Vol 54 No 12 December 2014 ₹ 100

Since 1961

Electrical India

India's oldest magazine on power and electrical products industry

Quality is

Our Facilities

Distribution

Oil Coole

Dry Type Cast Resin

Varnish Impre

Our Manufacturing Capacity

Oil Cooled: Up to 50 MVA - 132 KV Class

Dry Type: Up to 5 MVA - 11 KV & 33 KV Class

Unitized Substation / Multi Pulse / Furnace & Special Purpose Transformers

our Profession

ed

Induction Furnace

132 KV Class

Unitised Sub-station

gnated

Ring Main Unit

Multi Pulse

Iron Core Reactor

PETE - Hammond

Transformative Synergy

PETE - Hammond Power Solutions Pvt. Ltd.
Erragadda, Hyderabad - 500018, India.
Tel : +91 97000 41717 | Fax : +91 40 23706741
email : marketing@petetransformers.com
exim@petetransformers.com

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

Vol 54 No 12 December 2014 ₹ 100

Since1961

Electrical India

India's oldest magazine on power and electrical products industry

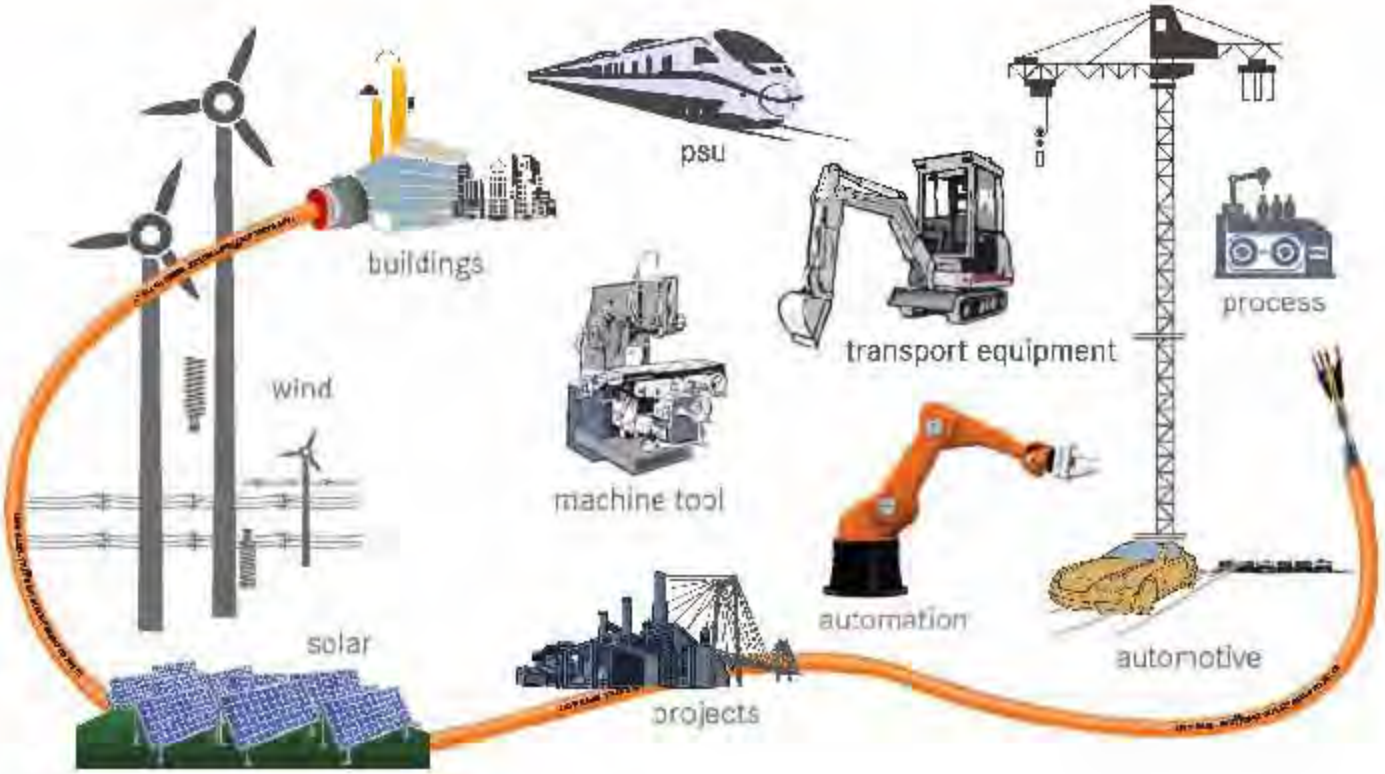
Fifty-fourth Year of Service to the Power Industry 54

ANNUAL 2014

A Chary Publication®

ÖLFLEX®

Legend. Not Just a Cable.



Comprehensive Cabling Solutions for

DIVERSE APPLICATIONS

We are a 100% subsidiary of the LAPP Group-Germany that manufactures Cables, Cable Glands, Conduits and Accessories. We are RELIABLY CONNECTING INDIA with 'Total Solutions in Electrical Connectivity'.

Cabling Solutions For:

Automotive Ancillaries & Spare parts | Automation | Building Segment | Electrical and Optical Equipment | Food & Beverage | Infrastructure | Machine Tools and Special Purpose Machines | Process Industry | Renewable | Textile

Our International Brands:

ÖLFLEX®	UNITRONIC®	ETHERLINE®	HITRONIC®	EPIC®	SKINTOP®	SILVYN®	FLEXIMARK®
Power and control cables	Data communication systems	Data communication systems for Ethernet technology	Optical transmission systems	Industrial connectors	Cable glands	Protective cable conduit and cable carrier systems	Cable marking products

www.olflex-lappindia.in

/lappindia

Lapp India Private Limited
Plot No. 96 J & K, Jigani Industrial Area,
Phase II Anekal Taluk, Bangalore South - 560 105.
Customer Service No.: 9243350000
Email : info@lappindia.com, Website : www.lappindia.com
Lapp e-Shop : www.thelappstore.com

LAPP GROUP

TAURUS
Innovative Technologies
An ISO 9001 : 2008 Company

Products & Services for Entire Electrical Operation & Maintenance

Generation

- DC Earth Fault Locator
- Insulation Tester
- Earth Tester
- Gas Leak Detector
- Corona Camera
- Power Quality Analyser
- HV Detector
- Thermo Vision Camera
- Winding Resistance Meter
- Ultra Sound Partial Discharge Detector
- X-Ray Imaging

Transmission

- Overhead Line Fault Locator
- Impedance Tester
- Corona Camera
- Infrared Camera
- Tower Footing Earth Impedance Measurement Instrument
- Insulation Tester
- Ultra Sound Partial Discharge Detector
- PID Test Kit
- Gas Leak Detector
- Circuit Breaker Analyser
- Transmission Line & Cable Impedance Tester

Distribution

- Overhead Line Fault Locator
- Earth Tester
- Insulation Tester
- Thermo Vision Camera
- Corona Camera
- Winding Resistance Meter
- Power Quality Analyser
- HV Detector
- Fault Passage Indicator
- X-Ray Imaging

Industries

- Insulation Tester
- DC Earth Fault Locator
- Gas Leak Detector
- Ultra Sound Partial Discharge Detector
- Thermo Vision Camera
- Power Quality Analyser
- Winding Resistance Meter
- Earth Tester
- Corona Camera
- HV Detector
- X-Ray Imaging

Railways

- Overhead Line Fault Locator
- DC Earth Fault Locator
- Corona Camera
- Insulation Tester
- Earth Tester
- Gas Leak Detector
- HV Detector
- Thermo Vision Camera
- Winding Resistance Meter
- Ultra Sound Partial Discharge Detector
- X-Ray Imaging

Overhead EHV AC Transmission Line Analyser

Portable On-line DC-Earth Fault Locator

Daytime Corona / UV Inspection Camera

Ultrasound Partial Discharge Detector

Digital Insulation Tester

Power Quality Analyser

Tower Footing Earth Measurement

Non - Contact High Voltage Detector

Power Station Earth Measurement Instrument

Gas Leak Detector

High Sensitivity SF6 AreaCheck Leak Detector

Transmission Line & Cable Impedance Tester

Fault Passage Indicator

Substation and Transmission line Innovative Testing, Analysis & Maintenance

STITAM
Services

The Legacy Continues...

https://www.facebook.com/TaurusPowertronicsPvtLtd
http://www.linkedin.com/company/taurupowertron ca-pvt-ltd

www.tauruspowertronics.com
info@tauruspowertronics.com

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

Booming Infrastructure, and need for more energy is at the threshold

Power and energy are ingredients for the functioning of nations' economy. The whole year, country had been engaged in the changing scene and priorities, amidst General elections and change of government in states. With new government, we expect brighter prospects for energy sources, network controls and automation. Considerable focus is being given upon new resources of green power and to target renewable energy largely. Booming infrastructure, and need for more energy is at the threshold point. Peak- demand deficit to be reduced with new electrical energy generation whose prime objective is emphasis on reliability and quality.

During the past few years, renewable energy sources have received greater attention and considerable inputs have been given to develop efficient energy conversion and utilization techniques. An article 'Grid Connected Wind Energy Control System' says the planning, design and operation of WECS connected to a utility grid requires study of various available options.

Five regional grids exist in India. Integrated grid operations require the normalization of frequency across distribution companies (DISCOS) in five Regions. An article 'Non-technical Losses and Availability-based Tariff in the Indian Power Sector', observes that improvement in DISCOS performance can be through digital technology adoption, and it contains AT&C losses also which are quite high in India.

Our January issue will have solar, nuclear as main focus and post-event coverage of Intersolar India and Nuclear energy 2014, would appear in it.

Do send in your comments at miyer@charypublications.in

Mahadevan

S.T. CHARY

Vol. 54 - No. 12 - December 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
gkaa@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 Bargje
Bharati Solanki

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

Printed, Published and owned by Mahadevan Iyer from 311, Rekha Chambers, Sewandi (E), Mumbai 400 088 and Printed at Print Tech., G-16, Royal Indl. Estate, Naigaum Cross Road, Wadala, Mumbai 400031

Editor : Mahadevan Iyer

A Chary Publication

PRIME MEIDEN

(A joint venture company of Prime Group of India & Meidensha Corporation of Japan)

POWER TRANSFORMER TO POWER YOUR WORLD

Prime Tower
Prime Group headquarter at Gurgaon

EHV Power Transformers upto 765 kV class	Shunt Reactors upto 125 MVAR, 420 kV	EPC Substation projects upto 400 kV	Mobile Substation upto 132 kV	Power Components

A World Class Power Transformer Manufacturing Facility upto 765 kV at Nellore in Andhra Pradesh

- An Indo-Japnese joint venture with more then 100 years of experience in its fold in the field of transformers & EPC Projects through Meidensha Corporation of Japan.
- Technical collaboration with world famous "VIT", Ukraine a part of Electozavod, one of the largest manufacturer of Power Transformers in the world.
- State-of-the-art manufacturing facility, fully integrated, dust controlled and air conditioned.
- Globally advanced swing shear technology based CRGO cutting & slitting lines with de-burring attachment from GEORG, Germany.
- World-class testing lab equipped with most advanced static test system from HIGH VOLT of Germany providing extremely accurate control over the testing process with capability to test both at 50 Hz as well as at 60 Hz.
- Advanced technology faraday cage designed for near zero partial discharge testing.
- State-of-the-art in house PICC manufacturing & Tank fabrication facilities.
- Highly skilled human resource trained by VIT specialities.

PRIME GROUP
LOOKING BEYOND

PRIME MEIDEN LIMITED

Corporate Office : Prime Tower, 287-288, Udyog Vihar, Phase-I, Gurgaon-122 016 (India), Tel: +91 124 4111999 (30 Lines), 8858999 (30 Lines), Fax : +91 124 4871698 99 Email : sales@primemeiden.com
WEB : www.primemeiden.com

Factory :
SEZ, Menakuru, Naidupeta, SPSR Nellore - District, Andhra Pradesh - 524 126 (India)

CONTENTS

Vol 54 | No 12 | December 2014

Annual 2014

POWERING THE NATION EVERYDAY, EVERYNIGHT

We, at Sudhir, are the industry leaders in the Indian power sector. For around four decades, we have been broadening the horizons of infinite opportunities.

TOLL FREE NO.
1800 102 7475


Sudhir-Cummins Gensets


Sudhir-Oil Transformers


Sudhir-Dupont Transformers


Sudhir-Schneider Substations


Sudhir-Tesar Transformers


Sudhir-Schneider LT Panels


Sudhir-Schneider HT Panels


Sudhir-Electrical Power Contracts

Strategic Alliances

Power Generation

Schneider Electric

Tesar

DUPONT

SUDHIR GENSETS LIMITED

Corporate Office:
Plot No-1, Sector-34, E.H.T.P., Gurgaon, Haryana
T: +91-124-4168000 (30lines)
E: info@sudhirgensets.com
www.sudhirgensets.com

Power Generation | Distribution | Electrification

Follow us on

CONTENTS

Vol 54 | No 12 | December 2014

Departments

Interviews

Ravin

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 30816666 29215000 | F +91 22 30816661, 29215011
E: sales@ravingroup.com | W: ravingroup.com

Energy technologies for sustainable energy supply and changing focus

> *Continuing current of energy occurring in natural environment*

Gopal Krishna Anand

The energy cycles progress of civilization through heating, cooling, lighting, internet and infrastructure connectivity. Coal contributing to over 53% of primary energy consumption, fuels over 65% of electricity generation of the country. Higher coal and gas prices will affect electricity distribution companies economic performance. Hydro activity is on the move now. India has enormous potential for renewable energy, though nuclear power capacity too ought to increase beyond long-existing 4780 MW for sustaining future needs of energy.

While addressing to a joint session of the Australian Parliament, Narendra Modi, spoke clearly on what India intends to do for its energy future. He called for a partnership with Australia to provide India, among other things, "Energy that does not cause our glaciers to melt: clean coal and gas, renewable energy or fuel for nuclear power and cities that are smart, sustainable." Country needs to realise solar advantage to focus in its plans to tackle country's energy deficit.

Renewable energy potential lies in the continuing current of energy occurring in natural environment. Towards this initiative, Ministry of New and Renewable Energy is organizing RE-INVEST 2015: Global Renewable Energy Investment Promotion Meet, during February incidental to 'Make in India' initiatives launched by Prime Minister, to boost and attract global investment in renewable energy sector of the country. Investors from all over the world have been requested to participate in Re-Invest event. India's recently announced target to install 100 GW solar power capacity by 2022 could make it one of the largest solar power markets in the world and put it in direct competition with China who, also has announced a target to achieve an installed solar power capacity of 100 GW by 2020. India had planned to add 9 GW between 2014 and 2017. The current installed solar power capacity in India is just around 2.7 GW, which needs accelerative thrust.

Yet, the challenge is energy storage technologies to meet urgent needs. For clear focus accentuating efforts in the direction of renewable scope as an entity is a coaxing stage to move further on. Renewable technology holds strength as the most sustainable form of future energy option for Indian power sector.

odules ● PowerLine Transducers ● Analog Panel & Switchboard Meters ● Digital Multimeters ● Digital Clampmeters ● Analog and Digital Insulation Te

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

MECO®

SINCE 1962

One Single Source for all your METERING needs...

Multifunction Meters

Digital Panel Meters and Modules

Power Line Transducers

Testing and Measuring Instruments

Battery Capacity Tester

Analog Panel and Switchboard Meters

Solar Module Analyzer

Environment Testing Instruments

Power and Harmonics Analyzer

Calibrating Equipment

Precision / Split Core Current Transformers

An ISO 9001-2008 Certified Company

MECO INSTRUMENTS PRIVATE LTD.

Plot No. EL-1, MIDC Electronic Zone TTC Industrial Area, Mahape, Navi Mumbai - 400710 (INDIA)

Tel. : +91-22-27673311-16 (Sales), 27673300 (Board) **Fax** : +91-22-27673310 / 27673330

Email : sales@mecoinst.com **Web** : www.mecoinst.com

VER:112014

● Solar Analyzers ● Battery Capacity Testers ● Environmental Testers ● Power and Harmonic Analyzers ● Energy Auditors ● 3φ / 1φ Clamp- On Powe

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

Indian Wind Energy Alliance launched

Indian Wind Energy Alliance the apex body for Wind Energy Industry in India, was launched by Piyush Goyal, Minister of State with Independent Charge for Power, Coal and New & Renewable Energy. IWEA is a consortium of Indian Wind Turbine Manufacturers Association (IWTMA) and Wind Independent Power Producers Association (WIPPA), the two trade bodies representing respectively the manufacturing and investing or customer side of the wind business. The objective behind this alliance is to promote and protect the interests of all stakeholders of Wind Energy Industry including wind energy producers, investors, manufacturers, component makers and other stakeholders. It will provide a pan India forum, create an atmosphere of cooperation and

address various issues faced by the wind energy stakeholders. IWEA will also work closely with the government to achieve target of 10 GW of new wind installations every year. Piyush Goyal said, "There is need to enhance wind power development in the country and the government will provide all the necessary support to the industry to achieve the target of 10,000 MW of wind power installations every year. The formation of IWEA will not only benefit the Wind Energy Industry as a whole but also partner with the Government in fulfilling Prime Minister's vision to bring power to every home by 2019" Sumant Sinha, the first Chairman of IWEA and Chairman and CEO of ReNew Power, said "The potential of the wind sector in India is far greater than what is currently being projected and the formation of IWEA will provide an impetus to the wind energy industry by establishing and assisting scientific laboratories, workshops, institutes and organization in the Wind Energy Industry. There is a lot of scope for the wind energy sector to grow in India and Government's support is critical to achieving the national objectives specially given the government's renewed interest on wind & other renewables."

600 MW capacity Haldia Thermal Power Plant of Haldia Energy Limited constructed

Providing a major impetus to power generation in West Bengal, Punj Lloyd

Chief Minister of West Bengal inaugurated the Haldia Thermal plant of Haldia Energy Limited, a subsidiary of CESC. The scope of work for the 2X300 MW Haldia Thermal Power Project awarded to Punj Lloyd (one of the major EPC contractors of this project) included complete design and construction of civil, supply, erection, testing and commissioning of mechanical and electrical packages of Balance of Plant, and erection, testing and commissioning of Boiler Turbine Generator (BTG) Island. The plant is ready for operation. During the execution of project, Punj Lloyd received whole hearted support from the CESC Haldia team. Atul Punj, Chairman, Punj Lloyd said, "The most critical factor in the successful completion of the Haldia Thermal Plant has been the unflinching support of CESC and Haldia Energy teams during the life cycle of the project. That explains how project execution was achieved without a single man-day loss. We value this relationship with CESC and are committed to delivering our best." Punj Lloyd was also the EPC contractor for the 600 MW thermal power plant at Chandrapur, Maharashtra of RP Sanjiv Goenka Group. On the event of the inauguration, Project Director, Amar Nath Mitra said, "The earnest cooperation we received from CESC ensured smooth progress and timely completion. We are also thankful to all co-partners who have been associated with us during the execution period especially Bridge & Roof and Powermech."

Launch of Deendayal Upadhyaya Gram Jyoti Yojana

The Union Cabinet, chaired by Prime Minister Narendra Modi, approved launch of Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) with components: to separate agriculture and non agriculture feeders facilitating judicious rostering of supply to agricultural and non-agricultural consumers in rural areas & strengthening and augmentation of sub transmission & distribution infrastructure in rural areas, including metering of distribution transformers/feeders/consumers. The estimated cost of the scheme for above two components is Rs 43,033 crore which includes the requirement of budgetary support of Rs 33,453 crore from Government of India over the entire implementation period. The Cabinet further approved, that the balance work relating to rural electrification as per CCEA's approval in August, 2013 with the norms of the ongoing scheme of RGGVY in 12th and 13th Plans will get subsumed in DDUGJY as a distinct component for rural electrification for which CCEA has already approved the scheme cost of Rs 39,275 crore including budgetary support of Rs 35,447 crore. This outlay will be carried forward to the new scheme of DDUGJY in addition to the outlay of Rs 43,033 crore. The scheme would help in: Improvement in hours of power supply in rural areas. Reduction in peak load; Improvement in billed energy based on metered consumption and Providing access to electricity to rural households. The process of sanction of projects shall commence immediately. After sanction of projects, contracts for execution of projects will be awarded by States Discoms / Power Departments. The projects shall be completed within 24 months from date of award.

