australia, & U.S. Figure 2 shows the drop in LCOE for solar photovoltaics for the European markets.

Since grid parity dictates the success of DER systems, it is clear that the associated tariff policies, tariff mechanisms, compensation and purchase arrangements play a vital role in sending clear signals to the public for their involvement. There are three compensation mechanisms that are designed to accelerate investments in DER systems:

- Power Purchase Agreement (PPA), also known as the 'Standard Offer Program' offers compensation that is generally below retail. It could be above retail,

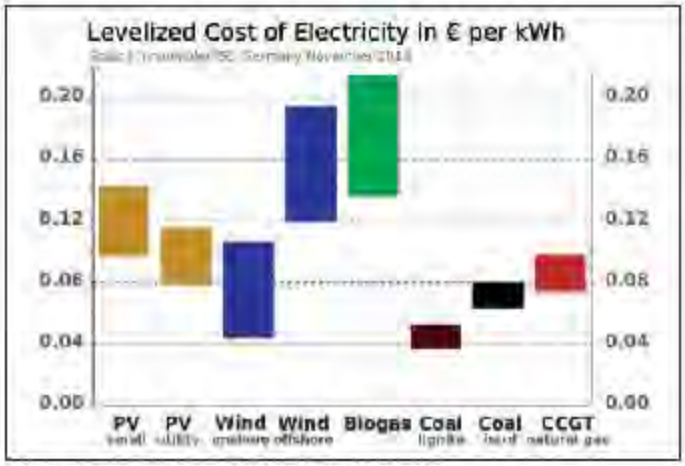


Fig. 1: Levelized Cost of Electricity for DERs

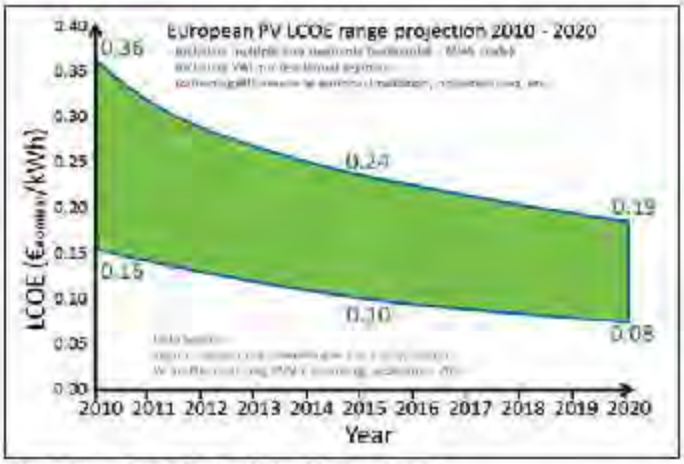


Fig. 2: Drop in LCOE for Solar Photovoltaics

particularly in case of solar where generation is close to peak demand.

- Feed-in Tariff (FiT) which is usually set initially above retail and reduces down to retail as the percentage of DER adopters increase.
- Net Energy Metering (NM) which is always at retail. Since the DER is mostly used for own consumption, technically, it cannot be termed as compensation, although it may be considered so if there is excess generation and if utility is allowed to make payments for the same.

In this article, we will take a close look at each of the three tariff mechanisms and understand their pros and cons. We also consider the experiences of some of the countries where implemented, so that we can pick one that is best suited for our country.

Plant Type	Capacity Factor	Levelized Cost (USD/MWh)
Geothermal	92	47.9
NG*: Advanced Combined Cycle	87	64.4
NG: Conventional Combined Cycle	87	66.3
Wind	35	80.3
Hydro	53	84.5
NG: Advanced CC with CCS	87	91.3
Conventional Coal	85	95.6
Advanced Nuclear	90	96.1
Biomass	83	102.6
NG: Advanced Combustion Turbine	30	103.8
Integrated Coal-Gasification Combined Cycle (IGCC)	85	115.9
NG: Conventional Combustion Turbine	30	128.4
Solar Photo-Voltaic (PV)	25	130.0
IGCC with CCS	85	147.4
Wind – Offshore	37	204.1
Solar Thermal	20	243.1

Table 1: Estimated U.S. Average Levelized Cost of Resources, 2019
** NG = Natural Gas*

Power Purchase Agreement (PPA) based System

Onsite renewable Power Purchase Agreement (PPA) allow agencies to fund DER projects with no up-front capital costs incurred. With the PPA, a developer installs a DER on agency property under an agreement that the agency will purchase the power generated by the system. The agency pays for the system through these power payments for the life of the contract, while the developer installs, owns, operates, and maintains the DER system over the same contract life.

Under the PPA mechanism, the energy generated and the consumed by the agency / consumer are metered separately using two meters, namely, the PPA meter and the standard consumer meter respectively (see Figure 3). Due to this independence, under the PPA, neither the agency who pays for the power generated by the DER system nor the developer who owns and operates the DER system need to be a consumer of electricity. The PPA solely binds the agency and the developer, and therefore, is outside the scope, jurisdiction, and purview of the Energy Regulatory Commissions (ERCs). An exception to this is when the agency happens to be a local electric utility, in which case the tariffs would be under the purview of the ERCs.

PPAs feature a variety of benefits and considerations for utilities or government agencies. Benefits to the utility/ agency:

- No up-front capital costs
- Typically a known, long-term energy price
- Ability to monetize tax incentives
- No operations & maintenance responsibilities
- Minimal risk.

Considerations

- Utility/ government sector experience with PPAs is in its infancy/ still growing
- Challenges and concerns with site access contracts
- Contract term limitations
- Inherent transaction costs.

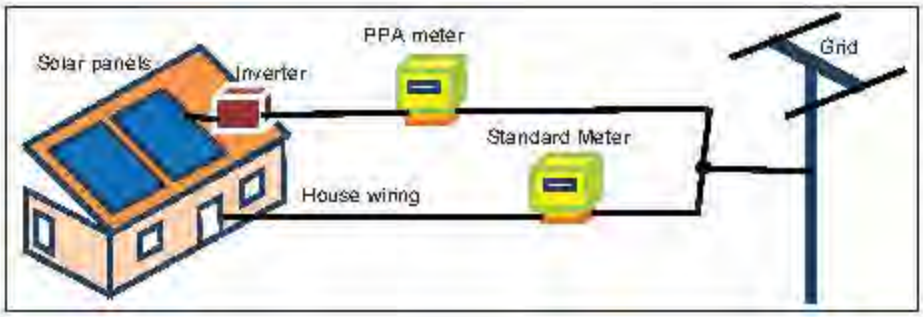


Fig. 3: Parallel Connected Power Purchase Agreement (PPA) Meter

However, as of 2009, many of the electric utilities have stopped accepting new PPA applications. For example in Ontario, Canada, the Renewable Energy Standard Offer Program (RESOP) has been replaced by the Feed-in Tariff (FiT) program. The PPAs are individual contracts and are of lower significance in our current context. Hence, we will proceed to evaluate the remaining two, more interesting, compensation mechanisms.

Feed-in Tariff (FiT) System

Feed-in Tariff (FiT) schemes are typically based on a 15-20 year long contract where prices are predefined above retail with a tariff degression, which effectively reduces the earnings over time. In the FiT, you get paid for every kWh you generate under an FiT contract.

The FiT system uses a separate meter called a FiT meter (see Figure 4) in order to measure the outflow of electricity generated from renewable energy on the consumer's premises independently. The FiT meter could be unidirectional, but if we are interested in knowing the consumption of small (usually insignificant) amounts of power by the DERs when they are themselves not generating, we could consider the FiT meter to be a bidirectional meter. The electricity consumption is measured by the Standard meter which is compulsorily a bidirectional meter (see Figure 4). The separation of electricity generation and consumption using two meters enables each to be priced separately.

Unlike the meter connections under the PPA scheme, in case of the FiT, it is possible to identify how much kWh units consumed by the consumer has been generated by his own DER system at any particular instant of time. Since only the surplus energy generated by the DER at any instant of time gets exported through the Standard meter, it is possible to have a tariff rate applied to the surplus energy that is different from the rate applied to the total energy generated by the DER system.

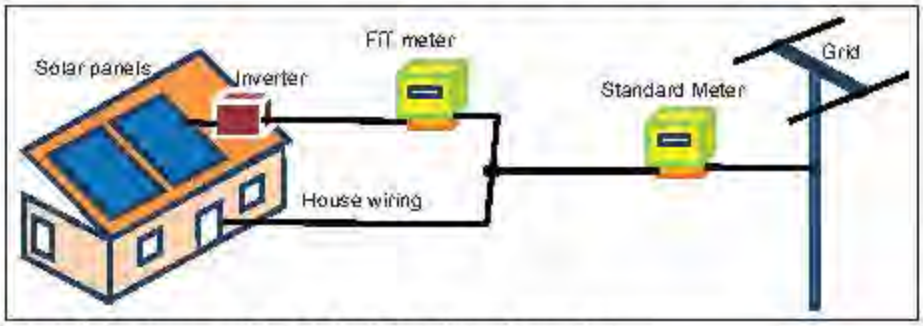


Fig. 4: Series Connected Feed-in-Tariff (FiT) Meter Connections

The FiT systems are popular for solar generation in several European countries including Germany. In order to boost solar power, German utilities once paid several times the retail rate for solar, but has successfully reduced the rates drastically while actual installation of solar has grown exponentially at the same time due to installed cost reductions. Since the German system pays what each source costs with a reasonable profit margin, wind energy, in sharp contrast, only receives around a half of the domestic retail rate. As a result of these measures, Germany has the highest PV installed capacity of 36 GW (as on 31st May 2014) of which 71% is in the rooftop segment.

However, long term contracts could have its risks. Malta is in the news, with a finding by its energy minister of irregularities in a €35 million FiT contract for the installation of photovoltaic panels on public buildings that binds the country for 35 years. While the contract provided a feed-in tariff of 23 cents per kWh for 25 years, it should actually have been 16 cents.

Net Energy Metering

Net Energy Metering or Net Metering (NM) is a service offered by the local electric utility to an electric consumer under which

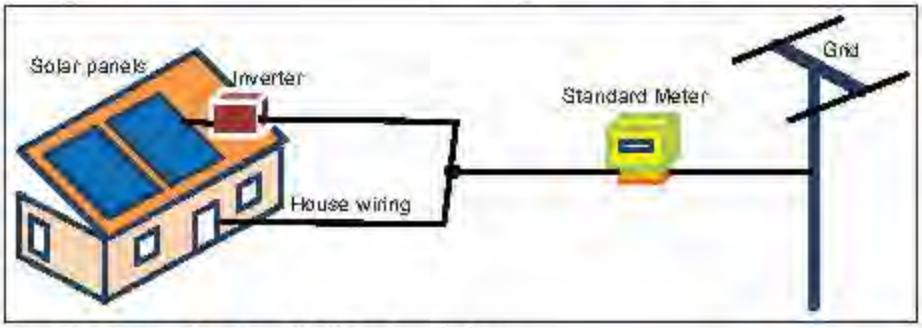


Fig. 5: Net Energy Metering (NM) Meter Connections

electric energy generated by that consumer and delivered to the local distribution grid may be used to offset the electric energy provided by the electric utility to that consumer during the applicable billing period. Unlike FiT, the NM requires just a single energy meter (see Figure 5). It may appear that the meters currently in use in India may suit the purpose. However, it should be noted that NM requires the

SEE THE HEAT WITHOUT GETTING BURNED

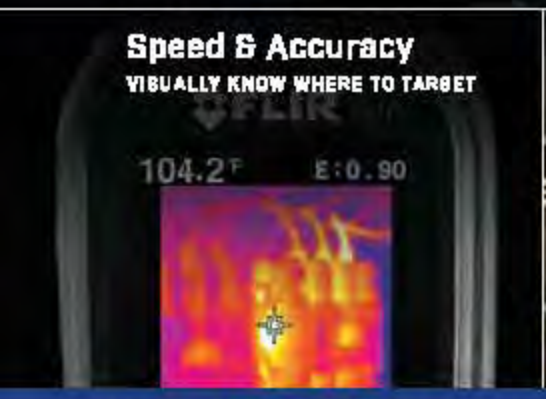
THE TG165 SHOWS WHAT'S HOT FOR INSTANT TROUBLESHOOTING.

The FLIR TG165 Imaging IR Thermometer bridges the gap between single spot infrared thermometers and FLIR's legendary thermal cameras.

Check out the interactive simulator to experience this groundbreaking tool in action.

Speed & Accuracy

VISUALLY KNOW WHERE TO TARGET



Stay Safe

24:1 SPOT SIZE RATIO

Rugged & Reliable

DESIGNED TO WITHSTAND THE HARSHEST ENVIRONMENTS

SEE THE HEAT AT FLIR.COM/TG165/ELECTRICAL

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

FLIR

The World's Sixth Sense™

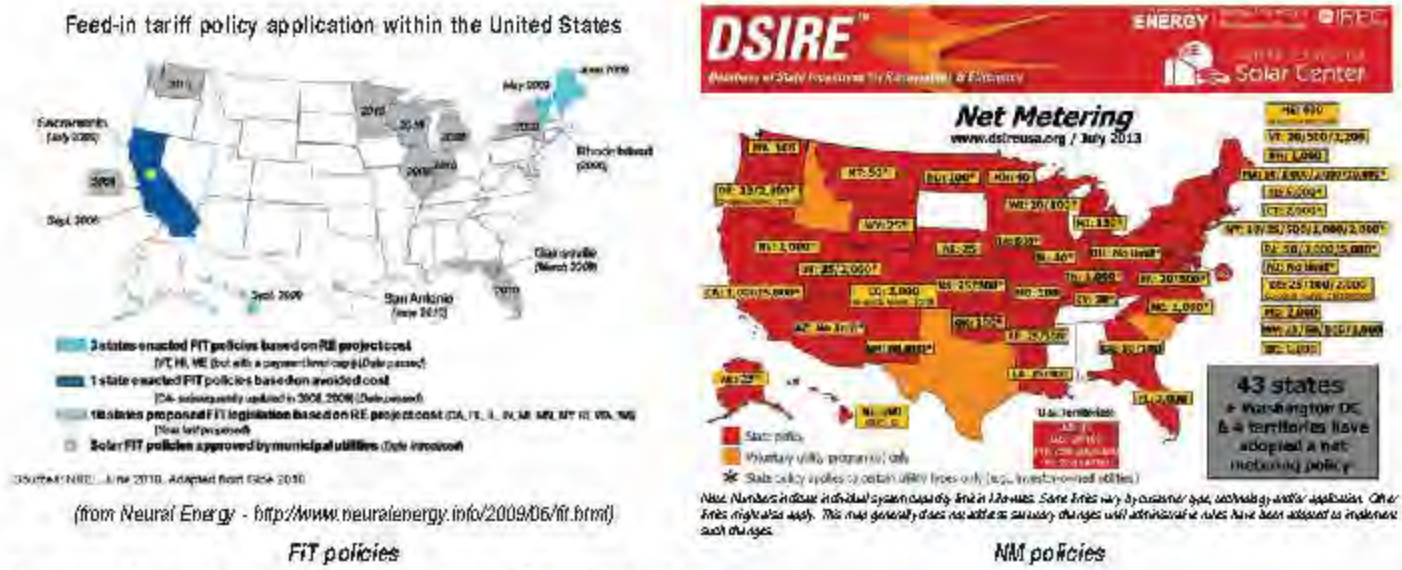


Fig. 6: Map showing states in U.S. that have enacted FiT and NM policies

standard meter to be bidirectional whereas the Indian meters are unidirectional.

Though the NM policy is designed to foster private investment in the renewable energy, it varies significantly by country and by state: if NM is available, if and how long you can keep your banked credits, and how much the credits are worth in retail or wholesale. In general, the NM policy involve a monthly roll over of energy (kWh) credits, a small monthly connection fee, monthly payment of the deficits which is the normal electric bill, and annual settlement of any residual credit.

It can be observed from Figure 6, that Net Metering is popular in 43 States. The US Energy Policy Act 2005 mandates all public electric utilities to make net metering options available to all the customers. California has over 1 lakh net metering consumers with maximum solar capacity of 991 MWp. The NM policies are far more popular than the FiT policies in the US and in Japan.

Comparison between FiT and NM

Table 2 highlights some of the differences between FiT and NM, their pros and cons.

Advantages of NM

We believe that any Indian consumer who is interested in generating energy using renewable means should be allowed to do so; moreover, encouraged to do so. NM needs no licence. NM is about respecting and protecting the rights of individual home owners to generate their own power for their own use particularly from a renewable resource. Therefore, we feel that NM is most appropriate for a democratic country like India.

Instead of wasting the excess electricity, under NM it is provided to the local distributor who will apply the credits for that excess towards the electricity bills. Grid-access has been the point of contention for NM. Electric

	Feed in Tariff (FIT)	Net Metering (NEM)
Pros	◆ guaranteed contract to sell electricity usually for a long period of 20-40 years. ◆ allows you to sell all your power if you're able to generate more than you use ◆ price is usually partly indexed to inflation ◆ fixed prices stabilize electricity rates, attract new investment ◆ guaranteed terms and low barriers to entry lead to job creation, economic growth.	◆ can offset your bill and you only pay for electricity used in excess of what you generate ◆ where it exists, there are laws that guarantee your right to net meter and offset your bill ◆ no licence or contract needed, easy and simple to implement ◆ acts like a perfect hedge against rising electricity prices.
Cons	◆ more complex to implement because you need to get a contract and it may be a competitive process ◆ a separate generator account and a licence is required ◆ usually rates paid by owners for electricity are higher than FIT contract prices therefore you may end up selling your electricity at one price and buying back the electricity you use at a higher price ◆ no hedge against rapidly rising electricity prices.	◆ rules can very significantly as to how long you can bank your credits (i.e. only a month or up to a year) and how much your kwh's that you banked are worth (retail or wholesale value) ◆ if you produce more than you use, you generally don't get paid for these kwh's, they expire.

Table 2: Comparison between FiT and NEM

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

utilities argue that under NM one may use an isolated DER to generate but not with a grid connection. To this, the counter argument would be – electricity is a perishable commodity that cannot be stored efficiently. It is in the best environmental interest to feed excess energy generated by DERs into the grid, and local electric utilities should facilitate the same.

Advantages of FiT

Since NM protects the rights of consumers, it does not mean that the FiT model has no role to play. Two decades back, Western Europe's landmark FITs were tremendously important in jump starting the solar industry. FITs work well in places where the cost of retail electricity is low and the cost of electricity from solar systems is high. FiTs are also far more stable since they are contracts with a binding term on both parties. But today we have outgrown those infant days when one needs to deliberately over-pay to get solar built.

Today, some say that there is contraction in the German market, turmoil in other European countries and in some states of US. The first and most famous U.S. FiT – the Gainesville Regional Utilities program started in 2009 has been suspended in 2014.

Over 5 years the utility has paid $11.4 million at a solar generated electricity price of 0.29 cents per kWh. To account for this FiT, residential rates were raised by 0.3 cents per kWh. But, due to FiT, Gainesville has reached its solar targets. It is to be seen if Gainesville will be setting new targets for the forthcoming years, and if so, the model it would choose.

Though U.S. favours NM, its residential consumers are not the major beneficiaries. Electric utilities also complain that NM takes the revenues away from the utilities base. A close study will reveal that it is solar leasing companies that derive their fees and maximum profit from NM. The utilities and consumers sell their rights to a leasing company to develop solar power.

On the other hand, community banks and credit unions prefer FiTs as they are more bankable. With a FiT, a community can take a loan from a bank and install renewable energy project on their own.

Germany has been the most successful with FiT after restructuring the Feed-in Law as the 'German Renewable Energy Act' in 2000. This Act has proved to be the world's most effective policy framework at accelerating renewable deployment. The German FiT policy (amended in 2004 and 2008) brought in important changes:

- Purchase prices were based on generation cost. This led to different prices for wind power, solar power, biomass/biogas and geothermal and for projects of different sizes.
- Purchase guarantees were extended to 20 years.
- Utilities were allowed to participate.
- Rates were designed to decline annually based on expected cost reductions, known as 'tariff degression'.

Under FiT, long-term contracts were offered in a non-discriminatory manner to all renewable energy producers. Purchase prices were based on costs. FiT policies typically target a 5–10% return. Efficiently operated projects yielded a reasonable rate of return. FiT resulted in growth of solar power in Spain, Germany, Ontario (Canada) while that of wind power in Denmark.

The success of photovoltaics in Germany resulted in an electricity price drop of up to 40% during peak output times. It resulted in savings between €520 million and 840 million for consumers. It also had a positive impact on job creation and economic growth.

However, savings for consumers have meant conversely reductions in the profit margin of the big electric power supply companies. Increase in the solar energy share in Germany also had the effect of closing gas- and coal-fired generation plants. The big electric power supply companies reacted by lobbying the German government, which reduced subsidies in 2012. Electric utilities also lobbied for the abolition, or against the introduction, of feed-in tariffs in other parts of the world, including Australia and California.

We believe that the NM suits residential scale DERs of capacities upto 100 kW, while the FiT is unparalleled at unleashing the commercial and community scale segments with larger DERs having capacities more than 100 kW.

FITs work well in places where the cost of retail electricity is low and the cost of electricity from solar systems is high. FiTs are also far more stable since they are contracts with a binding term on both parties.

Regulatory Framework in Gujarat

Let us now change focus to India and, in particular, to the State of Gujarat. The policies that has been put in place to accelerate the growth of renewable energy in India's energy mix are:

- The National Action Plan on Climate Change (NAPCC) launched by the Government of India in June 2008 - a comprehensive plan that targets an increase in renewable energy purchase by 1% a year with a target to achieve 15% renewable by 2020.
- Gujarat's Solar Power Policy-2009, launched in January 2009, with a target of installing 500 MW of solar photovoltaic and solar thermal generating plants by 2014.
- The Jawaharlal Nehru National Solar Mission (JNNSM) launched in January 2010 that targets 20,000 MW of net installed solar generating capacity throughout India by 2022.

To achieve the targets put forth in the JNNSM and Gujarat's Solar Power Policy:

- In December 2009, the Central Electricity Regulatory Commission (CERC) passed an Order determining tariffs for various renewable energy sources, wherein the levelized tariffs for solar photovoltaic and solar thermal projects were determined at ₹ 17.14 and ₹ 12.54 per kWh, respectively.
- Due to oversubscription at JNNSM, a reverse-bidding process was adopted wherein the solar photovoltaic projects selected had bids between ₹ 10.95 and

We put the we in Empower

Get empowered with Doble.

Register for the **12th IndiaDoble Power Forum**
Featuring two specialized tracks on high voltage asset management and power system protection

December 1 – 4, 2014 | Vadodara, India | events.doble.com/india

For nearly a century Doble has been amassing an unprecedented amount of knowledge and experience. We're sharing it with our partners and customers through products, services and learning events such as the IndiaDoble Power Forum. From theory and practical training through failure analysis, Doble is with you every step of the way.

Doble Engineering Pvt Ltd.
Vadodara, Gujarat, INDIA
tel +91 265 6557715
DobleSouthAsia@doble.com
www.doble.com

doble®

12.57 per kWh, while solar thermal projects selected had bids between ₹ 10.24 and 12.24 per kWh. Many States have directly adopted the CERC-determined tariff directly, while other states have determined solar energy tariffs independently.

- Gujarat ERC (GERC) passed its Solar Tariff Order in January 2010 determining a levelized tariff for solar photovoltaic projects at ₹ 12.54 per kWh (distributed as ₹ 15 per kWh for the first 12 years, and ₹ 5 per kWh for the next 13 years) and for solar thermal projects at ₹ 9.29 per kWh.
- Later in 2012, GERC vide Order 2 of 2012, has determined a levelized tariff for solar photovoltaic projects at ₹ 9.28 per kWh.
- GERC has further mandated a specific solar Renewable Purchase Obligation (RPO) at 0.25%, 0.5% and 1% for 2010-11, 2011-12 and 2012-13, respectively.
- Since the Gujarat Solar Power Policy-2009, more than 80 national and international companies have signed Power Purchase Agreements (PPA) totalling a sizable net capacity of more than 965 MW. Out of these, a substantial fraction were expected to be commissioned by 31 December, 2011.
- Additionally, the Government of Gujarat initiated the 500 MW Charanka Solar Park project in Patan District, and the pilot 5 MW Gandhinagar Photovoltaic Rooftop Programme.
- GERC has been regularly initiating Suo-Motu proceedings to verify the RPO compliance each year with Gujarat Energy Development Agency (GEDA), a nodal agency for monitoring of RPO in the State of Gujarat, as a party
- CEA has notified "Technical Standards for Connectivity of the Distributed Generation Resources-CEA Regulations 2013" in October 2013 which permits the grid connectivity of SPV rooftop also.
- CEA has submitted a draft "CEA (Installation and Operation of Meters-Regulation 2013" to Min. of Power for approval for metering arrangement for inter connection of SPV rooftop with grid.
- CERC has brought out the draft guidelines for grid connectivity and metering arrangements for SPV rooftops.
- MNRE has included Grid connected SPV rooftops in the "off grid and decentralised solar applications" scheme vide ammend no. 5/23/2009-P&C dated 30th October 2012 for SPV plants upto 100 kW capacity.
- MNRE subsidy upto 30% on the following benchmark cost of the projects is available: Upto 100 kWp: ₹ 100 /Wp, and for 100 to 500 kWp : ₹ 90 /Wp
- A separate scheme on "Grid connected rooftops and small solar systems" has been formulated which is under approval
- Gandhinagar city initiated a 5 MW (4 MW in government buildings and 1 MW in private homes) rooftop PV programme based on FIT/sale to utility.
- Two project developers for 2.5 MW each selected through reverse bidding with GERC cap of ₹ 12.44/kwh.
- Torrent Power to buy from Azur @ ₹ 11.21/kWh for 25 years and Azure will pass on ₹ 3.0/kWh to rooftop owner as roof rent.
- Recently 5 more cities-Bhavnagar Mehsana, Rajkot, Surat and Vadodara started installing pilot rooftop projects.

Reverse Bidding

The first reverse bidding done by Govt. of India for 620 MW (150 MW Photovoltaic + 470 MW Thermal) was carried out with respect to the base price decided by CERC/ SERC through the preferential tariff determination process. Accordingly 620 MW allocation was made by the Govt. of India (GOI). The price quoted by bidders varied from ₹ 10.95 to ₹ 12.75 (for Photovoltaic) & ₹ 10.24 to ₹ 12.24 (Thermal). It is expected that 104.55 MW of Solar Power Projects would get commissioned. The second reverse bid for 300 MW in Phase –II was later done under JNNSM by GOI.

In reverse bidding the various technical and commercial parameters for setting and running up plant design by the bidders based on its strategy and skills depend upon the aggressive bidding by the bidders. If the bidders bid aggressively, the price may seem attractive.

However, it seems from JNSMM batch I and batch II bidding, that the setting up of the plant and actual availability of the targeted quantity of power supply at a particular time from the project developers is uncertain. Moreover, wide variance has been observed in the price discovery process of reverse bidding due to different technical financial and commercial parameter considered by the bidders.

Rajasthan, Maharashtra have adopted the reverse bidding process for purchase of electricity from Solar Energy Projects.

Cost-plus Basis Tariff

All the Electricity regulatory Commission, i.e. CERC/SERC determine the tariff on cost-plus basis for Solar based energy project that provides a level playing field for the project developers. The developers are provided an opportunity to know the technical and financial parameters considered by the CERC/SERCs prior to setting up the project. This leads to the certainty of the power plant coming into existence once the PPA executed by the project developers and its survival. The risk factor - hedging is easily done by the project developer by knowing the parameters in advance.

The distribution licensees/ utility would know about the availability of supply from the solar projects in advance and can accordingly plan its impact in the future energy mix.

The cost-plus basis takes the prevailing market price and expected changes in the future to determine the tariff. It is a proven methodology to promote renewable energy based projects in the country.

REC Mechanism

Central Electricity Regulatory Commission (CERC) has notified a Regulation on Renewable Energy Certificate (REC) in fulfillment of its mandate to promote renewable sources of energy and development of market in electricity. The RE generators have two options– (i) either to sell the renewable energy at preferential tariff fixed by the concerned ERC or (ii) to sell the electricity generation and environmental attributes associated with RE generation separately. On choosing the second option, the environmental attributes can be exchanged in the form of REC. Price

Since 1961

The Subscription In-charge
Electrical India
Chary Publications Pvt. Ltd.
201, Premalaya, Next to Cafe 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 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.....

Address.....

.....

City.....PIN ☐☐☐☐☐☐

Tel.....

Email.....

Signature.....

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	900	

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

Now SUBSCRIBE/RENEW Online Just Log on to www.electricalindia.in

EI \ November 2014

Lighting India
Bi Monthly

The Subscription In-charge
Lighting India
Chary Publications Pvt. Ltd.
201, Premalaya, Next to Cafe 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 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.....

Address.....

.....

City.....PIN ☐☐☐☐☐☐

Tel.....

Email.....

Signature.....

No. of Years	Amount	US $	Tick ✓
☐ 1 (6 issues)	750	150	
☐ 2 (12 issues)	1350	275	
☐ 3 (18 issues)	2000	500	
☐ 5 (30 issues)	3600	700	

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

Now SUBSCRIBE/RENEW Online Just Log on to www.lightingindia.in

EI \ November 2014

of electricity component would be equivalent to weighted average power purchase cost of the distribution company including short-term power purchase but excluding renewable power purchase cost.

The REC will be exchanged only in the Power Exchanges approved by CERC within the band of a floor price and a forbearance (ceiling) price to be determined by CERC from time to time. CERC has notified Regulations for procurement of power from Renewable Energy Sources on 17th April, 2010. Pertinently, RPO is the obligation mandated by the State Electricity Regulatory Commission (SERC) under the Act, to purchase minimum level of renewable energy out of the total consumption in the area of a distribution licensee.

Renewable Purchase Obligation (RPO)

The minimum percentage of renewable power in Gujarat as per the Order dated 29/10/2005 has been 1% in 2007, 1% in 2008, 2% in 2009, 2% in 2010, 5% in 2011, 6% in 2012 and 7% in 2013. For the year 2012, GUVNL has fulfilled RPO of 4.2% for Wind as against the requirement of 5% while it has fulfilled only RPO of 0.25% for Solar as against the requirement of 0.5%. It has purchased a total of 2760 MUs from RE projects with a shortfall of 836 MUs. It is clear that the electric utilities need to put a lot more attention to Solar.

Proliferation of DERs in India

In the year 2014 many Indian states are still struggling with their 10,000 roof-top program while Germany has succeeded with it two decades back. The German FiT policy has resulted in a 40% drop in the price of electricity rates at peak times, and is considered to be most effective at accelerating renewable deployment. One of the main reasons why India has not been successful with the proliferation of solar is the discriminatory approach taken while offering contracts. In Germany, the long-term contracts were offered in a non-discriminatory manner to all the renewable energy producers on a cost plus basis with 5-10% return.