SCOPE

HISAC Ultima

HISAC Swift

SCOT MXP+

SA 30i

SA 10i

Circuit Breaker Diagnostic Testing Solutions from SCOPE

CB Dynamic Test Set for EHV / UHV CBs :
HISAC Ultima

- Measures Contact Timings, Coil Currents & Travel Characteristics
- Performs 6 channel DCRM test in one go
- Laptop operated & trolley mounted system
- Modular construction & easy upgradation

CB Operational Analyser for MV / HV / EHV CBs :
HISAC Swift

- Measures Contact Timings & Coil Current
- Performs 3 phase Static Contact Resistance measurement
- Portable instrument operated through colorful TFT touch screen display
- Ideal for quick testing of gang operated CBs
- Multiplexed Test Leads reduce testing time drastically

CB Time Interval Meter for MV / HV / EHV CBs:
SCOT MXP+ / SCOT M3K+

- Measures Contact Timings
- Lightweight, Battery operated Quick Check tool

*All above products are CE Certified

On-Line Surge Arrester Diagnostic Testing Solutions from SCOPE

SA Leakage Current Analyser for HV/EHV/ SAs:
SA 30i

- 3rd Harmonic Resistive Leakage Current Measurement as per IEC 60099-5 B2
- Automatic correction for System Harmonics, System Voltage and Temperature
- Built-in source for self-calibration check
- Simple, lightweight, portable & on-line test system
- Quick connect CT & Field Probe finishes the job in 5 minutes !
- Proven performance in 765kV switchyards
- Option of Field PT for GIS Sas
- Winner of Best Product Award at ELECRAMA

SA Leakage Current Meter for MV/HV SAs:
SA 10i

- 3rd Harmonic Resistive Leakage Current Measurement as per IEC 60099-5 B1
- Automatic correction for System Voltage and Temperature
- Simple, handheld, cost-effective on-line test system
- Quick connect CT finishes the job in 5 minutes!
- Ideal for quick testing of MV/HV SAs

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.

Toshiba reinforces Transmission & Distribution Equipment Manufacturing

Toshiba Corporation announced that it will reinforce its transmission & distribution (T&D) business in India with a 3-billion yen (approx.US$30-million) investment in new production capacity at Toshiba Transmission & Distribution Systems (India) Pvt. Ltd. (TTDI) in Hyderabad. A new line for large power transformers will come on line in spring 2015, at the same time as the full scale launch of a new line for switchgears. According to Dr. Kaisutoshi Toda, Chairman & Managing Director, TTDI, "India is a high growth market that Toshiba has positioned as a strategic base for its power-related businesses. In the period to FY2016, Toshiba plans to invest a cumulative 10-billion yen (approx.US$100-million) in its T&D business there, including this current round of investment." Alongside its existing production line of small- and medium-capacity transformers and low- and medium-voltage switchgears, the new power transformer line will support production of 765kV transformers with a capacity of 500MVA, while the new switchgear line will produce high voltage products. "Toshiba is seeking to secure a 20% share of the Indian market by 2018, and also reinforce Toshiba Transmission & Distribution Systems (India) Pvt Ltd as a core T&D production base for other major markets, including Europe, ASEAN, and Africa", added Dr. Toda. India continues to record high economic growth, and capital investment for infrastructure is expected in areas such as electricity and transportation. In T&D, – Indian government is promoting measures to increase number of 765kV substations, toward increasing the country's transmission capacity five times by 2017.

Coal ministry to consider Odisha's plea to allot blocks to PSUs

Ministry of Coal has agreed to consider the Odisha government's plea to award exclusive coal blocks for its PSUs and provide assured coal linkages to independent power producers (IPPs) that have made substantial headway on their projects. The state government had raised the two demands after the Supreme Court's order on August 24 that saw 204 coal blocks being deallocated. State PSUs like Odisha Mining Corporation and Odisha Power Generation Corporation (OPGC) ended up losing their coal blocks."I am informed that the two proposals have been sent to the Coal ministry. We will consider the proposals," said Anil Swaroop, Coal secretary, who took stock of the status of different clearances for 16 coal mine projects of Coal India Ltd's (CIL) subsidiary Mahanadi Coalfields Ltd (MCL). "It has been envisaged to ramp up coal output of CIL to one billion tonne from 500 million tonne (mnt) presently and that of MCL from 110 mnt to 200 mnt by 2019. At meeting, timelines were set to resolve issues pertaining to forest and other clearances for coal mines of MCL. The next such review would be done after two months," he said. Swaroop touched upon three key railway projects being executed in the states of Odisha, Jharkhand and Chattisgarh to boost coal transport. Among three rail projects, the one in Odisha (Jharsuguda-Barpali link) has made the fastest progress, the Coal secretary noted.

Tata Power Solar completes 25 Years of harnessing solar power

Tata Power Solar, India's largest integrated solar player, announced the completion of 25 years in the global renewable energy space. A pioneer in the Indian solar market, Tata Power Solar has touched the lives of over 30 million people and reduced carbon footprint by more than 6.2 million tonnes as of 2014. With businesses in cell & module manufacturing, EPC (engineering, procurement & construction) services and off-grid solutions, Tata Power Solar is one the oldest solar energy companies in the world. They were recently ranked the no. 1 third-party EPC player, no.1 domestic module supplier & no. 1 rooftop solar player in the industrial and commercial segment, for 2014, by Bridge to India. Tata Power Solar is globally recognized for its quality, efficiency, customer care and reliability, and has more than 8 lakh off-grid solar installations / products across the country. Commenting on the occasion, Ajay Goel, CEO, Tata Power Solar said, "Our 25 year journey is a testimony to the path-breaking work done in transforming lives of communities across the country. We hope to help countless customers adopt cleaner and efficient means of energy adoption, as well as mobilize communities with insufficient access to energy. As we steadily tread forward, we aim at expanding our reach into deeper parts of the country where we can contribute towards sustainability and make a mark by improving lives of millions more." The company has strived to make solar power accessible to the far-flung regions of India, touching thousands of lives in every corner of the country. From farmers in Andhra Pradesh to fisherfolk in West Bengal, and from sheepherders in Kashmir to shopkeepers in Tamil Nadu, Tata Power Solar continues to energize communities. Having built strong partnerships with numerous governments, non-profits and rural banks, Tata Power Solar has empowered those mired in energy poverty, and provided many access to electricity for the first time. To mark their 25th anniversary, Tata Power Solar has launched a coffee table book titled "Chasing The Sun", showcasing the impact of solar across India. A blend of reminiscent images of regions and lives of people transformed by Tata Power Solar, the book was recently launched at the TERI 'Leadership Summit for Sustainable Development' held in New Delhi.

riello ups

Reliable Power for a Sustainable World.

Riello UPS win *Product Leadership Award* 2013

FROST & SULLIVAN

Global Leaders in Uninterruptible Power Supply Systems

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

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

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

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

★ ★ Dealers and Distributors are Invited ★ ★

Riello PCI India Pvt. Ltd.

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

Prime Tower, Plot No: 287-288, Udyog Vihar, Phase - II, Gurgaon-122015, Haryana (India)
Tel: +91-124-6658999 Mob: 07838552211 Fax: +91-124-4571898 Email: ups@riello-pci.com Website: www.riello-ups.in

BHEL commissions sixth unit of 68.67 MW Hydro Generating Unit at Rampur HEP

With the commissioning of the last of the six units of 68 MW hydro generating unit of Rampur Hydro Electric Project (HEP) in Himachal Pradesh, Bharat Heavy Electricals Limited (BHEL) has commissioned the 412 MW hydro power plant of SJVN Limited. The 412 MW Rampur HEP powerhouse comprising 6 units of 68.67 MW each is located on River Satluj, a major tributary of the Indus Basin in Himachal Pradesh - 120 km from Shimla. The project is designed to utilise the water that comes out after generation from Nathpa Jhakri Power Plant and is diverted from Jhakri Tail Race Pond to the intake of Rampur HEP through a tunnel. The power stations at Jhakri and Rampur are designed to be operated in tandem. The project does not require construction of a dam, reservoir capacity or additional land inundation. The project is a green field project and the plant will be capable of generating approximately 1,770 GWh in a ninety percent hydrological dependable year when all the units are operating. The commissioning of Rampur HEP will result in reduction of greenhouse gas emissions and will help in achieving a low carbon development path for the state and the nation. BHEL's scope of work in the project includes supply, erection and commissioning of 6 numbers Francis turbines operating at a head of 119 meters with matching synchronous generators of 200 rpm, static excitation system, main inlet valves, penstock valves, digital governors, state-of-the-art control & monitoring system (SCADA), associated turbine, generator and station auxiliaries, Gas Insulated Switchgear (GIS) and electrical & mechanical Balance of Plant (BoP). BHEL has a long association with SJVN commencing with their first generating plant – 1,500 MW Nathpa Jhakri HEP, commissioned in 2003-04. Notably, nine hydro sets totalling to 641 MW were commissioned by BHEL in the year 2013-14. Fiscal 2014-15 is also progressing on a promising note for hydro projects, with commissioning of a 130 MW set at Parbati III in May, 2014 and two 68.67 MW Units of Rampur in June and July 2014, now followed by another 68.67 MW unit. BHEL is presently executing Hydro power projects of around 5,000 MW under various stages of implementation.

TÜV SÜD to conduct assessment on behalf of MPPGENCO

Indian energy provider MP Power Generation Company Ltd, commissioned the international technical services company TÜV SÜD to carry out extensive assessment of a thermal power station in the federal state of Madhya Pradesh. The contract is part of a comprehensive project initiated by the Indian Central Electricity Agency (CEA) in 2013 for the renovation and modernisation of thermal power stations. Within the scope of this project, over 50 conventional power stations will be fundamentally renovated & modernised by 2016 alone. On behalf of MP Power Generation Company (MPPGENCO), TÜV SÜD will inspect the national power supplier's conventional power station Sanjay Gandhi in in Birsinghpur in the federal state of Madhya Pradesh over the next months. The main objective of the contract is to survey the plant's condition and performance and determine the remaining service life of the power-station components. TÜV SÜD's power station experts will then summarise their results in Detailed Project Reports (DPR), which will form the basis for planning and implementation of the required renovation measures. "The assessment of thermal power stations in a relatively short time is a complex task that requires extensive expertise and experience and appropriate human resources." Through its renovation and modernisation programme, the Indian government has set its course for closing the growing gap between energy demand and energy production and fulfilling its ambitious climate targets. The 11th and 12th five-year plans provide for the rehabilitation of 129 plants with a total capacity of 26,238 MW and 95 plants with a total capacity of 21,212 MW respectively.

Commercial generation commences from Muzzafarpur power stations

The 110 MW unit II of Muzzafarpur Thermal Power station (Stage I) of Kanti Bijlee Utpadan Nigam Limited and the first 660 MW unit of NTPC's Barh Super Thermal Power Station commenced commercial generation with the declaration of Commercial Operation by Piyush Goyal, Union Minister of State (Independent charge) for Power, Coal, New& Renewable Energy, in Bihar. Chief Minister of Bihar presided over the functions. The Union Minister for Communications & Information Technology, Ravi Shankar Prasad, Union Minister for Agriculture, Radha Mohan Singh, the Minister of State (Independent Charge) for Petroleum and Natural Gas, Dharmendra Pradhan, Minister of State for Skill Development & Entrepreneurship and Parliamentary Affairs, Rajiv Pratap Rudy and Minister of State for Drinking Water and Sanitation were the guests of honour at the above functions. Leading dignitaries from the State of Bihar , officials from Ministry of Power, State Government and NTPC attended the functions. Situated at Kanti in Distt. Muzzafarpur in Bihar Muzzafarpur Thermal Power Station belongs to Kanti Bijlee Utpadan Nigam a subsidiary of NTPC (65%) in Joint Venture with Bihar State Power Generation Company Ltd (35%). Leading dignitaries from the State of Bihar were present on the occasion. Muzzafarpur Thermal Power station with a capacity of 2X110 MW was owned by BSEB both the units were under shut down. In order to revive the station, Govt. of Bihar handed over the station to a JV company formed by BSEB and NTPC. Project has 2 X 195 MW capacity under construction at present.

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

India's premier power trading platform promoting transparency and competition

97% Market Share* • **3,300+** Participants **2,900+** Industrial Consumers • **>80,000** MWh Daily Average Volume*
Recipient of several accolades including Exchange of the Year - Indian Electricity Market Awards 2014
*Statistics for FY 14-15 as on 31st October 2014

INDIAN ENERGY EXCHANGE (IEX)

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

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

PRODUCT PORTFOLIO

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

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

INDIAN ENERGY EXCHANGE LTD.
CORPORATE OFFICE: 100A/1 Ground Floor, Capital Court, Olof Palme Marg, Munirka, New Delhi - 110067
Tel: +91-11-4300 4000 | Fax: +91-11-4300 4015 | Email: info@iexindia.com | CIN No. U74999MH2007PLC169201
REGISTERED OFFICE: 1st Floor, Malkani Chamber, Off Nehru Road, Vile Parle (East), Mumbai - 400099

www.iexindia.com

Approved and Regulated by Central Electricity Regulatory Commission (CERC)

Gamesa expands facility in Chennai to introduce G114-2.0 MW turbine model into wind market

Gamesa, a global technology leader in wind energy, inaugurated the expanded nacelle facility in Mamandur, close to Chennai. The new installed production line will mainly be used to produce the G114-2.0 MW turbine model, which Gamesa expects to introduce into the Indian market over the course of 2015. In addition, as it is configured as a multi-model line, it will be possible to make two models in parallel: the G114-2.0 MW and the G97-2.0 MW. Both turbines are part of Gamesa's 2.0 MW-2.5 MW platform, 500 MW of which have already been installed in India. The investment in this new and enhanced production line will increase the factory's existing annual capacity up to 1,700 MW. The company's Indian nacelle factory began to operate in July 2013. Since then, 900 MW of Gamesa's 850 KW & G97-2.0MW turbines have been assembled at the facility. In recent years, India has emerged as one of the countries with the greatest potential for wind energy: according to BTM, India's installed capacity is set to increase from 21,000 MW to 36,000 MW by the end of 2018 due to growing demand for energy. "In order to defend this position and reinforce our commitment to development of the country's wind energy sector, over the next five years we plan to invest around €100 million in strengthening our manufacturing capabilities especially for the launch of new products like G114-2.0 MW, further developing our local supply chain and increasing our wind farm development pipeline, a strong competitive advantage in India", remarked Ignacio Martin, Gamesa's Chairman and CEO, during the inauguration ceremony. With a rotor spanning 114 metres, the G114-2.0 MW turbine's sweep area is 38% greater than that of the G97-2.0 MW, while it produces 20% more energy per annum. To date, Gamesa has locked in orders for over 800 MW of this new model, which is underpinned by proven technology, validated in the Gamesa 2.0-2.5 MW platform, one of the most reliable in the market, having been installed in 33 countries (cumulative installed capacity: 18,000 MW). Gamesa is present in India as technology provider and wind farm developer.

ACME Group achieves 80 MW Projects in Telangana

ACME Group, India's leading solar power player in India won the bid for 80 MW solar PV power projects at the 500 MW tender opening under RFP floated by Southern Power Distribution Company of Telangana Limited (TSPDCTL). As per the terms and conditions of the bidding document, the selected developer would sign 25 year long PPA with Telangana Discoms (TSSPDCL and TSNPDCL) on bided tariff. The project has to be commissioned within 10 months after signing of the PPA and the financial closure of the project must be done within 150 days after the signing of the PPA. Commenting on this momentous occasion, Manoj Kumar Upadhyay, Founder & Chairman, ACME Group said, "We thank the Telangana government and Southern Power Distribution Company of Telangana Limited (TSSPDCL) & Northern Power Distribution Company Limited of Telangana (TSNPDCL) for choosing Solar Power to meet the energy demands of the state. In our mission towards green meeting energy needs of the country through green energy, we are proud to partner the state and offer our full support to achieve the dream to bring power to every house by 2019. With this addition, our solar power portfolio has reached ~502.5 MW and we are on way to generate 1000 MW by year 2017." This project would entail an estimated investment of $ 107 mn (Rs. 660 crores). Last 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. Earlier, ACME also sourced an investment from IFC in the form of an A Loan.

Shakti Pumps bags award for Special Contribution

Shakti Pumps (I) Ltd, India's leading manufacturer of 100% stainless steel pumpsets, has been awarded for "Special Contribution" by EEPC for the year 2012 -13. The company won the award under the category – Highest Exporter in Thrust Markets for Thrust Products – Large Enterprise. The award was handed over by Gujarat Chief Minister Anandiben Patel to the company Chairman and Managing Director, Dinesh Patidar at a glittering ceremony in Ahmedabad, Gujarat. "We are extremely pleased to receive this award at the hands of the honourable chief minister. The award is a recognition of the company's strong export focused model as well as its ability to build brands globally. In our category we have been a pioneering multinational with exports to about 100 countries. We thank the EEPC for this award, "said Dinesh Patidar, CMD of Shakti Pumps (I) Ltd. The award consisting of a silver plaque has been given for the category submersible pumpsets, submersible pumps, solar submersible pumps set, open well pumps, pressure boosting pumps, self priming pumps, mono block pumps, vertical multistage centrifugal pumps and submersible motors. It is also recognition for exports to USA, Germany, UAE, Saudi Arabia, UK, Italy, Brazil, Spain,Thailand, and various place and china and France etc.

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 /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

DuPont Young Professor Award for Scientific Innovation

Ravi Maruthachalam, was selected as one of the top 10 international young faculty members to be recognized with a DuPont 2014 Young Professor (DYP) award. He formally received this recognition from Dr. Ranjan Patnaik, Director, DuPont Knowledge Center (DKC), Hyderabad, on the occasion of the Science Day celebration at DKC. The DuPont Young Professor program is designed to help promising young and untenured research faculty memebers working in areas of interest to DuPont. One of the most sustained programs for academic research, the DYP program has spanned four decades, providing over $50 million in grants to nearly 700 young professors in nearly 140 institutions in 14 countries since 1968. In addition to providing unrestricted funding to new faculty, this prestigious program enables DuPont to build future research partnerships with emerging global academic leaders. "Young professors award is one of the key DuPont initiatives to encourage academic research that help develop innovations to address the global challenges of food, energy and protection," said Dr. Ranjan Patnaik, Director, DuPont Knowledge Centre. "We are delighted to recognize talent in India who have the potential to make path-breaking research contributions." Dr. Patnaik added. During the three-year grant award period, each grant recipient is invited to present a seminar on his or her work to the DuPont research community. Ravi is an exceptionally talented young scientist with potential to develop into a world leader in the field of plant genetics says Prof. Ramakrishnan, Director, IISER Thiruvananthapuram.

Jindal Power wins CII - National Award for Excellence in Energy Management 2014

In recognition of its commitment towards energy conservation and efficiency, Jindal Power Limited (JPL) -Chhattisgarh has received the CII - National Award for Excellence in Energy Management, 2014. JPL won the award for -'Excellent Energy Efficient Unit'at the CII Convention held at the International Convention Centre, Hyderabad. On intimation of the award –Ravi Uppal, MD & Group CEO, JSPL said – "We are delighted to receive this prestigious CII Award. At JPL, we have created new benchmarks in the power sector, and this award is a testament of our unrelenting quest for innovation and operational excellence." The evaluation criterion of the award included a critical assessment of - trends of reduction in energy consumption, adoption of innovative energy saving initiatives, quantification of energy savings, specific methodologies adopted and proven efforts in harnessing renewable energy and waste materials.

New generation Sterling Generators DG Sets powered by Perkins Engines

Sterling Generators, one of the largest manufacturer of DG Sets in Asia, presents new generation Sterling Generators DG Sets powered by Perkins 4000 series engines that offer you a choice of 6, 8, 12 and 16 cylinder options to ensure you have the exact engine to suit your specific power generation needs. The Perkins 4000 Series family of 6, 8, 12 and 16 cylinder diesel engines was designed in advance for todays uncompromising demands within the power generation industry and includes superior performance and reliability. This range of engines is between 750KVA - 2250KVA Prime. Established in Peterborough in 1932, Perkins Engines are known the world over for their fuel-efficiency, ruggedness, and reliable operation under all conditions. The new generation DG sets from Sterling Generators powered by Perkins 4000 series engines are tough and durable and produce a consistence performance that will provide you electricity for years to come. Their premium design and specification features provide economic and durable operation as well as exceptional power to weight ratio, improved serviceability, low gaseous emissions, overall performance and reliability essential to the power generation market. These Engines produces higher power for the range compared to competition and have a highest average loading capability for Prime DG set to a tune of 80% on a 24 hours loading cycle along with the highest Power Density as compared to any makes available in this range. With an unmatched first step block loading capability, these DG sets also have the highest time between schedule preventive maintenance as compared to competition. With best in class ambient and altitude capabilities without de-rates, the commonality of components with other engines in the 4000 Series family allows reduced parts stocking levels. Commenting on the Sterling Generators Perkin 4000 series DG sets, Sanjay Jadhav, President, Sterling and Wilson Powergen Pvt Ltd says "One can be assured that these DG sets will measure up to the toughest demands you place on them. They offer the best in class emission levels and smoke characteristics and have lesser NOx, CO, PM & HC emissionlevels as compared to CPCB norms.

Vashi Electricals Pvt. Ltd.

1978 SINCE

WORLD CLASS BRANDS
UNDER ONE ROOF

SIEMENS

Switchgear

Finolex

Wires & Cables

Bonfiglioli

Geared Motors

SIEMENS

Motors

POLYCAB

Wires & Cables

legrand

MCB's / Wiring Acc.

hindustan ELECTRIC MOTORS

Motors

Panasonic

Compact AC Geared Motors

OMRON

Indl. Components

Castrol

Industrial Lubricants

PHILIPS

Lighting

EMERSON
Network Power

Network Power Solution

connectwell

Terminal Blocks

UNISTAR

Elastomeric Cables

Continental CONTITECH

V - Belt

SKF

Rolling Bearings

OUR PRESENCE

Mumbai	Gurgaon	Indore	Gujarat	Bengalore	Chennai	Kolkata
02522-681800 / 022-27628300	0124-4989589 / 90	0731-4045888	0265-2690399	080 - 26746116	09841072357	03239004888

TOLL FREE No. - 1800 266 1658

CIN NO : U31904MH1991PTC060890

Mumbai | Pune | Nashik | Nagpur | Goa | Gurgaon | Indore | Chandigarh | Vadodara | Ahmedabad | Vapi | Surat | Kolkata | Bangalore | Chennai | Hyderabad

www.vashielectricals.com Follow us on :- sales@vashielectricals.com

Commitment to 'Make in India' campaign: Lapp India announces expansion of its manufacturing unit at Jigani, Bangalore

Lapp India, a 100% subsidiary of the Lapp Group and a leading manufacturer of Cables, Connectors, Cable Glands, Conduits and Accessories in India announced the expansion of its Bangalore manufacturing facility. The project will increase the Company's production area from existing 5227 sqm to 10,803 sqm. The facility has the capacity to manufacture 60,000 kms of Multi Core cables and 78,000 kms of Single Core Wires per annum. The company has invested approximately 165 million INR (2.1 Million Euro) for this project. With this new expansion Lapp India aims at tapping into the increased demand for quality control cables in the market. This expansion with state-of-the-art safety and environmental features will enhance the facility layout, ensure better flow for effective lean management and also help generating more space for the new machines

and establish leadership in the control cable market. In 2012, Lapp India set-up its second Indian manufacturing facility in Pilukhedi, Bhopal which has strengthened the base in the Single Core wires segment as well as catered efficiently the growing demands in the building sector. Lapp India is currently commissioning a new leading edge multi core line in Bhopal which can produce 36,000 kms of Multi Core cables resulting in overall capacity increase of 60% in Multicore cables in addition to the existing 216,000 kms capacity in Single Core wires. Expanding operations in India has been a key focus for Lapp Group owing to the promising growth opportunities of the country.. Lapp India is the second largest company of the Lapp Group; the milestone set here in terms of business and the success garnered in retaining the position in the market has proved to be an example for other Lapp companies located worldwide. The industry friendly measures announced in the Union Budget 2014 along with a strong emphasis on the need to revive manufacturing industry came as a new lease of life to the Indian electrical equipment industry. PM Narendra Modi's strong emphasis on turning India into a manufacturing hub implementing the 'Make in India' campaign has been a great initiative to attract foreign investment in India. Lapp India expects a significant rise in demand for quality cables with the increased thrust by the new government to develop infrastructure with creation of new roads, ports, airports, rails.

Rays Power Infra bags single solar EPC project of Essel Infra

Rays power Infra Pvt. Ltd., one of the biggest Solar EPC companies in India,, announced bagging of the largest single Solar EPC project of Essel Group. Rays Power Infra has been chosen for Complete Design, Engineering, Procurement and Construction of the project. The company is all set to execute these projects in Punjab and UP in record time of three months. The total capacity of these plants in Punjab and UP is 31.5 MW and 35 MW respectively and is expected to generate power by April 2015. Together, they will power more than 30,000 households and is equivalent to planting 1.3 lac trees every year.The total investment outlay on these projects is 700 crores. The power that will be generated will be sold to respective state governments at INR 8.5 per unit. The projects are in line with PM Narendra Modi's aggressive plans to ramp up India's solar power generating capacity to 1,00,000 MW by 2022 from roughly 3,000 MW currently. Commenting on this, Ketan Mehta, Director, Rays Power Infra Pvt. Ltd. Said, "We are proud to be associated with Essel Group in execution of these land mark solar power projects in India. We have ramped up our in-house capabilities to execute up to one Mega watt every day in order to meet the timelines. We will erect 3 lac solar panels on an area of 400 acres in about 100 days. These are exciting times for the sector and we hope to make India a power surplus country by 2022." "We have a long standing association with Rays Power Infra, which is one of the leading Solar EPC companies in the country today. We are confident that the team at Rays Power Infra would be able to deliver quality service within the stipulated time-frame. The project is in line with the new government's mission to ramp up solar power capacity five-fold to 100 GW by 2022," said Harshad Joshi, Head Procurement, Essel Infra.

POWERGRID registers April-September, 2014 net profit at Rs 2,338 crore

Power Grid Corporation of India Limited (POWERGRID), a 'Navratna' Company and the 'Central Transmission Utility (CTU)' of the country, has posted a net profit of Rs 2,338 crore for the first half of FY 2014-15 (April-September, 2014), an increase of 3% against Rs 2,280crore reported during the corresponding half year ended September 30, 2013. Total Income (turnover) for first half (April -September, 2014), rose to Rs 8,384 crore, up by 8% from Rs 7,738 crore in the corresponding year-ago period. POWERGRID had registered a net profit of Rs 4,497 crore on a turnover of Rs 15,721 crore in the FY 2013-14 and had paid a total dividend of 25.8%. At present, POWERGRID is operating about 111,740 ckt. kms. of transmission lines along with 186 Sub-stations and transformation capacity of about 218,000 MVA.

EMI TRANSMISSION LIMITED

CONNECTING POWER TO THE PEOPLE

POWER TRANSMISSION LINE FITTINGS

Manufacturers & Exporters of Hardwares & Accessories

for Extra High Voltage Transmission Lines up to 1200 kV

ISO 9001: 2008 COMPANY

- Insulator Hardware Fittings
- Conductor Accessories
- Ground Wire Accessories
- Clamps & Connectors

Corporate Office
101, Centre Point, 1st Floor,
Dr. Ambedkar Road,
Parel, Mumbai - 400 012,
Maharashtra, India
Tel : +91 22 2418 8810
Fax : +91 22 2418 8886
E-mail : emi@bom5.vsnl.net.in

Factory
Plot No. 157 / 2 / 1, Village
Brahmanwada, Tal. Sinnar,
Dist. Nashik - 422 103,
Maharashtra, India
Tel : 191 253 280 2504 / 2219 / 2250
Fax : +91 253 280 2687
Web : www.emi.co.in

WACKER develops thermally conductive adhesive for electronics applications

The Munich-based WACKER chemicals group has developed a thermally conductive adhesive for electronics applications. The new silicone rubber with the trade name SEMICOSIL® 975 TC is characterized by high thermal conductivity and good flow and processing properties. Even light pressure is enough to form an ultrathin adhesive layer between the contact surfaces. This ensures not only good bonding, but also optimum heat dissipation by the heat sink. SEMICOSIL 975 TC is an ideal interface material for forming thermal and mechanical connections in power electronics components or packages. SEMICOSIL 975 TC is an addition-curing silicone rubber that cures at temperatures above 90°C. The one-component adhesive is electrically insulating and adheres to many of the substrates used in electronics. One of its key characteristics is its high thermal conductivity of 4.3 W/mK (as per ASTM D5470). It also offers good

processability, despite the fact that it has a high filler content which is necessary to achieve the requested thermal properties. SEMICOSIL 975 TC is a very pasty, non-sag material that becomes progressively free-flowing with increased shearing. This property can be precisely adjusted to processing requirements. As a result, SEMICOSIL 975 TC – unlike comparable previous products – can easily be fed at low pressure and applied as a bead. It can be processed directly from the pail or from a regular cartridge. The rheological flow properties of SEMICOSIL 975 TC also offer advantages for further processing. When a part is pressed in place, the applied silicone forms an ultrathin adhesive layer which conforms to the substrate surface without the need to apply high force. The minimum layer thickness (bond line thickness) that can be applied is between 90 and 100 micrometers, with its usability depending on the design of the interface. SEMICOSIL 975 TC is thus ideal for use as a thermal interface material in power electronics. The purpose of such materials is to fix semiconductor devices – such as insulated-gate bipolar transistors (IGBT) – in engine control units and LED components on heat sinks in order to dissipate the heat. Without heat dissipation, the service life of electronic devices would be considerably impaired. As a thermally conductive adhesive, SEMICOSIL 975 TC reliably couples the electronic component to the heat sink. The adhesive layer compensates for microscopic irregularities in the surfaces, thereby maximizing the contact area.

SunEdison & Anna University join to develop Solar Technology industry

SunEdison, Inc. a leading global solar technology manufacturer and provider of solar energy services, signed a memorandum of understanding with the 200 year old engineering institution Anna University. SunEdison and Anna University plan to further the solar photovoltaic (PV) industry in the State of Tamil Nadu through building a curriculum that develops technical expertise and new technologies in the solar energy field. "SunEdison takes immense pride in joining forces with India's premiere engineering institution, Anna University to develop talent and innovations in the field of solar photovoltaic technology," said Pashupathy Gopalan, President of SunEdison's Asia Pacific division, "this industry-institution partnership will foster collaborative research activities in solar photovoltaic technology and sustainable solar irrigation solutions." The Vice-Chancellor of Anna University, Chennai, Dr. M. Rajaram, explained that the memorandum outlines plans for Anna University and SunEdison to develop certification and training programs for the university's Institute of Energy Studies. Additionally, Anna University and SunEdison will cooperate in the future to conduct research on sustainable, affordable and reliable energy systems and processes. SunEdison is a global leader in transforming how energy is generated, distributed and owned.

Alstom to increase power transmission stability in Saudi Arabia

Alstom Grid has been awarded a €47 million turnkey contract by Saudi Electricity Company (SEC) to supply Flexible AC Transmission Systems in Saudi Arabia. Alstom will supply a Static VAr Compensator (SVC) to the Jeddah substation,

situated on the coast of the Red Sea in Western Saudi Arabia, and two capacitor banks to the Wadi Jaleel substation in Mecca, located about 200 km from the city of Jeddah. The SVC (-150 / + 300 MVAr at 110 kV) will substantially improve and increase power transmission stability and quality across Saudi Arabia's power transmission network. The project is expected to be completed by 2016. The Static VAr Compensator system, which will utilise the new Alstom patented SVC configuration (with blocking reactor) to improve technical performance, will provide fast voltage support at substations, stabilising power supply and strengthening the transmission grid; power will be fed to major areas across Jeddah and Mecca. 1 Bulk Supply plant consisting of voltage level 380 kV, 110 kV, 13.8 kV at same place Patrick Pias, According to Senior Vice President Grid Power Electronics and Automation at Alstom Grid, Saudi Arabia is one of the most significant and demanding market areas for power compensation systems.

QUALITY THROUGH ACCURACY

Switchgear

Our factory
produces contactors, MCCBs, ACBs, changeovers and of course, accuracy.

Presenting a state-of-the-art Havells Industrial Products Plant at Sahibabad, where accuracy in manufacturing ensures world class quality.




We, at **Havells** have set up one of the most advanced production facilities in the world to produce switchgear and controlgear. We brought the world's best machines, highest grade raw materials and the best production practices together, in order to 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 CNC 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 / 011-4166 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, enquiry.IP@havells.com, **www.havells.com** | Join us on Facebook at **www.facebook.com/havells** and share your ways to save the planet!

CG announces new Smart Grid Facility in France

Avantha Group Company CG will be opening a new facility in Grenoble to produce, test and calibrate over 2 million ZIV smart meters per year. CG has chosen Grenoble to open this new facility, so as to cover the demand for Linky meters in France, and thereby provide local support to ERDF. The company recently won an order from ERDF to participate in the supply of three million Linky smart meters, in the first phase of its 35 million unit rollout plan for 2021. This facility will house the Centre of Excellence for G3-PLC technology, be fully equipped to manufacture ZIV single and three phase Linky G1 and G3 meters, and will be ready to produce the first units by the second quarter of 2015. CG will also contribute to the creation of sustainable local employment, as this centre will make available, around 200 direct and indirect jobs in the area, once full production capacity is reached. The Grenoble manufacturing facility, together with the existing facilities in Spain, will enable CG to face new challenges from large-scale deployments in France, UK, Spain, the Netherlands and other countries in the area with greater agility. Europe's smart metering market is expected to grow sharply and hit 180 million units by 2020. The overall Distribution Automation market in Europe is expected to reach over 800 M$ by 2018. CG's ZIV smart meters are gaining a strategic position in the Smart Grid European market where it has achieved key wins in 2014.

Module Output key to reducing cost of Solar Systems

Solar PV manufacturers are switching over to higher efficiency monocrystalline cells to increase power output, but for solar energy systems, overall module output is key. "In order to balance costs and the power efficiency of solar systems, it is important to reduce CTM (cell to module) loss as well as place greater emphasis on module assembly technology and materials application," said Jason Huang, research manager at EnergyTrend, a division of the Taiwan-based market intelligence firm TrendForce. A number of solar PV firms are working to bolster module output. Other solar firms are using larger silicon wafers and more efficient cells, such as Komax Solar. Its HIP module has a larger area than a typical module and uses shading reduction to enhance output. Module power output of 60 pcs of polycrystalline cells is primarily 250W and 255W. But there is a new 300W module available that offers many advantages. Winaico's 300W module adopts the M1 mono-si wafer, which is larger than the traditional P-type mono wafer, and uses PERC technology. Along with special conductive pads with LCR (Light Capturing Ribbon), this technology can effectively reduce efficiency losses in the assembly process.

Accolade for energy management to ISO

NürnbergMesse is the first exhibition company to be certified to ISO 50001. For Dr. Roland Fleck and Peter Ottmann, CEOs of NürnbergMesse, this is another major step on the way to the company achieving its set energy targets. "We have set ourselves a really high standard with the energy campaign. After DGNB certification and the introduction of electromobility, the fact that our energy management system has now been certified to ISO 50001 as the first ever for an exhibition company is a veritable accolade!" The basis for the certification is an in-house energy management system previously implemented by a separate "energy team". A large package of measures has been assembled that covers items like systematically recording and processing energy data, optimizing lighting systems, reducing heat consumption or significantly increasing the share of renewable energy. The extensive auditing process calls for demanding logistic, technical and legal quality standards if the coveted ISO certification is to be achieved at the end. "When Peter Ottmann and I started as CEOs of NürnbergMesse in 2011, we also wanted to make our own mark in the energy segment. I am pleased to say that we can now harvest the first fruit from the seeds sown three years ago," says Dr. Roland Fleck. For CEO colleague Peter Ottmann, the company's energy campaign fits in 1:1 with the orientation of the NürnbergMesse programme: "We have a powerful portfolio of energy events and NürnbergMesse is also traditionally strong in sustainability matters. Our energy campaign is an excellent link between the two segments – and today's ISO certification is the icing on the cake." "Energy efficiency is a key element of the energy of the future. It enables companies to cut their energy consumption and optimize costs and improve competitiveness too," says Josef Hasler, Chief Executive Officer of N-ERGIE Aktiengesellschaft. "The specialists from NürnbergMesse and our subsidiary N-ERGIE Effizienz GmbH have cooperated outstandingly as a team on the path to certification." The purpose of this international standard is to define quality standards for the energy segment that result in energy efficiency, cost savings and a reduction of greenhouse gas emissions. Certification to ISO 50001 applies the requirements of the international standard to organizations and companies. NürnbergMesse was confirmed as the very first exhibition company to meet the high requirements in the audit conducted by TÜV Rheinland in October 2014. NürnbergMesse is one of the 15 largest exhibition companies in the world and among the Top Ten in Europe.

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?

HAVELLS

*Condition apply.

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!

Caterpillar Energy gets order for biogas gensets of waste water treatment plant

India's capital of Delhi, home to more than 11 million people, is India's second-largest city and has the highest population growth rate in the country. In a place where so many people are living, clean water is among the most vital basic necessities for the population. With the new Nilothi waste water treatment plant, the city is seeking to establish one of the most advanced plants in India. Up to 91 million liters of waste water are expected to be filtered in the Nilothi plant per day. Via its MWM India Distributor company, Green Power International Pvt Ltd, Caterpillar Energy Solutions from Mannheim received the order involving three biogas gensets for decentralized electric power in the plant. The three units of the MWM TCG 2020 V16 series can provide for autonomous approx. 4,5 MW of electrical Power and also thermal energy in the form of hot water for digester heating. The engines are run on biogas derived from digestion of the sewage sludge. In addition to

delivery of the three highly-efficient biogas gensets with overall efficiency rates of up to 85%, the order also includes a 10-year contract until 2024 for the maintenance and servicing of the engines. Thanks to the new Nilothi plant, the capital's waste water treatment capacity will be increased significantly. The independently-produced energy from biogas not only improves the environmental balance of the plant, energy costs are reduced as well. The treated sewage sludge will be available to regional farmers as compost, while the treated waste water will be fed into the Yamuna River without any burden on the environment. The MWM TCG 2020 V16 gensets are known for low operational costs as well as high reliability, and they boast the best electrical efficiency in their power class. By opting for MWM gas engines, the operators are relying on the best energy efficiency and high performance "made in Germany". Including this plant the total installed output of MWM gas gensets in India will grow up to approx. 395 MWe. 11% of it as biogas power. All of this output was installed and is maintained by company Green Power International Pvt Ltd. "This is the third sewage gas plant we install in India using MWM gensets, a segment which is growing considerably and where we see a high potential in the next years, as environmental friendly infrastructure investments continue growing" says Sanjeev Puri, MD of Green Power International Pvt. Ltd. "This project is surely a milestone, but at the same time only a next step" he continued. New Nilothi waste water plant is expected to filter up to 91 million liters of waste water per day.

French companies expertise in nuclear energy at 'Indian Nuclear Energy 2014'

UBIFRANCE India in partnership with G.I.I.N and AIFEN (French Nuclear Industry Associations) organised 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 represented 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 served 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. Considering the importance of nuclear energy in the growth of any country, the French Pavilion at the INE 2014 gathered 11 renowned companies offering high added-value solutions.