It is also important to note that almost all the programs initiated in India fall under the PPA category and not under the NM or FiT policies implemented in US or in Europe. For the proliferation of renewables there is an urgent need to re-design the tariffs under the NM or FiT after linking them to the existing consumer tariffs.

Sr. No.	For the Monthly Consumption	Rate: RGP (Rural) (₹ /kWh)	Rate: RGP (Urban) (₹ /kWh)
1.a	First 30 units (For BPL Consumers)	1.50	1.50
1. b	First 50 units (For other Consumers)	2.75	3.15
2.	Next 50 units	3.20	3.60
3.	Next 150 units	3.85	4.25
4.	Above 250 units	4.90	5.20

Table 3: Energy Charges for Residential Consumers

Linking to the Existing Residential Consumer Tariff

For large scale proliferation of the Solar Roof-Top projects, it is important to involve the residential consumers. To understand the impact of the current residential consumption tariff, let us take a look at one such tariff, for the year 2014-15, set as per the directives of GERC for an electric utility in Gujarat, namely, MGVCL. The tariff applicable to all residential premises located in the area serviced by MGVCL are covered under Rate: RGP (Rural) and Rate: RGP (Urban), as shown in Table 3.

It can be observed from Table 3 that the energy charges for residential consumers vary considerably as per their monthly consumption: from ₹ 1.50 per kWh to ₹ 5.20 per kWh. This is because in India, unlike developed countries, it is believed that concessions should be offered to low consumption households. Table 3 also show extra concessions available for consumers located in rural areas, and for consumers categorized to be 'Below the Poverty Line' (BPL).

As we stated earlier, we believe that anyone who is interested in generating energy using renewable means should be encouraged to do so. In particular, the smaller consumers should see a greater benefit accrue from solar generation. Only then can we consider the policies to be fair in a democratic regime.

NM Mechanism

From the tariff structure shown in Table 3, it is clear that, under the NM mechanism, the smaller consumers would benefit less from a solar project. The levelized cost (LCOE) of solar energy generation (₹ 7.50 per kWh) is much higher than the concessional tariff rates for consumption offered to a small consumer (say ₹ 2.75 per kWh for a rural consumer with consumption less than 50 units).

The large residential consumers in urban areas would benefit the most from the solar projects since they can offset their own more expensive consumption units exceeding 250 units costing a higher rate of ₹ 5.20 per kWh. Simultaneously, this large consumer can reap another benefit by automatically getting considered under the consumption slab of a small consumer carrying higher concessional rates which would apply to the small quantity of units that he may draw/ consume from the utility.

Since the NM mechanism requires no licences for solar generation, it is most ideal for a democratic country such as India. We believe that NM would offer to the current generation, a powerful mechanism - similar to what 'Salt production' offered to the pre-independence India (to abolish the 'Salt Act' under Mahatma Gandhiji's leadership). It is, therefore, a pity, that under the current subsidized tariff regime, small consumers would tend to lose their existing benefits under the NM mechanism. We believe that this anomaly may get overcome after a short while, when the LCOE for solar would drop down further. Till then we could consider the FiT mechanism described below.

FiT Mechanism

An FiT tariff can be designed in a fair manner unlike an NM policy. This is because to implement FiT we have two meters from which it is possible to take four readings, namely:

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

Sr. No.	For Consumers with Monthly Consumption of Generated Units (g-y) Units	Rate: FiT (Rural) (₹ /kWh)	Rate: FiT (Urban) (₹ /kWh)
1. a	First 30 units (For BPL Consumers)	6.00	6.00
1. b	First 50 units (For other Consumers)	4.75	4.35
2.	Next 50 units	4.30	3.90
3.	Next 150 units	3.65	3.25
4.	Above 250 units	2.60	2.30

Table 4: Compensation by Utility for Energy Generated & Consumed by Residential Consumers

g: Energy generated by the solar grid tie inverter (exported) by the FiT meter

s: Energy consumed by the solar grid tie inverter (imported) by the FiT meter

x: Energy drawn by consumer (imported) from utility grid as recorded by the Standard meter

y: Net Energy (exported) to the utility grid as recorded by the Standard meter

For all practical purposes, we may neglect the energy, s, consumed by the solar inverter. Even if *s* is significantly high, it would not make too much difference as this consumption gets accounted in the Standard consumer meter reading x. This strategy would help reduce the number of meter readings per consumer from four to three.

Total energy consumed by the consumer = (g + x) – y.

Part of solar generation consumed by the consumer = (g - y)

The tariff could be set simply based on three readings - g taken on the FiT meter, x and y taken on the Standard meter. The tariff on x would be same as that shown in Table 3, and can avail the subsidy carried under the RGP tariff regardless of the generated units - g, or the units exported to the grid - y. The utility is expected to compensate the consumers for the solar power generated, g. To be fair to these consumers, it is necessary to incorporate the subsidy factor for certain class of consumers (BPL/ Rural). Table 4 shows the FiT tariff that would be paid by the utility to the residential consumer for units generated using renewables and then consumed by the consumer (g - y). It may be noted that a BPL consumer would be given maximum compensation whereas high consumption consumers would receive less compensation.

For the excess units that is exported by the residential consumer, too, we see that a well tuned FiT tariff structure like that shown in Table 5 would incorporate maximum benefits for the rural and BPL categories assuming that their generation capacities are small. As the quantum of units exported increase, the compensation drops. For an urban consumer generating more than 250 units the compensation is the least at ₹ 7.20.

Solar Guerrilla

Solar Guerrilla is a term coined by Richard and Karen Perez, the editors of Home Power Magazine and is applied to someone who uses an alternative energy source to illegally supply electricity back to a public utility grid. The guerrilla solar movement started when solar advocates, fed up with the bureaucracy of utility companies, the requirement of the expensive, lockable disconnect, and expensive insurance policies, took things into their own hands. Activists across the country are now tying their systems into the grid without utility permission or knowledge.

The Guerrilla Solar Manifesto states that all energy is freely and democratically provided by nature, and that the monopolization of energy by utilities threatens our environment and our planet. In order to feed electricity back to the grid a Grid Tie Inverter is used. The concept is dangerous particularly when the GTIs do not have an 'anti-islanding' safety feature which will shut down the inverter's output if it detects a grid blackout. This would put the lives of linesmen, who assume that the power lines they are working on is de-energized, at risk. Moreover, if the local electric utility is not informed, then an accidental fire caused by an illegal GTI or solar installation would not be covered by insurance.

The Indian distribution system would become very unsafe for the linesman if Solar Guerrilla movement picks up in India. It is therefore, in the best interest of public at large, that the policy makers work out FiT or NM policies that would appeal to the consumers – particularly the residential ones.

Anti-Tamper Considerations

Another problem, that has been plaguing Indian distribution system and that could be an obstacle to the proliferation of renewable energy, is energy pilferage. Particularly, in the case of an FiT, it is necessary to ensure that the generation equipment such as the solar panels, the GTI and the meters themselves are easy to access by the utility meter readers. High commercial losses can be lowered if smart metering systems are introduced that can perform an online energy audit.

Also when there are subsidies offered by the utilities for generation using renewables (as shown in Section 7.3), consumers may get tempted to draw conventional power from the utility mains and illegally inject the same

Sr. No.	For Energy Exported by Residential Consumer y Units	Rate: FiT (Rural) (₹ /kWh)	Rate: FiT (Urban) (₹ /kWh)
1. a	First 30 units (For BPL Consumers)	10.90	10.90
1. b	First 50 units (For other Consumers)	9.65	9.25
2.	Next 50 units	9.20	8.80
3.	Next 150 units	8.55	8.15
4.	Above 250 units	7.50	7.20

Table 5: Compensation by Utility for Energy Exported by Residential Consumers

back through the FiT meter simply to avail of the subsidies for a 'fictitious' generation.

Conclusions

India is a nation in transition. Considered an 'emerging economy,' increasing GDP is driving the demand for additional electrical energy, as well as transportation fuels. It is also a nation of extremes - poverty remains in areas with no energy services, while wealth grows in the new business hubs.

India is blessed with vast resources of renewable energy in solar, wind, biomass and small hydro. In fact, the technical potential of these renewables exceeds the present installed generation capacity that is essentially coal fired. The development and deployment of renewable energy, products, and services in India is driven by the need to decrease dependence on energy imports, to lower the cost of energy supply, to augment supply to remote and deficient areas, and to provide normative consumption levels to all sections of the population across the country.

Currently, there is absolute lack of public domain knowledge of technical standards and guidelines for grid connectivity, metering, safety and security. The energy accounting and commercial settlement guidelines for grid connected solar rooftop projects are still evolving. Regulatory provisions relating to applicability of charges relating to wheeling, open access, cross subsidy etc. for solar rooftop projects needs clarifications. Renewable projects so far, implemented in India, have been either under gross metering arrangement or on captive consumption arrangements. In this scenario, we hope that the information provided here for implementing a FiT mechanism for residential consumers would prove useful for widespread proliferation of DERs in general, and solar systems in particular.

Profile

Dr Vithal N Kamat

Currently, serving as Managing Director of Baroda Electric Meters Ltd, has graduated from Birla Vishwakarma Mahavidyalaya, Anand, Gujarat, and completed post-graduation in Control and Instrumentation from the Indian Institute of Technology, Mumbai. He completed his Doctoral studies in Artificial Intelligence from the University of New Brunswick, Canada. His employment experience includes the Centre for Development of Telematics (CDOT), Centre for Apparent Energy Research, Centre for Embedded Software Engineering Solutions, as a technical consultant to NXP Semiconductors, and as a Principal of a Women's Engg. Institute – MBICT. His field of interest includes high voltage protection, learning machines, apparent energy tariffs, demand side management, and embedded software.

Harmonics Distortion by Non-Linear Loads

We share with you an energy audit case study in a Platinum rated IGBC green factory. Here we showcase about the industry's initiative to correct the defects if any, before the energy audit and steps taken by the industry immediately after the audit to reduce the THD harmonics dumped to the EB grid.

S Ashok & K Ramesh Babu

A green building is one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building.' This industry called us to conduct energy audit+ harmonic audit immediately on commissioning their plant and acted subsequently to implement the energy conservation measures proposed in our Energy Audit Report.

About IGBC Platinum energy rating to the Industry

The industry is platinum energy rated by IGBC and is one of the Greenest Factory in India. The industry manufactures precision injection moulds and finishing machinery for plastic products. This is expected to result in a reduction of carbon dioxide emission by over 500 Tonnes annually, a 45 per cent reduction in energy consumption through provision of energy efficient LED and Plasma lighting systems and energy efficient utilities in HVAC, air compressors, UPS etc., onsite waste management systems to facilitate recycling. They have utilised only about 15% of the site for the buildings and allowing the expansion in 10% more of the site space. This leaves about 75% of the site as landscaped all the time.

Industry Load Details

The industry is a HT consumer and the loads are mostly non-linear. The production machines are CNC machines and VFD driven Injection molding machines, the utility machines like the HVAC packages are also VFD operated, the Air Compressors are VFD type and even the lighting

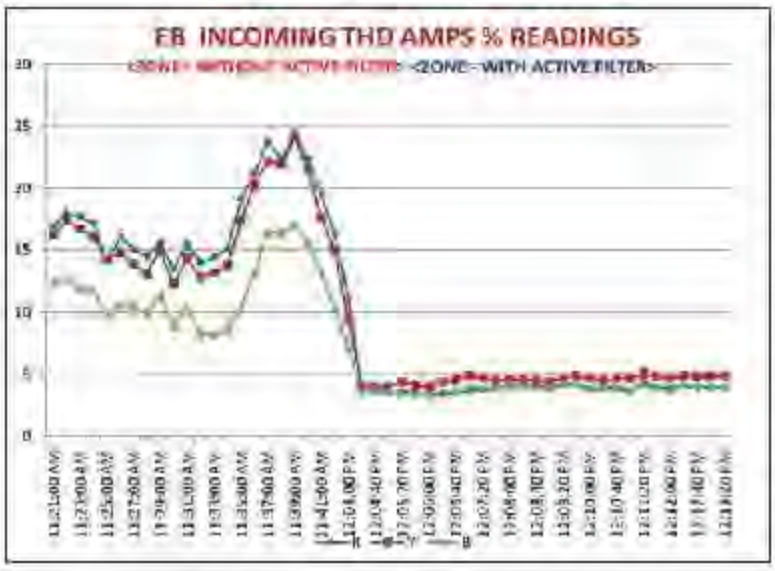
is LED and organic LED type. The Auxiliary included 500 KVA OLTC transformer, 180 KVAR APFC standard panel, 160 KVA and 400 KVA DG sets, 160 KVA IGBT type UPS for the production machine backup safety.

Energy Audit Observations & Recommendations

- The earthing was conventional type and we suggested the client to check and change the conventional earthing to Maintenance Free

Earthing type. And maintain the Earth grid single looping from the neutral to ground at one location near Transformer secondary instead of multiple stand-alone loopings, causing potential differences.

- When the APFC is switched ON at the MV panel end, automatically the THD increases and the PF goes to the Leading region at the EB incoming. So we have told to switch off the same now.
- Later, we have suggested to detune the existing APFC bank by using Reactance Coupled Capacitors to suit to the required KVAR demanded by the EB to maintain at 0.95 to 0.97 PF.
- We suggested to the client to talk to their Production & Utility Machine vendors like the Injection moulding machine, CNC machine, HVAC packages, Air compressor utility to provide Line Reactor Choke immediately in front of their VFD as the same is not provided by the vendors till date.
- After taking the initial step of reducing the harmonic distortion from drives, then we had suggested the client to take a trial of Active Harmonic Filter to bring down the THD levels as per IEEE 519 norms enforced by the EB now.
- Since the client had already done the Incoming energy parameters monitoring and net working to the computers, we had asked them to add a Energy Multi Function Meter with Harmonic monitoring + Alarm locally and the same to be networked to the computer for studying the trends etc.
- Because of non-linear loads, the DG set vendor offered higher sized 400 KVA DG set considering the future expansion as well. So now, 400 KVA set needs to be operated now for even 25 % of the loading, as the industry fears to run DG 160 KVA facing the alternator overloading possibility due to the existing non-linear load ends.
- Hence the industry gets only 1unit per liter of Diesel on sample study on 400 KVA DG set. So we suggested to oversize by 50%, the alternator of 160 KVA and that the industry can get 3 units per liter of Diesel. And plan to run the DG to suit to load KVA so that it is around 60% loading and above.



- The client initiated to take trial of the Active Harmonic Filter and he decided to fix the same after the successful trial, at the transformer secondary; so as to curb the harmonics dumping into the EB grid.
- We had suggested to the client to put the Active Harmonic Filter at the common PCC between the EB and the DG so that the AHF can function now for both the EB and the DG rated 160 KVA.

Pointers to the Industry Segment

- To brief the electrical contractors and consultants; before the start of the project itself about the nature of non-linear loads, the ratio of linear and non linear loading to the proposed K rated transformer in turn to EB.
- Try to locate capacitor to motor end panel to suit to any equipment motor above 5 HP.
- To check with vendors what is their motor no load KVAR before commissioning and add the capacitor rated 90% of no load motor KVAR size near the motor end panel.
- To plan to procure capacitor voltage rating to 440 volts instead of 415 volts when the industry has OLTC settings at 400 volts and for a non-OLTC transformer industry to go for 480/ 525 volt rated capacitors.
- In case of capacitor banks to be mounted on MV panel, plan for Reactance coupled cap banks.
- Strictly speaking, never allow the capacitors mounting at the incoming / SSB of non-linear loads like VFD etc.
- To buy the VFD etc drives from vendors after ascertaining the harmonic compliance from the OEMs.
- The vendors to commit that the PF will be maintained at say PF 0.95 for any loading levels and the harmonics to be reduced to the minimum level to the partially loaded machines.
- Since the majority of loads essential in production and in utility is non-linear, it is not required to fix only the standard linear capacitor banks or standard APFC systems to maintain PF of above 0.95
  - The EB norms call for maintaining the PF of around 0.95 and EB does not specify that the standard capacitor banks or APFC of RPFC to be installed strictly.
  - "That is KVAR to be sized to 40 % rating of sanctioned KVA" – this standard need not be followed, but achieve the result of 0.95 & above PF by the matched PF compensation.
  - It is suggested to the industry that the EB wants an optimum PF of 0.90 to 0.95 as monthly KWH / KVAH to maintain their distribution safely from the industry end to the substation.
  - But the industry is overacting now to maintain unity PF and show case to others that they are efficiently managing their electrical distribution. On the contrary, this causes instability within the industry electrical distribution and in the incoming route from industry to substation. Also the capacitors are added more in the unity PF region; hence consuming more, failing and amplify the electrical distribution instability.
  - EB suggested maintaining PF at 0.95 and above and the industry manager is provoked to maintain at 0.996 PF so as to

Because of non-linear loads, the DG set vendor offered higher sized 400 KVA DG set considering the future expansion as well.

get PF incentive in Rupees. The same has been withdrawn by EB as this was overdone. Since the existing APFC was operated in single CT mode sensing, always this resulted in leading PF region resulting in damages and penalties.

- Now by foregoing 5 % KVA by maintaining 0.95 to 0.97 PF region, the industry to certain extent, can avoid the EB penalties due to leading KVARH, exceeding Harmonic Distortion limits etc.

In General Aspects

- The capacitor compensation done at the linear load incoming ends like the motor; is equal to the Line reactor choke / Filter addition to the incoming of non linear loads like VFD so as to reduce the harmonic distortion feeding back to Incoming MV panel. Hence we can equate as-

Load end Capacitor + fixed bank + Automatic PF controller for linear loads =

Filter Choke + Reactance coupled Capacitor + Active Harmonic Filter for non linear loads.

PF improvement IN STAGES done before & now Harmonic distortion reduction IN STAGES required.

This hybrid working will be economical now for the initial costing, reduced running KWH cost of harmonic suppression & filtering, reduced Line losses since fraction of harmonics is arrested at the VFD load end.

- Before, what was done by the industry towards PF improvement in stages to suit to EB requirements, the same concept to be applied for non linear / mixed loads to reduce the harmonic distortion in stages from say 40% THD to say < 20% in first step at load end and at SSB. Next step and the final stage is to bring down less than 8% THD, using Active Harmonic Filter (similar to APFC) within EB norms & limits.
- Many caps are already de-rated / die silently or does not improve the PF but consume much more KW power than anticipated especially, in the Leading PF region. This is shocking to many in industry! Existing capacitors are becoming Fast Moving Consumable when fed to non-linear loads.
- Many industries are keeping decade-old capacitor bank in the power house MV panel. We find during our energy audits, that many of the capacitors are having de-rated KVAR, dead, very less improvement in PF but amplify the harmonics distortion that comes from non linear VFD loads.
- The DG sets also can run at PF 0.9 at the load ends. Frequent switching on & off the isolators at SSB leads to single phasing of the capacitors in many cases and here caps consume 10 times more the Watts! Motor single phasing can be noticed early. But capacitor single phasing silently happens. Please make it fool-proof.
- Till now, the VFD vendors have sold their products to perform the variable frequency drive function only to the process and the harmonic arrest at the source of VFD was not given the priority then at the time of sale to the industry. Now when you buy a VFD hereafter; ask the vendors, what the harmonics it will dump to the incoming and what harmonic compliance the vendor gives to the VFD.
- The partly-loaded motor always have poor factor and similarly, the Harmonics is more during part loading of VFD and that is where the vendor must state the harmonic distortion at each quarter of VFD loading.
- If the industry is using DG set to feed to non-linear loads, the above hybrid harmonic stage reduction will save the DG alternator. If your DG is feeding to the existing VFD loads, the DG alternator will fail quickly and you may have to replace with 50 % higher sized alternator to face that loads. Better alternative is to prevent the harmonics distortion to enter into the DG alternator now.
- By following the above practical steps,
  - Now we from the industry have taken care not to dump harmonics to the incoming EB side,
  - Also we have prevented the negative effects of harmonics to multiply horizontally inside.
  - Reduce the Harmonics spilling to other horizontal areas in our distribution network components,
  - Reduce failures in the electronic modules malfunction, heating of Neutral & other conductors,
  - Reducing the Line losses in KW and in KVA due to higher harmonic current, unbalance etc.
  - Arresting the Harmonics at the Source is beneficial to the industry first and next to the EB grid.
  - Let us collectively work towards reducing the Distribution Losses inside our industry FIRST and this will automatically reduce the Transmission Losses in the EB grid.

Profile

Ashok Sathuraman

BEE Accredited Energy Auditor has 25 years of Field Experience in India and Abroad. He conducts Energy audits under M/s POWERON Projects, Coimbatore. He shares & publishes energy articles in national magazines and through his website.

K Ramesh Babu

has 25 years of field experience in Textile & Electrical in Maintenance, Projects & Energy Auditing and he designs Motor Power Saver etc Electronic gadgets.

Transient and lightning protection systems

Your effective protection against surge voltages and lightning strikes

- Surge protection energy technology
- Surge protection, photovoltaics
- Surge protection device for data and information technology
- Protection and spark gaps
- Equipotential bonding systems
- Earthing systems
- Interception and arrestor systems
- Insulated lightning protection and OBO isCon® system

External lightning protection

Air termination → Down conductor → Earthing

Surge Protection

Power line → Telecommunication → Data line

OBO BETTERMANN India Pvt. Ltd.
A61, SIPCOT Industrial Growth Centre,
Oragadam, Sriperumbudur Taluk,
Kancheepuram - 602 105,
Tamilnadu, India
Tel: + 91 44 710 33 900/01/02
Fax: + 91 44 710 33 999
Email: sales@obolndia.com

OBO BETTERMANN

THINK CONNECTED.

Electronics surveillance

Successes and Failures

Surveillance in its various forms and for different situations has been practiced by human from time immortals. People used to accomplish this task (surveillance) for themselves and for others as a social obligation or as a paid job. When unlawful activities like thefts & crimes in the society are growing in an unprecedented & uncontrolled manner and law enforcing agencies are finding themselves incapable to cop up with the challenges and the smart modes of operandi by the thieves and criminals along with isolated & indifferent attitude of individuals towards society, role of electronic surveillance is becoming indispensable with.

Dr S S Verma

Electronic surveillance refers to the overhearing or seeing of individuals by employing electronic or electrical devices to do so. The evidence or information, usually predominately innocuous, is used to determine if probable cause exists to warrant further action. Electronics surveillance has made inroads in the walks of life with its different modes and applications. This article presents a brief summary of the successes and failures of electronic surveillance. What were the expectations and what are the present day failures, limitations and disadvantages of the electronic surveillance.

The use of varied methods of electronic security technology dates back to the mid-19th century and since that time, it has been used by investigative committees, security agencies, the military establishment, different departments/organizations, manufacturing and corporate concerns, private detective services, and private individuals. The use of electronic or electric methods to keep watch over persons or organizations, termed physical surveillance, has obvious advantages for law enforcement. It is a means to prevent detection so as to be able to observe suspected

individuals in normal, uninhibited states to gather possibly useful datum. Two general categories of electronic communication surveillance exist. Wire communications refer to the transfer of the human voice from one point to another via use of a wire, cable, or similar device. When law enforcement 'taps' a wire, they use some mechanical or electrical device that gives them outside access to the vocal transfer, thus disclosing the contents of the conversation. Electronic communications refer to the transfer of information, data, or sounds from one location to another over a device designed for electronic transmissions. This type of communication includes email or information uploaded from a private computer to the internet. The techniques and methods of electronic eavesdropping, offer the possibility of gathering evidence which would otherwise be unobtainable. The interception of wire communications is almost as old as the inventions of the telegraph and telephone. The late 1800s witnessed the inventions and use of the microphone, dictograph recorder, and hidden cameras to conduct surveillance, usually by private detective agencies. Wiretapping and other forms of electronic surveillance became big business as manufacturing concerns produced more elaborate and efficient means of eavesdropping. Moreover, planted bugs and wiretapping were used extensively in the 1940s and 50s. As the technology marched to its greater heights the debate centers on its successes and failures.

Electronic Security Solutions

The emergence of globalization and liberalization brought prosperity and improved standards of living. With rising level of incomes, the crime graph has also increased in almost every parts of the world. If people are earning big time, they also have to tackle with the fear of safety and security of their hard earned money. Apart from money, one needs to safeguard his family, loved ones and precious possessions. Governments worldwide try their best to protect the interests of their citizens but most often than not, it doesn't suffice. Because of this particular reason, most of the people especially in urban places prefer to have their own electronic security system installed in their homes and offices. Electronic security systems have become exceedingly essential for masses. It helps in several ways. First and foremost, it lets you have a peaceful sleep knowing that you and your family are safe and secure. The terror of burglars is everywhere. No house can be called as safe from burglars knowing that even these miscreants use latest technology and equipment to rob your valuables. It's always better to have a pro-active approach while thinking of installing electronic security systems. These security systems are wonderfully helpful in protecting your interests. One should never take a chance as far as home security is concerned. Nothing matters more than the lives of your loved ones. With so many advanced electronic security systems available in market, one should just take note of his priority and requirements and install the system as soon as possible. Make sure to have reliable electronic security systems that last long and where maintenance is also relatively easy. It is also advisable to properly know the operations of all parts of the system and teach it to your family members as well.

> ***Electronic surveillance is the monitoring of the behavior, activities, or other changing information, usually of people and often in a surreptitious manner. It most usually refers to observation of individuals or groups by government organizations.***

Electronic surveillance is the monitoring of the behavior, activities, or other changing information, usually of people and often in a surreptitious manner. It most usually refers to observation of individuals or groups by government organizations. The word surveillance may be applied to observation from a distance by means of electronic equipment (such as CCTV cameras), or interception of electronically transmitted information (such as Internet traffic or phone calls). It may also refer to simple, relatively no- or low-technology methods such as human intelligence agents and postal interception. Surveillance is very useful to governments and law enforcement to maintain social control, recognize and monitor threats, and prevent/ investigate criminal activity. In today's scenario of intrusion, unsuspected attacks and thefts, security planning is incomplete without intelligent deployment of technology. Technology can solve lot of issues which human beings can never handle effectively. To provide complete solution in domain of security, there is an exhaustive range of electronic systems which would provide much needed strength to human guarding. Comprehensive surveillance control systems and management solutions deliver feature-rich camera management, intelligent detection and delivery and the most advanced means of video monitoring.

Application Areas: banks, homes, shops, offices, jewellery shops, institutions, commercial complexes etc.

Home Security Devices: Electronic alarms, barrier bars and motion detectors are just a few of the home security options available. Electronic security systems are effective. In fact, many convicted burglars admit that if a home is protected by one, they will choose another target.

Types of surveillance: Computer surveillance, Telephones, Surveillance cameras, Social network analysis, Biometric surveillance, Aerial surveillance, Data mining and profiling, Corporate surveillance, Human operatives, Satellite imagery, Identification and credentials, RFID and geolocation devices, RFID tagging, Global Positioning System, Mobile phones, Surveillance devices, Postal services etc.

Video surveillance: One of the technologies that is gaining traction is video with a greater demand for it. This ubiquitous security medium has made it more acceptable for companies to have them as part of their arsenals. The two major applications for video surveillance are monitoring and forensics. Monitoring is when companies use it in real time to observe and react, and forensics is using the video system for review after an event happens. Analog cameras are the original CCTV cameras that are hooked into the wall. The newer network cameras, on the other hand, can be set up almost anywhere in a building; because of wireless capabilities, they are connected to

the company's network server, and video is streamed.

Safety alarms: Alarm systems with individualized messaging capabilities are another example of where technology is advancing. Not only can a fire alert be sent, but other predetermined messages such as one announcing a terrorist attack or a chemical release can inform employees as to what is going on during an emergency. When deciding on a safety alarm system, it is recommended to get the local fire department involved early in order to make sure the facility will be up to code and that the fire department will be able to familiarize itself with the company's fire safety system and evacuation procedures.

Mechanical Locks: The data transfer key is an example of a more contemporary key that still mechanically unlocks a cylinder, but the key's electronic circuit talks to the lock and records the employee's identification number. The information captured in the lock can be downloaded to the key itself, or a handheld device can be used to retrieve the information from the lock and take it back to a computer. A log of insertions for that particular lock can be developed, and this offers yet another layer of accountability. Vendors say there are other reasons for the mechanical lock's continuing popularity.

ID cards: Proximity cards and devices continue to remain the most popular form of identification. Proximity technology is very user friendly and cost effective. Their convenience makes them widely used across vertical markets. Smart cards, on the other hand, are the newer identification technology that someday may be more widely used if things like biometrics are adopted. While smart cards have many benefits over proximity cards, especially when it comes to using a single credential for multiple applications, not all end users require these additional security features, so proximity, which is a long established technology, is a perfectly suitable solution. Smart cards can store digital certificates, encryption algorithms, biometric information, and qualification information. And they maintain a contact or contactless interface, which is used to gain entry into access points.

Electronic surveillance of employees

Powerful reasons exist to monitor employee online behavior at work. Electronic surveillance of employees is increasing every year, according to the Electronic Monitoring and Surveillance Survey. There are pros and cons about the electronic surveillance of employees at work. Not every workforce, workplace, or work culture and environment is a candidate for electronic surveillance at work. In fact, in some work environments, depending upon the culture and environment desired, electronic surveillance of employees would injure trust, injure relationships, and send powerfully wrong messages to the workforce. The use of electronic devices to keep watch over a person has advantages for law enforcement. It can be a means to prevent detection so as to be able to freely observe and gather information on dangerous or suspicious individuals and organizations. On the level of espionage, it can aid in the accumulation and assessment of information foretelling hostile actions directed against the establishment/organization. Manufacturing and corporate concerns have used electronic devices to gain trade and marketing secrets as well as to monitor employees. Intense competition and jealously have provided the rationale for electronic snooping among private citizens. Large-scale gambling operations could suffer at the hands of a bettor privy to otherwise inaccessible information. The same could be said for the campaigning officials and the stock market. In essence, electronic surveillance offers the possibility to gather information on anyone, at anytime, for any duration. There are numerous electronic devices employed for electronic surveillance but a few are discussed here:

Wiretapping: the deliberate use of electronic or electrical equipment to intercept the oral communications of non-consenting parties by a third party. Although the means vary, the most sophisticated techniques involve a connection to the wires that conduct the communication at a central junction box, allowing the tapper the luxury of an extension to the desired wire.

Bugging: involves the placement of a miniature electronic device to overhear conversations. It is attractive because, unlike wiretapping, it can pick up many conversations if strategically planted.

Pen register: is an electronic device that can be placed on a telephone line and identifies the telephone number of calls made from a suspect's phone. This device is frequently used by telephone companies to detect fraud and harassment.

Photographic surveillance: refers to the use of audio-visual equipment to photograph individuals with the use of circuit television to gather incriminating evidence.

Wired agents and informers: this technique involves the wiring of an agent, informer, or consenting party to overhear and sometimes record conversations.

Question of individual privacy

Electronic surveillance, when utilized as a tool for national security, law enforcement, industrial espionage, or domestic relations can limit and ultimately negate the citizens right to be let alone. The history of the indiscriminate uses to which this technology has been applied on the domestic level, suggests that citizens are highly vulnerable to attacks on rights to personal privacy. Using electronic devices to keep surveillance over a person can implicate the investigated individual's Fourth Amendment rights. One form of electronic surveillance developed by law enforcement results in attaching a 'bug' to a person's telephone line or to a phone booth and recording the person's conversation. Courts have held that this practice constitutes a search under the Fourth Amendment because the Fourth Amendment protects an individual's privacy rights for situations in which the person has a legitimate expectation of privacy. Courts have held that when having a telephone conversation, one would not expect an unknown third-party government agent to listen in on the conversation. A person has a legitimate expectation of privacy if the person honestly and genuinely believes the location under search to be private and if the reasonable person under the same or similar circumstances would believe the location to be private as well.

Therefore, law enforcement has more leeway when intercepting communications in a public place than when the interception occurs in a secluded environment. The courts have given law enforcement the freedom to record conversation during jail visits, provided that the

Smart Prepaid Meters with full Remote Recharging System

- **TWO WAY COMMUNICATIONS** - JnJ Prepaid Meter has in-built communication and always connected to Central Server.
- **Utility & Consumer friendly Recharge token vending system, Emergency Credit, No disconnect on holidays, etc**
- **Tariffs can be set and revised remotely from Central Server**
- **Accepts Step Tariffs and Time of Use,** Daily deduction of Fixed Charges , Rebates if any. Grouping of customers as per tariff categories.
- **AUTOMATIC ALERTS by SMS & Email for Low Balance to consumers and also tamper alerts to Discom.**
- JnJ offers Operations & Maintenance of Prepaid Metering on Per Customer Per Month Basis. **NO SERVICE CHARGES ON PER TOKEN GENERATED BASIS**
- JnJ Prepaid Meter is an **All In One Smart Meter** - with inbuilt Communication modem (PLC/GPRS/LAN), Prepayment feature - flexibility to switch between prepayment to post-pay directly from the Central Server, Import/Export & Net Metering and all other Smart Meter functions.

JnJ Powercom Systems Ltd
JnJ House, Plot 41, Phase-III, Cherlapally IA, Hyderabad-500 051.INDIA
• **Tel** :+91-40-27266969 • **Fax** :+91-40-27266969 • **Mobile:** 98490 02180, 95737 84242
Email: info@jnjpowercom.com **Website:** www.jnjpowercom.com

monitoring reasonably relates to prison security. The debate reached a crescendo resulting in new legislation and adherence to the laws governing the use of electronic surveillance. Electronic surveillance is still very much a tool in the government's arsenal to ferret outlaw-breakers and to detect and prevent crime. The basic question seems to be the extent to which the intelligence community can employ non-conventional methods of law enforcement to check crime while at the same time preserve domestic tranquillity and not trample upon constitutional rights. A major argument against the use of these extraordinary means suggests that electronic surveillance violates the very rights it purports to protect.

Failures of electronic surveillance

Most people assume that all of this high technology that surrounds us these days is making us a lot safer. But that is not really the case at all. As technology advances, so do the criminals. And if we are not aware of our vulnerabilities, we potentially become easy prey for those that would like to take advantage of us. Some thieves used computers to replicate fake receipts for making cash returns, while others use fake credit cards or checks to purchase gift cards and other expensive goods. In some cases, employees are recruited to look the other way or to provide details about cameras or security systems. Gang members carry comprehensive shopping lists. They have designated roles, such as driver, lookout, picker, packer and supervisor. They use hand signals, cell phones, GPS devices and other electronic gadgets.

Electronic surveillance may offer advantages such as night view using infrared lighting (IR), which recognizes what is happening at the place even when it is pitch dark but does not protect per se against thefts. However, it can deter criminals up front – especially opportunistic criminals, who are looking for a quick way to steal valuable items. And: if a theft is committed, the recordings in your video surveillance can serve as evidence while also enabling to identify the culprit(s). With state-of-the art motion detection in surveillance cameras we can enjoy all-round protection, even in hardly accessible areas.

With the low crime detection rate for thefts and the high percentage of repeat offenders the advantages of a detailed surveillance with the chance of identifying the culprits are pretty obvious. But even with electronic surveillance in working, all over the world, thieves, criminals, law breakers are still actively operating in warehouses, production locations and in offices and are able to design the unique methods to dose electronic surveillance. Modern thieves will steal anything that isn't fixed to the floor. No place is safe from theft because through the internet almost every product can find a buyer somewhere.

Criminals always design new high-tech gadget giving them full access to the protected or places under surveillance. This is really frustrating because clearly they've figured out something that looks really simple and whatever it is they're doing. For thefts from ATMs, thieves use a device connected to a small laptop, and inserted the device into the card acceptance slot on the ATMs. Armed with this toolset, the men are able to install malware capable of siphoning the customer's card data and PINs. The device appears to be a rigid green circuit board that is approximately four or five times the length of an ATM card. The insertion of the circuit board caused the software running on the ATMs to crash, temporarily leaving the cash machine with a black, empty screen. The thieves would then remove the device. Soon after, the machine would restart, and begin recording the card and PINs entered by customers who used the compromised machines. The accused would return a few days after infecting the ATMs to collect the stolen card numbers and PINs. To do this, the thieves would reinsert the specialized chip card to retrieve the purloined data, and then a separate chip card to destroy evidence of the malware.

Criminals are using improvised electronic devices to electronically unlock vehicles and steal whatever they find inside. These mystery gadgets reportedly recreate the same signals that the key fobs that so many of us carry around send out. Thieves are using these mystery gadgets to remotely unlock car doors and disable alarm systems. Once a car has been unlocked, it takes these thieves just a few moments to take what they want before leaving without a trace. This is now happening all over the country, and authorities do not know any way to prevent it from happening. As cars get smarter, and more connected, the threats simply increase. Thanks to all of the "technology" that is in our vehicles these days, they are potentially more vulnerable to hackers than ever. Nobody, not even the car manufacturers, knows how it works. That's why, car manufacturers are working on a way to protect the dozens of tiny computers and electronic communications systems that are built into every modern car by uncovering and locking up vulnerabilities.

Profile

Dr S S Verma

working as Associate Professor in Sant Longowal Institute of Engineering and Technology is MSc and a PhD from IIT Delhi. He did postdoctoral studies in Japan at Toyohashi University of Technology. He has published about 40 research papers in journals and about 400 science and technology related articles. He has been nominated to various awards by International Biographical Centre (UK).

Complete End-to-End Solutions: T&D

SUPREME
www.supreme.in

COMPACT LINE & LINE UPRATING

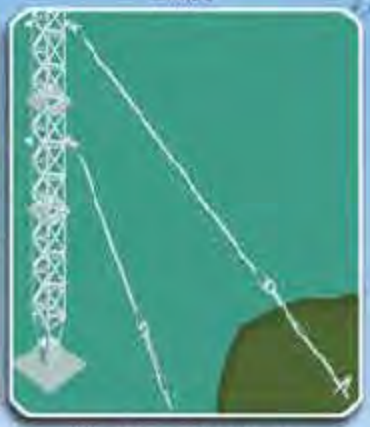
Pole-Type Structure for Transmission Line

Interphase Spacer to Reduce Phase to Phase Clearance

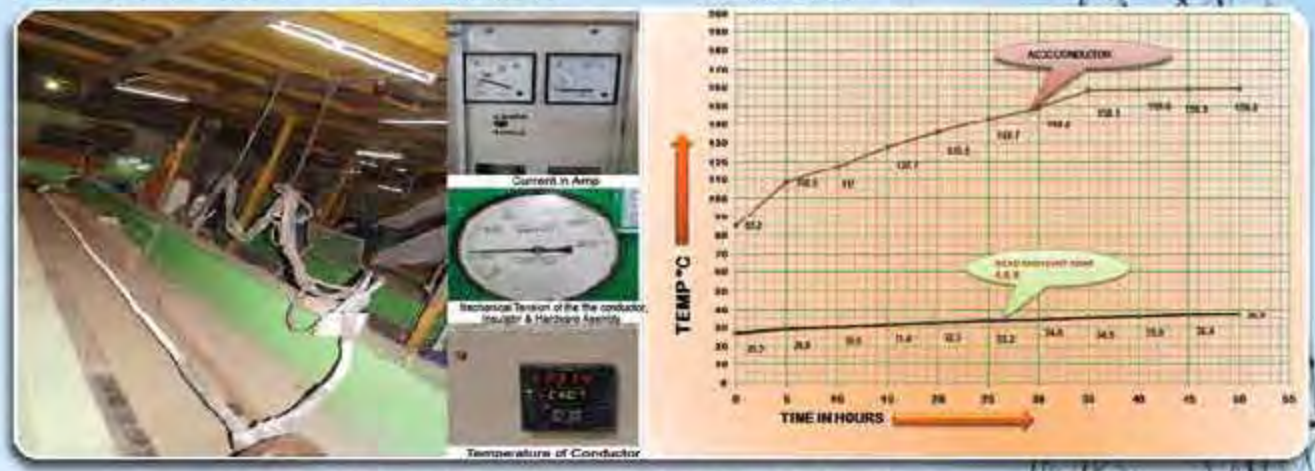
Insulated Cross-Arm for Compaction of Lines

Expanded Asymmetric Bundle for Higher Surge Impedance Loading

Temporary Bypass for Line Uprating with minimum shutdown



Anchoring Solutions for Emergency Restoration Tower System



Testing of HTLS Conductor with Dead-End Assembly

SUPREME & CO. PVT. LTD.
Contact: 91-9803999511 | 91-9803999566 | 91-9803999516
E-mail: info@supreme.in, sales@supreme.in

Superior Solution: IGBT Based Selective Shunt Active Filter (SSAF) for Harmonic Reduction

The Virus 'Harmonics' generated due to both linear and non linear type loads now a days is essential consideration for maintaining the power quality (PQ) of ever increasing electricity demands. Now a day's electrical consumer demands for reliability and good quality power supply.

- Haridas M Kakad, Ravindra P Wagh, Bhagat RS & Ghogare NM

There are some causes of power quality deterioration including use of power semiconductor devices, power capacitors for power factor correction, converters, rectifiers, variable speed drives etc. causes impure sinusoidal voltage and current waveforms. This paper represents a study about harmonics, sources of harmonics, and harmful effects of harmonics, ultimate economic impact of harmonic and superior solution for reducing the harmonic levels. The primary aim of the electric power supply company is to provide a virus free sinusoidal voltage at fairly constant magnitude throughout the network. Deterioration of power quality also caused due to natural and manmade reasons including lightning strokes, falling of tree branches, equipment failure, feeder switching, power electronic loads, arc furnaces etc. Harmonics also results into power quality issues, increased line losses, heating of electrical machines, malfunctioning of equipments, unfair operation of fuses and circuit breaker and reduced life of equipments. This article represents a superior solution for reducing the harmonics by using selective shunt active filters (SSAF) which enables the electrical consumer to provide the virus free supply.

What Is Harmonics?

Additional variable voltage and current waveform created by the non linear (switching) loads which causes distortion of original sinusoidal waveform is termed as harmonics. The distortion of waveform at normal frequency load is referred as simple harmonic distortion whereas the distortion of waveform at high frequency combine referred as total harmonic distortion (THD).

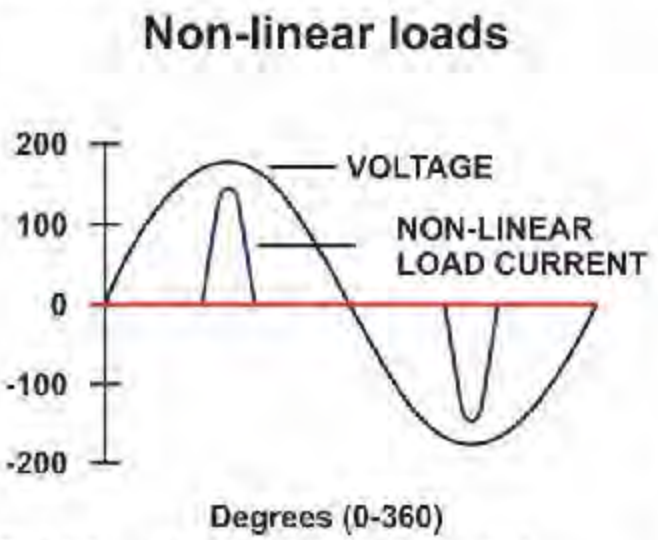


Fig. 1: Voltage and current waveform for non linear loads

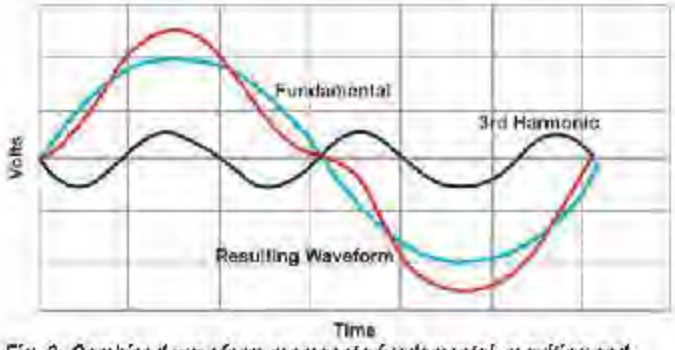


Fig. 2: Combined waveform represents fundamental, resulting and harmonic wave

Sources of Harmonics

As electric supply company provides a sinusoidal voltage and current at normal supply frequency, some of the distortions are produced by the transformer and end user is also capable of doing so, also non linear type loads allows non sinusoidal currents to flow at their terminal. These loads absorb frequency current and produce harmonic currents and act as harmonic suppliers.

Following are the sources of harmonics:

- UPS and SMPS
- Rectifiers and converters
- Switches and circuit breakers
- Power capacitors
- Variable speed drives
- Discharge lamps

Under normal condition if the phase currents are equal and neutral shows some current to flow (more than 70%) then there is possibility for the harmonic current in the system

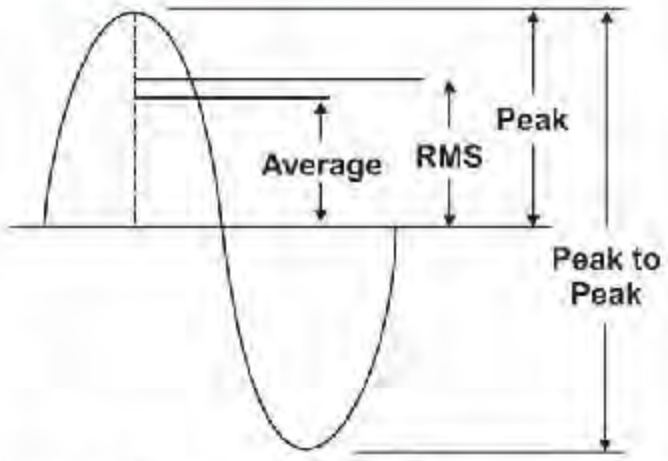
- Starters; Switching equipments
- Feeder switching; Arc furnaces
- Induction heating furnaces
- Other semiconductor devices.

Harmful Effects of Harmonics

- Reduces power quality of the supply systems
- Interference in communication systems (hissing noise etc)
- Problems in computerized operated processes (digital etc)
- Increases power line losses
- Reduces system efficiency
- Increases RMS and peak value of the distorted waveform
- Overheating of transformers, cables, conductors, control panels and protective devices
- Un sudden change in operation of fuse and circuit breaker
- Errors in energy meter recording (increased billing) and measuring equipments
- Reduces equipment life (Ageing)
- Breaking of winding/conductor insulation.

Identification of Harmonics

By measuring peak and RMS value of sinusoidal waveform



$$for\ voltage\ V_{rms} = Vp \times 0.707 = \frac{V_p}{\sqrt{2}}$$

$$for\ current\ I_{rms} = Ip \times 0.707 = \frac{I_p}{\sqrt{2}}$$

We are familiar with Peak factor; it is the ratio of peak value to the RMS value.

Peak factor= peak value / RMS value=1.41,so by using actual value RMS meter it possible to find the peak factor of sinusoidal waveform if its value found to be less than the actual (1.41) then it represents the presence of harmonics.

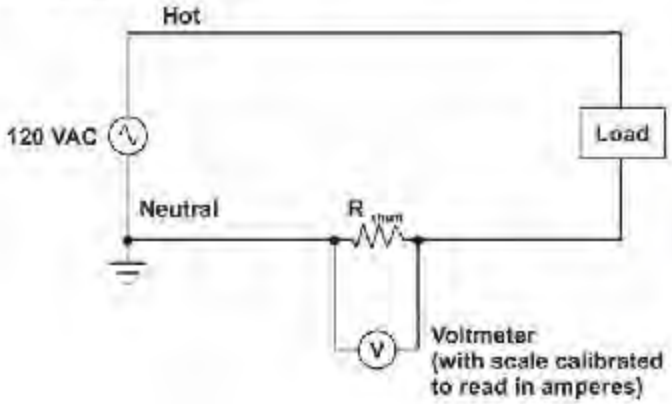
By proper inspection of connections

Check properly that the connections at the terminals are properly tight, loose connection causes overheating, which again results into insulation failure.

With the tight connections if overheating is observed then there might be possibility for the presence of harmonics.

By measuring the Phase and neutral current of the balance systems

We know that the balance system results into neutral current at zero level. Under normal condition if the phase currents are equal and neutral shows some current to flow (more than 70%) then there is possibility for the harmonic current in the system; at this stage it is essential to eliminate the harmonics.



By Comparing Transformer Temperature Conditions			
Sr No	Condition	Temperature status	Remark
1	Light load on transformer	Temperature under control	No Harmonics
2	Light load on transformer	Over heating	Presence of harmonics
3	Below rated load on transformer	Rated temperature	Harmonics in working

Table 1: By comparing the transformer temperature with loading condition & rated temperature

So by above conditions it is easy to detect the presence of harmonics.

Economic Impact

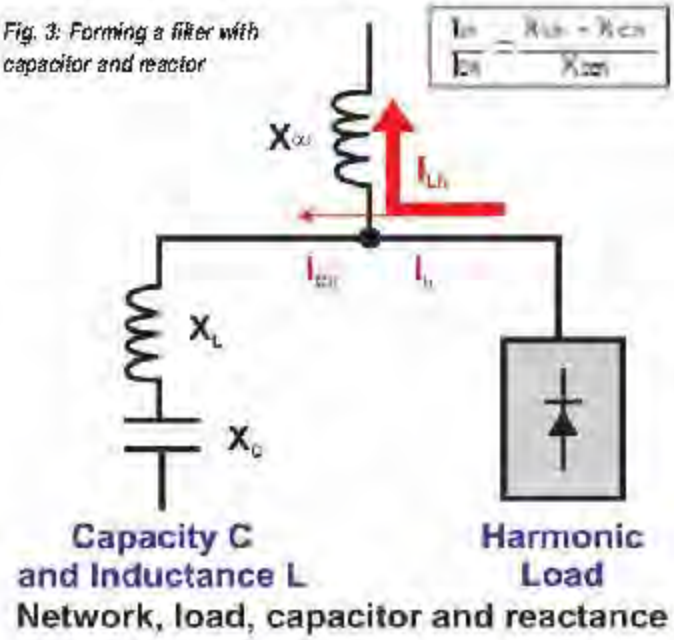
Harmonics leads to the increased cost of energy consumed per unit (Electricity Bills) due to misreading or extra power consumption due to harmonic current. It also leads to the increase maintenance cost due to insulation failure or damage of motor winding, increased equipment winding temperature due to harmonic current results into heating of machine which again results into insulation failure and can cause damage to the equipment. This intern increases the overall cost or makes the system uneconomical.

Simple Harmonic Reduction Techniques

Though harmonic currents can never be completely compensated however, their magnitudes can be reducing to a greater extent. Below mentioned is the simple procedure for harmonic reduction.

Forming a filter consist of capacitor in series

Fig. 3: Forming a filter with capacitor and reactor



In this method perfect tuning or the value of capacitor and reactor are so chosen that the value of impedance at tuning frequency is zero, this permits the absorption of harmonic current by the simple filter. In this method the capacitor and reactor is tuned at a frequency below the harmonic frequency, therefore the combination allows only small harmonic current to flow through the circuit.

Basic Consideration/Requirement for Simple Filter Circuit

- Equivalent output of the filter circuit
- Accuracy of the filter tuning
- Impedance of the filter circuit.

Advantages of Simple Filter Circuit

- Harmonic current can be reduce to a greater level
- Simple construction of the filter circuit
- Easy re insertion of the capacitor.

Disdvantages of Simple Filter Circuit

- Additional source is required.
- Addition of reactors in series with capacitors is costly which increases the cost of filter.

The Superior Solution: IGBT Based Selective Shunt Active Filter

The disadvantages contain by the passive filter is overcome effectively by the use of active filter. Active filter uses IGBT (Insulated Gate Bipolar Transistor) with other control loops for reducing the harmonics and improving the power factor. The active filter measures the magnitude of harmonic current and creates the same magnitude harmonic current in opposite to the original harmonic current. The equal and opposite

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.

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

harmonic current cancels out each other, thus by reducing the harmonic content.

Principle of Selective Shunt Active Filter

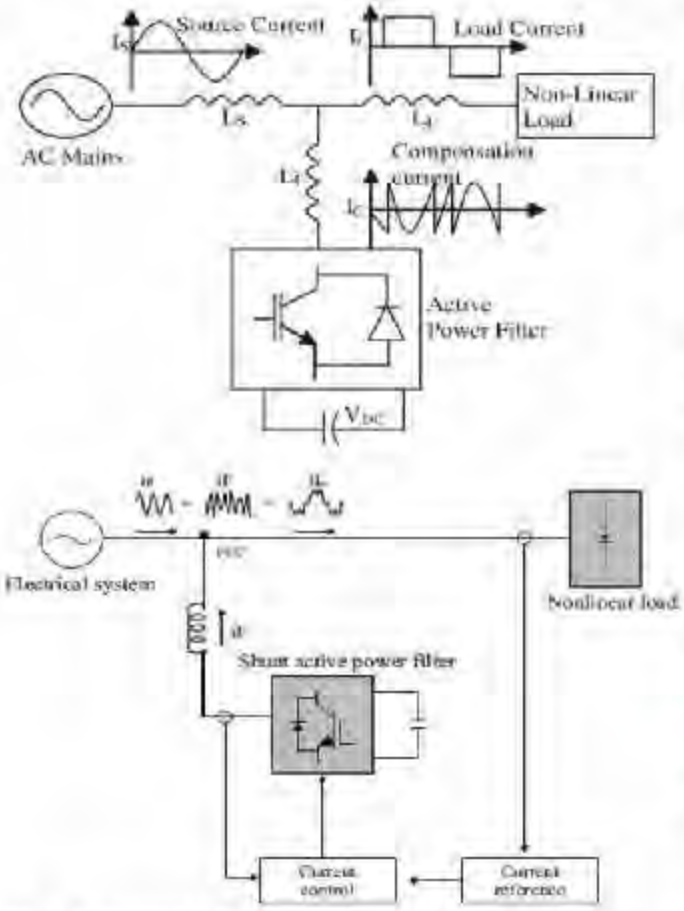


Fig. 5: Basic principle of closed loop shunt active filter

The Main Concept behind this technique is to generates a reference current by any usual method and process each and individual harmonics.

The Main purpose of selective shunt active filter is to supply the harmonics absorbed by the non linear load, in order to provide the grid current with a low harmonic content.

It consist of two basic control loops (closed) namely outer loop called as voltage loop which regulates the voltage across capacitor (P.F correction) and inner loop called as current loop which track the current signal. The inner current signal is generated by by sensing the load current and absorbing the harmonic content. Then this filter current is used for the inner current loop for tracking the load current harmonics. There is another alternative solution for generation of inner current loop current- by using grid voltage sensing. In grid voltage sensing, the grid current is allow to follow this sinusoidal signal. due to this, the load harmonics are indirectly given by the shunt active filter inductor current.

Advantages of Grid voltage sensing

- Allows use of low bandwidth current sensors.
- It gives fast transient response.

Advantages of selective shunt active filter

- Reduces harmonic content to larger extent.
- It compensates the most harmful load current harmonics which the other techniques are not capable to do so.
- With this techniques filter ratings, bandwidth of current control & dangerously interacted system resonances are reduced.
- The use of closed loop in selective shunt active filter provides relatively low error in steady state.

Disadvantages of selective shunt active filter

It requires additional algorithm for reducing the distortion coming from the grid voltage.

Applicable to

This method is successfully applicable to single phase and three phase systems

Benefits of shunt active filter

- Reduces energy cost
- Elimination of higher and lower order harmonics
- Improve load power factor
- Voltage improvement and stability
- Surge and transient protection
- Reduces voltage unbalances
- Reduces power line losses
- Increases system power quality
- Increases system efficiency.

Conclusion

Harmonics impact more on electrical power systems including electrical machines, conductors, electrical devices, measuring devices, electricity bills, starters, variable speed drives etc. Therefore, today it is not only required to reduced harmonic levels but also there is strong need for superior and accurate advance future development in harmonic reduction/ elimination techniques, as consumers are responsible for harmonic generation and power quality deterioration.

Profile

Haridas M Kakad
BE (Electrical) from Sir Visveswaraya Institute of Technology, Nashik is Lecturer at K K Wagh Polytechnic, Chandori, Nashik. His area of interest are Electrical Power System.

Ravindra P Wagh
AMIE (Electrical) from Institute of Engg. Kolkata is Sr. Lecturer in Electrical Engineering at K K Wagh Polytechnic, Chandori, Nashik. His area of interest are Electrical Power System,Traction System.

Bhagat R S
BE (Electrical) P. Dr Vithalrao Vikhe Patil C O E Ahmednagar, is Lecturer Electrical Engineering K K Wagh Polytechnic, Chandori, Nashik. His area of interest are Electrical Power System.

Ghogare N M
BE (Electrical) P. Dr Vithalrao Vikhe Patil C O E Ahmednagar, is Lecturer Electrical Engineering K K Wagh Polytechnic, Chandori, Nashik. His area of interest are Electrical Power System.

LIGHTNING AND SURGE PROTECTION FOR SOLAR APPLICATIONS

hakel®

www.hakel.com

•• DEALERS ENQUIRY SOLICITED ••

hakel

HAKEL Ltd.
Bratri Stefanu 980
500 03 Hradec Kralove
Czech Republic
Tel: + 420 494 942 300
Fax: + 420 494 942 303
Email: info@hakel.cz
Web: www.hakel.com

APS

Marketed in India:
ALLIED POWER SOLUTIONS
C-301, Delhi Rajdhani Apts
80, I.P. Extn. Patparganj
Delhi - 110 092 (INDIA)
Tel: + 91 11 2223 6074
Email: info@alliedpowersolutions.com
Web: www.alliedpowersolutions.com

Controlled operation of Doubly Fed Induction Generator under Isolated Conditions

Double fed induction generators are good options for power production in remote areas. Experimental study has been carried out to verify the simulation results for different values of prime mover speed of DFIG keeping the rotor induced frequency constant or rotor induced voltage constant. Genetic Algorithm is used to get the optimized value of the rotor voltage to keep the stator voltage magnitude and frequency constant for different operating speed. Moreover, adaptive neuro-fuzzy inference system (ANFIS) alongwith GA is used to improve the speed of computation. Constant voltage constant frequency based control strategy is exploited to suit its possibility for use in isolated operations.

Dheeraj Joshi & R C Bansal

The research and utilization of isolated or standalone mode of operation of doubly fed induction generator (DFIG) is not so common due to their wider grid connected systems. However, for smaller developing tropical island countries, it becomes very difficult to supply isolated loads. Thus in practice DFIG is used in isolated mode operation in these areas.

Synchronous and induction generators both can be used for wind energy conversion systems (WECS). Synchronous generators are generally used in variable-speed WECS with interfacing of power electronic circuitry while induction generators can be used in a fixed speed as well as variable-speed WECS. Various types of induction generators are mostly used in WECS i.e. squirrel cage rotor, wound rotor with rotor resistance control and doubly fed induction generator (DFIG). The squirrel cage rotor induction generators are utilized for fixed speed operation. It uses full-rated power electronic system for variable speed wind operation. The DFIG provides a wide range of speed variation and thus commonly used.

The research work on the analysis of DFIG in isolated mode of operation is relatively less. As normally self-excited induction generators (SEIG) are used for isolated operations. Unlike the grid connected case, where large consumer loads can be operated without greatly affecting the grid performance, isolated DFIG system have to be made more robust and very good control systems in order to operate the required loads which greatly affect the performance of the entire system. Further, power generated from the rotor circuit is fed to the stator circuit or load and in this way DFIG operation is more efficient as compare to SEIG.

Doubly-fed induction machines have four possible operating modes in which only two generating modes at sub-synchronous and super-synchronous speeds are of interest for wind power generation

In modern WECS, a DFIG is an adjustable-speed induction machine widely used in modern wind power industry. Due to numerous advantages such as high power output, simpler pitch control, wide range of controllability of reactive and active powers, modern wind energy conversion system use variable speed concept. Doubly-fed induction machines have four possible operating modes in which only two generating modes at sub-synchronous and super-synchronous speeds are of interest for wind power generation. In a DFIG, from rotor side can also be utilized for power production. When the generator is operating on super-synchronous speed then electrical power is delivered to the grid through stator as well as rotor side. If the generator is operating sub-synchronous speed then electrical power is delivered into the rotor from the grid.

The possibility of DFIG supplying an isolated load has been proposed by some researchers in which the steady state control was discussed. Further an isolated diesel-wind power system was used and a comparison is made between the different wind generator models. DFIG are used to integrate the small size hydro plants which are originally constituted with fixed speed drive. A unified control strategy has also been proposed for the small size hydro plants which are upgraded to variable speed mode with the addition of DFIG. Dynamic modeling of isolated systems containing DFIG was proposed where rotor voltage was controlled in order to control the DFIG characteristics.

This article deals with the steady-state modeling of DFIG. Load voltage and frequency is determined for different operating conditions. Artificial intelligent techniques i.e. genetic algorithm (GA) has been used in induction generator analysis and control. Hybrid GAANFIS based model is used here to find the optimum values of rotor voltage for constant voltage constant frequency operation of DFIG under different operating conditions. Experimental results on test machine confirm the validity of proposed GAANFIS based approach.