GAIL signs MoU with State Oil company of Republic of Azerbaijan

GAIL (India) Limited announced the signing of a Memorandum of Understanding (MoU) with State Oil Company of Republic of Azerbaijan (SOCAR). Under the MoU, GAIL and SOCAR intend to jointly pursue LNG opportunities through capacity booking, LNG procurement and promotion of LNG projects globally. Both companies shall also cooperate in optimization of LNG marketing, sourcing and shipping requirements. In addition, GAIL and SOCAR will pursue business opportunities in upstream assets across the world and joint investment in petrochemical projects. Speaking on the occasion, B C Tripathi, Chairman and Managing Director, GAIL said, "We are happy to enter into this strategic relationship with SOCAR. Skills and strengths of both the parties would be leveraged to explore business opportunities jointly in natural gas and LNG business including new business developments across the gas value chain."

"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

Power Generation
from Waste Heat Gas in Iron & Steel Plants

Iron and Steel industry is one of the most energy intensive industries in the world. The main units of the industry where iron making takes place are coke oven battery, sinter plant and blast furnace. These units consume much of electricity.

Mayadhar Swain

Statistics show that consumption of electricity in blast furnace, sinter plant and coke oven battery are 39%, 12.5% and 11.9% respectively of the total electricity consumption. During their process, these three units generate lot of heat which was conventionally wasted. Now technology has been developed to generate power from this waste heat. In this paper, these methods have been described.

Basic Theory of Heat Exchange

The heat from waste gas is used to produce steam in the waste heat recovery boiler. The basic formula for heat exchange is:

$$Q = V \cdot \rho \cdot C_p \cdot \Delta T$$

Where, Q = Heat content in Kcal

V = Gas flow in m^3 / hr

ρ = density of gas in kg / m^3

C_p = Specific heat capacity of gas in Kcal / kg^0C

ΔT = Temperature difference of gas at inlet and outlet of boiler in ^0C

Power from generator is calculated from this heat content taking into consideration of efficiency of boiler, turbine and generator.

Waste Heat Recovery from Blast furnace

In blast furnace, liquid raw iron is produced by smelting pellets or sinter in a reducing environment. The end products are usually

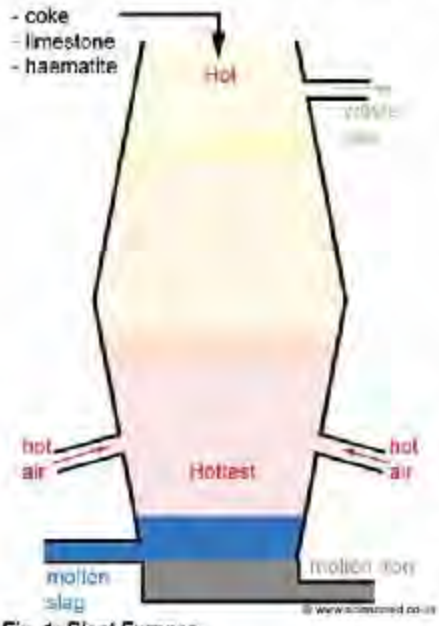


Fig. 1: Blast Furnace

A top pressure recovery turbine is installed to reduce the pressure & simultaneously also to generate power from this gas

Fig. 2: Top Pressure Recovery Turbine

molten metal, slag and blast furnace gas (BFG). BFG has high pressure and temperature. The pressure of BFG is between 1.6 and 2.5 bar. During the scrubbing process the gas cools, and its pressure drops about 0.3 bar. Dust catcher and Dry or wet scrubbing are used to remove fine particulates from the flue gas as it leaves the blast furnace. That needs to be reduced to 0.1 bar for the gas pipe network. In conventional practice, the energy of BFG was wasted by pressure reduction at septum valve before it is supplied to other processes at lower pressure.

Now, a top pressure recovery turbine (TRT) is installed to reduce the pressure and simultaneously also to generate power from this gas. It is a gas turbine. The TRT generates energy by exploiting a known property of all gases i.e. they expand as their pressure drops. The exhaust gas from the turbine is at low lower pressure and temperature and is supplied to other processes. There is no influence on the operation of the blast furnace and the flue gas is not consumed. As BFG is very combustible, it is normally utilized in other parts of the plant to generate heat for other processes. With the TRT system installed, the flue gas effectively generates energy twice – once in the turbine and again when it is burnt for its usual purpose.

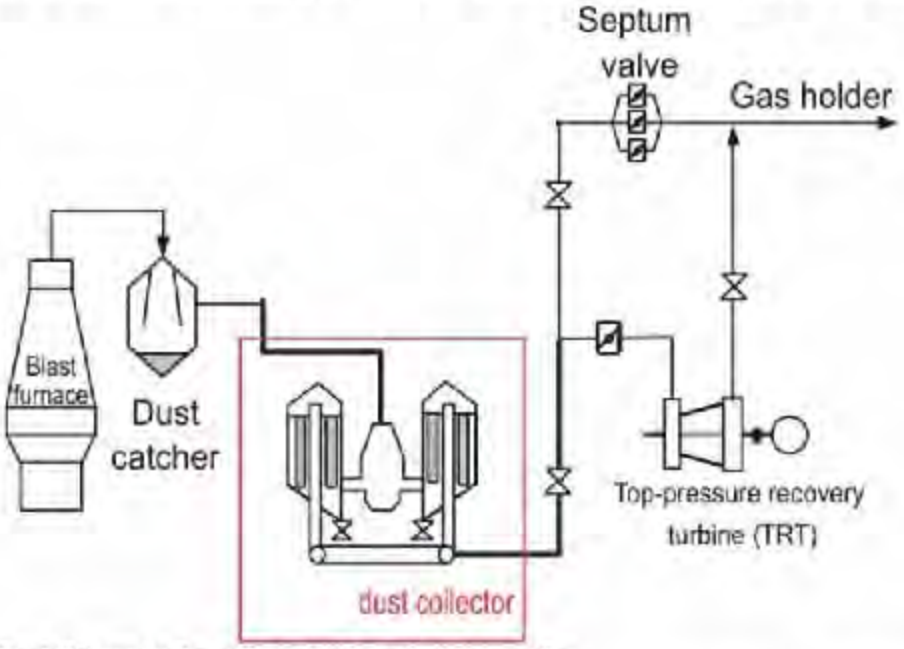


Fig. 3: Scheme for Power Generation from Blast Furnace Gas

A TRT unit could recover about 20% of electricity consumed by blast furnace including air blowers. The experts point out

that the blast furnace of capacity greater than 1000m³ should be equipped with TRT. The scheme for power generation is given in Fig. 3.

Typical TRT station data is given below.

- Blast furnace capacity: 3600 m³
- BFG flow through turbine: 550000 Nm³/hr
- BFG pressure at turbine inlet: 2.2 kg/cm²
- BFG temperature at turbine inlet: 50°C
- Rating of Generator: 14 MW.

Waste Heat Recovery from Coke Dry Cooling Plant

Coke is used in the blast furnace as a fuel and as the reducing agent. Therefore, coke manufacturing is performed as part of an integrated steel works activities. These are produced in coke oven battery by heating coking coal in an oxidation-free atmosphere. 1000kg of coal usually gelds 750-800 kg of coke. Red hot coke (temperature around 1000°C-1100°C) is brought from the battery to the CDCP where it is cooled by the inert gas. The inert gas is a mixture consists of mainly nitrogen (70%-75%) along with small amounts of CO_2 (0%-15%), CO (8%-10%) and H_2 (2%-3%). It cools the coke below 200°C.

The hot inert gas, after picking heat from the hot coke, comes out from the top at around 800°C. The gas is passed through a dust collector to remove the dusts and then it is conveyed to the waste heat recovery boiler (WHRB), where the sensible heat of the inert gas is used to produce steam at about 40kg/cm² pressure and about 440°C temperature.

The inert gas at the WHRB exit is pressurized by a blower and its composition is corrected by addition of nitrogen gas and then the cooling gas is injected at the bottom of the CDCP chamber. The temperature of the cooling gas is around 170°C.

In modern three-chamber CDCP, a nominal steam capacity of 50 tons per hour is achieved per chamber. Normally, two chambers are in full operation and one is in 'hot standby' status. CDCP is normally operated in such a way that two chambers and the boiler work at full capacity. A schematic of the system is shown in Fig. 4.

The parameters of CDCP-4 of Visakhapatnam steel plant are given below:

- Temp. of hot coke: 950°C-1000°C
- Temperature of cooled coke: 200°C-250°C
- Coke production: 700,000 tons
- No. of boilers: 4
- No. of coke dry cooling chambers: 4
- Steam generation rate: 25 t/hr/boiler
- Steam pressure: 40 ata
- Steam temperature: 440°C
- Turbine inlet steam pressure: 32 ata
- Turbine inlet steam temperature: 420°C
- Exhaust steam pressure: 0.12 ata
- Steam flow to turbine: 80 tph
- Rated power: 14 MW.

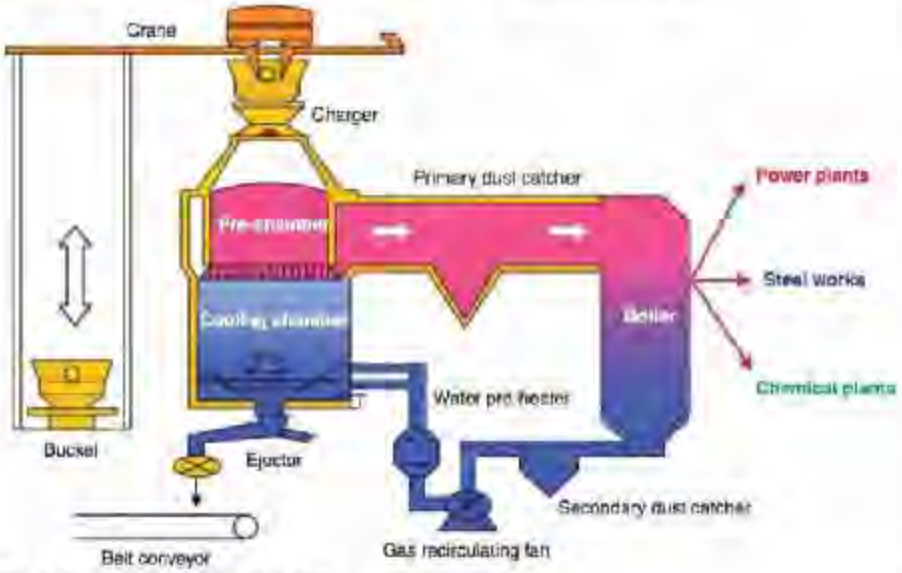


Fig. 4: Schematic diagram of CDCP

Waste Heat Recovery from Sinter Plant

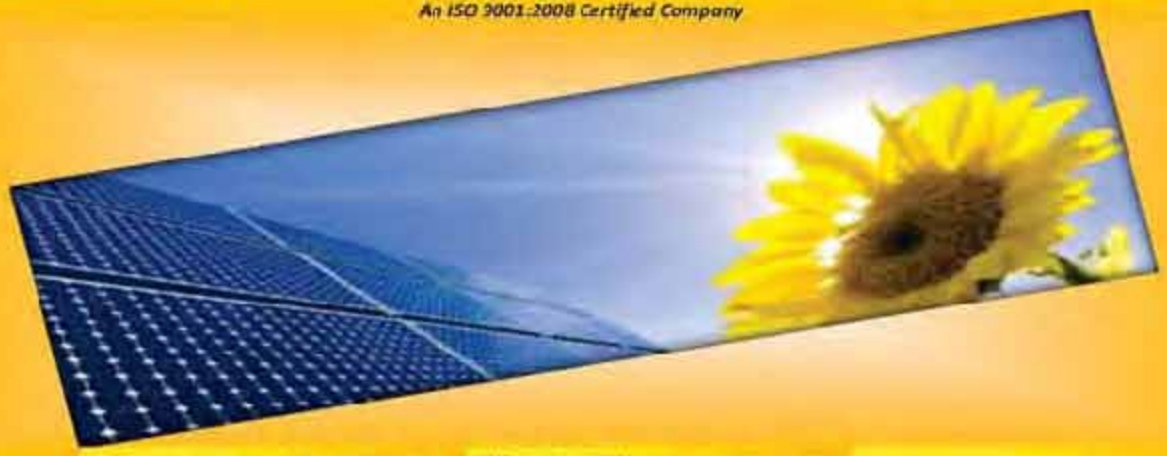
Sinter making is a method of fusing iron ore fines into larger particles suitable for charging into the blast furnace. In other words, it is the agglomeration of fine mineral particles into a porous mass by incipient fusion caused by heat produced by combustion within the mass itself. Iron ore fines, coke breeze, limestone and dolomite along with recycled metallurgical wastes are converted into agglomerated mass at the Sinter Plant. Dry dusts from blast furnace gas clearing plant and iron oxide scales from the rolling mills generally become part of the raw feed to the sinter plant. This technology was developed in the early twentieth century and since it has become the widely accepted and preferred blast furnace burden material. It is the predominant source of iron in many blast furnace processes. Agglomeration of the fines is necessary to enable the passage of hot gases during the subsequent blast furnace operation. Presently more the 70% of hot metal in the world is produced through the sinter. In India, approximately 50% of hot metal is produced using sinter feed in blast furnace.

Sintering involves the heating of iron ore fine with flux and coke fines or coal (1300 to 1480°C) to produce a semi-melting mass that solidifies into porous pieces of sinter with the size and strength characteristics required for feeding into the blast furnace. The sinters formed in the sintering machine are generally transported to blast furnace by conveyors. Before feeding to blast furnace these are cooled by fans. The temperature is reduced on an average from 75°C to 80°C. The hot air is escaped to the atmosphere. Now, technology has been developed to produce electricity from this waste heat. For this, wind boxes are covered with hood and hot gas is made to pass by ducts to a waste heat recovery boiler. At the boiler steam (generally at low pressure around 20 Kg/cm²) is produced which is passed through a steam turbine to generate electricity. A typical scheme is given in Fig. 5.

Hot air from the boiler is either escaped to the atmosphere or re-circulated through circulating fan. In India, the first such power plant has been established at Visakhapatnam Steel Plant (USP) of Rashtriya Ispat Nigam

VAIBHAVGROUP

An ISO 9001:2008 Certified Company



WE TAME "" SUN"" FOR ENERGY

Vaibhav Structurals, one of the companies of Vaibhav Group, an ISO 9001:2008 Certified Company, is a Turnkey EPC Solution Provider based in Kota, Rajasthan. The group was established in 1996 and has a rich experience in execution of conventional Sub-stations, Transmission Lines and Water Management, Renewable Energy (Solar and Hydro Power Plant) of small and medium sizes.

The company, one of the most competitive companies in Rajasthan, a state abundantly rich in solar energy generation, offers a complete range of Engineering, Contracting, Commissioning and Operations and Management Services in the Solar Power Sector. The company has a strong, experienced and competent in-house team of senior executives drawn from the state utility services and regular business asscciates dedicated to the development of Solar Parks and Solar Power Projects.

We offer the following Key Services to our esteemed clients.

- ***Engineering***
  - Layout of the land and Single Line Diagrams
  - Services pertaining to the detailed engineering and design of the plant along with Total Bill of Materials
  - Preparation of Civil, Electrical and General Layout Drawings
- ***Contracting***
  - Complete range of Civil and Electrical Works.
  - Material and manpower services and management
  - Transmission Lines and Power Evacuation Infrastructures development.
- ***Commissioning***
  - Invertory and Supply Chain Management
  - Identification and Management of Contractors
  - Management of resources along with their proper allocations
  - Dedicated Supervision and Quality Control Services for on time completion of quality work
- ***Operations and Management***
  - Services pertaining to Scheduled and Preventive mainterance of all equipments
  - Services pertaining to generation of various reports and their analysis for proper monitoring
  - Co-ordination with State Transmission Utilities for Billing and Grid Availability

Contact:
Vaibhav Structurals
1 – Ra - 11 Vigyan Nagar, Kota, Rajasthan, India
Tel: +91 744-2427809/10
Email: info@vaibhavgroup.com / Web: www.vaibhavgroup.com

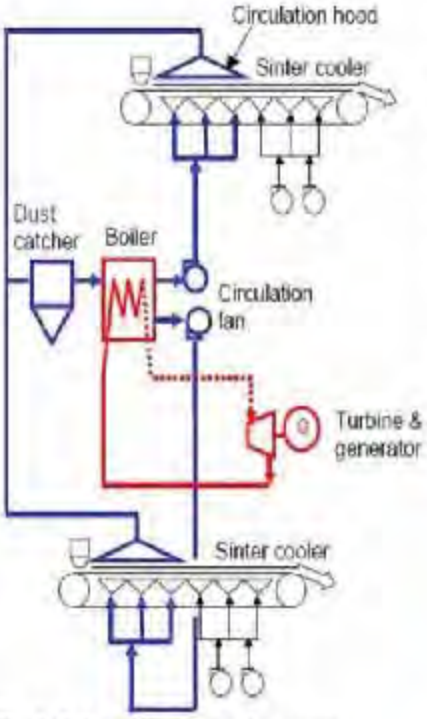


Fig. 5: Schematic diagram for power generation from waste heat of sinter cooler

Limited (RINL) under an MOU between Govt. of India and Govt. of Japan. The steel major JP Steel Plantec (SPCO) of Japan is providing the technology and MECON, Ranchi is the consultant for the project. Salient features of the project are-

- Sinter production: 5.256 MT / Sinter / Year
- Inlet gas temperature to boiler: 390°C
- Outlet gas temperature from the boiler: 190°C
- Steam pressure at superheater: 21 bar
- Steam temperature at superheater: 329°C
- Turbine inlet steam pressure: 18.5 bar
- Turbine inlet steam temperature: 324°C
- Steam flow to turbine: 110 tph
- Exhaust steam pressure: 0.1 ata
- Rating of generator: 20.6 MW.

Conclusion

Production of electricity from waste heat gas does not require any fuel and hence cost of energy is less. Further, waste heat is not allowed to enter to the atmosphere, which reduces thermal pollution. No fuel is burned and so no CO_2 or other greenhouse gasses are generated. Also benefit of Clean Development Mechanism (CDM) can be availed for such type of projects.

Mayadhar Swain

is BSc Engg. (Electrical) from University College of Engineering, Burla, Odisha and ME in Water Resources Development from IIT Roorkee. After serving in NTPC, Talcher Thermal Power Station and Odisha Hydro Power Corporation in different capacities, he is now working as Deputy General Manager in MECON Limited, Ranchi. At present he is working in consultancy jobs for Thermal and Hydro Power Plants. He has published 50 papers in different journals including Electrical India. Throughout service period, he has worked in Design, Erection, Commissioning, Operation and Maintenance of Thermal and Hydro Power Plants.

Profile

Panasonic

VISION

IT'S NOT JUST A SWITCH. IT'S A SWITCH WITH A VISION.

Presenting Vision switches, a perfect combination of sleek design, great comfort & redefined safety.

Design

6mm-thin plate and scratch resistant textured surface with matte finish. Available in elegant white & silver black.

Safety

India's 1st switch with screwless termination for safe & fast wiring. Fire Retardant Urea back-piece.

Comfort

A design for silent switch operation and soft touch. Cover plates available with inbuilt locator.

When idea meets technology and desire meets design; the outcome is often revolutionary. Take the Vision switches for instance. With futuristic ideas and cutting-edge technology, Vision switches are designed with just one aim in mind; to amaze.

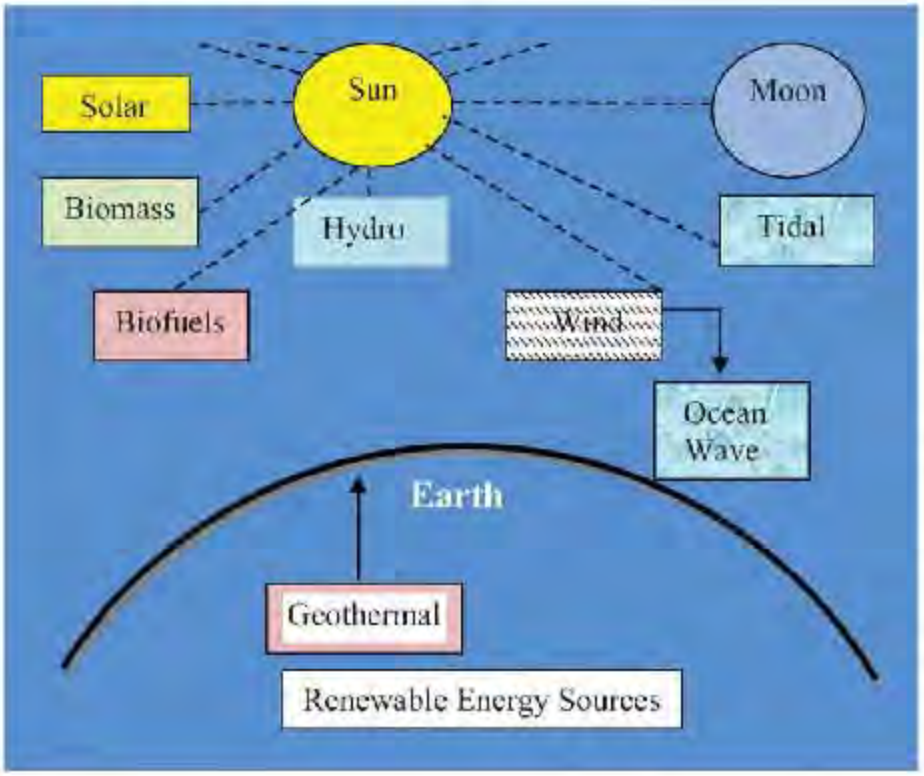
SCARETOW/AEPL/14/11/21

For more information please visit www.anchor-world.com or contact
EAST - Sharad Lakhani - 9324659046 | WEST - Anand Joshi - 9309037175 / Riyazali Nalband - 7498614917, 9371657600 | NORTH - Udham Singh - 9419139745 / Sharad Dave - 7428259882 | SOUTH - Vishal Patel - 9322656234 / Mahesh C R - 9916043746

RoHS Compliant

product design award 2019

Non-technical losses and Availability-based Tariff in Indian Power Sector



To deal with the non-technical losses, the Accelerated Power Development Reforms Programme (APDRP) of the Indian Power Sector under the 12th Five Year Plan (2012-2017); the Availability Based Tariff (ABT) and the concept of smart grid are explained in this article. Development of Solar and Wind Power is also described.

C S Indulkar

The Aggregate Technical and Commercial (AT&C) losses in India are quite high However, a few private and government owned DISCOS have demonstrated significant improvement in their performance through digital technology adoption. In the 11th Five-Year Plan there was a comprehensible focus to use technology to address these issues. Integrated grid operation which required the normalisation of frequency across all five Regions in the country has been achieved through proactive load management by beneficiaries and despatch discipline by generators. The front image, Fig. 1, and Fig 2 show respectively, the various renewable energy sources, a thermal power plant connected to the grid, and a nuclear reactor.

To deal with non-technical losses in distribution networks, India undertook a 6-level intervention strategy under the accelerated power development and reforms programme (APDRP). The objective was to:

- make the power distribution sector financially viable
- increase accountability and revenue realization with increased metering
- convert unmetered connections to metered connections, and
- improve billing and collection efficiency.

The 6-level intervention strategy was as follows:

- **National Level Interventions:** The issues were related to policy matters, legislation, uniform standards & energy conservation accounting standards.
- **State Level Interventions:** Formation of State Electricity Regulatory Commissions (SERC), giving out regular tariff orders, providing legislative support to local

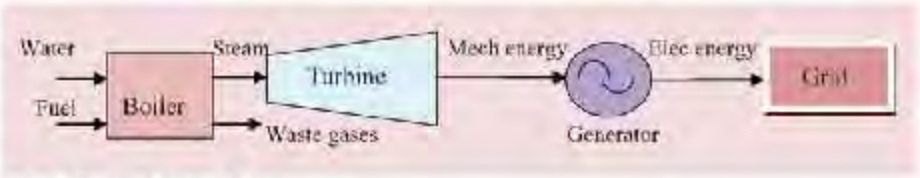


Fig. 1: Thermal power plant

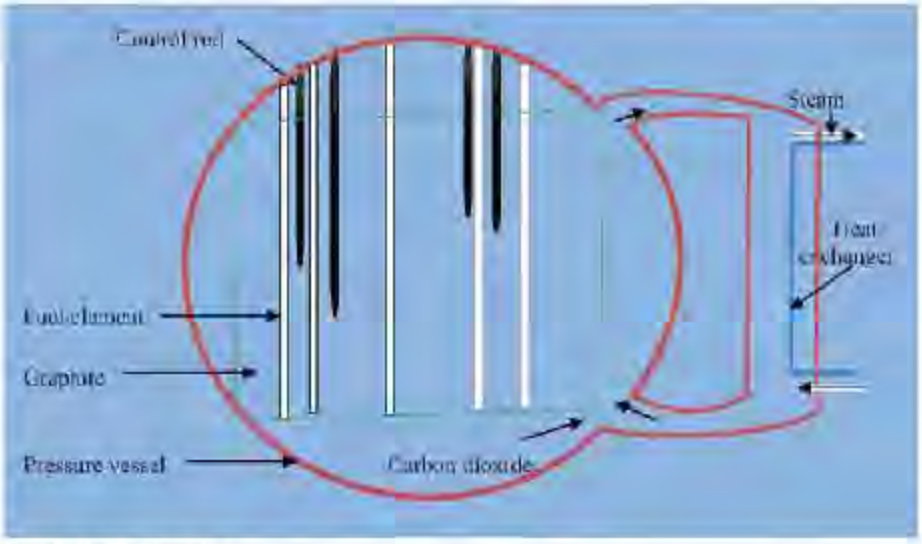


Fig. 2: Nuclear reactor

bodies in management of distribution business, and removal of tariff anomalies.

- **State-owned Utility Level Interventions:** The issues were restructuring, accountability, commercial accounting, integrated management information system, grid discipline, and time-of-day (TOD) metering.
- **Distribution Circle Level Interventions:** The issues at this level were related to:
  (a) Increasing the Income: Increasing the billing, reduction of pilferage, more remunerative pricing of energy, and optimum utilization of physical assets.
  (b) Reducing the Expenditure: Sourcing of least-cost energy and reducing energy-handling cost.
- **Feeder Level Intervention:** 11 kV Feeders are the basic source of income to an electricity utility. The issues confronting it are metering and billing, bill collection, abnormal voltage, and ensuring the overall quality of power supply.
- **Consumer Level Intervention:** The issues at this level are related to mandatory metering, compliance of billing, consumer satisfaction, and energy conservation.

Availability Based Tariff (ABT)

Five Regional grids exist in India. Some linkages between Regions are also in place. The five Regional grids work at vastly varying frequency levels. Integrated grid operations require the normalization of frequency across all five Regions. The alternative is to insulate each Regional Grid by Back to Back HVDC links. Normalization of frequency requires proactive load management by beneficiaries and dispatch discipline by generators. The Availability Based Tariff (ABT) provides financial incentives to promote grid discipline. Chronic surpluses in some areas and shortages in others can result in sustained functioning of these grids at frequencies which are far beyond the normal band (49.5 to 50.3 Hz). Continued functioning at non-standard frequency results in long-term damages to both generation and end-use equipment leading to higher costs which are borne by the customers in the long term. The ABT induces corrections in the prevailing frequency to bring it within the permissible band by introducing grid discipline. The two-part tariff of the ABT assures that each beneficiary is liable for payment of the fixed cost associated with its share of allocated generation capacity.

The ABT order emphasizes prompt payment of dues. ABT has three parts:

- A fixed charge (FC) payable every month by each beneficiary to the generator for making capacity available for use. The FC varies with the share of a beneficiary in a generator's capacity.
- An energy charge per kWh of energy supplied as per a pre-committed schedule of supply drawn on a daily basis.
- A charge for Unscheduled Interchange (UI charge) for the supply and consumption of energy in variation from the pre-committed daily schedule. This charge varies inversely with the system frequency prevailing at the time of supply and consumption.

ABT is different from normal procedures to determine generation tariff:

- The ABT procedure does not consider most of the cost drivers like ROE, operational costs, depreciation rate, composition of the Rate Base, capital structure etc.
- ABT is a function not only of the behaviour of a generator but also of the behaviour of the beneficiary. Disciplined beneficiaries and generators stand to gain. Undisciplined beneficiaries and generators stand to lose.

Important features of ABT design

- Electricity tariffs should be two-part comprising of a fixed charge and a separate energy charge.
- Mis-declaration of availability entails severe penalties.
- Incentives are to be earned by generators only where there is a genuine demand for additional energy generation.
- It permits market pricing for the trading of surplus energy by beneficiaries and generators.

Fuel Supply Issues

Planning new Gas-based capacity during 12th Plan (2007-2012) and availability of Gas from domestic sources/RLNG are also to be implemented. Main fuel supply issues are as follows:

- Ways & means to expedite development of coal blocks allocated to CPSUs/ IPPs/ States etc.
- During the 12th plan no Gas-based capacity has been considered due to non-availability of Gas. However, for Green Power Development, there is a need to develop some Gas-based capacity to reduce CO_2 emissions.

Latest Technology Options

The development of the power sector has to be in accordance with low-carbon strategy growth. Hence, for efficient technologies for coal-based power

generation, impetus to increased adoption of super critical technology is necessary. Since a number of Thermal power projects are facing difficulties in getting required allocation of water round the year, technologies for minimizing consumption of water need to be adopted, including Air cooled condensers and Hybrid Systems for cooling.

Electricity trading with neighbouring countries

Despite low electricity per capita consumption in India, the country is going to achieve surplus electricity generation during the 12th plan (2012 - 2017) period provided its coal production and transport infrastructure is developed adequately. Surplus electricity can be exported to the neighbouring countries in return for natural gas supplies from Pakistan, Bangladesh and Myanmar.

Restructured APDRP (R-APDRP) under 11th Five-Year Plan (2007-2012)

The focus of the Restructured APDRP was on actual, demonstrable performance in terms of loss reduction. State Power Utilities were expected to reduce AT&C (Aggregate Technical and Commercial) losses to 15%. The Utilities were also to achieve the following target of AT&C loss reduction for the Utility as a whole:

- Utilities having AT&C loss above 30%: Reduction by 3% per year.
- Utilities having AT&C loss below 30%: Reduction by 1.5% per year.

12th Plan (2012-17) Capacity addition

It was proposed to adopt a Low Carbon growth strategy for development of Power Sector during 12th Plan and beyond, as detailed below -

- Capacity addition from conventional fuel based plants complemented by Renewable Energy based plants to the maximum extent possible.
- In case of Conventional Energy Sources, highest priority to be accorded for setting up of Hydro and Nuclear Power plants. Gas based plants to be accorded higher priority as compared to Coal and Lignite plants to the extent feasible depending on availability of adequate Gas at reasonable price.
- Emphasis on efficiency improvement of existing stations, and retirement of old Thermal Power Projects and less efficient plants and small size generating units.
- Other measures to be adopted include reduction in T&D losses, and coal quality improvement.
- Efforts to be made to increase Unit Size of Coal based Plants.
- Impetus on increase in adoption of super-critical technology.

Conventional Energy Sources	MW
Hydro	20,000
Nuclear	3,400
Coal	74,000
Lignite	2,500
Total (say)	1,00,000

Table 1: Generation mix for the 12th Plan from conventional energy sources

A capacity addition of about 1,00,000 MW from conventional power projects is required during the 12th Plan to meet the All-India demand projections. The most probabilistic generation mix for the 12th Plan from conventional energy sources is shown in Table 1.

Gas-based capacity has not been firmed up for the 12th Plan due to uncertainty about availability of Gas for Power Sector. However, efforts are required to be made to plan some Gas based capacity either on indigenous Gas or RLNG. This will help in reducing CO_2 emissions per kWh of energy generation.

Since we continue to depend heavily on coal-fired generation, clean coal technologies need to be encouraged to minimize CO_2 emissions. Super critical technology will have to be developed in a big way in the 12th & 13th Plan to develop mass indigenous production of Super-Critical Boilers and Turbine-Generators to meet the demand of equipments and to reduce the cost of production.

Transmission system during 12th plan (2012-2017)

Generation capacity addition of about 1, 00,000 MW is envisaged during 12th Plan consisting of Thermal- 76,500 MW, Hydro-20,000 MW and Nuclear- 3,400 MW. The Thermal Generating Stations / UMPPs on imported coal would be near coastal areas and Thermal stations with indigenous coal would be located near Coal pit-heads in Orissa, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, West Bengal etc. The Hydro Projects would be mainly in Arunachal Pradesh, Sikkim, Uttarakhand, H.P. and J&K, apart from cross-border imports from Bhutan.

As per the Tariff Policy, future procurement of power is going to be increasingly through Tariff based competitive bidding. As a result of liberalization, a large number of Thermal and Hydro generating stations are coming up in Private sector and would participate in bidding.

CEA has evolved a broad contour of Transmission plan for the 12th plan period based on which the individual Transmission schemes would be finalized depending upon the materialization of various Generating projects in real time. Perspective Transmission plan has been evolved for Hydro projects proposed to come up in various river basins in NER, Sikkim, Bhutan, HP, Uttarakhand as well as for large Thermal stations proposed to come up in Chhattisgarh, Orissa, Jharkhand, MP, Andhra Pradesh, Tamil Naidu etc. Transmission planning for Nuclear power projects is to be taken up at appropriate time.

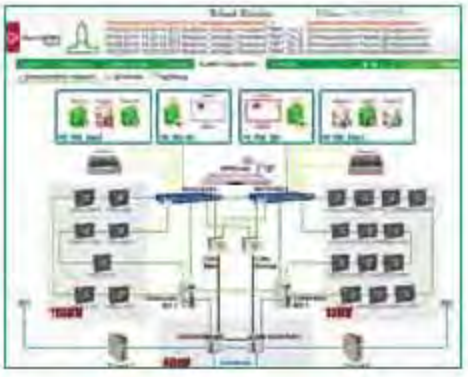
Inter-Regional Transmission System, Substations and Transmission line Requirements during 12th Plan

Some Transmission schemes of early 12th Plan have already been firmed up and remaining Transmission requirements would be arrived at after some clear picture of the projects which are likely to materialize is available. It is anticipated that inter-regional Transmission capacity would be of the order of 57,000 MW by 2015 and about 75,000 MW by end of the 12th Plan. The anticipated requirement of Sub-stations & Transmission lines in the 12th Plan corresponding to 1,00,000 MW capacity additions would be as shown in Table 2.

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
- Multitariffs: 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 53361Y

MeterApp - complete metering catalogue download on Apple iOS and Android >>

Schneider Electric

+-800 kV HVDC Bipole Projects, 6000 MW	2 to 3 Nos.
HVDC Bipole +/- 800 kV length	4,000 to 6,000 ckm.
765 kV/400 kV Substations	40 to 50 Nos
765/400 kV substations capacity	1,20,000 MVA
765 kV Transmission Line lengths	25,000 to 30,000 ckm.
400/220, 400/132 kV Substations capacity	80,000 MVA
400 kV Transmission Lines length	50,000 ckm
220/132,66, 33, 11 kV substations capacity	85,000 MVA
220 kV Transmission Line length	40,000 ckm

Table 2: Anticipated requirement of Sub-stations and Transmission lines in 2012-2017

Electricity distribution during 12th plan

During the 12th Plan it is expected that AT&C loss level of DISCOMs would be much less as compared to the level in 2011 and the economic viability of DISCOMs shall improve.

Intervention of IT & Distribution Automation

Indian Distribution sector is poised for radical transformation in the next decade in the following areas of activities:

- Adoption of Automatic Meter Reading System for HT consumers and High Value Consumers.
- Implementation of SCADA system.
- Consumer Indexing.
- IT based Energy Accounting and Fault Management System.
- Establishment of Modern Consumer Service Centres.
- Mapping of Entire Distribution Network through Geographical Information System for enabling Quicker Fault Location and Speedy Resolution of Faults.
- Use of Energy Efficient Distribution Transformers.

Enhancement of Manufacturing Capacity for Main Plant Equipment Commensurate with Planned Capacity Addition

In view of large capacity addition required during the coming few plans, there is an urgent need for more indigenous manufacturers of Thermal Main Plant, particularly with capability to manufacture super-critical technology based units in the country to meet the enhanced requirement. There is a need to bring down the cost of super-critical Boilers and Turbine-Generators which is possible with indigenization of manufacturing facilities. There is also a need for the manufacturers of Main Plant equipment to play an active role in the development of ancillaries units and vendors commensurate with their own manufacturing capacity and to ensure that deliveries are sequential and in time.

Development of Renewable Energy Sources Including Solar Technology

The renewable energy sources are shown in the front image of the paper. According to the Electricity Act - 2003 and the Tariff Policy, the appropriate Electricity Regulatory Commissions have to specify the minimum percentage of energy to be procured by Distribution licensees from Renewable sources. Unused Land at Thermal power plants could be utilized for solar installations to give a boost to solar power. Co-generation through indigenous Gas with combined cooling also needs to be encouraged for efficient use of Gas.

Development of Solar Power

A National Solar Mission has been launched under the National Action Plan for Climate Change (NAPCC) to significantly increase the share of solar energy in the total energy mix while recognizing the need to expand the scope of other renewable and non-fossil options such as Nuclear, Wind Energy and Biomass. The ingress of solar technology for energy use has been slow due to a number of factors, predominantly the high capital cost and large land requirement for solar installations. A further constraint has been its availability only during the day for energy use, thereby requiring additional high cost for storage systems.

Plans for Development of Solar Power

The 12th five-year Plan (2012-2017) will involve scale up of various validated applications (primarily grid-tied applications), continued rollout of rural electrification business models and commercial deployment of Solar Thermal Plants. This phase is also likely to see pilot deployment of next generation technologies like dish-sterling, concentrated solar power, thin film applications and storage systems. Solar lights and solar water heaters are to be promoted in the market mode without capital subsidies. The Target of the 12th plan is to achieve an installed capacity of about 6000 - 7000 MW by 2017.

Development of Wind Power

India's electricity sector is amongst the world's most active players in renewable energy utilization, especially wind energy. http://en.wikipedia.org/wiki/Electricity_sector_in_India - cite_note-13 Table 3

Grid Connected Power	
Technology	**Installed Capacity (In Mw)**
Wind	18420.40
Small hydro	3496.14
Biomass	1246.60
Bagasse (the pulp or dry refuse left after the juice has been extracted from sugar cane. Use: fuel, cattle feed, making paper) Cogeneration	2239.63
Waste-to-Energy (WtE)	96.08
Solar	1176.25
Off-Grid, Captive Power	
Technology	**Installed Capacity (In Mw)**
Waste to Energy-Urban	113.60
Biomass non-bagasse cogen	426.04
Biomass Gasifiers – Rural	16.696
Biomass Gasifiers – Industrial	138.90
SPV Systems (>1 kW)	106.33

Table 3: Renewal energy installed capacity in India (as of 31 December 2012)

MIDEL®

Synthetic Ester Natural Ester

We can help you make the right choice for your project

MIDEL 7131 synthetic ester and MIDEL eN natural ester are the world's leading ester-based transformer dielectric fluids.

MIDEL 7131 synthetic ester offers increased fire safety, environmental protection and could extend asset life by at least 5 times longer than mineral oil. It is suitable for breathing and sealed systems and very cold climates.

MIDEL eN natural ester is made from 100% renewable vegetable oil and offers similar protection to MIDEL 7131 but it is only suitable for sealed systems and temperate locations.

t: +91 (0)11 6517 7114 -16 **f:** +91 (0)11 4104 7850
e: midelsales@mimaterials.com **www.midel.com**

M&I MATERIALS APREZON METROSIL MIDEL WOLFMET

12th Plan (2012 – 2017)	13th Plan (2017 – 2022)	14th Plan (2022 – 2027)
Completion of ongoing smart grid pilots	Nationwide AMI roll out for customers >10KW load	Development of 50 Smart cities
Augmentation of data centers and communication network for AMI Roll out	Mandatory Roof Top Solar for large establishments	Mandatory roof top solar
Distribution Automation & GIS/ Automated distribution substations	Total Renewable integration of 60GW;	Total Renewable integration of 130 GW;
Development of indigenous smart meter	EV charging infrastructure	10% EV penetration
Dynamic tariffs, Sustainability initiatives –promoting distributed generation	Development of micro grids in 10000 villages	Nationwide AMI roll out for customers
	Distribution Automation	Continuous Research & Development;
		Choice of electricity supplier
		Stable 24X7 power supply

Table 4: Key targets and highlights in the smart grid roadmap for India

shows the renewable energy installed capacity (grid-connected and off-grid) in India (as of 31 December 2012).