Modeling and Operation of DFIG in Isolated Mode Operation

An isolated mode operation of DFIG is characterized by the fact that stator voltage has to be controlled along with stator frequency. Expression for stator frequency in terms of rotor frequency and rotor speed may be written as follows;

$$f_s = \frac{1}{30(30f_r + N_r)} \tag{1}$$

Here f_s, f_r and N_r are stator frequency, rotor frequency and rotor speed respectively. Fig. 1 gives the equivalent circuit diagram of isolated DFIG for resistive and inductive loads. For isolated mode operation, the stator voltage V_s is replaced by the following expression:

$$V_s = -(R_L + jX_L)I_s \tag{2}$$

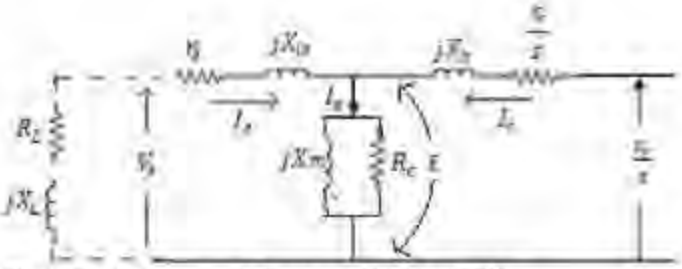


Fig. 1: Equivalent circuit diagram of isolated DFIG

The voltage equations from the Fig. 1 can be written as,

$$(r_1 s + (jX)_1 ls + R_L L + (jX)_1 L)\, I_s = -(jX)_1 1\,(I_s s + I_r r) = E \tag{3}$$

$$(r_1 r + (jsX)_1 lr)\, I_r r - V_r r = -jX_1 1\,(I_s s + I_r r) = E \tag{4}$$

Where

$$R_1 = \mathrm{Re}\left(\frac{jRcX_a}{R_c + jX_a}\right) and\ X_1 = lm\left(\frac{jRcX_a}{R_c + jX_a}\right) \tag{5}$$

DFIG in its isolated mode operation is fed from rotor side and is connected to the load from stator side. By properly adjusting the rotor frequency with speed to keep the stator frequency constant and controlling the amplitude and phase sequence of rotor voltage, the stator voltage may be kept constant until a certain stator current limit, for a given load power factor is reached. Neglecting the core loss resistance the following equations are derived.

$$I_s = \frac{V_r}{R_{eq} + jX_{eq}} \tag{6}$$

$$R_{eq} = \mathrm{Re}((jX_m(R_L L + (jX)_1 L)) / ((R_1 r + (jsX)_1 r)(R_a + R_L L + j(X_a + X_L L))) \tag{7}$$

$$X_{eq} = lm((jX_m(R_L L + (jX)_1 L)) / ((R_1 r + (jsX)_1 r)(R_a + R_L L + j(X_a + X_L L))) \tag{8}$$

$$R_a = \mathrm{Re}[r_s + (jX)_1 s + ((jX)_1 m(r_r/s + (jX)_1 lr)) / r_r/s + (jX)_1 lr + (jX)_1 m)] \tag{9}$$

$$X_1 a = lm[r_s + (jX)_1 s + ((jX)_1 m(r_r/s + (jX)_1 lr)) / r_r/s + (jX)_1 lr + (jX)_1 m)] \tag{10}$$

$$X_r = X_{ar} + X_{lr}$$
$$X_s = X_{as} + X_{ls} \tag{11}$$

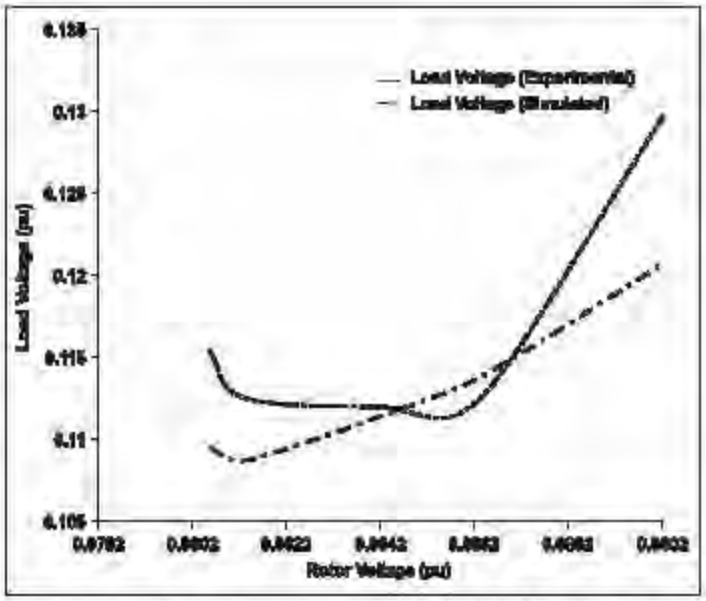


Fig. 2: Comparison of experimental and simulated load voltage for constant prime mover speed at 0.6566 pu and for almost constant rotor induced voltage and constant load, R_L=4.9081 pu

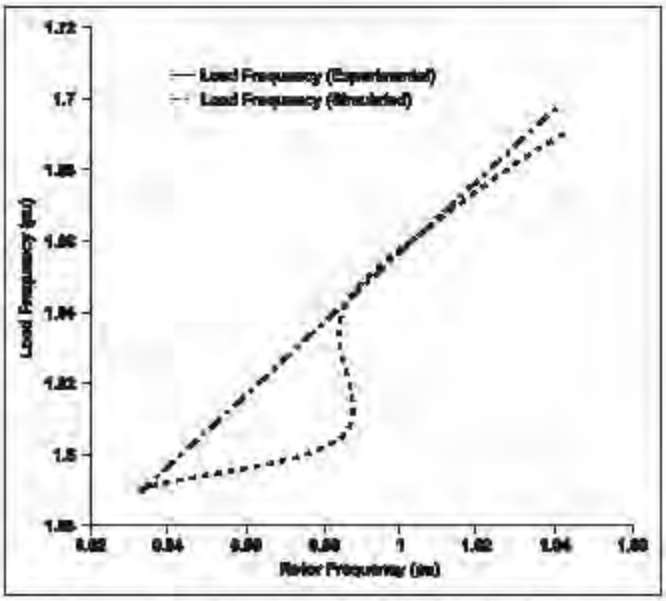


Fig. 3: Comparison of experimental and simulated load frequency for constant prime mover speed at 0.6566 pu & for almost constant rotor induced voltage & constant load, R_L=4.9081 pu

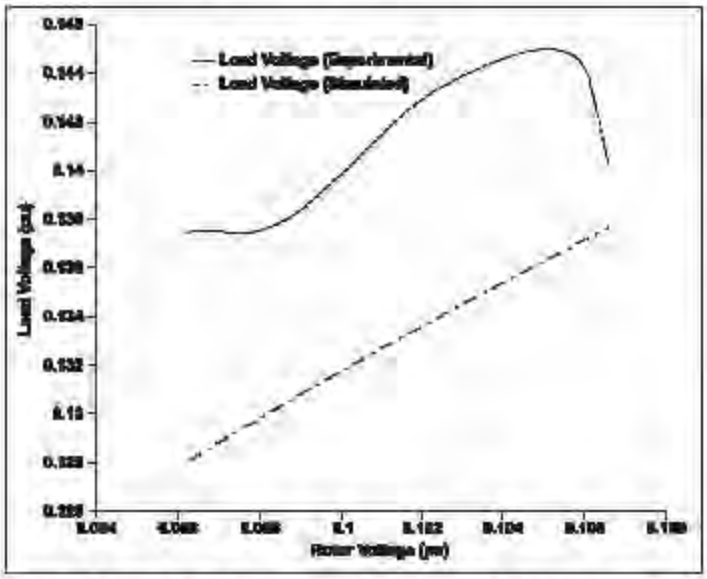


Fig. 4: Comparison of experimental and simulated load voltage for constant prime mover speed at 0.5920 pu and for variable rotor induced voltage and constant load, R_L=4.9801 pu

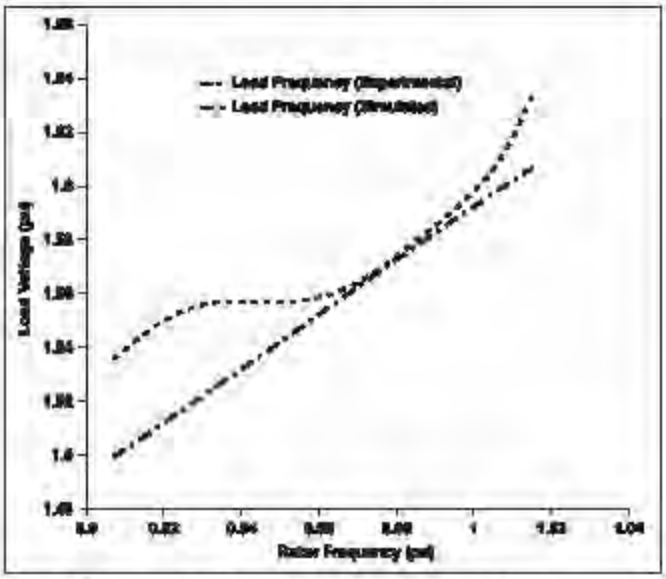


Fig. 5: Comparison of experimental and simulated load voltage for constant prime mover speed at 0.5920 pu and for variable rotor induced voltage and constant load, R_L=4.9801 pu

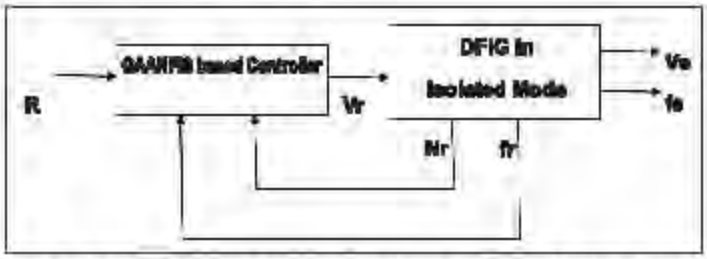


Fig. 6: Constant voltage constant frequency output of isolated mode DFIG.

Genetic Algorithm is used here with the optimization criteria as minimum least square error in load voltage and frequency. To implement it, following objective function (OF) is formed;

$OF=|V_{ref}-V_s|^2+|f_{ref}-f_s|^2$

Here V_{ref} and f_{ref} are the rated values of stator voltage and frequency, where V_s and f_s are actual values respectively. f_s and V_s are calculated from equations (1) and (2) respectively. For the given values of load resistance, R and rotor speed, N_r, rotor voltage, V_r and rotor frequency, f_r are the variables to achieve

WT500

Power Analyzer

ENERGY STAR

Measure Renewable Energy more Intelligently!

To prevent global warming, the photovoltaic generation and wind energy are heralded as the new energy substitutes for fossil fuels.

Thermoelectric generation with limited resources such as crude oil and coal emits CO2, causing global warming and adversely impacting the environment.

Solar & wind power generation, on the other hand, does not require fossil fuels or other natural resources and does not emit CO2. These clean, new energies will likely be an important source of energy in the future.

The **WT500 Power Analyzer** can concurrently measure direct current and alternating current signals with extreme precision, making it the perfect tool for assessing voltage, current and power conversion efficiency in the burgeoning solar and wind power generation systems. Also the WT500 is an **accepted device by Standard Performance Evalution Corporation (SPEC)** used for Power Efficiency Benchmarking.

Features:

- The WT500 provides highly precise measurements of power conversion efficiency in the photovoltaic generation system that has became a focus of world attention as new energy.
- One unit of the WT500 concurrently measures direct current signals from the photovoltaic generation and converted alternating current signals.
- The WT500 measures the electric power conversion efficiency of the power conditioner including the converter and the inverter with a high accuracy.
- High currents up to 40A and high voltage up to 1000V can be measured.
- Both numeric and voltage and current input/output signals are displayed on the color TFT liquid crystal monitor.

QUALITY ■ INNOVATION ■ FORESIGHT

YOKOGAWA

Yokogawa India Limited
Plot 96, Electronic City
Hosur Road, Bangalore - 560 100
Tel: 080-41586000 Fax: 080-28528656
Email: tmi.india@in.yokogawa.com
Web: www.tmi.yokogawa.com

the constant load operation for DFIG. Moreover, under different loading conditions, load resistance, R can also be taken as variable quantity. Here GA is used for constant load operation.

Furthermore ANFIS design is used to give rotor voltage, V_r as output based on the rotor speed and rotor frequency are selected as input variables for given value of load resistance. The proposed approach is applied on isolated DFIG as follows.

Step 1: Firstly, optimum value of rotor speed and rotor frequency are computed for rated operation of DFIG using GA based approach.

Step 2: Secondly, ANFIS is trained for these optimum values to get applied rotor voltage.

Step 3: Finally, complete algorithm is tested under different operating conditions.

Results and Discussions

In order to verify the simulation results, experiments have been performed out on test machine (10 HP, 4 pole, 50Hz, star connected, 415 V, 14.7A). Fig. 2 and Fig. 3 gives the comparison between the simulated results and experimental results when the prime mover speed is maintained at 0.6566 pu for a load of 4.9081 pu and keeping the rotor induced voltage almost constant. Fig 4 and Fig. 5 gives the comparison between the simulation and experimental results when the prime mover speed is maintained at 0.5920 pu for a load of 4.9801 pu and keeping the rotor induced voltage almost constant. It has been observed that the %error is very low ranging from 6% to -2% for load voltage and from 3% to -1% for frequency.

The optimized values of the rotor induced voltage and frequency are determined using Genetic Algorithm in order to get almost constant

Fig. 7: Variation of training error with epochs.

Fig. 8: Different firing rules for a specific test condition.

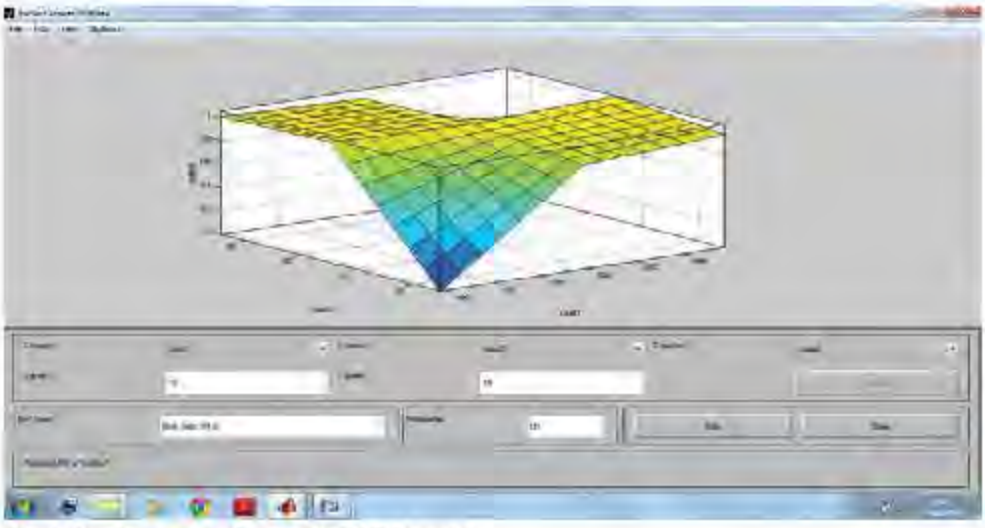


Fig. 9: Input output surface using ANFIS model.

We are *your* solution

Various ElectroMech cranes
at a windmill blade manufacturing facility

Customised crane solutions for safe handling at your power project

Handling needs in the power industry are demanding. Manufacturing of heavy and valuable equipment, from windmill blades to transformers. Handling of equipment, maintenance of critical components or even handling of hazardous spent fuel. Time-bound project completion and safe operation depend on a well engineered handling system.

Yes, find an ingenious customised crane solution from us - for every requirement. Reliable and safe, with assured performance round the clock. No wonder, we are your preferred solutions partner - every time, anywhere in the world.

www.emech.in +91-20-6654 2222 solutions@emech.in

ElectroMech

Solutions | Service | Satisfaction

Visit us at:

CeMAT India Hall No.14, Pragati Maidan, New Delhi Dec.10-13, 2014

IC India 2014 H1-NOI Indoor, India Expo Center, Greater Noida Dec.15-18, 2014

05-14-15

voltage and frequency at the load side when running at different speeds. ANFIS is trained using such values. The simulation results are shown in Table 1. It is found that using ANFIS, the computational time is very less.

Thus GAANFIS based methodology has been used to find the optimum values of control variables and that can be used for constant voltage constant frequency operation of DFIG under isolated mode under different operating conditions. Complete scheme is shown in Fig. 6.

Fig. 7 shows the effectiveness of GAANFIS model for control of DFIG. It is found that training error is very small and result are quick enough to use it in real time.

Fig. 8 and Fig. 9 shows the different firing rules and surface of ANFIS model. It also shows that there is no need to create fuzzification and prepare rule base like conventional fuzzy logic.

Conclusions

Experiments has been carried out to verify the simulation results for different values of prime mover speed keeping the rotor induced frequency or rotor induced voltage almost constant. Genetic Algorithm is used to get the optimized value of the rotor voltage for keeping the stator voltage magnitude and frequency constant for different operating speeds.

ANFIS is used to improve the computational speed for control purpose. Thus constant voltage constant frequency based control strategy can be possible for isolated DFIG operations using proposed approach.

Profile

Dhaeraj Joshi

BE from University of Rajasthan; ME (Power Apparatus and Electric Drives) from University of Roorkee, is PhD. He is Associate Professor in Electrical and Electronics Engg Deptt. in Delhi Technological University. He is member of BOS of various national universities. He has 84 publications to his credit. He got Best Paper Prize also & is life member of ISTE.

Prof. Ramesh Bansal

is Professor and group head (Power) in the Department of Electrical, Electronic and Computer Engineering at the University of Pretoria, South Africa. He was with University of Queensland, Australia, BITS, Pilani; University of the South Pacific, Fiji; and Civil Construction Wing, All India Radio. He has published over 200 papers. He is a Fellow, and C Engg IET-UK, Fellow Engineers Australia, Fellow Institution of Engineers (India) and Senior Member-IEEE.

SAARC Countries Finalized Framework Agreement for Energy Cooperation

5th SAARC Energy Ministers Meeting finalized the SAARC Framework Agreement for Energy Cooperation (Electricity). This is a significant achievement of the Ministers' meeting, as this Agreement has been pending since 2010 and is a crucial step towards developing a SAARC Market for Electricity (SAME) on a regional basis.

Two days meeting concluded here with the Ministers assurance to get the Framework Agreement approved from their respective Governments so that it could be signed during the forthcoming SAARC Summit scheduled to be held in November, 2014 in Kathmandu, Nepal.

India proposed to host the Seminar on 'Sharing Experiences on Energy Pricing Mechanism in the SAARC Region'. India also proposed to host the Second Meeting of the Expert Group on Technology/Knowledge Sharing (including Energy Efficiency, coal, etc.) in 2015. Bangladesh will convene the Meeting of Energy Regulators /Bodies in SAARC countries by December 2014.

The Meeting noted that all the four Expert Groups have already finalized their ToR and Work Plans and urged the lead Member States to continue convening of Expert Group meetings regularly, preferably on annual basis.

The Member States apprised the Meeting of the initiatives taken with regard to Renewable Energy projects. The Meeting referred the matter to the Expert group on Renewable Energy for further deliberations.

The meeting approved the 8 reports of earlier meetings of the Working Group on Energy, separate Expert Groups on Electricity, Technology and Knowledge Sharing, Renewable Energy and the reports of the Inter-governmental Meetings on 'Study on South Asian Regional Power Exchange', organized by ADB.

The Indian side presented two Concept Reports namely, 'Framework for planning cross-border transmission links and associated system strengthening through joint system studies' and 'Operation of stable and secure SAARC Electricity grids'. Bangladesh has also prepared the Concept Paper on 'Structures, functions and institutional mechanisms for SAARC regulatory issues on electricity exchange/ trade' and the same would be circulated among Member States, shortly. Member States to offer their views/comments on the Concept Papers by December 31, 2014.

The next meeting of the SAARC Energy Ministers' will be held in Nepal.

GIANTLOK

CABLE TIE AND FASTENING SYSTEM


CABLE TIES


TERZES® CABLE TIES


ROUND HEAD TIES


RELEASABLE TIES


HEAT RESISTANT CABLE TIES


MARKER TIES


PUSH MOUNT TIES


DOUBLE LOOP TIES


MOUNTABLE HEAD TIES


BUTTON HEAD TIES


SELF ADHESIVE CABLE TIE MOUNTS


SELF ADHESIVE WIRE SADDLES


SELF ADHESIVE TWIST LOCKS


CABLE CLIPS


DUAL RAIL CABLE CLIPS

CABLE PROTECTION


SLOTTED/SOLID WALL WIRING DUCTS


TELEPHONE WIRING DUCTS


WRAPPING BANDS


BUTTON TUBES


HOOK & LOOP TUBES

CONDUITS AND FITTINGS


PE FLEXIBLE CONDUITS


FIVE-PIECE CONDUIT ADAPTORS


ANGLE TYPE CONDUIT ADAPTORS


QUICK-FIXED CONDUIT ADAPTORS


CONDUIT MOUNTING BRACKETS

WIRE TERMINATION


WIRE CONNECTORS


CORD-END TERMINALS


TERMINALS


HEAT SHRINKABLE TUBES


COPPER / CABLE LUGS

TOOLS


CABLE TIE TOOLS


BANDING TOOLS


MULTI-CUTTER


WIRING DUCT CUTTER


TERMINAL TOOLS

Corporate Office India
GIANTLOK INDIA PVT. LTD.
#43, 2nd Floor, Community Center,
Naraina Industrial Area Phase-1, New Delhi - 110 028, India
Tel.: +91-11-47001540; Fax: +91-11-47001525
Email: dhananjay@giantlok.com; http://www.giantlok.com

Electrical Contact Resistance

The Fires which originate from defects in electrical equipment are called as Electrical fires. The electrical fires originate from four main categories of reasons which are 'overloading of electrical equipments; defects or deterioration of electrical insulation; deterioration & failure of pressurized contacts between various components in electrical installation; mechanical failure (fracture) of current carrying components. Out of above major causes, deterioration & failure of pressurized contact involves the importance of electrical contact resistance.

Prof Jitendra M Patil, Prof Gorhe N S & Dr Sachin S Bharatkar

When two electrical conductors are held together to make possible the passage of electric current from one component to the other, there exits some additional electrical resistance at the point of surface contact. Such a resistance is called as electrical contact resistance. As an electric current passes through it, heat will develop within it [H=I2Rt Joules]. If there is any deficiency in design, manufacturing & maintenance of electrical contacts, in an electrical installation, the temperature can rise to levels at which insulating material may get damage. It can lead to development of an electrical fire.

Electrical contact resistance depends on factors:

- Normal force between contacting surfaces.
- Resistivity of metals at the contacts points.
- Yield points of the metals.
- Cleanliness of contacts surface.

This article describes a brief theory of electrical contact resistance, factors that decides it, and precaution required in maintenance of them.

Electrical Contact Resistance – Theory

When two electrical conductors are held together with a view to enable the passage of electric current from one component to the other, there exists some additional electrical resistance called electrical contact resistance. Assume that two copper conductors in rod shape p & q are touching each other as shown in Fig 1.

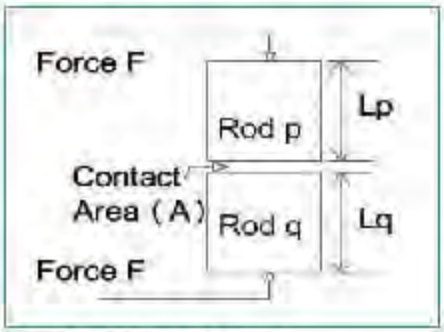


Fig. 1: Formation of Contact

Lp = Length of rod -p

Lq = Length of rod -q

Ap and Aq = Cross sectional area of rod- p and rod- q

p = Resistivity of Copper

Rp = Resistance of rod -p

Rq = Resistance of rod -q

Rc = Electrical contact resistance between rod- p & q.

Rt = Total resistance

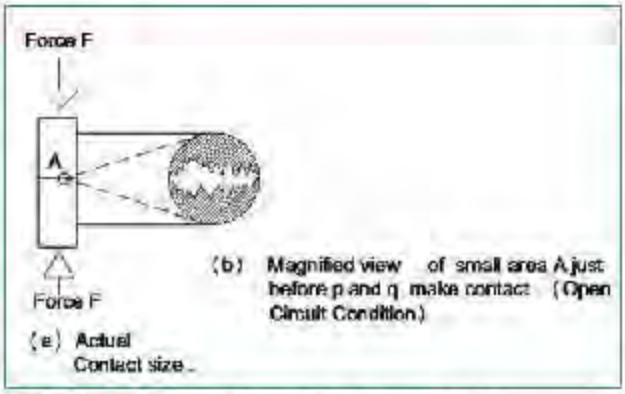


Fig. 2: Actual Contact before application of force

When these two copper rods will be subjected to the compressive force 'F', then two metal flats of area are to be pressed together as shown in Fig. 2.

It will appear as if the area of contact is A, but it is not so. The real contact area is much less because of surface irregularities. If this contact surface is observed through a power microscope, there exist ridges & valleys as shown in Fig. 3.

The dimensions of them are around few microns. It means that when two copper rods touch each other, they actually touch at only few points. The remaining space between the surfaces is filled with air that acts as a bad conductor of electricity. As the compressive force 'f' is increased, the ridges in contact will get crushed & the area of contact (actual) is equal to the compressive force (F) divided by yield point of material i.e. Copper. The electric current spreads out from these small contacts area into the rest of conductor as shown in Fig. 3.

The actual area of contact is usually less than 5 % of the nominal contacts area and that depends on two factors i.e. compressive force (F) and yield point of the material.

Now the resistance involved in this electrical connections are-

$Rp = p \times l_p/Ap\ \Omega$

..... Equation 1.1

$Rq = p \times l_q/Aq\ \Omega$

..... Equation 1.2

$Rt = R_p + R_q + R_c\ \Omega$

..... Equation 1.3

Factors that decides Electrical contact resistance-

The electrical contact resistance depends upon following factors -

- Normal force between the two contacting surfaces /components. [Created by threaded of fosterers /springs]
- Resistivity's of metal at the point of contact.
- Yield point of metal
- Cleanliness of the contacting surfaces.

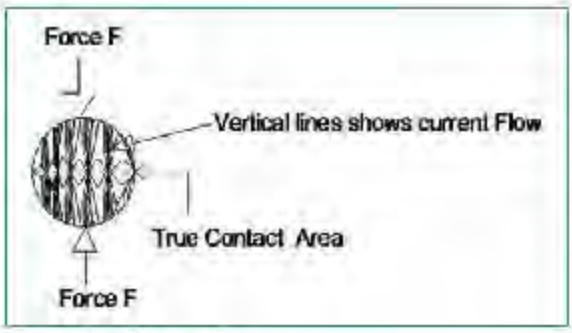


Fig. 3: Real Contact Area

The normal force i.e. perpendicular to the surface is the most important factor in deciding value of electrical contact resistance Electrical contact resistance is inversely proportional to the normal force or compressive force. A typical graph of variation of electrical contact resistance w.r.t.normal force is as shown in Fig. 4.

The resistivity of metals at the point of contact surface should consider at hot temperature of it. Because flow of current through contact surface will lead to increase in temperature of it. The yield of metal decides the actual contact area of surface for given normal or compressive force. The cleanliness of surface will directly affect the value of electrical contact resistance. When compressive force applied is low as in low current rated relay or auxiliary contacts, it is desirable to enclose these contacts in dust tight covers or place these contacts in room of sealed and pressurized with clean filtered dust free air. It is essential to reduce possibilities of bad contact due to accumulation of dirt & dust. But when compressive force (Normal force) is high, electrical contact resistance may be insensitive to the cleanliness condition of contact surface because during application of this force, contact squeezes out & breaks any oil, oxide film, scale or foreign particles, thereby developing a proper metal contact between the surfaces of the two components.

Precaution in preventing electrical contact failure

The most important point to be considered in preventing electrical contacts failure in electrical installation due to overheating or arcing is the force between the contacts surface i.e. Compressive force. If this force is provided by threaded fasteners, they must not only be tightened fully, but also retained in that state by use of appropriate locking devices. If force is obtained by spring, then consider following points:

- The dimension of the spring should adhere to drawing design.
- For plug and socket connector, the force of pull out the pin should be within specified limits.
- The spring characteristics and spring deflection do not get reduce during service.
- The spring deflection in the final assembly must be within specified limit.
- In case of light contacts force, the surfaces of contact should be kept dust free by suitable covering in low current equipment.

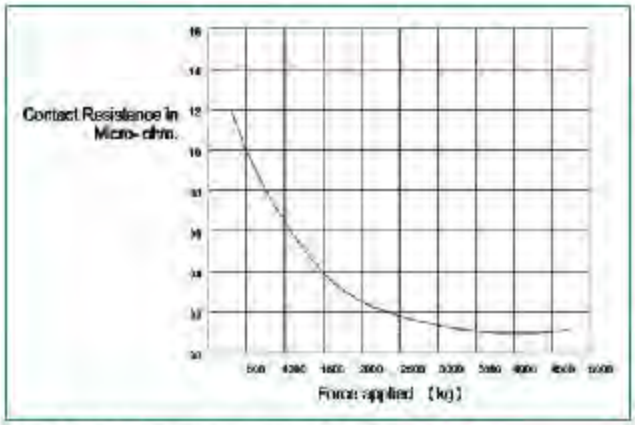


Fig. 4: Variation of contact resistance w.r.t. force

Conclusion

When an electric current passes through circuit breaker contact heat will be develop within it ($H = I^2RT$ Joules). if there is deficiency in design, manufacturing, and current through contact exceeds rated capacity, it leads to development of an electric fire it should be noted that an electric contact resistance is inversely proportional to the normal force or compressive force acting on it. Electrical contact resistance also depends on resistivity of metals at contact points. Other parts of metals, cleanliness of contact surface. So we should reduce electrical hazards accidents by maintaining proper pressure of contacts it's surface cleanliness.