India plans to add about 30 GW of installed electricity generation capacity, based on renewal energy technologies by 2017. http://en.wikipedia.org/wiki/Electricity_sector_in_India - cite_note-pib1211-61 India has the fifth largest installed wind power capacity in the world. In 2010, wind power accounted for 6% of India's total installed power capacity, and 1.6% of the country's power output.

Future scenario

A capacity addition requirement of about 1,02,000 MW (compared to 1,00,000 MW for the 12th Plan) has been assessed for the 13th Plan (2017-2022). In addition 14,500 MW Hydro power is also expected to be imported from Neighbouring countries.

Development of solar power

13th Plan (2017-2022) will be focused on very rapid scale-up across all validated applications with minimal or no subsidies, as achievement of Tariff parity with conventional grid power is expected. 13th Plan is also likely to see commercialization of storage technologies and indigenously developed PV/Solar thermal technologies. Target of 13th Plan will be to rapidly increase the installed capacity to 20 GW by 2020.

Smart Grid

Concerns about climate change, energy security and dwindling fossil fuel reserves are stimulating ever increasing interest in the generation, distribution and management of renewable energy. While a lot of attention has been devoted to generation technologies, an equally important challenge is the integration of energy extracted from renewable resources into existing electricity distribution and transmission systems. Renewable energy resources like wind and solar energy are often spatially distributed and inherently variable, necessitating the use of computing techniques to predict levels of supply and demand, coordinate electricity distribution, and manage the operations of energy storage facilities.

A key element of the solution to this problem is the concept of the "Smart Grid". A smart grid is broadly perceived as an evolved form of the traditional electricity grid where advanced techniques such as Information and Communication Technology (ICT) are used extensively to detect, predict and intelligently respond to events that may affect the supply of electricity. A smart grid generates a large amount of data from its various components, examples of which include renewable energy generators and smart meters; the potential value of this data is huge but exploiting this value is almost impossible without the use of proper analytics. With the application of systematic analytics on the smart grid's data, its goal of better economy, efficiency, reliability, and security can be achieved. Therefore, data analytics is an essential tool that can help to imbue the smart grid with "smartness".

The key targets and highlights in the smart grid roadmap for India are shown in Table 4 herein.

Profile

C S Indulkar

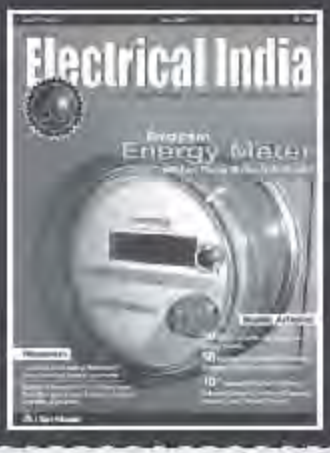
Retired as Professor and Head of Electrical Engineering from IIT Delhi, he has authored a number of technical papers in various refereed journals, including IEEE Transactions and IET Proceedings. He has also been a reviewer of papers for the above journals and for several other International Journals of Electrical Engineering.

Since 1961

Electrical India

India's oldest magazine on power and electrical products industry

SUBSCRIPTION FORM



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

The Subscription In-charge
Electrical India
Chary Publications Pvt. Ltd.
201, Prema aya, Next to Cafe Coffee Day,
Opp. Telecom Factory, Deonar, Mumbai - 400 088.
E-mail: sub@charypublications.in

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

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. ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Date of Birth ☐☐ ☐☐ ☐☐☐☐ (D D M M Y Y Y Y) Card Expiry Date: ☐☐ ☐☐☐☐ (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 \ December 2014

Contents of the magazine :

- Latest News from entire Electrical Industry
- Interviews and Opinions of eminent people from the industry
- Articles related to Power Generation, Transmission, Distribution Systems and Electrical Product Industry written by eminent people from the industry
- Events
- Book Review
- Product Avenues / New Products

... and much more.

Major Industries covered :

- Power Generation Equipments
- Transmission and Distribution
- Rectifiers
- Switchgears & Controls
- Transformers, Transformer Oil and Lubricants
- Financial Institutions Financing Power Plants
- Automation, Electronics and Instrumentation
- Test and Measuring Equipments
- Energy Management
- Power Generation
- Motors, Starters and Pumps
- Lighting and Lighting Components
- Safety Devices
- Nuclear Energy
- Capacitors and Condensers
- HVAC
- Circuit Breakers & Relays
- Cables, Contractors and Accessories
- UPS

... and related accessories

Reach :

Industries Like :

- Manufacturers of Electrical / Electronic Goods
- Power Generation
- Fertilizers
- Chemicals and Petrochemicals
- Oil and Gas
- Paper and Pulp
- Independent Power Producers
- Military / Defence
- Textile
- Drugs and Pharmaceuticals
- Sugar
- Construction
- Packaging Industry
- Renewable Energy
- SEB's
- Govt. and Semi-Govt. Bodies
- Institutions

Professionals like :

- Engineers
- Policy Makers
- Corporate Management
- Distributors, Traders, Contractors and Suppliers
- Wholesalers, Agents, Retailers
- Advisors / Consultants
- Purchase Managers
- Diplomats
- Entrepreneurs
- Investors
- Technical Management
- Education / Research Training
- Architects

Several Others.....

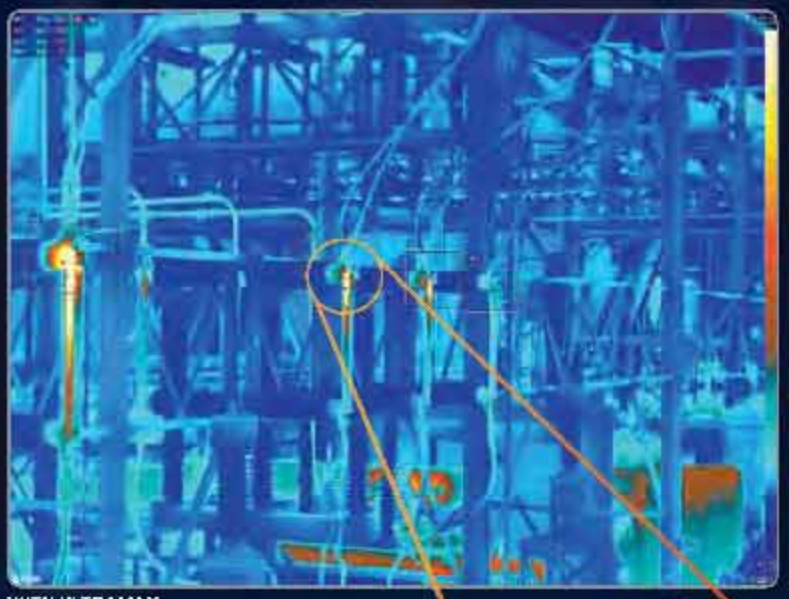
FLIR | The World's Sixth Sense™

THERE'S NOT ENOUGH SPACE HERE FOR THE FULL ULTRAMAX™ STORY.

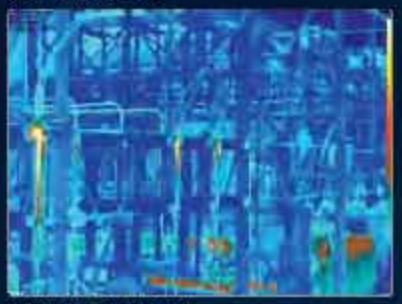
ONLY ROOM FOR A FEW GOOD EXAMPLES.

There's much more you'll want to know about how well FLIR's stunning new UltraMax resolution works and the difference it could mean to your inspections.

GET THE COMPLETE LOWDOWN AT WWW.FLIR.COM/ULTRAMAXELECTRICAL



WITH ULTRAMAX



WITHOUT ULTRAMAX

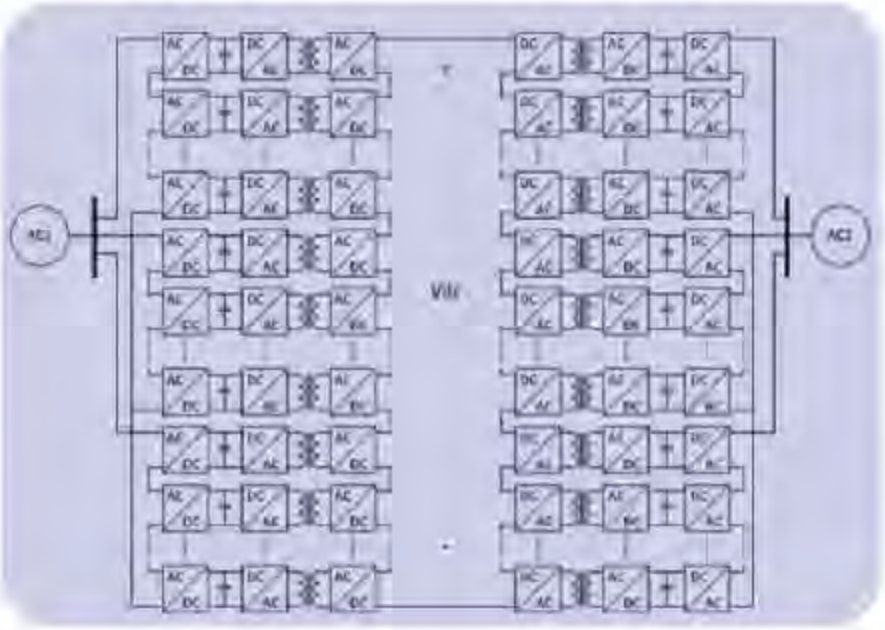
ULTRAMAX AT 6X ZOOM

EXCLUSIVELY ON ALL THE LATEST T-SERIES CAMERAS

For further information, please contact us at:

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

FLIR
The World's Sixth Sense™



Recent advances in Multilevel Converter and its Applications

Multilevel converters enable power conversion technology for high voltage high power applications in today's power industries. Multilevel converters possess greater advantage but there has not been an industrial boom in the industrial applications in the past decade. Currently there is a tough competition between the classical two level converters and the multilevel converters. Nowadays researchers all over the world are spending greater efforts trying to improve its performance such as control simplification and voltage balancing.

Dr Sarat Kumar Sahoo, S Prabhakar Karthikeyan & W Razia Sultana

This article provides a brief overview on multilevel converters with its pros and cons and provides an insight to its control techniques along with its applications.

In recent years, multilevel inverters have gained much attention in the application areas of medium voltage and high power owing to their various advantages. Comparing Voltage source inverter topologies at the same power ratings, multilevel inverters also have the advantages that the harmonic components of line-to-line voltages fed to load are reduced owing to its switching frequencies. The elementary concept of a multilevel inverter to achieve higher power is to use a series of power semiconductor switches with several lower voltage DC sources to perform the power conversion by synthesizing a staircase voltage waveform. Capacitors, batteries, and renewable energy voltage sources can be used as the multiple DC voltage sources.

Multilevel converters are considered today as a very attractive solution for medium-voltage high-power applications. Today multilevel inverters are extensively used in high-power applications with medium voltage levels. The field applications include use in laminators, mills, conveyors, pumps, fans, blowers, compressors, and so on. The back-to-back configuration of this inverter for regenerative applications has also been a major plus used, for example, in regenerative conveyors for the mining industry or grid interfacing of renewable energy sources like wind power.

Advantages of Multilevel Converters

Multilevel converters have the following advantages.

- They are suitable for medium to high power applications.
- They are an ideal interface between a utility and renewable energy sources such as photovoltaic or fuel cells.
- Their efficiency is very high (>98%) because of the minimum switching frequency.
- They can improve the power quality and dynamic stability for utility systems.
- Switching stress and EMI are low.
- Because of their modular and simple structure, they can be stacked up to an almost unlimited number of levels.

The use of a multilevel converter to control the frequency, voltage output (including phase angle), and real and reactive power flow at a DC/AC interface provides significant opportunities in the control of distributed power systems.

Classification of Multilevel Converter

By increasing the number of levels in the inverter the output voltages have more steps generating a staircase waveform, which has a reduced harmonic distortion. However, a high number of levels increases the control complexity and introduces voltage imbalance problems. Three different topologies have been proposed for multilevel inverters-

- Cascaded (H-Bridge),
- Diode-clamped (neutral-clamped) and
- Capacitor-clamped (flying capacitors).

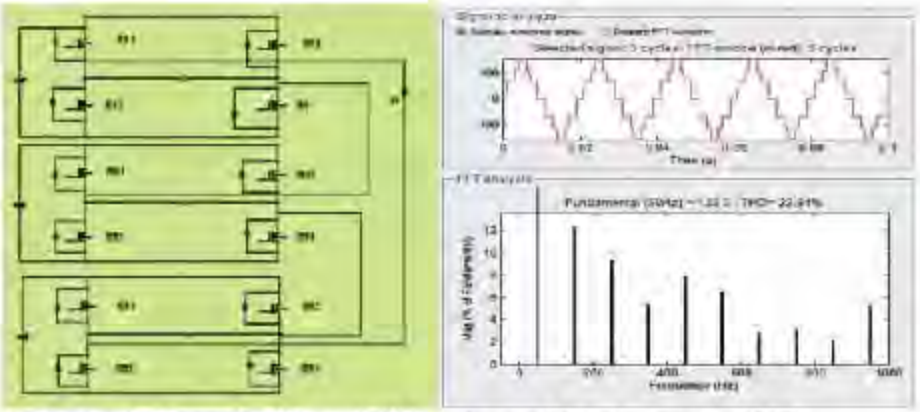


Fig. 2: Circuit of seven level Cascade MLI topology and Output voltage and THD

Fig. 1: Converter Classification

Cascaded MLI

The inverter consist of familiar H-bridge (sometimes referred to as full-bridge) cells in a cascade connection. Since each cell can provide three voltage levels (zero, positive DC voltage, and negative DC voltage), the cells are themselves multilevel inverters. As this topology consist of series power conversion cells, the voltage and power level may be easily scaled.

The cascaded H-bridge has been successfully commercialized for very high-power and power-quality demanding applications up to a range of 31 MVA, due to its series expansion capability. This topology has also been reported for active filter and reactive power compensation applications, electric and hybrid vehicles, photovoltaic power conversion, uninterruptible power supplies, and magnetic resonance imaging.

Diode clamped MLI

The diode-clamped inverter provides multiple voltage levels through connection of the phases to a series bank of capacitors. The key components that distinguish this circuit from a conventional two-level inverter are the clamping diodes. These diodes clamp the switch voltage to half the level of the DC-bus voltage.

Main features of this converter are low device count, good harmonic profile, and they are more suitable for medium voltage operation. The practical use of four- or five-level inverters has not been reported. Main reasons for this are difficulties in DC capacitor voltage control, large number of clamping diodes.

Flying capacitor converters

Another fundamental multilevel topology, the flying capacitor, involves series connection of capacitor clamped switching cells. This topology has several unique and attractive features when compared to the diode-clamped inverter. One feature is that added clamping diodes are not needed. Furthermore, the flying capacitor inverter has switching redundancy within the phase which can be used to balance the flying capacitors so that only one DC source is needed. They have found particular applications for high bandwidth-high switching frequency applications such as medium-voltage traction drives.

The advantage of these converters are low harmonic distortion and modular design. The drawbacks are large number of DC capacitors, complex pre-charging circuits and difficulties in DC capacitor voltage balancing control.

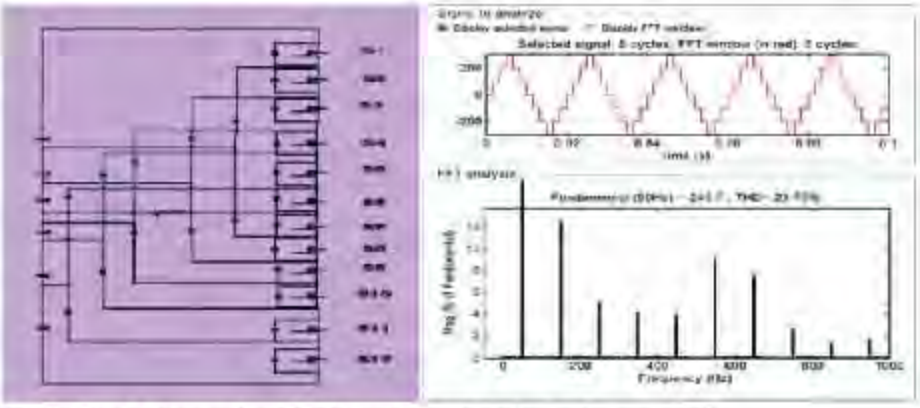


Fig. 3: Circuit of seven level DCMI topology and Output voltage and THD

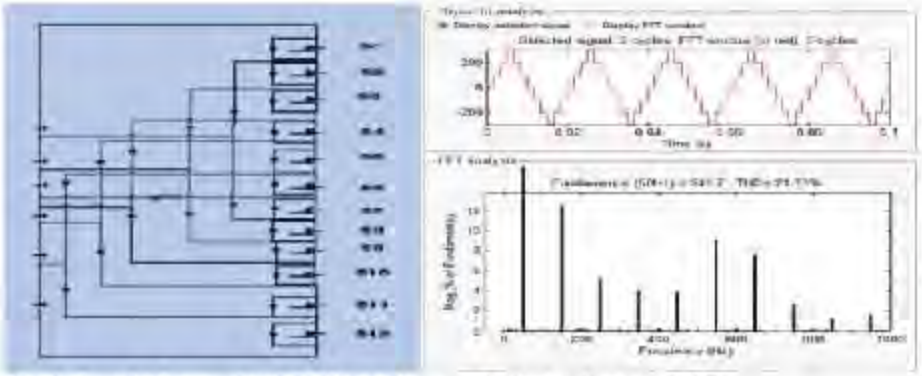


Fig. 4: Circuit of seven level FCMI topology and Output voltage and THD

Modulation Techniques used for Multilevel Converter

The following Figure shows the classification of Control techniques in multilevel inverter.

Fig. 5: Control Techniques of Multilevel inverter

Status of Multilevel converter

Inverter Configuration	Switching Device	Power Range	Manufacturer
Two-Level Voltage Source Inverter	IGBT	1.4MVA – 2MVA	Alstom (VDM6000)
Three Level Neutral Point Clamped Inverter	GCT	0.3MVA – 5MVA 3MVA – 27MVA	ABB (ACS1000) (ACS6000)
	GCT	3MVA – 20MVA	General Electric (Innovation Series MV-SP)
	IGBT	0.6MVA – 2MVA	Siemens (SIMOVERT MV)
	IGBT	0.3MVA – 0.4MVA	General Electric–Toshiba (Dura-Bilt5 MV)
Multilevel Cascaded H Bridge Inverter	IGBT	0.3MVA – 22MVA	ASI Robicon (Perfect Harmony)
	IGBT	0.5MVA – 6MVA	Toshiba (TOSVERT-MV)
	IGBT	0.46MVA – 7.5MVA	General Electric (Innovation MV-GP Type H)
NPC/H-bridge Inverter	IGBT	0.4MVA – 4.8MVA	Toshiba (TOSVERT 300 MV)
Flying-Capacitor Inverter	IGBT	0.3MVA – 8MVA	Alstom (VDM6000 Symphony)

Applications of MLI

- **Renewable Energy Systems:** In response to the growing demand for medium and high power application Multilevel converter have been attracting growing consideration in Variable speed Wind Turbine and Photo Voltaic systems recently. Multilevel converter enable the output voltage to be increased without increasing the voltage rating of the switches, so that they offer direct connection of renewable energy systems to grid without using expensive and bulky transformers. Cascaded multilevel converters are usually used in PV applications, due to its modularity and structure. The Diode clamped converter is widely used in the transformer less grid connected systems due to its minimum number of active components and shared DC Link voltage.