Profile

Prof Jitendra M Patil

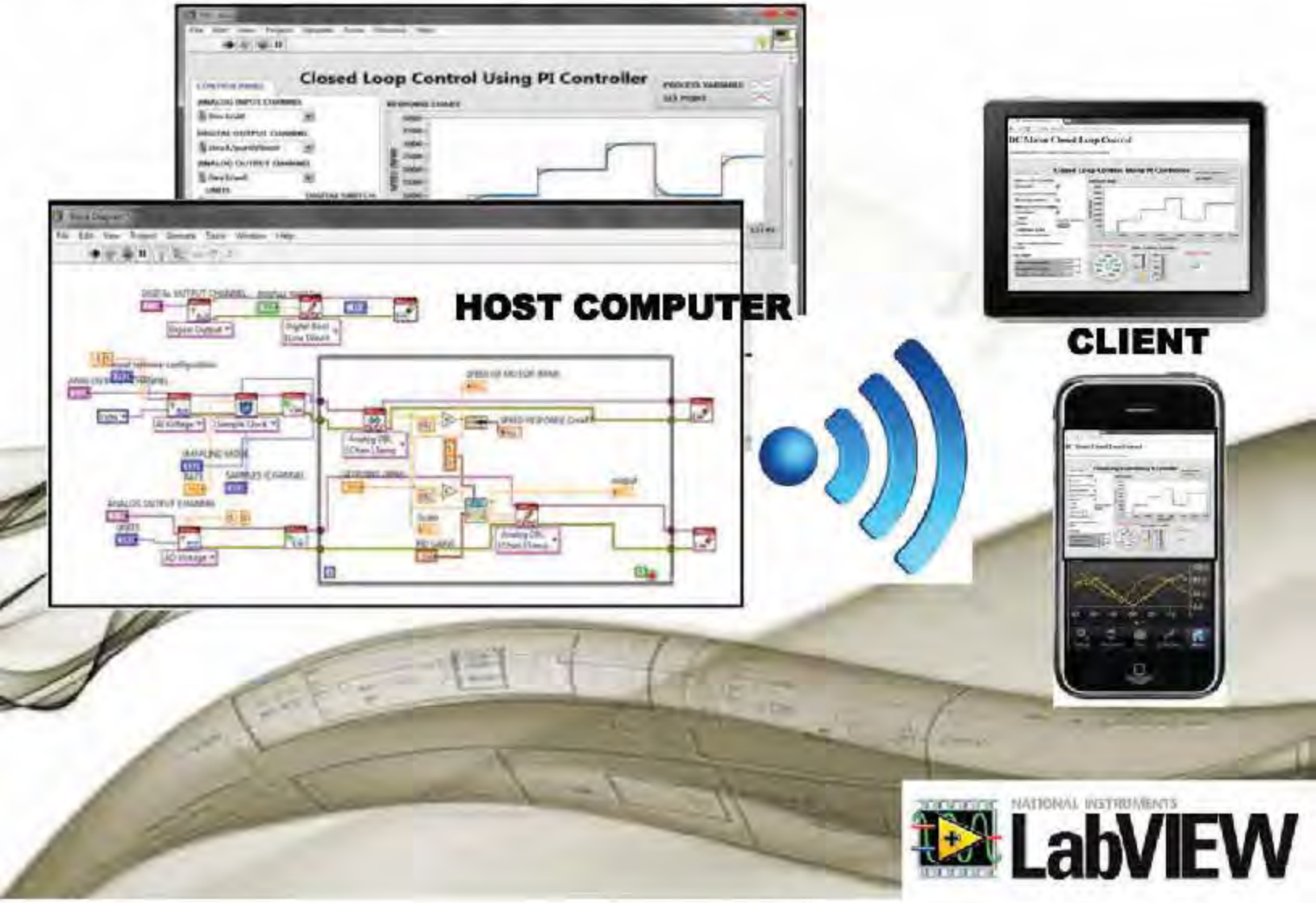
Head of the Department, Electrical Engineering K. K. Wagh Polytechnic, Chandori, is BE (Electrical) from Government College of Engineering, Aurangabad. His area of interest: Electrical Power System, Utilisation System, Electrical Measurement.

Prof Gothe N S

Lecturer in Electrical Engineering K. K. Wagh Polytechnic, Chandori. BE (Electrical) from Walchand College of Engineering Sangli. His area of interest: Electrical Power Generation, Circuit & Network, Electrical Machine.

Dr Sachin S Bharatkar

Selection Gr. Lecturer – Electrical Engineering, Government Polytechnic, Washim is BE (Electronics and Power) from Government College of Engineering, Amaravati (M.S.) MTech (I.P.S.) from VRCE Nagpur (M.S.), PhD (Electrical Engg.) from Jadavpur University, Kolkata, West Bengal. His area of interest: Electrical Machines, Utilization System, Power Electronics & Power System.



LabVIEW based Low-Cost OnLine Monitoring and Control

In the rapid growing era of modern technology, the need of automatic and web-based control system is required. Virtual instruments developed by National Instruments (NI) based on Graphical User Interface programming (GUI), has many unique features like: measurement and control in real-time, supports many network communication which makes LabVIEW a powerful tool. A low-cost online system has been implemented to control and monitor the speed of DC motor performing on host computer by the client system over an internet. This is performed by developing a communication channel between a "Client" & a "Server" by using web server & TCP/IP protocol.

System Description

The online transmission of data between a host computer and a client device is performed using build-in web server application in LabVIEW. Once the configuration is performed, the HTML page is generated using Web

The block diagram of whole set up is shown below

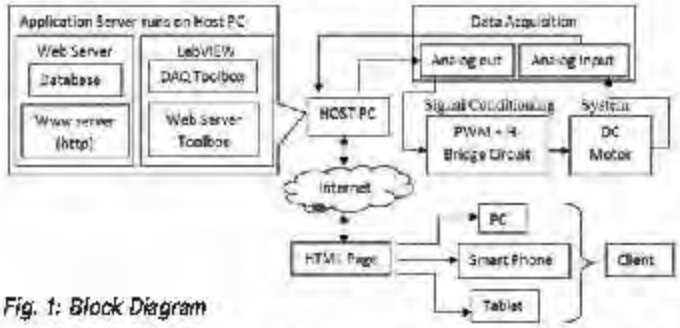


Fig. 1: Block Diagram

Publishing Toolkit containing a front panel of host computer which can be operated by the client. The client can provide a speed reference signal using HTML page through web browser. The obtained reference signal is converted to (0-5) volts output signal using DAQ USB 6009 which varies the duty cycle from (0-100)% of Pulse-Width Modulation signal followed by H-bridge circuit which drives the DC motor. The feedback signal is received from the tachogenerator and is compared with the set point and errors are computed by the PI controller. The experimental setup is shown below.

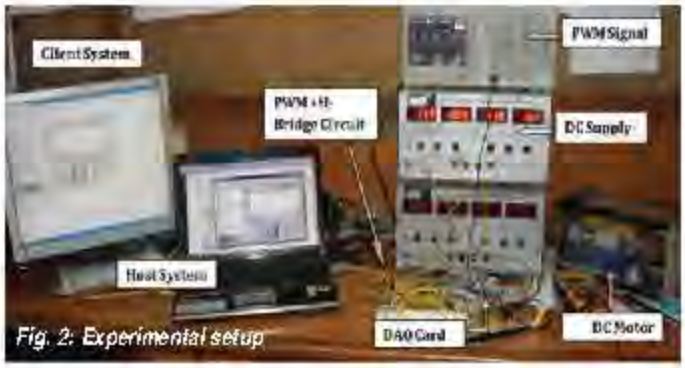


Fig. 2: Experimental setup

Results and Discussion

The main program contains the DAQ card resources, such as channel configuration, sampling rate, number of sample, sampling

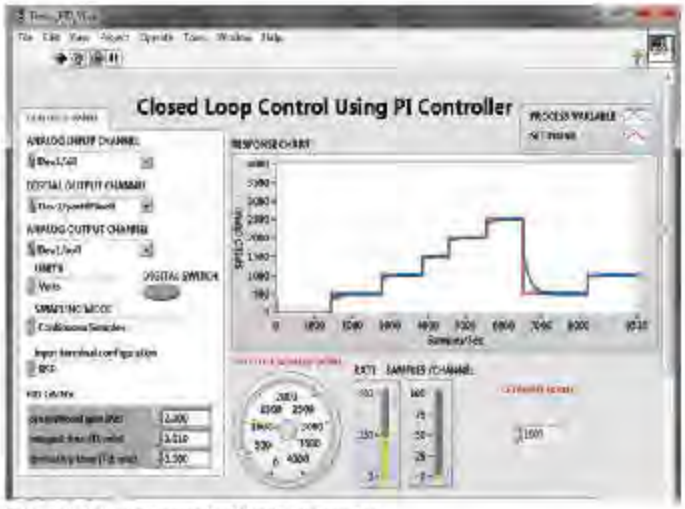


Fig. 3 (a): Front panel of host computer

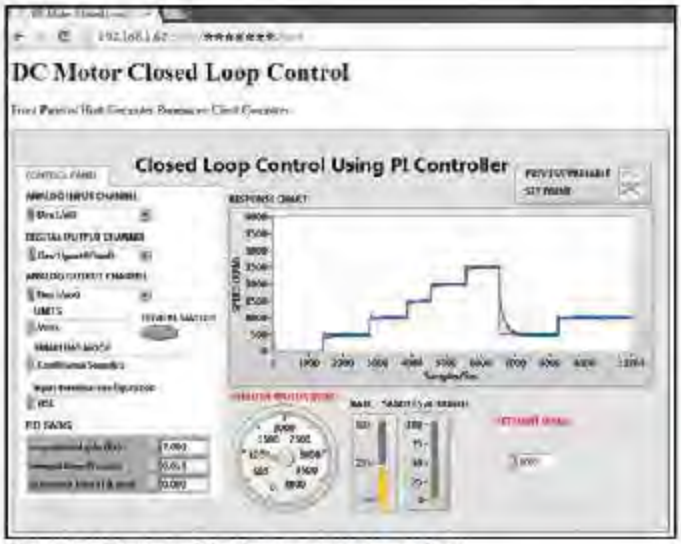


Fig. 3 (b): Front panel of host computer on client

mode, PI gain, and some indicators and graphs. The DC motor is controlled by PI controller algorithm and tuned in LabVIEW. A client can control the speed of DC motor remotely by accessing the host front panel through which motor is connected via the following address http://192.168.1.62:8000/VI_Name.html. The front panel of control loop on host computer and its corresponding HTML page published in web browser on client system is shown in Figure 3 (a) and 3 (b).

Conclusion

In addition to high accuracy, this system reduces the cost and assembling time for remote monitoring and control as faced in PXI systems. In all, it is quite useful for distance-learning and can be used for educational purpose at very low-cost.

Profile

Prof. Narendra Kumar

Electrical Engineering Department, Delhi Technological University, is BE in Electrical Engineering from IIT Roorkee, ME from P.E.C. Chandigarh and PhD from D.C.E. Delhi has published many research papers in journals and conferences. He has published two books as International Contributor. He has guided vast number of projects to PG and UG students. He is also guiding PhD students. His current areas of interest are Instrumentation, Control and Power Electronics applications.

Nitin Singh

MTech Student is BE in Instrumentation and Control Engineering from NSIT, Delhi. Now, he is pursuing MTech in Control and Instrumentation from DTU, Delhi. His areas of interest are Control systems, Data Acquisition & Virtual Instrumentation. His one research paper has been accepted in IEEE conference, PIICON 2014.

Testing of Transformer Oil for Fault Analysis

In order to maintain stability in the electrical system, condition monitoring of the sensitivity equipments in power system is very essential. Among those equipments in which higher level of concentration required is Power transformer.

- Dr Sukhbir Singh

Transformer life time gets reduced because of deterioration of insulation, which may be solid or liquid insulation. Solid and Liquid insulation system are designed to withstand stresses like Power frequency voltage and transient stresses like Lightning impulses, Switching impulses and Short circuits. The deterioration of solid insulation system may be examined by various methodologies like analysis of furan content and Degree of Polymerization. Monitoring of liquid dielectrics is achieved by examining various critical parameters like acidity, Break down voltage (BDV), viscosity, volume resistivity, loss tangent, Resistivity and Dielectric constant .In this work an effort has been made to analyze various critical electrical parameters like acidity, breakdown voltage (BDV), viscosity, volume resistivity, loss tangent, resistivity, dielectric constant and refractive properties for different range of thermal degradation of transformer oil with various composition of materials like pressboard, Kraft paper and water contents. Thermal degradation of transformer oil at 100^{O}C for 5, 7, 10, 15, 20, 24, 30 hrs are conducted and variations on some of the critical electrical characteristics are observed.

Testing of Transformer Oil and Test Conditions

Experiments are conducted as per American Society of Testing and Materials (ASTM), Indian standards (IS) and International Electrotechnical Committee (IEC) standards. Various standards adopted for testing of each parameter is given in the Table 1.

Same sample of oil is used for different thermal ageing test, influence of press boards, Kraft papers and water contents on dielectric

S. No.	Parameters	Testing standards adopted
1	BDV	IS6792
2	Flash Point	ASTM D 3828
3	Fire Point	ASTM D 3828
4	Viscosity	ASTM D 2162-06, IP 70
5	Volume resistivity	IEC 60247
6	Dielectric constant	IEC 60247
7	Loss factor	IEC 60247
8	Acidity	BS 2000 Part 1

Table 1: Standards and Testing

characteristics are analysed to find the degradation. Various trends of changes in the critical characteristics of oil, i.e. like acidity, Break down voltage (BDV), viscosity, volume resistivity, loss tangent, dielectric constant and refractive properties of oil were examined.

Those are listed as follows:

- Thermal Degradation test on transformer oil.
- Thermal Degradation test on transformer oil along with Press board and Kraft paper.
- Degradation test due to accumulation of water content on transformer oil.

Testing of Transformer OIL

Traditional Tests for Fault Diagnosis

- Dissolved Gas Analysis (DGA)
- Degree of Polymerization (DP)-ASTM D 5837-1996

Non Traditional Tests on Transformer Oil

- Break down voltage (BDV)\
- Acidity (Acid number—NN)
- Flash point
- Loss factor
- Tan-delta, resistivity and dielectric constant
- Viscosity Interferential Tension (IFT) ASTM–D 971
- Water Content (Test Method IFC 814).

Most of the stated tests on transformer oil are carried out at different testing laboratories or data collected from such testing laboratories. One of the test set to carry out water contents in the transformer oil is shown in Figure 1. Permissible safe limits for above said non traditional tests to be carried out periodically on transformer oil for fault analysis/diagnosis of power transformers is given in Table 2.

Most of the stated tests on transformer oil are carried out at different testing laboratories or data collected from such testing laboratories

Fig. 1: Water content testing set up (Courtsy: CPRI, Testing Laboratory Noida)

S. No	Properties	Highest equipment voltage, KV		
		<72.5	72.5 to 170	>170
1	Electric Strength KV/mm, Min	>30	>40	>50
2	Dielectric dissipation factor @ 90°C, Max	1.0	1.0	0.2
3	Specific resistance, 90°C 10^{12} ohm.cm, Min	0.1	0.1	0.1
4	Water content, ppm, Max	≤50	≤40	≤20
5	Neutralization value, mgKOH/g, Max	0.3	0.3	0.3
6	Interfacial tension mN/m, Min	15	15	15
7	Flash point, °C, Min	Min 125°C or Max decrease by 15°C		
8	Sediment & Sludge	Nil	Nil	Nil

Table 2: Permissible limits as per IS 1866:2000

Thermal Degradation test on pure transformer oil

The Initial sample parameters for pure transformer oil are given in the Table 3.

Parameters	Values
Acidity(mgKOH/gm)	0.0269
Viscosity (centistoke)	20.06
Breakdown Voltage (KV/2.5mm)	15
Flash point (°C)	160
Fire point (°C)	220
Volume Resistivity(ohm-cm)	$339X10^9$
Dielectric constant	1.08
Tan-delta(90°C)	0.1444

Table 3: Initial samples parameters

Various changes in the critical characteristics like BDV, Flash point, Fire point, Loss factor, Resistivity, Dielectric constant, Acidity and Viscosity were examined. Test results for thermal degradation of oil are given in Table 4. From the Table 4 various parameters changes are noticed. Acidity value slowly increase at the initial stage of heating up to 10 hours of heating, then after 20 hours of heating it remains unchanged. It shows that acidity value after 30 hours of heating was within the accepted level. Viscosity value shows a sharp increase at 10 hours of heating and then trends to decrease down rapidly therefore flow rate of oil get increased. BDV gets increases at the initial stage; the reason is the moisture content in oil gets evaporated at starting stage.

Volume resistivity at initial stage shows a peak increase, but when the oil is heated the value of volume resistivity trends to decrease. It is conferred that resistivity value of oil reduces on days of heating. Dissipation factor value at initial stage shows a higher value but on further heating the dissipation factor value gets decreased. Dielectric constant at initial stage gets lowered and then it shows a steady increase.

Thermal Degradation test on oil with Press board and craft paper

Another set of tests with press board and craft paper, all the test samples were heated up to 5, 7, 9, 12, 15, 18, 20 Hours. Test is conducted to simulate the real time thermal degradation of oil along with deterioration of

Sample	No of Hrs of heating	Total Acid value	Viscosity (Cts) at 30°C	BDV Kv/mm	Flash Point	Fire Point	Volume resistivity	Loss tangent	Dielectric constant
1	5	0.02940	15.742	25	160	185	119	0.385	1.56
2	7	0.03205	14.253	33	160	190	452.36	0.117	0.56
3	10	0.03457	13.65	23	160	205	145.76	0.35	1.54
4	12	0.03478	17.206	25	160	207	123.77	0.36	1.49
5	14	0.03479	14.253	20	160	200	219.89	0.087	0,38
6	16	0.03478	14.201	19	160	187	201	0.265	0.76
7	18	0.0336	14.109	20	159	191	198	0.301	0.80
8	20	0.03501	13.109	18	160	192	195	0.372	0,81
9	24	0,03490	13.101	17	161	201	188	0.388	1.28
10	30	0.03491	12.789	16	160	203	180	0.396	1.51

Table 4: Thermal degradation test on transformer oil

solid insulation like press board and craft paper. The total weight of press board and kraft paper mixed along with oil is of 300gm. Maximum temperature maintained inside the apparatus is of 100°C. Various changes in the critical characteristics like BDV, Flash point, Fire point, Loss factor, Resistivity, Dielectric constant, Acidity & Viscosity were examined. Test results for Thermal Degradation test on oil along with Press board and paper is given in Table 5.

Sample	No of Hr of heating (hrs.)	Total Acid value	Viscosity (Cts) at 30°C	BDV	Flash Point	Fire Point	Volume resistivity X10³	Loss tangent	Dielectric constant
1	5	0.5142	18.65	17	160	165	506.39	0.078	0.33
2	7	0.8530	22.89	10	170	180	2242.23	0.008	0.02
3	9	0.7462	20.07	16	165	205	4002.14	0.006	0.01
4	12	0.7831	19.09	15	154	202	4000.58	0.005	0.01
5	15	0.8310	18.90	13	163	197	3780.00	0.008	0.02
6	18	0.8309	18.01	13	164	208	3500.27	0.008	0.02
7	20	0.8308	17.02	11	162	203	2289.91	0.009	0.01

Table 5: Thermal Degradation test on oil along with Press board and Kraft paper

Various observations are made from Table 5. Acidity value slowly increase at the initial stage of heating up to 10 hours of heating, then after 20 hours of heating it remains unchanged. It shows that acidity value after 30 hours of heating was within the accepted level. Viscosity value shows a sharp increase at 7 hours of heating and then trends to decrease down rapidly therefore flow rate of oil gets increased. BDV gets increases at the initial stage the reason is the moisture content in oil gets evaporated at starting stage. On increasing the hours of heating BDV trends to decrease rapidly. Flash point values at the initial stage gets sharp increase and then further heating it will gets reduced. Fire point value shows increasing trend characteristics and more or less it attains a saturated value after 15 hours. At the initial stage the peak absorption value sharply increases up to 9 hours of heating and then it shows a gentle increase of value. Transmission property of oil shows a variation of up and down values, at one stage (18 hours) the value starts to decrease. Volume resistivity value obtained in the sample of oil along with press board and craft paper is very high compared to characteristics value of pure oil. Volume resistivity at initial stage shows a peak increase, but when the oil is heated the value of volume resistivity trends to decrease. It is conferred that resistivity value of oil reduces on days of heating. Loss factor value obtained in the sample of oil along with press board and Kraft paper is very low compared to characteristics value of pure oil. Dissipation factor value at initial stage shows a higher value but on further heating the dissipation factor value gets decreased. Shows the variation of Dielectric constant to hours of heating, the value slowly degrades on increase of hours of heating.

Degradation test due to accumulation of water content

In this test all the test samples were mixed in the proportionate of 10%, 15%, 20%, & 25% of 700 ml of water. Trends of changes in the characteristics were analysed. Test is conducted to simulate the characteristics changes due to availability of higher concentration of water content (ml) in oil. Various changes in the critical characteristics like BDV, Flash point, Fire point, Loss factor, Resistivity, Dielectric constant, Acidity and Viscosity were examined. Test results for Degradation due to accumulation of water content are given in Table 6.

Sample	Water content (ml)	Total Acid value	Viscosity (Cts) at 30°C	BDV	Flash Point	Fire Point	Volume resistivity X10³	Loss tangent	Dielectric constant
1	70	0.02944	22.61	9	180	200	Not obtained because of water contents		
2	105	0.112705	20.07	16	Not obtained because of water contents				
3	140	0.16229	33.82	10					
4	175	0.034735	17.78	4					

Table 6: Influence of water content

ENERGY EFFICIENT LIGHTING SOLUTION

Innovative RIO system with Superior Optics

Immense Energy saving further enhanced by cost saving on existing 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

Bright Ideas Bold Innovation

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
Rewards / Matches Electronic Ballasts
Costs lower than Electronic Ballast
Longer life
Can be replaced in the existing Fixtures

Test	Method	Significance
Interfacial Tension	Measures the attraction force between unlike molecules.	Indicates polar contaminants including deterioration products. Index of deterioration/ contamination.
Flash point	Measures the minimum temperature at which momentary flash occurs	To find flammable mixture in transformer oil.
Neutralization value	Measures Acidic constituents in oil.	Acids are highly corrosive, polymerize to form insoluble sludge. Acids are undesirable.
Electric strength	Measure of minimum voltage at which oil breaks.	Indicates free water, dirt, fiber or conducting particles.
Dielectric dissipation factor or Tan-delta	Measure of dielectric loss in oil- energy dissipated as heat.	Very sensitive to moisture, conducting impurities contaminates & products of oxidation like acid.
Specific resistance	Measure of resistance per unit volume.	Sensitive to moisture, contaminates and products of oxidation like acid. Gauge of Purity of oil.
Water content	Measure the total water present on oil.	Moisture cause metal corrosion reduces electric strength and increase the rate of deterioration of oil / paper/ press board.
Sludge content	Measure the sludge formed by combination of degradation products of oxidation.	Sludge deposits on core, coil & cooling ducts lower heat dissipation & increases aging.

Table 7: Significance of Tests

Correlations of Electrical Characteristics Observed during Different Test Conditions

Correlations among the critical electrical characteristics in different test conditions were analysed. The test results give some good information about the variation of electrical characteristics like BDV, volume resistivity and loss factor. The relationship among the electrical parameters has been examined and as follows:

Correlation of electrical characteristic

Transformer oil without Press Board and Kraft paper

It is clearly noticed that loss factor value steadily decreases for increase of volume resistivity. Another variation of loss factor to BDV, the characteristics clearly shows the variation of loss factor to BDV, on increase of Dissipation factor values the BDV value gets decreased. It is clearly established that on increase in values of resistivity the withstand capability BDV of oil shows a rapid increase.

With Transformer oil with Press Board and Kraft paper

Samples with press board and Kraft paper have very highest value of resistivity. It is clearly confirmed that loss factor value steadily decreases for increase of volume resistivity. Next variation of loss factor to BDV, it is seen that whenever the loss factor increases, the BDV value shows steady decrease. It is also observed that there is an increase in resistivity but BDV capability of the oil increases rapidly.

Degradation tests with water contents

Some of the observations are made from the test results given in Table 6. Acidity value slowly increases on increase of water content, but whenever the level of water content increases beyond certain percentage of limit the acidity value trends to decrease. Viscosity value shows a sharp increase at 20% of water content and then trends to decrease down rapidly, therefore flow rate of oil gets increased. On increasing the water content values the BDV value reduces also rapidly.

Transformer oil samples are drawn periodically in specially designed containers with safety and precautions from the transformers. Some national/international standards are observed at every stage of oil testing. These test results are available to the engineers/utilities to analyse/ diagnose the incipient faults in the transformers. These reports are also available to the organizations and utilities to plan their service activity without disrupting the power supply to the consumers or to avoid catastrophic failure of transformer. The following significance of such test are given in Table 7.

Conclusion

Experimental investigations have been carried out on transformer oil with various levels of thermal degradations to study critical electrical characteristics changes. Critical parameters of oil is analysed for various level of thermal degradation with combinations of insulation materials. Ageing characteristics analyses of transformer oil using refractive property gives some idea towards level of degradation. Correlations among the electrical characteristics were examined and the results were inferred. Effective condition monitoring of transformer oil surely paves way for increased life time of insulation, as a result catastrophic failure & forced outages shall be minimized.

Profile

Dr Sukhbir Singh

Master of Engineering (C&I) from Delhi College of Engineering, (Delhi University)), PhD from NIT Kurukshetra, retired from Indian Air Force in 1994 and since then in academics, taught in engineering institutes/universities in India and abroad as well. He also has an interest in Fuzzy and Neural Networks applications in electical engineering applications.

Cooling India

Monthly

The Subscription In-charge
Cooling India
Chary Publications Pvt. Ltd.
201, Premalaya, Next to Cafe 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/ ☐☐☐☐

Now SUBSCRIBE/RENEW Online Just Log on to www.coolingindia.in

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 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.....

Address.....

.....

City.....PIN ☐☐☐☐☐☐

Tel.....

Email.....

Signature.....

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	900	

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

EI \ November 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 Cafe 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/ ☐☐☐☐

Now SUBSCRIBE/RENEW Online Just Log on to www.medicalmagazine.in

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 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.....

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 \ November 2014

An Exclusive Magazine on the Air Conditioning & Refrigeration Industry

Monthly

Do You Wish

To Know More About The Modern / Newer Medical Equipments

then Subscribe today

BI MONTHLY

Over Five Golden Decades of dedicated service to Power Sector

For over five decades now, one name has facilitated Applied Research in electrical power engineering, enabling Testing and Certification of electrical Power Equipment as an Independent Third Party laboratory-CPRI. The Institute is renowned Internationally as a reputed brand and well-recognised for its Quality and Excellence. CPRI is adequately equipped with advanced infrastructure to handle Collaborative Research with Academic Institutions and Training to Utilities/Industry

CPRI

TESTING & CERTIFICATION

- State-of-the-art Test facilities for High Power Short Circuit, Ultra High Voltage, High Voltage testing of Transformers and Switchgears, Cables and Capacitors, Transmission Line Towers, Material characterisation, Seismic Qualification, Power System Studies, Energy meter testing.
- Four Short Circuit testing facilities
- Facilities for testing equipment of 800kV/1200kV rating
- Evaluation of Vibration Characteristics
- Protocol testing for Power System Automation
- Refrigerator and Air Conditioner test facility
- Pre-Qualification Tests on Cables & Accessories up to 400kV

RESEARCH

- Center of excellence for undertaking Collaborative and advanced Research in Power Sector
- Sponsored Research Projects of relevance to Power Sector
- Coordination of National Perspective Plan Projects

2400kV, 240kJ Impulse Voltage Generator

CONSULTANCY SERVICES

- Smart Grid initiative - Design and Development of Pilot Project for BESCOM
- Third Party Independent evaluation agency for Energy Accounting and SCADA/DMS Consultant for R-APDRP
- Third Party Inspection and Supervising work under RGGVY scheme
- Diagnostics & Condition Monitoring of Power Equipment
- Consultancy in Power System Studies, Real Time Simulation of Power System Controls, Power System Protection Audit
- RLA and R&M, Energy Efficiency & Audit Services
- Third Party Inspection Services & Vendor Assessment

TRAINING

- Customised Training Programmes
- One year PG course on Testing & Maintenance of Electrical equipment

ACCREDITATIONS

- **Accredited as per ISO/IEC 17025:2005**
- **Member - Short Circuit Testing Liaison(STL)**
- **Corporate Member in DLMS UA, UCA IUG**
- **ISO 9001:2008 Certification for Research and Consultancy activities**

केन्द्रीय विद्युत अनुसंधान संस्थान

CENTRAL POWER RESEARCH INSTITUTE

(Autonomous Society under Ministry of Power, Govt. of India)
Prof. Sir C.V. Raman Road, Sadashivanagar P.O,
P.B. No.: 8066, Bangalore - 560 080, INDIA
Ph: +91-80-2360 2029 Fax: +91-80-2360 1213
E-mail: hegde@cpri.in / kamala@cpri.in / shyamr@cpri.in / manoharaguta@cpri.in
Website: www.cpri.in

2500MVA Short Circuit Generator

HVDC Generator at UHVRL, Hyderabad

1200kV Insulator String testing

Erection of Tower for Testing

Cable Testing

Your Trusted Partner in Research and Testing in Power Sector

CPRI UNITS: BHOPAL, HYDERABAD, NOIDA, NAGPUR, KOLKATA, GUWAHATI

Synchrophasors

Implementation, Testing & Operational Experience

As the electric power grid continues to expand and as transmission lines are pushed to their operating limits, the dynamic operation of the power system has become more of a concern. Synchrophasors provide power system information and facilitate a variety of applications. Phasor measurements are continuously streamed information. They provide actionable quantities to give clarity during a rush of events. This is important during line outages, generation changes, voltage fluctuations and other complex operating conditions. It is desirable to have PMU over traditional state estimators that provide lagging and inaccurate system information when the system is experiencing an event.

The conventional power system monitoring, protection & control system are based on local measurements. However, it is quite difficult to maintain the stability and security of the system on the whole, if only local measurements are utilized in the monitoring, protection and control schemes. One promising way is to provide a system wide protection and control, complementary to the conventional local protection strategy. While it is not possible to predict or prevent all contingencies that may lead to power system collapse, a wide-area monitoring and control system that provides a reliable security prediction and optimized coordinated action is able to mitigate or prevent large area disturbances. The main tasks, which can be accomplished through PMUs are early recognition of large and small scale instabilities, increased power system availability through well coordinated control actions, operation closer to the limit through flexible relaying schemes, fewer load shedding events and minimization of the amount of load shedding. The main disadvantage of the present conventional methods of system monitoring is the inappropriate system dynamic view, or the uncoordinated local actions, like those in decentralized protection devices. Solution to the above can be achieved through dynamic measurement system using synchronized phasor measurement units i.e. PMU. Phasor measurement unit (PMU) is a device, which can extract phasors with respect to a time synchronized reference signal. In addition, it could be able to determine analogue measurements such as frequency, rate of change of frequency (ROCOF) and power as well as digital measurements such as circuit breaker status.

PMU Applications

PMUs are a very promising technology for the protection applications of the future. There are some wide area protection schemes, such as load shedding, which are in use today

PMUs are a very promising technology for the protection applications of the future. There are some wide area protection schemes, such as load shedding, which are in use today. For normal protection, PMU technology has some limitations. Though steady-state requirements of a PMU are well-defined, transient behavior of a PMU is not well-defined, and various units operate differently under transient conditions. Due to the slow response time of PMU technology, it has been applied mostly for backup protection applications. The backup applications where present PMU technology has been applied are power system stability, two ended fault location algorithms, system diagnostics, distributed bus bar protection, load shedding, line reclosing selectivity, and wide area frequency monitoring.

Power Swing Detection

One of the most promising applications of PMU is in the power swing detection. When a fault occurs on a system, the power transfer between two buses where the fault occurred increases. At each end of a line that connects separate buses, voltages can become unstable and continuously change at both ends. The change in bus voltages is caused by power swing, and the angle between the buses will oscillate. By observing the angle and applying equal area criteria to the power curve, it can be determined whether it is a recoverable power swing (stable power swing) or unrecoverable power swing (unstable power swing). If it's a recoverable power swing, which can be determined by measuring the angle swing between the two buses, appropriate actions can be taken. If it is determined to be an unrecoverable power swing, a different set of actions or criteria can be determined to isolate the problem. Some power swing conditions, whether stable or unstable, can be determined by using a special algorithm. This is only possible by making real-time measurements and making decisions in real-time, which is provided by the PMU technology.

Special Integrity Protection Scheme

Special Integrity Protection Scheme, such as load-shedding schemes, requires measurement of voltage and current throughout the system. Based on the system wide measurements, appropriate actions can be taken. Traditional schemes were based upon predetermined sequences of actions based on assumed extreme conditions. The extreme conditions and actual system conditions are different so the effectiveness of the SIPS scheme is somewhat compromised. PMUs provide actual data in real-time, which can determine corrective actions to keep the system intact. Wide area stability and voltage control systems can use PMU data to make intelligent decisions and prevent wide area blackouts. This is the biggest area of potential growth of PMU applications today.

Distance to Fault Location

Distance-to-fault location calculation is another area that is very promising. Single-ended algorithms for detecting fault locations have been readily available technology for several years, but having a double-ended algorithm, determined by information provided by PMUs placed throughout the power system is a very desirable application. Thanks to today's communication technology advancements and accurate time-stamped power system values provided by PMUs, system performance can be measured and verified to help determine fault locations. Using negative sequence values provided by most PMUs, it is very easy determine distanced to fault location for all types of fault except three phase fault. For three-phase faults, positive sequence values are used. Following figure indicates the equivalent power system network for the fault condition.

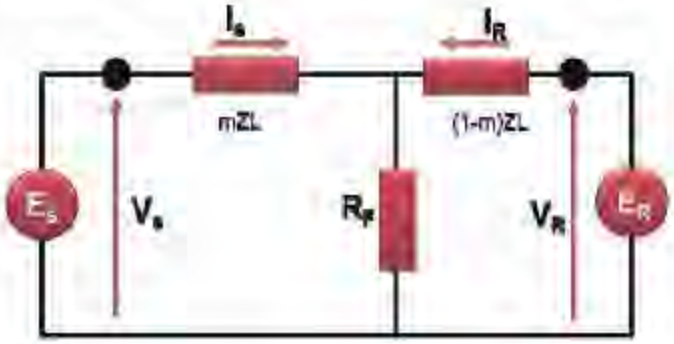


Fig. 1

In the above figure, Vs and V_R are the sending and receiving end voltages respectively measured by protection at each end. R_F is the fault resistance and 'm' is the distance to fault (0.5 for 50% of fault), Z_L is the positive sequence impedance of the line.

The equivalent negative sequence network is as shown in the following figure.

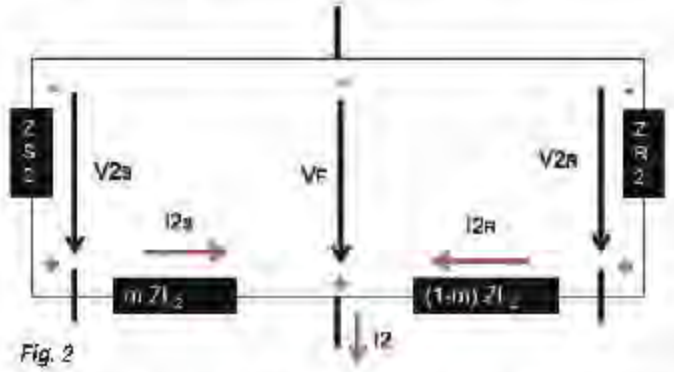


Fig. 2

Using PMU at both end of the line, it provides all the data of voltages and currents seen at each end of the line. The above figure allows us to calculate value of 'm' as shown below.

$$V2_S - I2_S * mZL_2 + V_F = 0 \text{ and } V2_R - I2_R * (1-m)ZL_2 + V_F = 0$$

$$V_F = I2_S * mZL_2 - V2_S \text{ and } V_F = I2_R * (1-m)ZL_2 - V2_R$$

$$I2_S * mZL_2 - V2_S = I2_R * (1-m)ZL_2 - V2_R \qquad \textit{Fig. 3}$$

From the above equation, the value of "m" can be calculated as shown below.

$$m = \frac{I2_R * ZL_2 + V2_S - V2_R}{ZL_2 * I_2}$$

Fig. 4

Using PMU data the distance to fault calculation can be done with high accuracy as data from both end of the lines are available. With the single ended fault locators the errors in the calculations are quite high. Lack of information provided from the other end provides as much as 10 to 15% error in fault calculations. Three terminal line applications can have as much as 38% error. The fault location accuracy, using PMU technology with a two terminal lines algorithm, is 1.878%, compared to the 10 to 15% with single-ended fault location algorithms. Accuracy of three terminal line PMU algorithm applications is 1.35%, compared to 40% for single ended fault location algorithms. In addition to fault location calculations, real-time decisions of reclosing functions can be made when there is a mix of overhead lines and underground cables. If the distance to fault location suggests faults in the overhead section, reclosing can be initiated while if the fault location algorithm indicates fault in the cable section, reclosing can be blocked.

PMU Testing

Goal: under various conditions, make sure that the reported each PMU data message matches the expected values for each Phasor Vector, Frequency Deviation and Rate Of Change Of Frequency (ROCOF). Highly precise protection test sets with versatile time synchronization features can cover a significant range of test cases. Protection test sets are different than other general purpose laboratory testing equipment for time, voltage and current. They are perfectly adapted to the domain of three phase electrical power systems and allow the specification of the test signals in familiar terms.

Why it is required?

- Errors in station sensors (CTs, PTs)
- Time synchronization accuracy (GPS receiver clocks – crystal used, drift, ageing, etc)
- Inherent error in the PMU device over time

Standard requirement

- Steady state tests
  - Frequency
  - Voltage
  - Current
  - Phase (discrete or continuous)
  - Harmonic Distortion
  - Out of band interference
- Dynamic tests
  - Phase and Amplitude Modulation
  - Phase Modulation
  - Linear Frequency Ramp
- Transient tests
  - Magnitude step
  - Phase step.

Test Set up

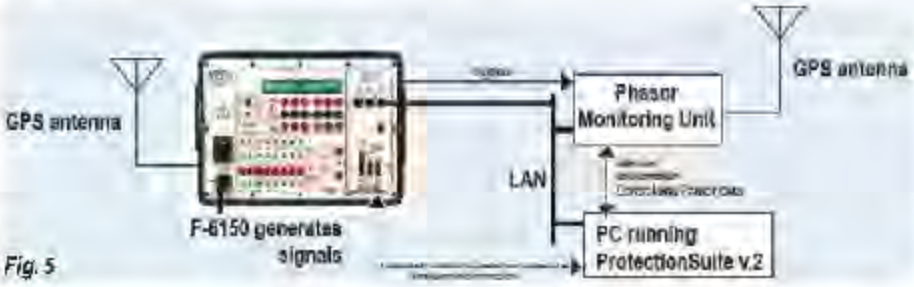


Fig. 5

Operational Experiences

Case Study 1: Automatic Generator Shedding Using Synchronized Measurement

In Mexico, most of the generation is at one end of the country, while most of the load is in the center of the country. The power is transmitted over 400 KV network. The network is shown in the diagram above. It was observed from the simulation that loss of a 400 KV line could put this system in out of step conditions. So to protect against it, the scheme needed to measure the angle of the separation and make sure it trips the generation, when necessary. By carrying out experiments, it was determined that, when both lines are out of service, the angle separation between bus and generator is 14. When one line is out of service, the angle of separation is 7. CFE implemented an automatic generation shedding scheme (AGSS) to implement a scheme to shed the generation when the angle of separation reached 10 or greater.

Case Study 2: The Europe Power System Disturbance happened on November 4, 2006

On Saturday, November 4, 2006 the interconnected power systems of the UCTE synchronous area were affected by a serious system disturbance originating from the North German transmission grid. The disturbance had its starting point in Germany, but subsequently large parts of the European power systems interconnected in the UCTE synchronous area suffered from it. After the tripping of many high voltage lines the UCTE grid was divided into three areas (West, North East and South East).

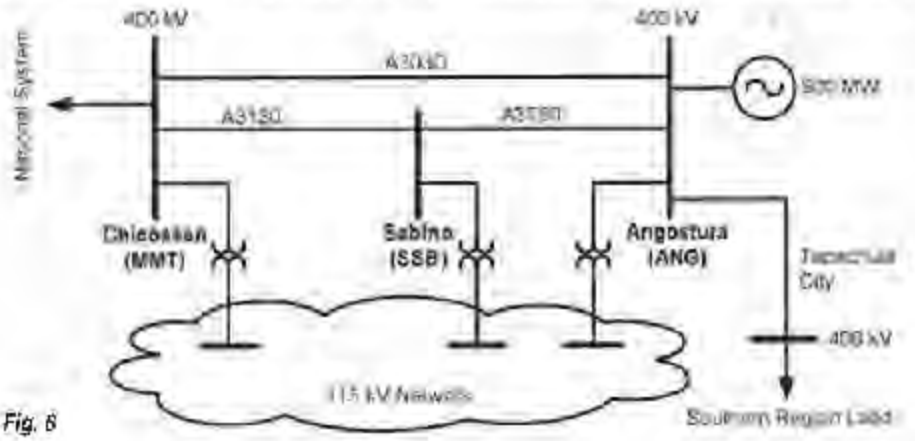


Fig. 6

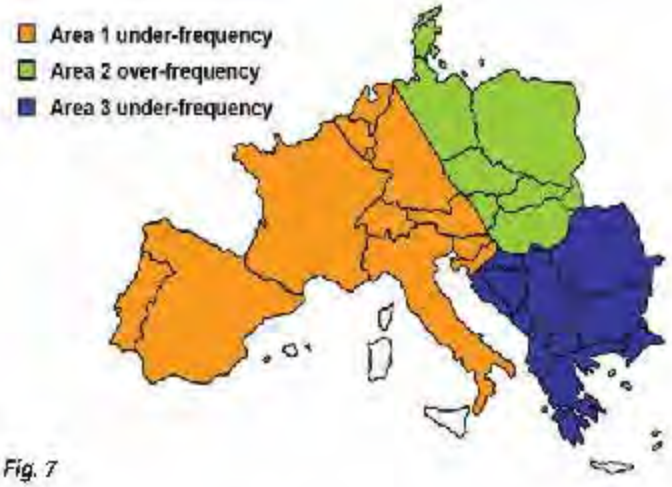


Fig. 7

Fig. 8

This resulted in significant power imbalances and frequency deviations in each area.

PMU based Wide Area Measurement System (WAMS) was installed in UCTE system. With the help of Wide Area Measurement System in UCTE system, transmission system operators perform resynchronization actions immediately after having awareness about the system splitting. The whole system restored in record time as following:

- Full resynchronization of the UCTE system was completed 38 minutes after the splitting.
- The Transmission System Operators (TSO) were able to re-establish a normal situation in all Europe countries in less than 2 hours.
- The final report about the facts and analyses on the root causes of the disturbances as well as finial conclusion and recommendations came out in 87 days.

In conclusion, practical experience has proven that the application of PMU in power system significantly speeds up the system restoration process and technically simplifies the event analysis process.

Conclusions

PMUs and WAMS enable a new dimension of monitoring power grid operation. Synchrophasors solve the problem of time incoherency

required for wide-area power system control. With the ability to use time-synchronized measured values from across power systems, new protection and control schemes like those described in this paper are being implemented today. Synchrophasors can be put as following in power system protection and control.

Uttam Mishra

graduate in Electrical Engineering is working as protection application engineer at Doble Engineering Company, India. He has presented several papers in national/ international conferences & has more than 7 years of experience in power system studies, relay testing and application. Uttam is member of CIGRE and Institution of Engineers.

Profile

Interview

One-stop provider for Smart Community solutions

Ashish Tandon, VP - Sales & Marketing
Landis+Gyr

Landis+Gyr, the leading global provider of integrated energy management products offers the broadest portfolio of products and services in the energy metering industry, and is paving the way for the next generation of smart grid. With annualized sales of more than US$1.5 billion, Landis+Gyr, operates in 30 countries across five continents, and employs 5,300 people with the sole mission of helping the world manage energy better. In an exclusive interview to **Electrical India, Ashish Tandon** states, Landis+Gyr is highly committed to sustainable development.

What the scope & status is for smart metering solutions in India as well as globally? Also what improvements would you like to suggest for market growth?

The electricity transmission and distribution ecosystem is rather complex today. Intricacy in regulatory controls and the higher consumer expectations is giving rise to gigantic amounts of data. The smart metering technology is an innovative answer to the challenges faced by utilities. Smart metering solutions help leverage the data to address the convolutions of consumption while planning for growth. Advanced Metering Infrastructure (AMI) will engage customers in conservation initiatives by managing energy better. Smart metering is being favoured as the technology of tomorrow across the globe. The size of the global smart grid market is estimated to be around 2 trillion USD by 2020. The estimated Smart grid in emerging markets, especially in BRIC countries, would be about 275 billion USD by 2020. North America has already made substantial investment in the past several years in which L+G played a major role. Countries in Western Europe have already implemented smart metering and some countries like Germany, France and Spain are going to follow the suite soon, we have already deployed more than 20 million endpoints in Europe. We believe that the scope of Smart Metering is really going to be big in medium to long term. The biggest opportunity we are working on currently is TEPCO, Japan who are deploying about 27 million new smart meters. While in India, we are still in a nascent stage, the market is receptive. India has taken initial steps in its Smart Grid endeavors.

We foresee substantial smart grid and smart meter projects coming up in India. We need some strong push from the government to foster growth and expedite the evolution of smart metering. There has to be a proper framework to define the requirements and encourage various players to work collaboratively for creating the solutions to the present problems faced by the Utilities. Also the Utilities need to prepare themselves for embracing the changes and improving their engagement with various stakeholders.

Could you share in brief the product range of the company?

At L+G, we emphasize on precision, durability, demand-driven functionality, and cost effective solution as pre-requisites for energy meters for residential, industrial and

commercial applications. While we have the widest range of products and solutions globally, in India we have developed multiple products in our Global Development Centre in Noida. The portfolio consists of products suitable for Residential, Commercial & Industrial segments. We are also in the advanced stage of development of smart meters for Indian market along with various communication technologies, robust Head End System (HES) & Meter Data Management System (MDMS) with consumer portal and data analytics. This will help us to offer end-to-end Advanced Metering Infrastructure solutions to our customers.

What is L+G's annual production capacity of meters and its salient features? What benefits do you see in replacing conventional metering system in the country?

We have capacity in excess of 4 million energy meters annually in two of our manufacturing units in India. With the advances in smart metering arena, the utilities can serve the customers better while putting the greenest & best foot forward. Replacing the conventional metering system in the country with the Smart Energy Management technology has the following benefits:

- Improved forecasting and quick response to demand spikes
- Improved operations & reliability from better outage detection and capacity planning
- Automated services to control operating costs & faster turn-around time
- Accelerated data gathering, reporting, and regulatory compliance
- Reducing theft of service, and even prevention and recovery
- Driving greater energy efficiency, enabling customers to save energy.

Could you share about Landis+Gyr strategic alliances and partnerships? Also which are the next targeted countries for expansion?

Landis+ Gyr truly believes in the synergistic alliance & collaboration with other companies to get the best results for its valued customers. We will be open to develop partnership with leading System Integrators. Telecom Companies for providing communication backbone to the metering industry and also contractors of global repute for deployment & managed services for our AMI deployments.

Has the company invested in joint product development, if yes what is the scope and progress made?

We being a global organization are supported locally by our Global R&D setup, based out of Noida. Our robust manufacturing & R&D facilities under the guidance of global expertise make us a self- sufficient entity, but we are very open to the idea of a symbiotic association.

Would you share the company's activity in the carbon footprint and greenhouse gases emission field?

Landis+Gyr is highly committed to sustainable development. Since 2007 Landis+Gyr records its carbon footprint by engaging an independent company to quantify the firm's greenhouse gas (GHG) emissions. Progress is monitored by collecting detailed emission data and by constantly analyzing this data and defining further improvement potential. We proudly affirm that we have been able to reduce our GHG emission by 40 % since 2007. Also by virtue of promoting smart metering across the world we have been helping Utilities globally in reduction of carbon footprint.

What is the involvement of Landis+Gyr in the upcoming Smart Grid projects?

We are actively monitoring the Smart Grid projects & will ensure our participation wherever possible. We do understand that the smart meter is the heart of a Smart Grid; but we believe it is a continuous journey and involves active participation of all stakeholders with a long term vision. As mentioned earlier, we are closely working with System Integrators to participate in various Smart Grid projects being executed by the leading utilities. We wish to seriously pursue the endeavor and hope to be a benchmark in the field of smart metering. We believe that the partnership amongst different stake holders is the most critical success factor for the Smart Grid evolution.

Would you share your views on Landis+Gyr receiving an award as Global AMI company of the year for 2013?

We are proud to have been awarded this distinguished recognition by Frost & Sullivan in two successive years. It is a testimony to our 5,300 employees, and their tireless efforts, as well our customers, & the confidence they have demonstrated in selecting our products, solutions & services.

What is Toshiba Corporations role in growing smart metering business with Landis+Gyr?

The objective of Landis+Gyr, together with Toshiba, is to become the leading one-stop provider for Smart Community solutions. Toshiba is investing substantially in product development & Smart Community solutions. Our group management and Toshiba Management see India as a growth market in coming years and we are committed play an important role in Smart grid evolution in India.

What are future manufacturing expansion plans and your vision in the next two years?

L+G India business is supported by two manufacturing units, based in Joka, Kolkata (West Bengal) and Baddi (Himachal Pradesh). The Joka facility is huge and has ample scope for future expansion. The other manufacturing facility is at Baddi (Himachal Pradesh) which is in the close proximity of our R&D Centre at Noida. The plants together have the flexibility to manufacture all types of meters with a capacity of over 4 million meters per year. In the near future, our facilities will be manufacturing the complete AMI products range including smart meters & network elements. Depending on the market needs we will consider appropriately on any expansion of capacity in our units.

Where to use SP, TP, TPN and 4P Circuit Breaker

Based on the number of poles, the breakers are classified as-

- SP – Single Pole
- SPN – Single Pole and Neutral
- DP – Double pole
- TP – Triple Pole
- TPN – Triple Pole and Neutral
- 4P – Four Pole

SP (Single Pole) MCB: In Single Pole MCCB, switching & protection is affected in only one phase.

Application: Single Phase Supply to break the Phase only.

DP (Double Pole) MCB: In Two Pole MCCB, switching & protection is affected in phases and the neutral.

Application: Single Phase Supply to break the Phase and Neutral.

TP (Triple Pole) MCB: In Three Pole MCB, switching & protection is affected in only three phases and the neutral is not part of the MCB.

3 pole MCCB signifies for the connection of three wires for three phase system (R-Y-B Phase).

Application: Three Phase Supply only (Without Neutral).

TPN (3P+N) MCB: In TPN MCB, Neutral is part of the MCB as a separate pole but without any protective given in the neutral pole (i.e.) neutral is only switched but has no protective element incorporated. TPN for Y (or star) the connection between ground and neutral is in many countries not allowed. Therefore the N is also switches.

Application: Three Phase Supply with Neutral.

4 Pole MCB: 4pole MCCB for 4 wires connections, the one additional 4th pole for neutral wire connection so that between neutral and any of the other three will supply.

In 4-Pole MCCBs the neutral pole is also having protective release as in the phase poles.

Application: Three Phase Supply with Neutral.

Difference between TPN and 4P (or SPN and DP)

TPN means a 4 Pole device with 4th Pole as Neutral. In TPN opening & closing will open & close the Neutral. For TPN, protection applies to the current flows through only 3 poles (Three Phase) only; there is no protection for the current flow through the neutral pole. Neutral is just an isolating pole. TP MCB is used in 3phase 4wire system. It is denoted as TP+N which will mean a three pole device with external neutral link which can be isolated if required. For the 4 pole breakers, protection applies to current flow through all poles. However when breaker trips or manually opened, all poles are disconnected. Same type of difference also applies for SPN and DP.

Where to Use TP, TPN and 4P in Distribution panel

For any Distribution board, the protection system (MCB) must be used in the incomer. For a three phase distribution panel either TP or TPN or 4P can be used as the incoming protection.

TP MCB: It is most commonly used type in all ordinary three phase supply.

TPN MCB: It is generally used where there are dual sources of incomer to the panel (utility source and emergency generator source).

4P MCB: It is used where is the possibility of high neutral current (due to unbalance loads and /or 3rd and multiple of 3rd harmonics current etc) and Neutral / Earth Protection is provided on Neutral.

Where to use 4 Pole or TPN MCB instead of 3 Pole (TP) MCB

Multiple Incoming Power System:

When we have a transformer or a stand-by generator feeding to a bus, it is mandatory that at least either of the Incomers or the bus coupler must be TPN or 4-Pole Breaker please refers IS 3043.

In multi incomer power feeding systems, we cannot mix up the neutrals of incoming powers to other Power Source so we can use TPN or 4P breakers or MCB instead of TP MCB to isolate the Neutral of other power sources from the Neutral of incomer power in use. We can use 4 Pole ACB instead of TP for safety reasons. If there is power failure and DG sets are in running condition to feed the loads, if there is some unbalance in loads (which is practically unavoidable in L.V. distribution system), depending of quantum of unbalance, there will be flow of current through Neutral. During this time, if Power Supply Utility Technicians are working, and if they touch the neutral conductors (which is earthed at their point) they will likely to get electric shock depending on the potential rise in common neutral due flow of current through Neutral conductor as stated above. Even fatal accident may occur due the above reason. As such, it is a mandatory practice to isolate the two Neutrals.

We can use 4-pole breakers or TPN Breakers when the system has two alternative sources and, in the event of power failure from the mains, change-over to the standby generator is done. In such a case, it is a good practice to isolate the neutral also.

4 pole circuit breakers have advantages in the case when one of the poles of the device will get damage, and it also provides isolation from neutral voltage.

Normally, Neutral is not allowed to break in any conditions, (except special applications) for human & equipment safety. So for single incomer power fed systems, 3P breaker is used, where only phases are isolated during breaking operations.

Where We have dual Power like in DG & other electricity supply sources, it is required to isolate neutral, where neutral needs to be isolated in internal network TPN MCB or 4P MCB can be used.

Where to use 4 Pole MCB instead of TPN MCB

Any Protection Relay used on Neutral (Ground Fault Protection of Double ended System):

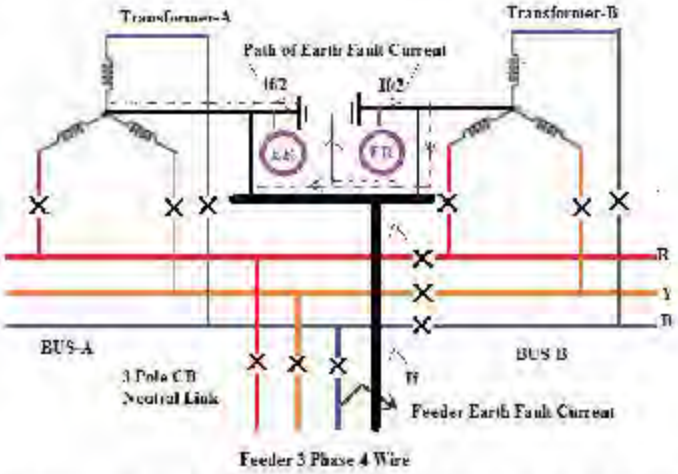
The use of four poles or three poles CB will depend on system protection and system configuration.

Normally in 3 phase with neutral we just use 3 pole CB and Neutral is connected on common Neutral Link but if application of 3 pole will affect the operation of protective relay then we must use 4 pole CB.

System evaluation has to be required to decide whether three-pole circuit breakers plus neutral link can be used or four-pole breakers are required. If unrestricted ground fault protection is fitted to the transformer neutral, then the bus section circuit breaker should have 4-poles and preferably incomer circuit breakers should also have 4-poles because un cleared ground fault located at the load side of a feeder have two return paths. As shown in fig a ground fault on a feeder at the bus section 'A' will have a current return path in both the incomers, thus tripping both Bus. The sensitivity of the unrestricted ground fault relay is reduced due to the split current paths.

For System Stability

In an unbalanced 3 phase system or a system with non-linear loads, the neutral gives the safety to the unbalanced loads in the system and therefore it must not be neglected. In perfectly balanced



Feeder 3 Phase 4 Wire

conditions the neutral functions as a safety conductor in the unforeseen short-circuit and fault conditions. Therefore by using 4-pole MCB will enhance the system stability.

4 Poles will be decided after knowing the Earthing Systems (TT, TN-S, TN-C, IT).

- IT (with distributed neutral) System: The Neutral should be switched on & off with phases. Required MCB: TPN or 4P MCB.
- IT (without distributed neutral) System: There is no neutral. Required MCB: TP MCB.
- TN-S System: Required MCB: TP MCB because even when neutral is cut off system remains connected with Ground.
- TN-C System: Required MCB: TPN or 4P only, because we cannot afford to cut neutral doing so will result in system loosing contact with Ground.
- TN-C-S System: Neutral and Ground cable are separate. Required MCB: TP MCB Because Neutral and Ground cable are separate.
- TT System: Ground is provided locally. Required MCB: TP MCB because ground is provided locally.

Conclusion

Its compulsory to use TPN in TN-C system rest everywhere you can use MCB.

Profile

Jignesh Parmar

is an Electrical Engineer and has more than a decade experience in Power Transmission, Power Distribution (T&D Loss control, Electrical energy theft detection), electrical Maintenance and Projects. He designs unique Excel base Electrical programs as per NEC, IEEE code. He is also Technical Blogger and contribute Technical papers to various national and international site.

Interview

Energy management from a wired to wireless solution

Sam P Cherian, Chairman
Elecon Measurements Pvt Ltd

ELMeasure, is a leader in the energy management sector with national and international presence. Headquartered in Bangalore, Elmeasure India Pvt Ltd has latest technology products to provide innovative solutions for energy savings, control applications, and automation systems. It has four state-of-the-art manufacturing facilities with an annual capacity of 500,000 meters. Its product offerings and solution help customers manage power and take control of the entire electrical system, the backbone of every industry. In an exclusive interview to **Electrical India, Sam P Cherian** states, a growth strategy has been plotted for Elmeasure for the next five years.

➢ Could you share your journey and global experiences and now being chairman of Elecon Measurments Pvt Ltd?

Our story will inspire many Indians and I am proud to share our success story and our humble beginnings. Few months prior to October 2004, three young engineers came together and discussed beginning a company and the principles by which it should be run. I personally only knew Babu TK, CEO of our company, and he expressed their desire to start such a company and mailed me a business proposal, clearly stating the purpose and a detailed road map of the company with a definite 5 year and 10 year plan. Thus began our humble journey on 14th October 2004, we put into motion a company that would strive to deliver products that would help conserve energy, an already scarce resource. The journeys has definitely been exceptional in terms of the products and solutions we have delivered and the immediate acceptance we garnered for a quality product designed with our customers in mind. Today, we are in 30 different countries with Japan being our largest export market, which attest to the high standards of quality and technology we deliver. Today, we deliver a wide range of products and solutions to meet the diverse needs of our customer and help them manage energy and add to their to bottom line. In the month of October we are celebrating 10 years and would like to thank our channel partners and customers for making the Elmeasure dream come true.

➢ What according to your perception is the scope of metering in India during the changed governance in India?

At present we see a large potential for T&M Instruments industry both nationally and globally. ElMeasure being in the energy field has seen incredible growth due to scarcity of energy globally. The push created by the new government to improve production and the goal to provide electricity to every Indian will definitely see the sector grow. The push for 100 smart cities is also exciting as we see a huge opportunity to provide

solution for smart metering, lighting and water management.

➢ Could you highlight the range of products/ solutions and cutting edge technology over similar competitive products by other companies?

Our product range includes BEMS (Building Energy Management System) with complete automation and control features. To compliment it we have products like Prepaid Energy Meter with an option to integrate process parameters with electrical parameters and protection, Power Distribution Unit, Multifunction Meters, Digital Panel Meters and control products such as Compact Demand Controllers with 4 relay output and 4 row LED display meter with auto scaling, Power Factor controllers, Motor Protection Systems, Earth Leakage Relay etc. Most of our products can accept digital input for cost effective networking, 4 digital outputs with full flexibility for controlling. Another unique product that has been launched recently is 'Power Duos', a unique product that can measure both AC and DC power source. This product has received good response from our customers.

The latest addition to our basket of products is the intelligent Lighting and Water Controller that enables the customer to monitor and control their lighting and water consumption remotely

➢ Which of your product/ solution command major market share & do you plan to expand Elmeasure portfolio?

ElMeasure's Energy Management System, ElNet commands significant market share in addition to our metering products. The recently launched version ElNet V.05 has a unique dashboard that contains all the critical information and one can easily analyze the status of the electrical system with a simple glance.

The Pre-paid Energy meter is a great product and we are seeing many of the Indian utilities encouraging switching from post-paid to pre-paid as it eliminates an entire layer of collections as all the energy is paid in advance of consumption. We are making great strides with this product as we offer a wide variety of communication platforms with payment gateway where the recharge can be made from your smartphone.

In terms of future product expansion, we have already introduced a product called the aggregator which will become the brain of our energy management system completely avoiding the need for a PC and will push all the data to the cloud to be accessed by anyone anywhere. Besides this we are getting into street light management and water management.

➢ Since you have global experience in customer relation, what strategy do you have for marketing departments to enhance sales?

Our marketing strategy can be simply explained as providing a quality product with excellent afters ales service. Our marketing strength both nationally and internationally has been to tailor make the product to meet the customers specific need. The above coupled with our passion for innovation has completely transformed brand ElMeasure and today we are proud to say that we are a company that provides our customer with infinite possibilities to manage energy. Our strategy is to promote the concept of Energy Management and explore application areas in a power utility. We utilize our time with the customers in understanding their manufacturing process, the challenges and problems encountered and appropriately leveraging our products and solutions to realize energy savings. Our technology speaks for itself and today we as a company are moving energy management from a wired to wireless solution. Our products and solutions are scalable, user friendly, and cost effective with an average ROI of twelve months.

➢ What is your vision in the next two years?

We have acquired 3 acres of land at the Hardware Park launched at Devanahalli near the Bangalore International Airport. Our plans are to come up with the State-of-the-Art manufacturing facility measuring close to 2,00,000 Sq ft. The first phase of construction will be close to about 35,000 sq ft and is expected to be completed in next 12 months. A growth strategy has been plotted for Elmeasure for the next five years. Vertical integration, acquisitions, product development, and new horizons in product offerings are part of the plan being designed for the future.

Remote Monitoring - Energy Conservation

The Energy Conservation Bill 2001 was passed by the Parliament in August 2001 and was expected to clear the way for to check Wastage Energy. This Bill was suppose to control huge wastage of Power. The Energy Conservation Bill 2001 prepared by group of expert committees discussed and debated at various forums, was passed by the Indian Parliament in August 2001. This a Bureau called the Bureau of Energy Efficiency (BEE) was established and managed through Governing council.