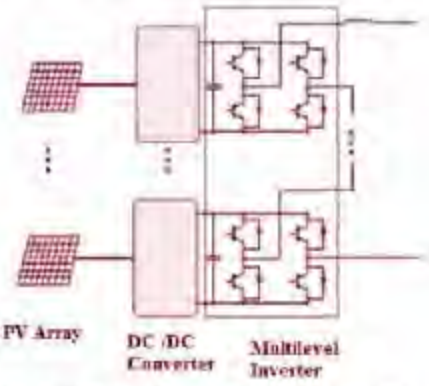


Fig. 6: Multilevel converters in PV systems

- **Application to power grid:** With long-distance AC power transmission and load growth, active control of reactive power (var) is indispensable to stabilize the power systems and to maintain the supply voltage. Static var generators (SVCs) using voltage-source inverters have been widely accepted as the next generation reactive power controllers of power systems to replace the conventional var compensators, such as thyristor switched capacitors (TSC's) and thyristor controlled reactors (TCR's). By using the Y-connected cascade multilevel inverter, the major problems associated with the transformers in the conventional multipulse inverter have been overcome. The Y-connected cascade multilevel inverter is suited for STATCOM or static VAR generation, power line conditioning, series compensation, and so on. The renewable energy resources are intermittent in nature under the influence of climatic fluctuations, which may produce a bad effect on grid voltage and frequency stabilization. Battery energy storage systems are essential to promote grid connections of massive renewable energy resources, thus making battery energy storage systems crucial in the smart grid. Modern battery energy storage systems are based on the combination of a

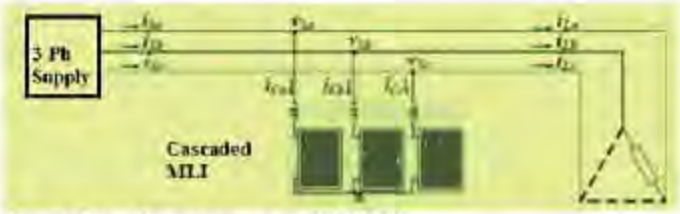


Fig. 7: Cascaded converter as STATCOM

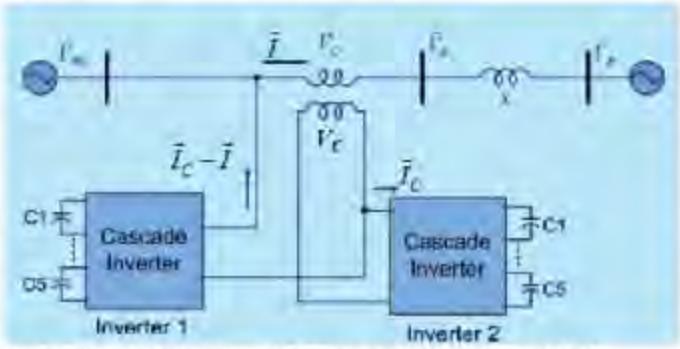


Fig. 8: Face to face connected cascaded converter for UPFC

multilevel converter such as diode clamped and cascade H-bridge topologies with an advanced battery technology, such as lithium (Li)-ion, sodium sulphur (NaS), nickel metal hydride (NiMH), and so on. ABB and Saft have recently developed a 600-kW, 200-kWh battery energy storage system based on a neutral-point clamped (NPC) converter and a Li ion battery for the 11 kV distribution system of EDF Energy Networks, U.K. The multilevel cascade converter may be one of the most suitable multilevel topologies for the modern battery energy storage systems.

- **Large Electric Drives:** The voltage and current ratings of IGBTs have today reached 6600 V, 600 A. Although high voltage ratings are available, it is inadvisable to retain the 2-level configuration for higher voltage motors. This is because high voltage pulses will be applied to the motor causing dv/dt stresses. The 3-Level inverter, on the other hand, allows the motor voltage to go up in steps. This reduces the dv/dt stress for the same DC bus voltage Vdc . Also, using IGBTs of a given voltage rating, higher voltage motors can be catered to. Today, medium voltage induction motors rated at the MW level are generally controlled using three level inverters.

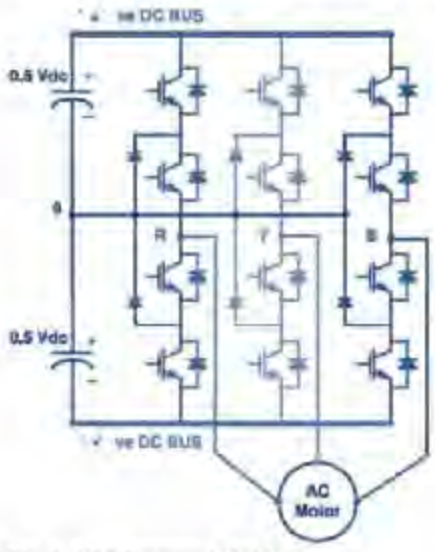


Fig. 9: NPC inverter fed drives

In theory, inverters of higher number of levels such as 5 and 7 level can also be constructed. However, the circuit assembly becomes very complex and issues such as keeping all the sections of the DC bus voltage equal have to be addressed. Therefore the 3-Level inverter remains the most popular choice at higher power levels and medium voltages.

Conclusions

Multilevel inverters have developed from being an evolving technology to a well-established and smart solution for many applications. Control strategies design and modulation methods development have been carried out extensively in recent years. Currently, multilevel converter topologies such as NPC, FC, and CHB own very attractive features in terms of power quality, power range, modularity, and other characteristics by which high-quality output signals are achieved and therefore being specially designed for medium- and high-power applications. The current trends & challenges faced by energy applications, such as renewable power conversion and distributed generation systems, together with the recent developments in multilevel converter technology, are opening a new vast area of applications where this technology has a lot to offer.

Profile

Dr Sarat Kumar Sahoo

working as a Associate Professor in the School of Electrical Engineering, VIT University is MTech in Computer Application to Industrial Drives from VTU, Belgaun, Karnataka and PhD in Power Electronics and Drives from JNTU, Hyderabad. He has published/ presented 37 technical research papers. He is author of a text book. He is a member of various national & International Technical bodies like IEEE, IET, ISTE, International Science Congress Association, Kolkata and International Innovative Scientific & Research Organization. His research interests are on varied electrical subjects.

Dr S Prabhakar Karthikeyan

BE (EEE) from University of Madras, Tamil Nadu, ME (Electrical Power Engineering) from the M.S. University of Baroda, Vadodara, and PhD from VIT University, Vellore, Tamil Nadu is in the School of Electrical Engineering of the same University. His area of interest includes Deregulation and restructured Power systems, issues in distribution systems.

W Razia Sultana

BE from Madras University, Chennai, is MTech from SRM University, Kattangulathur, Tamil Nadu. Her research interests include Power Electronics, Mathematical modeling of electrical systems, Modern electrical drives India. She is currently working as Assistant Professor and pursuing PhD in the school of Electrical Engineering, VIT University, Vellore, Tamil Nadu.

Product Range for Nuclear\Power

MICROTEX
Standby-Power

4 OPzS 200
5 OPzS 250
6 OPzS 300
6 OPzS 420
7 OPzS 490
6 OPzS 600
8 OPzS 800
10 OPzS 1000
12 OPzS 1500
16 OPzS 2000
20 OPzS 2500
24 OPzS 3000

TBS/OPzS
TUBULAR

CALCIUM-Plus™

Patent applied for - terminal bush design to eliminate cell cover bulging and crack due to plate growth which is a normal failure mode.

Standby-Power **OPzS** SERIES Stationary Cells in transparent SAN containers

For Nuclear Power plants, Electric Power Generation facilities, Petrochemical plants, Switchgear and control applications, Wind, hydro & solar photovoltaic, Large UPS Systems, Railway signaling, Telecommunications.

Manufactured by
Mysore Thermo Electric (P) Ltd
36 & 82, 4th Main, 3rd Phase, Peenya Industrial Area, Bangalore - 560 058, India
Tel : + 91 80 2839 2380, Fax : +91 80 2839 7243
info@microtex.in www.microtex.in facebook/microtex.energy

Interview

"AREVA constructed First 125 MWe solar thermal power plant in Rajasthan"

Erwan Hinault, Chairman & Managing Director
AREVA India Pvt Ltd

AREVA, focused on providing India with solutions for low-carbon power generation, both nuclear and renewable is ranked first in the global nuclear power industry, AREVA is engaged with the Nuclear Power Corporation of India Ltd to build two first EPRs out of proposed six at Jaitapur. AREVA plays a key role in meeting India's energy needs by renewable sources with a clear focus on solar and bio-energy. In an exclusive interview to **Electrical India, Erwan Hinault** states, we are very optimistic that this government will address the issues that will expedite the progress of nuclear technology in general.

➢ Could you share your vast experiences till becoming President of AREVA India?

I hold a master's degree in Engineering from the French National Institute of Applied Sciences (I.N.S.A.) obtained in 1991. And, I have been working for AREVA for the last 20 years including 14 years in Japan and 5 years in France, holding various positions within the group. Before taking my position in India, I was Executive Vice President of AREVA Japan during 4 years. From 2006-2009 I worked for the back-end business in France as Deputy Director of the Recycling Project unit of the Engineering & Projects organization, in charge of EPC projects for our La Hague used fuel recycling plant. I was also president of the Japanese subsidiary of Canberra, a world-leading supplier of nuclear instruments, a division of AREVA.

➢ How challenging is it to work for AREVA India after working with Japan and France?

Each country has a different environment and, therefore, its own challenges. What is exciting about India is the economic situation of the country: with very high growth, the challenge for energy production is even greater in order to support and sustain the continued development of the country. India is changing quickly, and it needs to enhance its own energy capacities and support the growth of the industries and business. We are sure that we can play a role in its development; thanks to the range of products that AREVA offers. The task is not easy, but we are ready to rise to the challenge by providing safe and reliable nuclear energy at competitive rates through the EPR project at Jaitapur. The two first reactors are currently under discussion. With four EPR reactors already under construction and two planned for the United Kingdom, this project has the potential to be the 7th and 8th EPR reactors built by AREVA.

What is your perception about power and energy sector in India?

Even though the country relies mainly fossil energy right now we believe there is great potential both for nuclear and renewable energies in India, as the country has to satisfy an already huge energy demand which is anticipated to significantly grow in the coming decades. An average of 16 GW additional power generation capacity is required each year until 2020 to meet the country's fast-growing electricity demand. Yet, despite substantial capacity addition in recent years, more than one-third of households suffer from either supply shortages or lack of access to electricity. India, just as many other countries, has to meet its environmental and climate change commitments while still ensuring the country's energy independence and security of supply and offering its citizens affordable electricity. The new government seems favourable to accelerating the development of low-carbon energies, be it renewable or nuclear, which is why AREVA has a role to play now to help India's power sector to grow.

How far AREVA has been successful in providing India the solution for low carbon power solutions to nuclear as well to renewable energy?

AREVA started its cooperation with India more than 10 years ago now, providing to the country its products and expertise in both nuclear and renewable energies. AREVA has already completed the installation of five biomass plants in India, totalling more than 47 MWe of generating capacity and is committed to continuing supporting the development of renewable energies in India. AREVA has also set up a 125 MW concentrated solar thermal power plant for Reliance Power in Rajasthan, which has just been successfully connected to the grid in November of this year.

As for nuclear, France and India signed a Nuclear Cooperation Agreement in 2008, and AREVA and NPCIL signed a Memorandum of Understanding in February 2009 for a partnership in nuclear power generation to build up to six EPR reactors at the Jaitapur site in Maharashtra and provide lifetime fuel supply for these units. A General Framework Agreement (GFA) was then signed in December 2010 for the construction of the first two EPR reactors and supply of fuel. Commercial negotiations are now ongoing.

As a third generation reactor, the EPR provides the highest levels of safety and security. Its design incorporates important lessons learned including improved resistance to external hazards against aeroplane impact for example. With four reactors already under construction around the world, the EPR design benefits from unrivalled return on experience, reinforcing project certainty. The EPR reactor has been approved by authorities in Finland, France, China, and the United Kingdom.

AREVA India is supporting in nuclear waste management in India? Could you share your engaging experience on spent fuel reprocessing plant?

As of today, AREVA India has not started working in the nuclear waste management field in India, but we are looking forward to it. AREVA has leading technological and industrial expertise in this field and is an industrial leader in recycling used nuclear fuel, making it the preferred partner in this field worldwide. Our activities include the recovery of 96% of the used fuel's reusable materials (95% uranium and 1% plutonium) and the safe conditioning of the remaining 4% end waste.

The 96% recyclable materials are separated from the end waste at the AREVA recycling plant in La Hague. These materials are then used to manufacture the recycled fuels, including MOX fuel assemblies, based on a mixture of uranium and plutonium oxides as well as enriched recycled uranium fuel assemblies, based on the recovered uranium that is then re-enriched in order to be used as nuclear fuel.

Worldwide, more than 40 reactors have been loaded with MOX fuel since 1972. Recycling allows the reuse of the energy still contained within used fuel, saving up to 25% of natural uranium. Recycled uranium fuel may also be a solution of interest for India as an additional fuel sources for its nuclear reactors.

How was the response at India Nuclear Energy 2014 held in Mumbai? Also, do share with us range of products and solutions displayed by AREVA?

INE event met the expectations and objectives of AREVA India, which were to exchange information with industry representatives and to reinforce AREVA's commitment to Indian market. We were pleased to participate at the INE, which is a leading event for our industry in India. As the conference and exhibition attracted many visitors, it enabled AREVA India to hold meetings with industry players.

We provided detailed explanation about the EPRTM reactor, planned for Jaitapur and we met with suppliers from India, France and UK, as well as with the Indian nuclear industry institutions which were also represented during the event.

AREVA has been awarded the largest solar power plant of Asia to build a 2x125 MW concentrated solar power installation in Rajasthan. Could you detail about its operation and characteristics?

AREVA has constructed for Reliance Power the first 125 MWe solar thermal power plant in Dhursar, Rajasthan. This project utilizes AREVA Solar's Compact Linear Fresnel Reflector (CLFR) technology for solar thermal generators. This project was achieved; thanks to the local talent and resources, and the total localization of the project was more than 60%.

The plant was connected to the grid in November 2014, and we look forward to the commissioning, which should take place shortly.

What are your suggestions to improve energy sector so that India can meet its growing power needs?

We believe that nuclear is a key element for country's energy mix as it provides low-carbon, competitive energy and guaranties energy security of supply. India has been a precursor in this field and has announced nuclear capacity targets of 27,500 MW by 2032 with the objective to supply 25% of its electricity from nuclear power by 2050.

Also, Prime Minister Narendra Modi has reaffirmed the country's commitment to nuclear energy since coming to office. This is a very encouraging sign because we believe that governments have a key role to play in the development of nuclear energy by supporting the right conditions to develop nuclear projects, which require significant capital expenditure.

In the UK for example, the Government has pursued the electricity market reforms and, as part of this, implemented the "Contracts for Difference." These are mechanisms to encourage utilities and private investors to invest in new, low-carbon electricity generating capacity like nuclear energy. We are very optimistic that this government will address the issues that will expedite the progress of nuclear technology in general.

What are your quick priorities for the Indian market and your vision in the next two years?

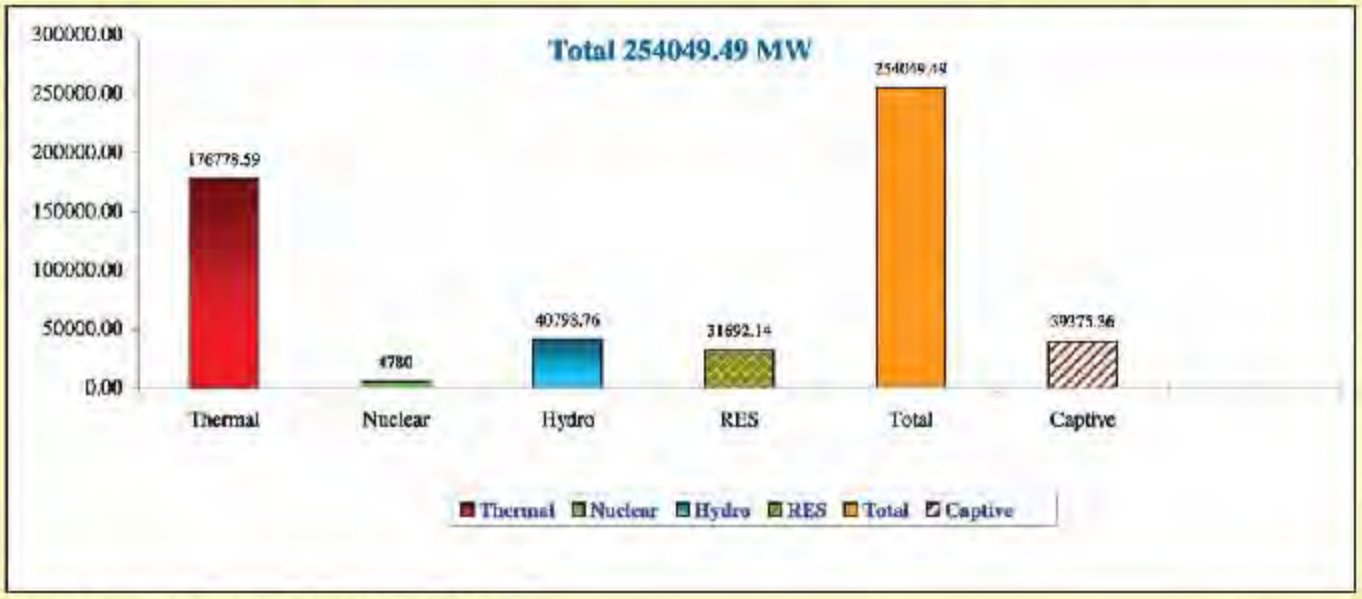
Following the Indo-French Nuclear Cooperation Agreement signed in 2008, AREVA and NPCIL signed Memorandum of Understanding and General Framework Agreement (GFA) respectively in February 2009 and December 2010 for the construction of the first two EPRTM reactors in Jaitapur, Maharashtra.

AREVA is now eagerly looking forward to launch the early works and to reach an agreement with NPCIL on all technical and commercial terms of the contract. Discussions with NPCIL are progressing well, and we expect to be in a position to reach an agreement on the technical aspects of the project in the near future.

Power Statistics

All India Installed Capacity (MW) as on 30-09-2014 Region -wise

Region	Thermal				Nuclear	Hydro	RES	Grand Total
	Coal	Gas	Diesel	Total				
Northern	39481.00	5331.26	12.99	44825.25	1620.00	16598.11	5935.77	68979.13
Western	59519.51	10915.41	17.48	70452.40	1840.00	7447.50	11271.07	91010.97
Southern	27382.50	4962.76	939.32	33284.60	1320.00	11398.03	13784.67	59787.30
Eastern	26527.88	190.00	17.20	26735.08	0.00	4113.12	432.86	31281.06
North-East	60.00	1208.50	142.74	1411.24	0.00	1242.00	256.67	2909.91
Islands	0.00	0.00	70.02	70.02	0.00	0.00	11.10	81.12
ALL INDIA	152970.89	22607.95	1199.75	176778.59	4780.00	40798.76	31692.14	254049.49



Note: Captive Genaration is not included in the total

Source: CEA

SYSELEC TECHNOLOGIES PVT. LTD.

Sf6 Gas has been classified as a GHG (Green House Gas) by Kyoto Protocol. IEC 60480 & IEC 60376 & CIGRE B3.02.01 have laid strict guideline for the Qaulity Management of SF6 Gas.

Gas Carts :

Syselec's wide spread range of SF_6 gas carts ensures recovery, recycling & reclaiming of any amount of sf6 gas. What's more, evacuation of air & moisture is also carried out by these carts.