However the implementation of Energy Conservation Bill 2001 has to be done through well qualified and experienced Energy Managers with the designated consumers and the Energy Auditors to check & certify that every such consumer complies with the provisions of this bill, thereby conserving the Energy, which of course will benefit the consumers themselves reducing their own Energy Bills and such savings increasing their profitability.

Bureau of Energy Efficiency (BEE) also play key role in creation of professionally qualified energy managers and auditors with expertise in energy management, project management, financing and implementation of energy efficiency projects as well as policy analysis. It is a Law to force firms to make more profit and not an Act to control and monitor Energy Consumption of Industry. Under the BEE's PAT Scheme (Perform, Achieves & Trade) for few Industrial Sectors, it is mandated to compulsorily improve their Energy Efficiency by adopting all the available measures including replacement of their old Equipments with New and Energy Efficient Equipments.

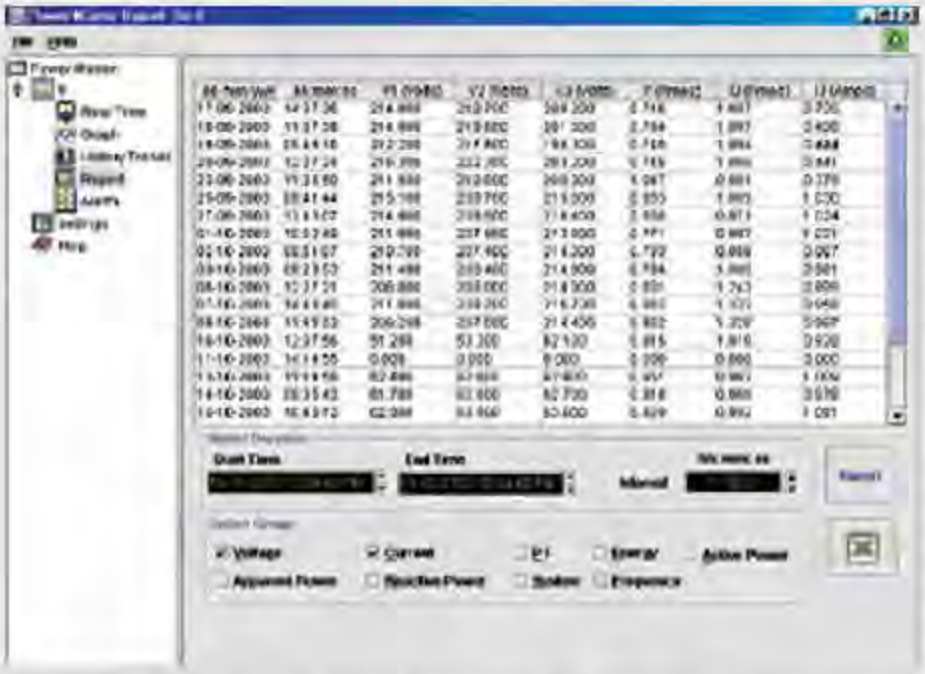
The Energy accounting gives the overall picture of Energy availability & its use. The Energy Audit enables analyzing the data in meaningful manner to evolve measure to introduce checks & balances in the system to reduce leakages and losses and also to improve technical performances. Increasing spread of utilities over a wide network only necessitates an efficient, reliable and cost-effective solution for remote monitoring. Real-time monitoring of efficiency in performance and ahead-of-time indication of a probable maintenance are aspects critical to every company.

Innovative device with GPRS connectivity, time and date facility, display, event logger and serial ports provides accurate information on energy consumption by each process, each location, within a stipulated time period as it is important to measure and monitor energy. Data is analysed on a continuous basis and user-defined trends for individual parameters such as RMS Voltages & Currents, PF, Frequency, KW, kWh, kVarh, kVAh, Maximum Demand,, etc. are created.

Supervisory Control & Data Acquisition System (SCADA)

In 1993 it was determined that a Supervisory Control & Data Acquisition System (SCADA) system was needed to monitor the campus electrical supply and distribution system. Most of the packaged systems involved the purchase of a complete SCADA system as opposed to the method of using single meters as the basic component.

In 1994 the Utilities Division started installation of the campus SCADA system using Intelligent Electronic Devices (IEDs) and SCADA software package. The Energy Management Control Systems (EMCS) group, which is a department in the Utilities Division, also needs data from building meters. The IEDs provide communications to the SCADA software as well as an analog output signal (proportional to kW) which is read by the building EMCS. The building EMCS (a Rosemont system) records this signal to track electrical energy demand and Kilo Watt Hours (KWH).



Additionally, this system allows the Facilities Operations - High Volt Technicians to view the big picture (a section of campus), and then tunnel down to a detailed view (a single-line) as needed. SCADA automatically generates alarms and monthly energy reports and is easily expandable as the needs grow. The new system is extremely flexible and is completely expandable as IED meters are added.

Benefits

Long Term Benefits and Future Needs : Power System Operators need to be able to continue to remotely and instantaneously, identify electrical power system failures at any location in the distribution system. Accurate real time alarming and historical information is needed to continually meet the needs of a diverse community of energy users. A continuation of the demands for high reliability and accurate performance and trending data is paramount. This will allow users to access specific information by using a web browser instead of expensive third party software (e.g., energy consumption report, performance data, etc).

"MECO" Multifunction Power & Energy Monitor, Model : "MFM-96S" Microcontroller based with MODBUS RTU Protocol is indigenously designed, tooled and manufactured by the R & D Department of MECO and Competitively Priced. "MFM-96S" is Super Bright Red LED Displays with Inbuilt Memory to store CTR, PTR, Inst. Address, Password & Energy Reset facility. It has Simultaneous Display for Voltage, Current, Active Power, Reactive Power, Apparent Power, Frequency, Power Factor, Active Energy, Reactive Energy & Apparent Energy (Import / Export - 4 Quadrant operations). TRMS Measurement, 3 Phase 3 Wire / 3 Phase 4 Wire (User Selectable) CTR, PTR, Instruments address, Password Protected, Energy Reset & Auto / Manual Scroll Display (Programmable) are key features of "MFM-96S"."MFM-96S" is Ideal to monitor & acquire Power Data from Generator, Remote Monitoring, Building Management System, PLC's / SCADA application, Energy Audit, QC Testing, Power Management, etc.

RS485 Port with MODBUS Protocol & Power Master Software to store parameters on the PC can be grouped into table or graph for Analysis & Management of any Electrical System. The software feature like Real time display, Tabular representation, Graphical display of Measured, Stored values, History trends, Alarms for Max./ Min. values etc. These values can be converted to Excel format for further data processing & import into other software platforms. "MFM-96S" is having IP54 (Meter Front) & CE Complaisance as per EN61010-1, ENG61326-1. The objectives of this Energy Monitoring & Energy Conservation are very good but the road ahead is very long, rough and tardy but with the cooperation and strong will, nothing is impossible.

Profile

Haren Shah

Senior Marketing Executive, Meco Instruments Pvt. Ltd

Jointly organized by China Electricity Council International (CEC) and Adsale Exhibition Services Ltd, The 15th International Exhibition on Electric Power Equipment and Technology (EP China 2014), the 8th International Exhibition on Electrical Equipment (Electrical China 2014), 2014 International Exhibition on Electric Power Automation Equipment and Technology (EPA 2014), opened at China International Exhibition Center, Beijing, PR China during 22-24 October 2014.

The show had over 800 worldwide exhibitors from 16 countries/regions, exhibiting in 8 exhibition halls with over 30,000 sqm. EP China has become an annual event for local and overseas professional buyers and exhibitors of the electric and power industry. It serves as an ideal professional one-stop business platform for machinery and equipment sourcing and solutions. Visitors come from various fields, including worldwide power supply, power grid construction and transformation, power generation, electricity engineering maintenance and construction, power research and design institutes. Industrial end-users from building and construction sector, railway and transportation sector, metal sector, and ship and boat sector also join the show. The opening ceremony was attended by a number of industry leaders and governmental representatives. Wei Zhao Feng, Vice President of CEC delivered his speech for the opening of EP China 2014. Some of the distinguished guests included Engineer General of National Energy Administration; Vice President and Secretary General of CEC; Deputy Headmaster of North China Electric Power University; Vice President of China Energy Engineering Group; Deputy Director General of Nuclear Power Dept, China Nuclear Engineering Group and Stanley Chu, Chairman of Adsale

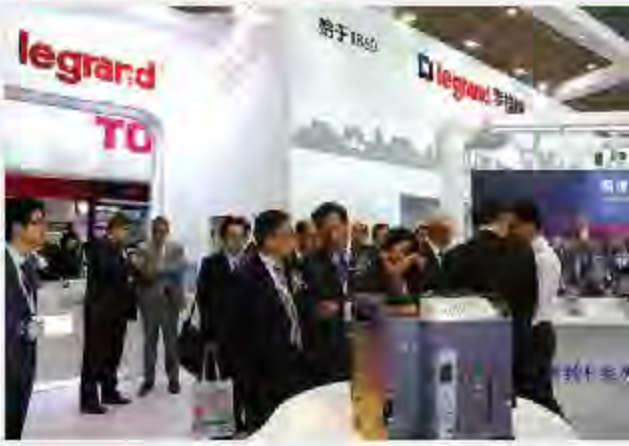
EP China 2014 Beijing Gathers Over 800 Exhibitors Worldwide

as pavilions from USA, Germany and Taiwan, reflecting EP's powerful impact in industry. To correspond with China's latest growing concern on environmental protection, 2014 China International Exhibition on Energy Conservation & Environmental Protection Equipment and Technology introduced in Hall 2 for the first time, provided promotion platform for exhibitors in the field of energy conservation and environmental protection.

Concurrent Forums and Conferences

On top of the concurrent forums and conferences, the organizer has also organized symposia and seminar on topics of smart grid, power T&D and energy conservation and environmental protection.

Jointly organized by China International Exhibition Center and State Grid Yingda Group, the "2014 Smart Grid Conference" also started with the opening of EP China. Riding on past year's success, the full day event attracted near 200 power and industry leaders and practitioners to explore on topics including distribution automation applications in urban grid, distribution automation communications technologies and applications, smart distribution grids and distributed energy resources, smart grid and intelligent life and electric vehicle charging and discharging technology in smart grid application etc. Co-organized with Saier Media, the "Power Quality Forum" was also held on the first show day. Forum topics cover an overview of modern power quality technology, user intelligent power distribution systems and solutions, analysis on comprehensive solution for power quality, etc. The forum attracted over 300 industrial practitioners.



Exhibition Services Ltd. Many industry leaders from provincial power corporations & power grid corporations, representatives from consulates, trade associations and trade delegations also attended the ceremony.

An International Hub for Exhibitors Worldwide

This year the show has extended to 8 exhibition halls. It is the first year for the establishment of the Brand Hall, which allows exhibitors to promote their brand and their latest technologies to target customers and media more effectively. The organizer provided a series of brand promotion programs, including arranging media visit and VIP delegation group. The exhibitor includes ABB, Hyundai, Legrand, Shanghai Huaming, Rittal, KGE, Toshiba, Multi-contact, Jilin Yongda, Jiangsu Senyuan, Minghan, Shenglong Electric, TENGEN, People Ele., Taiyong etc. as well

20 Delegations Visited for Purchasing Needs

The electric power exhibition, EP China 2014 is highly trusted by industry practitioners worldwide & is widely supported by trade associations, commerce association and institutes. This year, the show had near 20 buyer delegations from local and overseas & over 25,000 worldwide buyers.

EP China / EP Shanghai, jointly organized by China Electricity Council and Adsale Exhibition Services Ltd., are held in Beijing and Shanghai alternately. Since its launch in 1986, EP exhibition has been recognized as the largest electric power and electrical exhibition in China. It is also the only electric power event in China that is endorsed as a UFI Approved Event. EP Shanghai 2015 - The 10th International Exhibition on Electric Power Equipment and Technology will be held on October 14-16, 2015 at Shanghai World Expo Exhibition & Convention Center, China.

3rd India Composites Show in Mumbai

This December from 10-12 at Bombay Exhibition Centre, Goregaon (E), Mumbai, India's only dedicated exhibition for composites and advanced materials will take place the 3rd time. After organising 2 editions in New Delhi, this year exhibition will be taking place in Mumbai for the very first time to capture promising market of western India.

Composites industry professionals, moulders and end-users representing a variety of sectors would gather for networking, learning and business opportunities. ICS 2014 is co-located with India Composites Conference, a two day program focusing on the trends, challenges and opportunities faced by the industry. Technical Textile and Adhesives and Sealants zones are also special features of the event. Last year, India Composites Show was attended by 3,910 trade visitors from 37 countries and featured 86 exhibitors. At ICS 2013, 37% visitors were final decision makers, 44% had recommending role in decision making, 78% evaluated for future purchases and 80% fulfilled their objectives of visit.

At ICS 2014 more than 175 Raw-Materials, equipments, machineries and solutions will be displayed representing solutions such as Raw materials, fabricators, composite products, process machinery, technical textile, Intermediate Products, Equipments. Exhibitors from India and other nations including China, Taiwan, Italy, Japan, Korea, France, Germany and USA are participating. ICS also features 'Composites Europe' exhibition pavilion.

"Currently, Indian composites market is experiencing a transition in terms of technology and demand. It is therefore important to constantly upgrade and meet the changing needs of the market. ICS gives you an opportunity to explore latest solutions & connect with the core of the industry" said Anuj Mathur, MD of Reed Manch Exhibitions, organisers of India Composites Show. The India Composites Conference taking place on 10-11 December will be featuring topics such as Aerospace composite materials, Current and future trends of Carbon Fiber in India, Renewable value: Remarkable success in the recycling of composites, Epoxy and polyurethane systems solutions for filament winding composites, Light-weighting and cost reduction in automotive, Electrical & electronics: The future for composites, Advanced technical textiles and emerging applications, Adhesive solutions for transportation & construction industry and The recent initiatives for composite application in the new sectors.

ExxonMobil showcases Lubricant Technology Innovations at Forum of Chinese Equipment Builders

The 2014 ExxonMobil Forum of Chinese Equipment Builders washeldin Shanghai. Expertsfrom ExxonMobil Product Technology demonstrated lubricant technology innovations that deliver the benefits and competitive advantages in safety, environmental care, and productivity. To support the development of the latest lubricant technology, ExxonMobil has announced the launch of the Asia Products Technology Center (APTC) in Shanghai in 2015. APTC will serve as a hub that provides innovative lubrication solutions for customers in Asia Pacific, especially in China, combining technical services, applications expertise, collaborative programs, training and marketing support.

Located at the ExxonMobil Shanghai Technology Center,APTC will become a part of the ExxonMobil Products Technology global network and enhance collaboration with key emerging Original Equipment Manufacturers (OEMs) and Equipment Builders (EBs) inthe fast-growing China and other Asian markets.

According to ExxonMobil's The Outlook for Energy: A View to 2040,China's industrial energy demand is expected to be 25 percent higher by 2040 than in 2010. During this period, China will encounter huge sustainability challenges while society will place increasing importance on environmental care and safety as a result of projected rapid economic growth. The era of purely pursuing productivity has come to an end. More and more industrial enterprises demand more value from lubrication, expecting to improve production quality rather than just being focused on sheer output. Mobil Industrial Lubricants integrate safety, environmental care and productivity advantages into lubricants and services through innovative product technology. For safety –mitigate potential employee injury caused by direct contact with equipment; For environmental care, to create products and services with commitment to reduce environmental impact and for productivity – control costly downtime and delays.

"ExxonMobil invests US$1 billion in research and development every year, and employs more than 19,000 scientists and engineers who are working on innovative product technologies, creating the structure for a strong global technology network," said Grant Karsner, PhD., vice president of ExxonMobil Research &Engineering Company. "At ExxonMobil, we recognize the key role of technology, and the continuous breakthroughs of Mobil lubricant product technology are enabling our industrial customers to achieve sustainability." Mobil Industrial Lubricants embrace the lubricant value of safety, environmental care and productivity and the concept of sustainable development, and constantly launch innovative products and services in the Chinese market, benefitting numerous industries. Mobil Industrial Lubricants introduced the high-technology Mobil Wind Turbine Service to China, resolving problems of traditional service fill, such as the high safety risk of unprofessional steeplejack, environmental impact of used oil, low efficiency with manual oil changing, etc. To date,Mobil Wind Turbine Service has provided professional oil changing services for more than 500 wind turbines across China.

The forum marks the 100th anniversary of cooperation between ExxonMobil and equipment builders.

inter solar

connecting solar business | INDIA

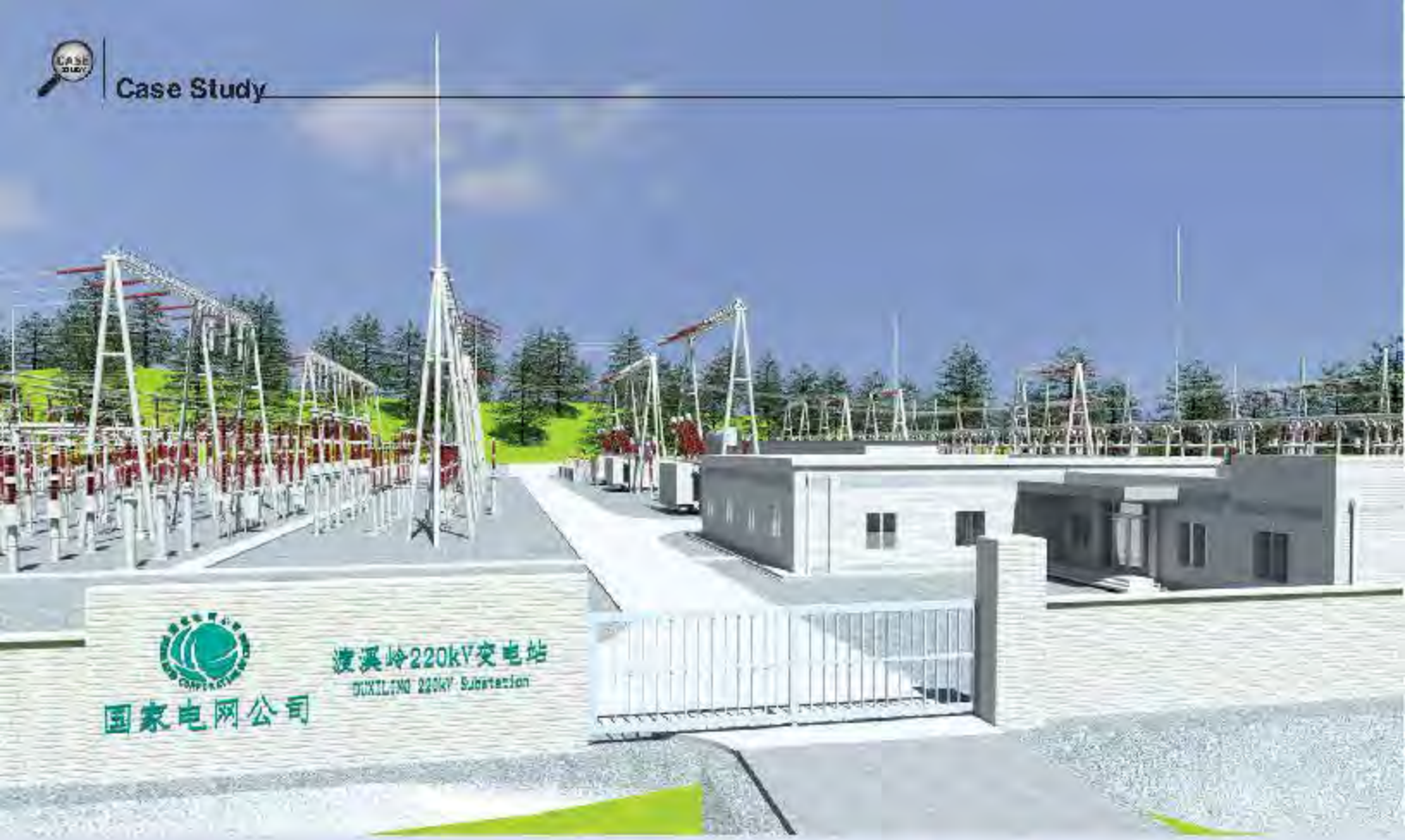
NOV 18–20 2014

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



Jiangxi Electric Power Design Institute increases Substation Design Efficiency

Unified Environment for Structural, Physical, and Electrical Design Eliminates Inconsistencies and Enables Concurrent Engineering.

Accelerated Substation Design enables Economic Development

As an energy industry leader, the Power Construction Corporation of China (POWERCHINA) provides the full range of services from planning, survey, design, and engineering to finance, construction, installation, and operation and maintenance of hydropower, thermal power, new energy, and infrastructure projects. POWERCHINA's subsidiary, Jiangxi Electric Power Design Institute (JXEPDI), delivered the 220 kilovolt Duxiling Substation for owner-operator China State Grid Corporation to support economic development and enhance the quality of life in Jiangxi Province by improving the electricity network and power supply reliability. Using Bentley's substation solution, which provided a unified environment for structural, physical, and electrical design, the institute was able to eliminate inconsistencies and perform concurrent engineering. As a result, the design efficiency of the CNY 81 million substation was significantly enhanced by avoiding silos of data and many errors that can occur with the use of separate products for site design, physical layout, and electrical systems design.

Seeking to improve the Substation Design Process

The design institute recognized that past substation design practices had been inefficient and caused duplication of effort. Without a collaborative design process, each design discipline (site, structural, physical, and electrical) had created its own separate substation model, which led to design inconsistencies, collision problems, and rework. This workflow also had rendered the design team unable to provide a comprehensive substation model for construction.

JXEPDI sought a comprehensive solution that could help accomplish substation projects more efficiently through a collaborative design process among all disciplines. The institute routinely promotes technological innovation, and communicates with both domestic and international leaders in the field to learn from their experience and adopt the best practices. Bentley's substation solution was adopted to improve collaboration, quality and efficiency, and to facilitate the transfer of a digital substation model to construction.

Integrated Substation Design

Bentley's substation solution is comprised of integrated design, simulation, and collaboration software products that enable all disciplines to accelerate design, improve constructability, and reduce the operating

costs of electric substations. The solution components implemented by the design institute included Bentley® Substation™, GEOPAK Civil Engineering Suite, Bentley® Raceway and Cable Management™, Bentley® ProSteel™, STAAD.Pro®, and AECOsim Building Designer.

- Bentley Substation, the only integrated software product for intelligent electrical and physical substation design, supported the creation of an intelligent substation model. The designers were able to develop a 3D physical layout with wiring and sag modeling to check clearance and spacing. From the comprehensive 3D physical model, 2D schematics and 2D construction drawings were generated, along with bills of material and 3D renderings for review by the owner.
- GEOPAK Civil Engineering Suite, proven civil engineering and road design software for designing and sustaining infrastructure, enabled the generation of the digital terrain model using topographic data from a site survey. The software supported the design of roads, and the calculation of cut-and-fill quantities. The complete site model was exported for use by the structural and physical design disciplines.
- The design institute used Bentley Raceway and Cable Management to execute efficient layout, routing, and material quantities for raceways, cable trays, conduits, and cables.
- ProSteel was used for the structural design of truss work, gantries, and other support structures for electrical equipment, conductors, and cables as well as the structural design of control and switch house buildings located on site.
- The design institute used STAAD.Pro, which integrated seamlessly with ProSteel, for advanced analysis and design of support structures.
- Starting with the structural models developed in ProSteel for consistency, the design institute used AECOsim Building Designer to construct a single model for the on-site control and switch houses, encompassing architectural, structural, mechanical, and electrical systems design, construction documentation, and 3D visualization.

Project Collaboration Environment

The institute also implemented ProjectWise, Bentley's project collaboration and information management software developed explicitly for the design and construction of architecture, engineering, construction, and operations projects. Used for multi-discipline collaborative design and results sharing, the ProjectWise environment unified the design team with a single source of truth for models and analysis created using the various design applications.

The standardized working environment, engineering data, and project information were all hosted on a dedicated ProjectWise server. With ProjectWise's directory management & permissions controls, appropriate read, write, and other access permissions were set up according to the needs of the project team members.

Increased Quality and Efficiency through Concurrent Engineering

Although the institute gained independent productivity and quality benefits from each software application for substation design, the biggest gains in efficiency and quality arose from the collaboration environment enabled by ProjectWise. Having the entire substation design process in a unified environment improved work quality and efficiency both within and across disciplines. Hosting all project information on a dedicated ProjectWise server enabled convenient sharing of up-to-date models across disciplines (for example, between structural and building, with ProSteel, STAAD.Pro, and AECOsim Building Designer) eliminating duplication of work and inconsistencies. This timely and accurate exchange of current project information transformed what was a step-by-step design process into an agile, concurrent engineering process that shortened design time while increasing design quality.

The 3D substation model enabled lightning protection modeling and visualization

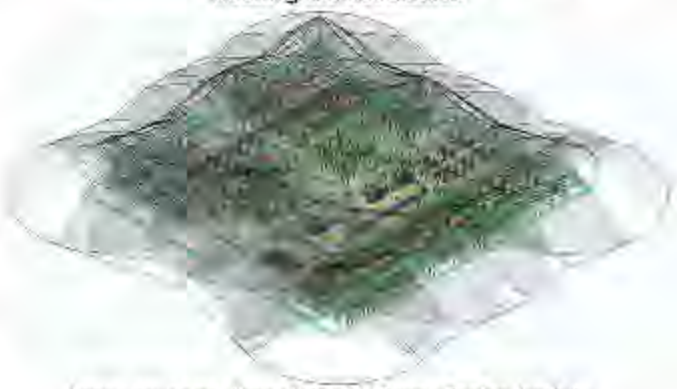


Image courtesy: Jiangxi Electric Power Design Institute

Bentley's Substation Solution enables Faster Design

Bentley's substation solution allowed the institute to achieve concurrent, streamlined workflows that improved quality and increased substation design efficiency by approximately 30 percent. At the same time, stakeholder communications were improved due to the ability to deliver an integrated 3D visualization of the civil, structural, and electrical design in the context of the surrounding terrain. Upon project completion, the design team delivered a comprehensive, intelligent digital substation model that will improve the efficiency of operations, maintenance, and subsequent refurbishment projects.

Project Summary

Organization:
POWERCHINA, Jiangxi Electric Power Design Institute

Solution:
Utility Transmission and Distribution Infrastructure

Location:
Pingxiang, Jiangxi, China

Project Objective:
- Design and deliver the 220 kilovolt Duxiling Substation
- Improve design quality and efficiency by implementing a unified, multi-disciplined, collaborative design environment
- Deliver an intelligent digital substation model for construction and operations

Courtesy: Bentley Systems

Constellation Energy Upgrades to Electronic Performance Improvement Center using Bentley's eB

R.E. Ginna Nuclear Plant's Best Practices support Compliance with Industry Guidelines

Need for a Fully Integrated Process

The R.E. Ginna Nuclear Power Plant in Ontario, N.Y., is one of five nuclear plants within the Constellation Energy Nuclear Energy Group. Commissioned in 1970, it is one of the oldest U.S. nuclear plants still in operation. As Constellation Energy began aligning business processes and integrating information systems across its fleet, Ginna became the first plant to implement a centralized electronic Performance Improvement Center (ePIC) to replace its existing paper-based corrective action program.

Constellation Energy's ePIC program was developed in response to numerous industry guidelines issued since the late 1990s, all aimed at performance improvement. Industry-wide benchmarking projects were conducted and led to guidelines that improved the safety and efficiency of nuclear power plants. These included:

- Self-Assessment, 1999
- Trending Activities, 2000
- Corrective Action, 2000
- Human Performance, 2001

Each project systematically defined a process and identified best practices based on full industry participation. In addition, the projects confirmed the perception that a more fully integrated process was necessary.

In 2005, the Institute of Nuclear Power Operations (INPO) published INPO 05-005, "Guidelines for Performance Improvement at Nuclear Power Stations." It was designed to present performance improvement as an integrated process, making a strong case for the benefits of overall integration driven by leadership and culture, and incorporating industry best practices into a closed-loop system to promote process efficiency and safety while minimizing business risk.

In addition, performance improvement best practices have been driven through the knowledge base created by the Operating Experience network, an INPO organization that shares events data on a daily basis from all U.S. nuclear sites. In total, these guidelines became the foundation for steady performance improvement, and in 2007, the U.S. nuclear industry achieved record-low production costs and record-high electricity production.

Challenges in Performance Improvement

Constellation Energy operates a nuclear fleet that encompasses plants it built and plants it acquired. The fleet produced 60.9 percent of the total power generated by Constellation Energy in 2007 and currently includes:

- Two units at Calvert Cliffs in Lusby, M.D., from affiliate Baltimore Gas & Electric Company,
- Two units at Nine Mile Point in Oswego, N.Y., acquired in 2001 from Niagara Mohawk,
- One unit at Robert E. Ginna in Ontario, N.Y., acquired in 2004 from Rochester Gas & Electric.

Constellation Energy is planning to build additional nuclear units at Calvert Cliffs, Nine Mile Point, and other locations nationwide. It is coordinating its license submission as a member of the UniStar alliance.

Nuclear fleets share both human and material resources across the enterprise. Being able to promptly and accurately recognize conditions adverse to quality is a key goal of performance improvement that reduces risk and increases safety. Streamlining the performance improvement process across the fleet optimizes operating experience, allows the organization to address human performance elements, and

instills a safety conscious culture. Until recently, no integrated software tool has been available to the industry that allowed the automation of the entire performance improvement process, seamlessly integrated with other critical plant information systems.

With five units across three sites, plus a separate headquarters site – all using disparate and antiquated systems – Constellation Energy realized the new performance improvement system had to drive process excellence, rather than merely being compliant with regulations. With no knowledge-sharing across facilities, a paper-based system, and no automation, there was little visibility into the information needed to make critical business decisions across the fleet. To meet industry guidelines and prepare the company for future growth, it would be critical to develop an integrated approach to establish standardized fleet operating practices that would provide the process efficiencies and information governance required to comply with nuclear regulatory requirements.

Integrated Approach

With representatives from all plants, Constellation Energy selected a single integrated system for performance improvement using eB nuclear applications from Bentley. Though this case study will focus on performance improvement, eB applications are also currently used by Constellation Energy for master equipment lists, configuration management, records management, and information management.

Constellation Energy previously implemented eB as a configuration management system, and was familiar with its ease of integration. Knowing that eB would integrate with a variety of legacy systems and would scale fleet-wide provided additional evidence to support the selection. Along with Bentley's unparalleled knowledge of, and commitment to, the nuclear industry, additional overall factors included.

- eB offers a modern multi tier service oriented architecture based on Microsoft technology. The platform offers scalability, flexibility, rapid application development, and simplified integration with other systems.
- eB offers the unique ability to manage information in context by linking (associating) events, documents, records, and actions with assets, people, knowledge, skills, processes, projects, functions, surveys, and behaviors. This capability creates multidimensional contextual bridgework that delivers complete and accurate information on demand.
- eB includes industry best practices in the implementation of performance improvement, as well as configuration management and nuclear records/information management. Yet it provides the ability for each organization to tailor business rules, workflow processes, and terminology to suit its unique requirements.

Through a centralized web-based interface available to all personnel, ePIC manages condition (problem) reports, corrective actions, operating experience, and various surveys for Human Performance Measurements, providing an integrated solution that fully complies with the established industry guidelines. Integrated with Insert Key Solutions for Equipment Reliability and IBM Maximo for Work Management, eB enforces compliance and increases visibility to business and industry governance rules.

The capability to link interdependent information allows eB to provide information integrity through the design and engineering environment, ensuring that the plant configuration remains consistent with its design basis, and, as such, compliant with its operating license. A robust trending module ensures consistent trending of all events according to a fleet standard set of trend codes, allowing valuable key performance indicator and statistical reports for management oversight.

Single Process Definition Implemented Across Fleet

Bentley and a peer team consisting of process implementation specialists and performance improvement representatives from headquarters, Ginna, Calvert Cliffs, and Nine Mile Point began an in-depth analysis to develop a single process definition that would eventually be implemented across the fleet. Through this process, fleet standards were coordinated and developed and site-to-site implementation milestones were set. In addition, Ginna was selected as the first site to implement the fleet solution, which has been in production since May 2006.

eB identifies, classifies, and manages enterprise information, including documents, records, assets, people, processes, events, and

> ***The ePIC Performance Monitoring functions are closely linked to Constellation's commitment to knowledge transfer and retention. Integrated with the corrective action program and other business processes, KT&R addresses the risk of losing experienced individuals and identifies gaps in process and program health. With eB, information is readily accessible in a predetermined object modeling system, so personnel turnover does not affect process efficiency and safety.***
>
> *– Jeffrey Germain, R.E. Ginna Nuclear Plant*

projects through predefined information objects. These objects have defined data and behavior based on industry best practices. With this foundation eB defines the context of objects within its system, thereby defining the interactions and interdependencies between different objects. In addition, the objects encompass structured (database) and unstructured data (documents, email, etc.), allowing visibility and interpretation of a broader base of enterprise information.

The basis for ePIC was the eB Performance Improvement application, developed according to Constellation Energy's detailed requirements as launch customer, and validated against other eB Nuclear customers as well as applicable industry standards.

Web-Based Architecture Contributes to Ease of Deployment

The peer team migrated legacy data into the new system, trained Ginna staff, and over a period of six months configured and implemented the ePIC system as legacy systems were phased out. Software deployment was greatly simplified by taking advantage of the eB web-based architecture, which also contributed to usability and rapid adoption by end users. With the exception of independent oversight, all performance monitoring process steps recommended by oversight organizations are handled by ePIC and/or key performance indicators that come from the ePIC database. Of these, the eB Performance Improvement application handles the majority of performance monitoring procedures.

The development of a standard Constellation Energy fleet performance improvement program has been culturally challenging because consensus had to be reached at each plant to create standardized best practices. Peer teams now meet by conference call once a month and in person twice a year to establish new milestones for further improvement.

Constellation Energy has positioned itself as an industry leader, guiding its fleet to one cohesive process that is fully compliant with industry guidelines. Since implementing eB for ePIC, Ginna has undergone a full NRC 95002 inspection, and, facilitated by the ease and visibility with which eB accesses accurate information, received a successful result of "No Significant Findings."

With the adoption of the ePIC system, Ginna has successfully achieved its goal of performance excellence. The results of the NRC inspection are significant, as they indicate the strength of the safety culture that has been instilled throughout the Constellation Energy fleet, following the 13 components of NRC Safety Culture.

- Decision Making
- Resources
- Work Control
- Work Practices
- Corrective Action Program
- Operating Experience
- Self- and Independent Assessments
- Environment for Raising Nuclear Safety Concerns
- Preventing, Detecting, and Mitigating Perceptions of Retaliation
- Accountability
- Continuous Learning Environment
- Organizational Change Management
- Safety Policies.

Benefits have extended beyond meeting compliance and safety requirements. With staff across all sites trained on a single system, relocation can occur as needed without requiring additional training, resulting in significant administrative savings.

Constellation Energy and Bentley did architect and implemented ePIC to be a proactive, fully integrated, self-contained, and self-supporting system that provides robust feedback to management processes. This data-rich feedback function provides management with a wealth of critical information governance for change management across the enterprise.

ePIC has been fully deployed across the fleet and future expansion includes further consolidation to enable enhanced fleet oversight. This will enable management to be more proactive with needed improvements at any site at all times.

Project Summary

Organization:
Constellation Energy Nuclear Group

Solution:
Power Generation/Nuclear

Location:
Ontario, N.Y.

Project Objective:
- Implement a centralized electronic Performance Improvement Center (ePIC) to replace existing paperbased Corrective Action program
- Pilot ePIC in advance of rollout to Constellation Energy nuclear fleets.

Products Used:
eB Nuclear Application Suite

Courtesy: Bentley Systems

Havells India Limited

Havells India Limited is a $1.3 Billion leading Fast Moving Electrical Goods (FMEG) Company and a major power distribution equipment manufacturer with a strong global footprint. Havells enjoys enviable market dominance across a wide spectrum of products, including Industrial & Domestic Circuit Protection Devices, Cables & Wires, Motors, Fans, Modular Switches, Home Appliances, Electric Water Heaters, Power Capacitors, CFL Lamps, Luminaires for Domestic, Commercial and Industrial Applications.

Havells in 2007 created history by acquiring world's renowned lighting company Sylvania Today, Havells owns some of the most prestigious global brands like Havells, Crabtree, Sylvania, Concord, Luminance and Standard. Its global network constitutes of 6500 professionals across 91 branches & representative offices in over 50 countries. Its fourteen state-of-the-art manufacturing plants in India located at Haridwar, Baddi, Noida, Sahibabad, Faridabad, Alwar, Neemrana and seven world class manufacturing plants located in Europe, Latin America & Africa are manufacturing globally acclaimed products, synonymous with excellence & precision in the electrical industry.

A 20000 strong global distribution network continuously strives to set new benchmarks in prompt delivery and service to customers – powering their smiles like none other electrical brand in the country. Further to this the company pioneered the concept of exclusive brand showroom in the electrical industry with 'Havells Galaxy'. Today 200 plus Havells Galaxies across the country are helping customers, both domestic and commercial, to choose from a wide variety of products for different applications. Havells became the first FMEG Company to offer door step service via its initiative 'Havells Connect'. Due to the quality of products and quicker service, it has minimum customer complaints and highest customer satisfaction. Havells and its brands, have earned distinction of being the preferred choice of electrical products both in India and abroad. Havells offers same quality products and its products & processes have acquired a number of International quality.

Certifications, like BASEC, CSA, KEMA, CB, CE, ASTA, CPA, SEMKO, SIRIUM (Malaysia), SPRING (Singapore), TSE (Turkey), SNI (Indonesia) and EDD (Bahrain) – thus complying with stringent quality norms at even the most testing markets, worldwide. It is committed with its state-of-the-art innovations and energy-efficient solutions. Currently 70% of its product offering is energy efficient. Social and environmental responsibility has been at the forefront of Havells operating philosophy and as a result the company consistently contributes to socially responsible activities. The company is providing mid-day meal in government schools in Alwar district, covering more than 50000 students per day. The group company, QRG Healthcare runs a 140 bed hospital in Faridabad and will soon launch another 400 bed hospital in Faridabad by end of the year. In the past, the company has generously contributed to the society during various national calamities like the Bihar Flood, Tsunami and Kargil National Relief Fund etc.

Havells' has the expertise of its fine team of professionals, strong relationships with associates and the ability to adapt quickly and efficiently, coupled with the vision to always think ahead.

Some of the 'Firsts' from Havells:

- Sets up India's First New Generation CMH Lamp Plant at Neemrana in the year 2010
- Launched India's 1st HPF CFL in the year 2009
- Havells launched India's 1st BEE 5* Rated Fan in the year 2009
- First Indian CFL manufacturers to have adopted RoHS, European norms on Restriction of Hazardous Substances in CFLs in the year 2008
- First Company to get the ISI Certification for complete range of CFLs in the year 2006
- Awarded the KEMA certification by The Dutch Council for Accreditation, making QRG the only group to attain this certification in the year 2005.

For further details contact:
marketing@havells.com

EVENT

12th IndiaDoble Power Forum

The 12th IndiaDoble Power Forum is regarded as one of the most valuable events for the region's practicing engineers and executives in electric power utilities and industries. This forum allows participants to share experiences and exchange new ideas for the reliable and safe operation of high voltage equipment and power system protection. Participants will also have the opportunity to get acquainted with the latest techniques. The 12th IndiaDoble Power Forum will be held from December 1-4, 2014 in Vadodara, India. The programme is divided into two specialized tracks:

- Challenges in high voltage asset management through field testing and diagnostic experiences; and
- Challenges in power system protection through applications and field experiences in generation, transmission & distribution.

Join this training experience and gain knowledge to navigate the ever-changing landscape of the power industry, and make your systems more efficient & enable quicker response time.

For further details contact:
www.doble.com

New adjustable test probes from MC by Multi-Contact India C/o Stäubli Tec Systems Pvt. Ltd.

Accuracy and Safety in line with the standard IEC/EN 61010-031:2008.

Multi-Contact's (MC) probes and test leads have proved their worth over a period of more than a couple of decades, and are highly reputed for their safety, high quality and reliable characteristics. MC probes and test leads are used worldwide and also supplied as standard equipment with well-known measuring equipment makers.

The stringency of the safety requirements for service technicians, electricians, employees of power distribution companies etc. varies according to their working environment. For electrical measuring equipment, IEC/EN 61010-031:2008 defines different categories with corresponding requirements for the devices used.

For the length of bare metal probe tips, this standard prescribes:

– Max. 4 mm in measurement categories CAT III and CAT IV

– Max. 19mm in measurement category CAT II.

Their adjustable probe tips enable users to alter the length of the tip so as to work safely and in conformity with the standards in different measurement categories. To alter the length of the tip, the inner part can be shifted in relation to the outer holding part and fixed in two defined positions. Since it cannot be shifted without the use of a tool, its position cannot be changed accidentally. The measurement category and the rated current, as determined by the position of the movable inner part, are shown in an indicator window on the probe.

The adjustable probes are available in the plug-on version with Ø 4 mm safety socket at the rear end of the probe – for use with standard Ø 4 mm safety measuring leads – or with a permanently connected lead.

For further details contact:
india@multi-contact.com

The probe is available with a variety of tips for different fields of application:

XSAP-4, XSPP-419... Ø 4mm tip with MULTILAM, e.g. for connection to grounded power sockets in European & Asian countries

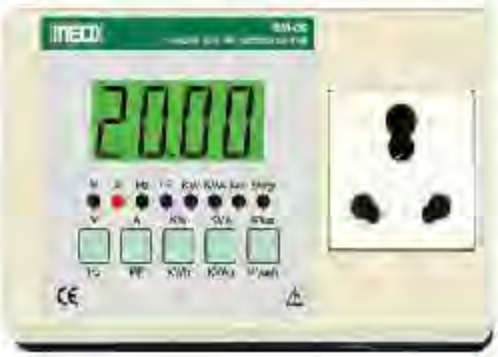
XSAP-2R, XSPP-2R-419... Round Ø 2mm tip of Monell® for universal use

XSAP-2F, XSPP-2F-419... Flat, 1.6 x 5mm tip, e.g. for connection to mains power sockets in the USA and Asia.

Meco: 1 Phase Multifunction Appliance Meter-TRMS (Model : EM09)

MECO offers a Single Phase Multifunction Appliance Meter – TRMS, Model EM09 (1A, 5A and 20A). It measures 10 parameters on 10 display pages on a large LCD display (20 mm). It is equipped with 5 keys to view all the parameters and for programming of the meter.

The Meter is ideal for HVAC industry.



Features

Measures V, A, PF, Hz, KW, KVA, KVar, KWh, KVAh, KVarh;
TRMS Measurement;
Can be used for Continuous Monitoring;
Auto/ Manual Scroll Display (User Selectable);
State of Art Microcontroller Design;
Portable, Easy to Carry and Simple to Use
LCD Display with Backlight;
RS-485 Port (5KV Isolated) with MODBUS RTU Protocol (Optional);
POWER MASTER Software for MIS Reports (Optional).

Applications

Appliances Testing (AC, Refrigerator, Washing Machine, Air Cooler, Microwave Oven etc.);
LED Lights Testing;
Can be given to Field Technicians in their Tool Kit;
Can be used by R&D Dept. in Designing Energy Efficient Products;
Energy Audit and Plant Maintenance;
Studying Energy Efficiency of Electrical Equipment;
Building Management Systems;
Power Management;
Product Quality Testing.

For further details contact:
www.mecoinst.com

intelect

2015 IEEE-IEEMA INTELECT Conference and Exposition

connected intelligence in electricity of things

22-24, JANUARY 2015

BOMBAY EXHIBITION CENTRE, MUMBAI

jointly organised by

IEEE Advancing Technology for Humanity

ieema your link to electricity

ONE MISSION: SMART INDIA 24x7

24X7 SMART use of electricity at Home, Hotel, Hospital & Office

GET READY FOR POWER PLAY UPTO **11000V**

AN INTERACTIVE EXHIBITION THAT WILL SHOWCASE THE LATEST POWER DISTRIBUTION EQUIPMENT & TECHNOLOGY, RANGING FROM 110V TO 11000V.

24X7 SMART use of electricity from Street to Home

IEEMA has partnered with IEEE to bring together INTELECT-2015 (January 22-24, Bombay Exhibition Centre, Mumbai) which will showcase the immense opportunities for India to build and sustain - Smart Cities, Smart Electricity and the entire value chain of the power segment.

Conference cum expo will cut across:

- Sustainable living in growing digitalized and networked societies
- Home & Building Automation, Security & Surveillance, Lighting & HVAC
- Renewable, Off grid, Micro-grid & Rural Smart Electrification
- Infotech & Software Development, Cloud Computing & Data Centers
- Efficient Distribution Systems
- Industry 3.0, Machine to Machine communication
- E Mobility, People Movers & Energy Storage Solution

CONCURRENT SHOW

UPTO 11kV SHOW

POWER PLAY UPTO 11,000 VOLTS

UPTO 11KV SHOW in line with distribution reforms, this show will give a unique opportunity for Electrical equipment manufacturers to showcase their latest equipment, technology & services and interact with Utility officials.

SUB EVENTS

- DISCOM PAVILION
- UTILITY ROUNDTABLE CONFERENCE
- SME HELP DESK: SOURCING OPPORTUNITIES

INTERACTIVE DEMONSTRATION PAVILIONS | WORLD CLASS CONFERENCE | WORLD CLASS EXHIBITION

"IEEMA is preparing to have two shows in January 2015 on upto11kV and intelligent usage of electricity. I would like to see what strength the Indian industry has to able to partner and bring value to 100 Smart Cities Project. Smart electricity management is critical for smart city development"

- Shri. M. Venkaiah Naidu, Union Minister of Urban Development, Housing & Urban Poverty Alleviation and Parliamentary Affairs, Govt. of India.

for more information on Intelect:

Ajay Mahajan
Head - Trade Fairs Marketing
+91 9850 49037
ajaymahajan@ieema.org
www.intelect.in

For upto11kVshow, Contact:
Shina Jose
info11kv@ieema.org
M: +919967491435
www.ieema-upto11kvshow.com

supported by:

Ministry of Urban Development, Govt. of India

Ministry of Power, Govt. of India

Dept. of Telecommunications, Ministry of Communications & IT, Govt. of India

IEEE computer society

IEEE COMMUNICATIONS SOCIETY

ELECRAMA

CDSMA

Power Clamp Meter New launch from Rishabh Instruments

With the world transforming from breakdown maintenance to predictive maintenance the right tool can make the difference between quick solution or awkward frustration. Rishabh Instruments with its cutting edge products has addressed this space for years.

Rishabh is all set to launch it new Power Clamp meter which is not just another power meter its a irreplaceable product combining functions of a clamp meter, power quality meter and multimeter which makes it an ideal tool in high current and power quality maintenance applications.

Rishabh Power clamp meter is the most feature packed clamp meter in the industry with following higlights:

Inrush/ Peak Value Measurement;
Inbuilt Three Phase power measurement;
Energy Measurement;
Active, Reactive & Apparent Power;
Horse Power Measurement;
Upto 49th Harmonics;
Phase Angle;
THD;
Power factor;
Crest factor;
Ripple content in DC;
Non Contact voltage detection;
AC/DC Voltage upto 1000 V;
AC/DC current upto 1000A.

Harmonic Distortion is one of many predictive maintenance applications of power quality. Harmonic distortion is a normal consequence of a power system supplying electronic loads such as computers, variable frequency drives, electronic lighting ballasts, and control systems. Using a power clamp meter can help one pinpoint issues in system thus help avoiding huge breakdown costs.

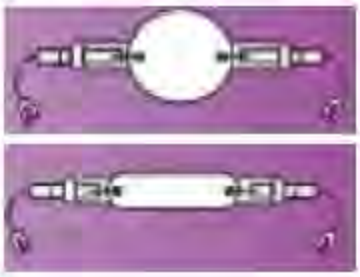
In-rush current, or the amount of current drawn by a motor during startup, is another feature incorporated in some clamp meters. This data can be interpreted to determine the condition and loading of an individual motor.

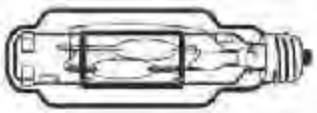
If working on conveyor motors, HVAC motors, or air compressors, this is the specialized clamp meter that needs to accurately measure motor inrush current. Thus making Rish Clamp Power Clamp meter the perfect tool for motor maintenance.

Rishabh Power clamp meter can be used to make sure all three phases on feeders are pulling identical current in a convenient manner. Its inbuilt 3 phase power measurement feature enables easy measurements in symmetric as well as asymmetric networks without any manual calculation like other clamp meters. With such unparalled features for the user this new Power clamp meter is all set to make waves in the power quality measurement arena.

For further details contact:
info@rishabh.co.in

Sports Lighting High Wattage - Short/Long Arc & Double Ended by Venture Lighting India Ltd





Features

High lumen output;
Compact linear lamp;
Excellent optical control;
Cooler base design;
Improved field performance;
High CRI 90+;
Also Available in Elliptical & Tubular;
Range: 1000W, 1500W, 2000W.

For further details contact:
marketing@vlindia.com

Intelligent Pressing system by Klauke India

Intelligent Pressing system has more intelligence, Power and ergonomics. It offers a generation for clear, safe, comfort powerful, efficient, effortless operations.

Advantages

On-site control: Control and Inspection; electronics with integrated pressure test provides an immediate error display without the use of additional equipment.

Final records: Analysis of data via optical interface and USB adapter for written documentation of correct function.

Efficiency control: Multifunctional LED indicates maintenance and battery control.

Extremely short charging time utilizing Makita MAKSTAR technology.

Automatic retraction stop (ARS) after completed crimping: stops at the correct position to secure further multiple parallel crimps of similar type.

For further details contact:
info@klauke.textron.com

Comprehensive range of surge protection solutions

NEW LINE

Surge-Trap®

Lightning current arresters and surge protective devices
Type 1, Type 1+2, Type 2 and Type 2+3 SPD's to EN/IEC 61643

Mersen India Pvt Ltd
(EP Activity)
Plot no 19, 4th Cross,
Bommasandra Industrial Area,
Bangalore- 560099
Email: sales.ep.India@mersen.com
Tel: +91 80 27834005/4006
Website: www.ep.mersen.com

Download the new Surge-Trap® brochure on:
ep.mersen.com

MERSEN
Expertise, our source of energy

FLIR Systems launches Groundbreaking TG165 Imaging IR Thermometer

FLIR Systems, Inc. announced the release of its TG165 Imaging IR Thermometer, a powerful, affordable, compact tool that see invisible heat patterns, measure temperatures accurately, and conveniently store images and measurement data for reporting.

Built around FLIR's exclusive Lepton® micro thermal imaging camera core, the TG165 eliminates the blind guesswork of troubleshooting by combining a single spot IR thermometer with the power of a thermal camera in a rugged, compact package anyone can use. This unique combination of technologies speeds troubleshooting, making it easy to find invisible hot and cold spots from a safe distance it can investigate and solve problems quickly.

Fast and easy to use, the TG165 lets get right to work with no training required. Its dual lasers visually mark the edges of what is being measured and the cross hairs pinpoint the center point of the measurement area.

The TG165 is designed to withstand a two-meter drop, making it rugged enough for industrial professionals while offering the simplicity valued by do-it-yourself homeowners.

"The TG165 bridges the gap between current generation IR thermometers that offer no imaging capability, and FLIR's market-leading thermal cameras," said FLIR President and CEO, Andy Teich. "By leveraging our new Lepton core's revolutionary price, size, and low power consumption, the TG165 transforms one of the most commonly used measurement tools into a discovery device that gives facility maintenance workers, contractors, electricians, HVAC techs, and homeowners greater capability to solve heating and electrical issues quickly and safely."

For further details contact:
flirindia@flir.com.hk

Megger brings Easyloc – Unique Cable Line Locating System

The easyloc location system is designed for the uncomplicated and user friendly determination of the location, orientation and depth of metallic lines (e.g. cable and pipe lines). It can be used to probe areas for unknown lines or for locating specific lines.

The key feature is that it makes optimum preparations for building work which is executed quickly and reliably. It avoids cable damage and help to minimise costly accidents and inconvenient delays.

The operations is quick, simple and hassle free. Also helps in locating metallic pipes and cables quickly and reliably. The cable depth can be measured at the push of a button, even without a transmitter. It has an 33kHz which is compatible with other location systems. There is an large display with automatic backlight. Available with and high – performance 0.5W transmitter for connecting to and tracing pipes and cables and induction method for searching unknown metallic utilities. It also as an automatic sensitivity control with self calibration check routine which helps in saving annual maintenance costs.

For further details contact:
india.sales@megger.com

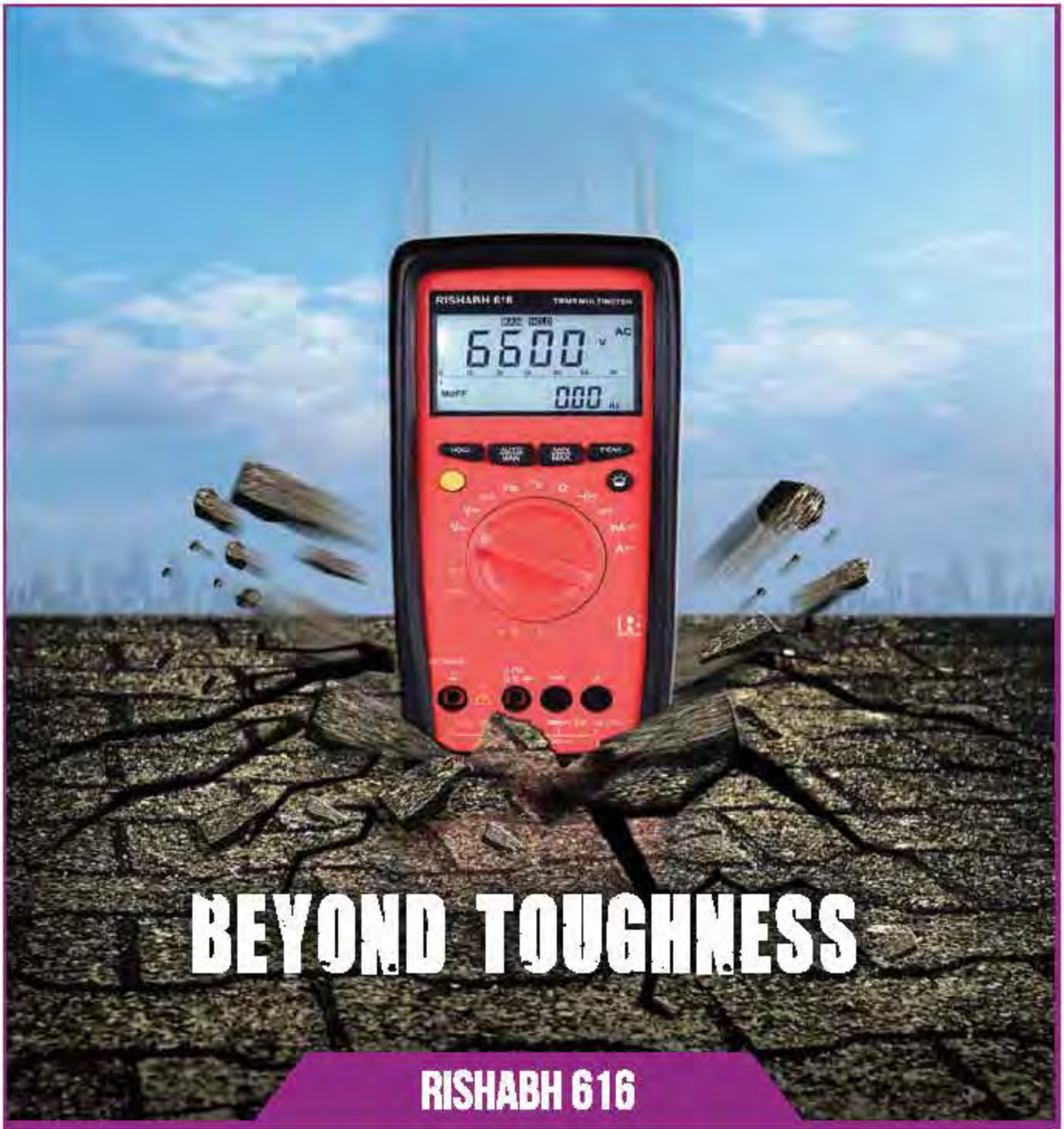
Goliya Instruments Pvt Ltd offers Digital Multimeter

MECO-G includes a new series of handheld Digital Multimeters 3 ½ Digit with backlight LCD display incorporating latest technology.

These Digital Multimeters can measure AC Voltage, DC Voltage, DC Current, AC current, Resistance, Capacitance, Temperature, Battery Test Voltage and Frequency. Additional features like Diode Test, Transistor Check, Continuity check, Low Battery display, Data Hold and Auto Power Off is also available.

These Multimeters have a built in holster for anti-sliding. These meters are useful for various industries, manufacturing units and domestic purposes. Goliya Instruments Pvt Ltd manufacturs electronic, electrical measuring instruments, power line line transducers and modules.

For further details contact:
sales@goliyainstruments.com



RISHABH 616

Make measurement smart and simple with all new **Rishabh 616 TRMS** Digital Multimeter. Packed with powerful features and built to last long, **Rishabh 616** is one of its kind in India. Get power at your fingertips, with the most durable and trusted Digital Multimeter in the Industry brought to you exclusively by Rishabh Instruments.

RISHABH INSTRUMENTS

Analog & Digital Panel Meters | CTs & Shunts | Digital Multi Meters | Insulation & Earth Testers
Clamp Meters | Transducers & Isolators | Multifunction Meters & EMS | CAM Switches | Power Supplies
Protective Relays | Recorders | Temperature Controllers | Convertors & IOs | Power Quality Analyzers

FORECAST

Tel: 91 263 2202202 / 026 | E-mail: info@rishabh.co.in | Web: www.rishabh.co.in

Intersolar India November 18-20, Mumbai
India's Largest Exhibition and Conference for Solar Industry

Electrical India is participating in the Intersolar event being held at from November 18 to 20, at Bombay Exhibition Center. Around 200 exhibitors will showcase the solar industry value chain covering photovoltaics, PV production technologies, energy storage systems and solar thermal technologies. For the first time, the Intersolar India Conference is also taking place in parallel, and is expected to attract around 100 speakers.

During September more than 170 representatives from business, government and research gathered for the Intersolar Summit India in the southern Indian city of Bangalore to discuss upcoming developments such as the opportunities created by the new policies, technical subjects and practical examples.

Intersolar Summit

During the summit, two Indian guests of honor spoke about the current policy adjustments under the second phase of the Jawaharlal Nehru National Solar Mission a major initiative of the Indian government, which aims to greatly promote the development of solar energy in India.

The government led project, JNNSM, which started its first phase in 2010, is one of the world's most extensive initiatives for the use of solar energy to provide power. Renewable energies currently account for around 13% of all Indian energy installations. However, only 8.4% of that is presently generated by solar power.

India's finance minister has promised investment during fiscal year 2014-15 totalling equivalent of almost 6.5 million € (Euro) for promoting the production of solar technology and installation of the equipment. An analysis by the consulting company Bridge to India during the conference showed that despite initiation of many other government-sponsored projects such as "Solar Cities", actual implementation, and particularly in the southern Indian territories, would be sluggish. Overall, the participants felt that the government's goal to increase the currently installed capacity of 2.8 GW nationwide to a total capacity of 20 GW in 2022, could be achieved. However, there were doubts regarding the domestic production of solar technology and the ambitious goal of the JNNSM program to take a global leadership role in the foreseeable future. Also included were technical lectures, such as ensuring energy independence through decentralized power generation (Distributed Energy Resources), the benefits and the use of solar thermal energy as well as the technical perfection and efficiency improvement of Indian PV products by applying TÜV Rheinland Group India testing methods.

The participants discussed current problems. In particular, the analysis and recommendations of the consulting firms, such as Infosys, were received. However, the overall assessment was that Indian solar energy industry, in comparison to other international markets, needs rapid developments.

Partners of Intersolar Summit India

The Intersolar Summit India was supported by Knowledge Partner Bridge to India, the local partners Alliance for an Energy Efficient Economy (AEEE), All India Association of Industries (AIAI), the National Solar Energy Federation of India (NSEFI), the Solar Energy Association of Gujarat (SEAG) and Solar Thermal Federation of India (STFI) as well as by Indo-German Chamber of Commerce (AHK India) and TÜV Rheinland (India) Pvt Ltd.

Conference and exhibition under one roof for the first time

This year, the exhibition conference are taking place for the first time under one roof at the Bombay Convention Centre (BEC). This will allow for more in-depth exchange between exhibition and conference attendees. A session on first conference day is devoted to the national PV market and the individual federal states. A further session on the same day focuses on international markets in Europe, MENA region and Asia. Another series of presentations highlights current developments and applications in the solar thermal market. A set of presentations on the second day of the conference addresses the latest situation and market outlook for off-grid installations in India.

Conference will highlight practical knowledge of technologies and applications. Several sessions deal with the development, financing, safety and operation of large-scale PV power plants, as well as with training specialist staff. In addition, further presentations focus on industrial and commercial roofs, solar/diesel hybrid systems and the topic of energy storage. Winners of the Intersolar Award are going to be announced in the official Award ceremony on November 18, 2014 at Intersolar India event in Mumbai.

Index to Advertisers

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.

Save time!
With Multiple taps in one test

Measure resistance
on short-circuited winding CT.

About Megger:

For over 100 years Megger is the premier provider of electrical test and measuring equipments 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 26740403
E inquiries@megger.com

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

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