Features :

- Suited for servicing small volume SF6 equipment.
- Recover, Refill and Purify SF6
- Evacuate air and moisture prior to filling
- Consolidate SF6 cylinders
- Mounted of a convenient hand cart with 10" (250mm) pneumatic tyres for ease of movement
- Capable of liquid SF6 storage
- Purifies, dries and filters to 0.1 microns during recovery and re-pressurization instead of copper/brass corrosion resistance.
- High pressure, direct-drive oil-less compressor with 1000:1 compression ratio (capable of 1000psi - 69 bar)
- Color changing moisture indicator to monitor moisture in gas without the bulk and high price of a large skid or trailer mounted unit.
- Purifies recovered SF6 twice during regular routine
- Purification of SF6 (removes particles, moisture, and SF6 decomposition products)
- Filters are easily changed without disconnecting any tubing or using any special tools
- Mounted on a cart with casters and rack for storage up to three S/6 storage bottles (Total onboard storage up to 350lbs/160kg) - 660lbs/300kg with optional storage tank).

Sf6 Gas Analyzer

As per IEC 60480, SF6 gas needs to be checked for following 6 parameters :
SF6 purity, Dewpoint, HF, SO2, CF4, Air. Syselec's zero waste SF6 gas analyzer ensures the gas is tested as per IEC60480 & IEC60376 with no wastage of gas & in conformance to environment.

Features :

- Drift free, auto temperature & auto pressure compensated gas analyzer's
- Non-dispersive infra-red technology based sensor.
- Portable & mobile due to its battery operation
- Fully compliant with all current IEC and CIGRE methods
- Smallest amount of Sf6 gas sample : Only uses 250cc's of SF6 - suitable for low voltage breakers
- Works at very low pressure : - 0.1 Bar upto 10 Bar
- Built in Pressure regulations and measurement
- The lightest "Pump Back" SF6 analyser
- The most accurate - laboratory quality analysis in a portable analyser
- Multi Sensor - Hi/Lo ppm Technology (SO2)

Syselec Technologies Pvt Ltd.
B-603/604, Kanakia Western Edge II,
Behind Metro Cash & Carry Mall,
On Western Express Highway,
Borivali- (East), Mumbai - 400 066,
Maharashtra, India.
Tel : 022 2870 2143, Fax : 022 2870 2153,
Web : www.syselec.net

Mumbai | Delhi | Chandigarh | Nagpur | Bangalore | Chennai

SF6 Gas

Handling Techniques in Electrical Utilities

Upcoming trends in SF_6 gas maintenance and management

SF_6 gas has been classified as a potent Green House Gas by environmental and climate change organizations. Releasing of SF_6 in atmosphere will be aggravating the current scenario of global warming and climate change. However, SF_6 is also a popular dielectric used in High Voltage switchgears, and contrary to the popular notion, SF_6 does decompose and lose its dielectric strength. This requires quality checks and regeneration of SF_6 in a timely manner.

Hrushaabh P Mishra

SF_6 gas is an essential gas for electrical equipments such as circuit breakers, transformers, CTs etc. Sulphur Hexa-Fluoride or SF_6 is a non-toxic, inert, insulating and a cooling gas of high dielectric strength and thermal stability. It is particularly suited for the following applications.

- In both High Voltage and Medium Voltage Power Circuit Breakers: SF_6's excellent arc quenching capacity is put to use here.
- In High Voltage Cable: SF_6 gas insulated transmission cables can carry higher capacity of power.
- Power Transformers: On account of their high operational safety, SF_6 gas filled transformers are employed in hazardous operational areas such as mining. Their light weight, compact design & low noise levels are decisive advantages.
- Particle accelerators, X-ray equipments and UHF transmission.

SF_6: Chemical Properties

SF_6 is a very stable and inert gas, colourless and odourless, non-toxic and non-flammable and insoluble in water. It is one of the least reactive of all known gases and in normal conditions, it attacks no known substance with which it will come in contact.

Physical Properties

SF_6 is 5 times heavier than air and is one of the heaviest known man-made gases. Due to leaking of SF_6 in air, it will mix insufficiently with air, and will retain itself near-to-ground levels. SF_6 gas cannot be separated easily from by air. SF_6 exhibits 2-5 times better heat transfer properties than air.

Density	6.14 kg/m^3
Thermal Conductivity	0.0138 W/m/k
Critical Temperature	45.55°C
Critical Density	730 kg/m^3
Critical Pressure	3.78 MPa Absolute

Table 1: Physical Properties of SF_6

Electrical Properties

Electronegativity is an attribute of a molecule to attract and bind electrons towards itself and there not allowing the build- up of electron avalanche. SF_6 is highly electronegative. It has a pronounced tendency to bind free electrons forming heavy ions with low mobility making the development of electro avalanches very difficult. Corona, resulting due to high potential electric field present in SF_6 gas, does not lead to increase in conductivity within SF_6 gas. Additionally, SF_6 gas is an excellent recombination gas. It has been observed that SF_6 breaks down into free sulphur and fluorine atoms from 150^{0}C onwards. However, as soon as the ambient temperature is attained, the free atoms of sulphur and fluorine

once again recombine. During arcing of contacts, the released energy is utilized for dissociating the SF_6 gas molecules, without letting to further build temperature inside the compartment.

SF_6 as Greenhouse Gas

Man made pollutants due to extensive human activity have been harming the atmosphere since the industrial revolution. Two prominent outcomes of these pollutants are:

- Stratospheric Ozone Depletion
- Average Global Temperature Increase.

Due to the reflectivity of CO_2, H_2O, O_3, by default present in the atmosphere, and the increasing presence of man-made gases such as CO_2, N_2O (intensive agriculture), and CFCs (spray propellants & refrigerants), the IR energy being irradiated from the earth's surface, fails to escape to the atmosphere and it eventually leads to increase in earth's temperature. With a GWP of 23,900 times that of CO_2, SF_6 has been classified as a potent GHG by Inter-governmental Panel on Climate Change. The proportion of SF_6 has been increasing at an annual rate of 7%, mostly because of its use in electric utilities. Once released to atmosphere, it has an extremely large lifetime of 800-3200 years. In Europe, SF_6 gas falls under F-Gas directive which bans its usage for all applications except switchgears. The consequences of Global Warming are far reaching and some of them have been listed as below:

- Unprecedented combinations of climate change along with associated disturbances such as floodings, drought, wildfires, insects, ocean acidification.
- Approximately 20-30% of plant and animal species assessed are likely to be at increased risk of extinction if increase in global average temperature exceeds 1.5 to 2.5°C.
- In dry and tropical regions, like India, crop productivity is projected to decrease for even small local temperature increase (1-2°C) which would increase the risk of hunger.
- Coastal territories are to be exposed to increasing risks due to sea level rise, leading to increased flooding.

ISO14064

In line with IPCC directive & Kyoto Protocol,

Proportion of SF6 has been increasing at an annual rate of 7%, mostly because of its use in electric utilities. Once released to atmosphere, it has an extremely large lifetime of 800-3200 years

The ISO 14064 standard, published in 2006, revolves around environmental management and quantifying, monitoring, reporting and verifying greenhouse gas emissions. The standard is published in three parts.

- ISO 14064-1: 2006 specifies principles and requirements at the organisation level for quantification and reporting of greenhouse gas emissions and removals. It includes requirements for the design, development, management, reporting and verification of an organisation's greenhouse-gas inventory.
- ISO 14064-2:2006 specifies principles and requirements and provides guidance at the project level for quantification, monitoring and reporting of activities intended to cause GHGs emission reductions or removal enhancements. It includes requirements for planning a GHG project, identifying and selecting GHG sources, sinks and reservoirs relevant to the project and baseline scenarios, monitoring, quantifying, documenting and reporting GHG project performance and managing data quality.
- ISO 14064-3:2006 specifies principles and requirements and provides guidance for those conducting and managing the validation or verification of GHG assertions. It can be applied to organisational or GHG project quantification including GHG quantification, monitoring and reporting carried out in accordance with ISO 14064-1 and ISO 14064-2.

Origin of Contamination

Contamination during handling

Mishandling during filling and recovering of SF_6 are the major causes of contamination of SF_6 with moisture and air. The residual air present in pipework and valves, air leaking in through sealings, and by the residual air left inside the enclosure after evacuation and before filling with SF_6 go unnoticed and eventually dilute the purity of SF_6. The ingress of air and gas-entrained dust can be minimised by:

- Appropriate Design work of pipes & valves
- Appropriate handling procedures
- Careful evacuation of the air from the enclosure before filling with SF_6 (a residual air pressure of 1 millibar is recommended)

Contamination by leakage

The diffusion of air and humidity might happen from the outside to within the compartment because the partial pressure of air and water outside the enclosure is higher than that inside. The main leakage paths are enclosure porosity, sealings of mechanically moving transmission elements, and O-ring sealings. SF_6 half-empty cylinders over a period of time may become corroded and might start leaking. The pressure within them may become destabilized, which might cause a potential burst too.

Contamination by desorption

During the assembly of the equipment itself, accumulation of Humidity and gases within the inner surfaces of the equipment or in the bulk materials are released within SF_6 during its normal operation and at elevated internal temperature. Polymeric materials such as epoxy are highly hygroscopic and have poor moisture retention capability at increased temperatures. Adsorbers which have not been properly handled may contain both humidity and adsorbed SF_6 decomposition products which can be released during evacuation or at elevated temperature. The quantities of the desorbed substances are difficult to estimate because they depend on the specific materials employed, production methods, quality control and the assembling & maintenance procedures.

Decomposition by Electrical Discharges

SF_6 is partially decomposed by electrical discharges which can be grouped into four major types namely:

- Partial Discharges of the corona type
- Spark Discharges
- Switching arc
- Failure Arcs

Partial Discharge

PD is defined as a localised breakdown. PD activity is initiated within SF_6 gas due to the presence of moisture and air, protrusions or abrasions on the insulator surface, freely

floating particles within the gas. Corona is defined as a type of Partial Discharge that occurs in gaseous medium around the conductor. It is the ionisation of the surrounding gas and usually develops around the freely floating electrodes. Corona is an electron dominant process. The electron temperature is much higher than the gas temperature, since the gas exists under non-equilibrium conditions. The mean energy of the electrons in the corona is limited to 5 to 10 eV. This already exceeds the SF_6 bond energy between SF_5-F of 3.5-4 eV and the electron impact will dominate the decomposition process. The electron impact dissociation process can lead to the following reactions:

$e + SF_6$ ----------> $SF_X + (6-X)F$, $x < 5$

$e + SF_X$ ----------> $SFx + F$

Multi-step dissociation leads to the formation of lower fluorides of Sulphur such as SF_2 & SF_3. In the absence of contaminants in the gas or on the surface of insulators, the products of decomposition of SF_6 quickly recombine though relatively rapid process to explain the thermal conversion of $SF_4 + F_2$ into SF_6. However, in the process of oxygen and moisture, the recombination process can be interfered with by the reaction between the lower fluorides of sulphur and the contaminants to form sulphur oxyfluoride, HF and metallic fluoride. Some of the reactions can be expressed as follows:

$SF_5 + OH$ --------> $SOF_2 + HF$

$SF_5 + O$ ---------->$SOF_4 + F$

$SF_4 + O$ ---------> $SOF_2 + 2F$

$SF_2 + O$ ---------> SOF_2

$SF_4 + OH$ --------> $SOF_2 + HF + F$

$SF_4 + O_2$ --------> $SO2F_2 + HF$

$SF_4 + H_2O$ --------> $SOF_2 + 2HF$

$SOF_2 + H_2O$ --------> $SO_2 + 2HF$

$SOF_4 + H_2O$ --------> $SO_2F_2 + 2HF$

Outside the corona discharge region, slower reactions between the long-lived lower sulphur fluorides such as SF4 and stable oxyfluoride with the contaminants will further lead to the formation of other types of compounds such as SO_2, SO_2F_2 and SOF_2.

Spark Discharges

Spark Discharges may occur at large scale insulation defects such as floating conductors and during disconnector switching operation. The decomposition products generated are of

Fig. 1: Traces of flashover on a busbar

Fig. 1: Surface carbon deposition due to failure arcs

the same kind as in corona discharges but their quantitative generation rates and compositions are different.

Switching Arcs

Switching arcs occur during the load breaking operation of power circuit breakers. At the centre of high current breaking arc, the temperature rises to be as high as 20000 K. As the arc cools, recombination of sulphur and fluorine to form SF_6 occurs rapidly, often in the microseconds scale. In the presence of oxygen, H_2O and metal vapour, resulting of electrode heating, the recombination process is altered which leads to the formation of various arc by-products. The high current flow in these arcs leads to substantial erosion of the contacts and insulation material by the hot arc. The main cause for SF_6 decomposition is the reaction of these erosion products with the fragments of thermally dissociated SF_6 and other trace gases such as moisture and oxygen. The most important of these reactions can be expressed by the below three formulae:

$Cu + SF_6$ --> $CuF_2 + SF_4$

$W + 3\ SF_6$ --> $WF_6 + 3\ SF_4$

$CF_2 + SF_6$ --> $CF_4 + SF_4$

The first two reactions are associated with eroded material from the arcing contacts for which copper tungsten (Cu-W) is normally used. The last reaction is due to eroded PTFE (a CF_2 polymer), which is employed in most switchgear to contain the arc.

Failure Arcs

Failure Arcs are a result of insulation breakdown or switchgear interruption failure and occur extremely rarely. In these events, the arc burns mainly between metallic minerals which are not designed for arcing such as aluminium, copper and steel. These materials have relatively high arc erosion rates.

Mechanical generation of dust particles

Metal dust particles may be generated by mechanical friction of metal surfaces. In properly designed equipment these particles usually fall into areas where they have no effect on the insulation integrity of the installation. If however they fall into the area of high electric field stress such as an insulating barrier, they may cause tracking on the insulator surface and flashover.

SF_6 Impurities

The impurities resulting in the SF_6 gas are Air, Moisture, HF, CF_4, and SO_2. Permissible limits have been laid for the aforementioned impurities according to IEC60376 & IEC60480. IEC60376 lays down the guidelines for checking brand new SF_6 gas and IEC60480 lays down the guidelines for checking used SF_6 gas.

Impurity	Specification according to 60376
Air	0.05% by volume
CF_4	0.05% by volume
H_2O	22 ppmv
HF	2.2 ppmv

Table 2: Maximum acceptable impurity levels for new SF_6 gas (or gas filled in cylinders)- IEC 60376

Impurity	Specification according to 60480
Air and /or CF_4	3% by volume
H_2O	200 ppmv
HF	25 ppmv
SO_2	50 ppmv

Table 3: Maximum acceptable impurity levels for reuse of SF_6 gas – IEC60480

Fig. 2: HF dust accumulated at the bottom of HV contact plate

new

PX8000

Precision Power Scope

Where Power Meets Precision

The PX8000 brings together Yokogawa's world-leading expertise in power measurement with our long heritage in oscilloscope design to deliver a true test and measurement revolution: **the world's first precision power scope**. With the launch of the PX8000, R&D professionals need no longer compromise on their need for high-accuracy time-based power measurement, a need that conventional power analyzers and oscilloscopes were never designed to meet. As more and more innovation focuses on energy consumption and the integration of electronics into power-based systems, so more and more engineers are demanding accuracy and precision from their power measurement.

Features unique to PX8000:

- **Multifunction snapshots** - Up to 16 different waveforms – including voltage, current and power – can be displayed side-by-side, giving engineers instant snapshots of performance.
- **Detailed transient analysis** - The PX8000 supports the measurement of all power waveform parameters between precisely defined start and stop cursors.
- **Trend calculation** - The PX8000 has built-in functions for the direct calculation of variables, RMS and mean power values, to enable the identification of cycle-by-cycle trends.
- **De-skew compensation**

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

Effects of contamination

A functional deterioration of equipment by SF_6 contaminants can, in a general sense, be viewed in the following six respects:

- Health risk
- Corrosion
- Insulation Performance of gas gaps
- Insulation Performance of insulator surfaces
- Switching capability (for switchgear only)
- Heat transfer.

Health Risk

SO_2 and HF constitute a health risk, whereby they might cause irritation effect in eyes and nose and lead to difficulty in breathing. HF, one of the highly corrosive gases, causes severe skin burns if it comes in contact with the skin of human personnel.

Corrosion

HF, corroding the contacts and the internal metallic parts of a gas compartment will lead to the formation of metallic fluorides in form of dust particles. Reaction of SO_2 and HF with insulator surfaces leads to pitting and decrease in surface resistivity. This results in surface tracking and increased conductivity.

Insulation Performance

Air and CF_4 are chemically inert gases. SF_6 is usually diluted with these two gases in order to reduce the release of SF_6 & the associated environmental impact. However, the dielectric strength of a mixture of SF_6 with Air or with CF_4 is always lesser leaser than that of pure SF_6. SF_6 mixture with air/ CF_4 has greater arcing time and the interruption derating occurs. If the performance has to be maintained, then the pressure will have to be risen or the redesign of the arc extinguishing zone would need to be done.

Heat Transfer

Air and CF_4

Modern Designs however avoid the use of corrosion sensitive materials. Some of the contaminants are chemically inert such as Air, CF_4 and moisture may affect the gas insulation capability and the circuit breaker switching performance, if present in too high concentrations. They may also have an influence on the convective heat transfer by the insulating gas. The main conducting liquid contaminant is water condensing from moisture in the form of water droplets or films. As water has an extremely high dielectric constant and high electric conductivity, it causes local field enhancements at droplets and conducting surface films along insulators both of which deteriorate insulation performance . Moisture is mainly introduced by desorption from surfaces and from the bulk of polymers. Its condensation is controlled by the absolute moisture which is expressed as partial water vapour pressure pH_2O. Non-conducting solid decomposition products are generated from arc eroded metals by reaction with dissociated SF_6. They mainly consist of copper fluoride CuF2, tungsten oxide WO_2, the tungsten oxyfluorides WO_2F_2 and WOF_4 originating from switchgear contact erosion and Aluminium Fluoride AlF_3 in case of internal arcing. They are non-critical for insulation as long as they are not exposed to excessive moisture. Conducting solid contaminants such as carbon and metal dust may become critical when deposited on field exposed insulator surfaces as conducing layer. Carbon may be generated by carbonisation of polymeric materials. Metallic dust particles generated by mechanical friction may be transported by gas flow.

Infra-Red Technique based SF_6 gas Analysis

Infra-red based analyzers require the smallest amount of gas for analysis. It gives the readings at the fastest rate with no cross interference or contamination. Infrared based SF_6 gas analyzers are preferred today since they differ from the conventional sensors on following grounds:

Removal of SF_6 Impurities

While SF_6 itself is not consumed in significant quantities its performance can degrade due to contamination by air, moisture, decomposition products. It is desirable both from an ecological & economic point of view, to keep SF_6 at a low contamination level by careful handling so that it can be reclaimed on site many times. SF_6 continually should be reused during equipment development, product testing, commissioning, maintenance and repair and decommissioning where the criteria of IEC60480 can be achieved. It thus goes through a continuous cycle of reuse. Such a systematic re-use of SF_6 requires that the gas be kept at the stated quality level at which it can perform its functions. With properly maintained reclaiming equipment, humidity and reactive decomposition products can almost always be removed on-site so that non-reusable gas can be transported. In the rare case that the gas cannot be purified sufficiently on-site to achieve the reclaimed criteria it still has reuse potential when treated by a specialised processing company. This allows it to be rendered reusable in the majority of cases & some SF_6 producers are already offering such a purification service. Only a very small fraction of the residue will have to be processed for the final disposal in an environmentally compatible way.

Reclaiming Equipment

Gas reclaimers have been used successfully since the introduction of SF_6 technology. They are commercially available in a variety of sizes, gas processing capacities & storage capacities

Conventional Technique based analysis	NDIR (Non-dispersive Infrared) Spectroscopic Analysis
Less reliable as the electrolyte has to come in contact with the analyzed gas	Highly reliable as it is a non-contact based measurement
Highly susceptible to temperature and humidity drifts	Temperature and humidity compensation is possible
Less accurate due to invariable response. This leads to false alarms	Highly accurate due to minimal drifts due to temperature & humidity effects. This leads to accurate alarms
Slow responding	Very fast in responding and producing results
HF detection is not possible as it corrodes the sensor	HF detection is possible since it is a non-contact based measuring method
Affordable cost wise	Expensive technology

Table 4: Comaprison between Conventional and NDIR Technique

PSPC

TRAPPED KEY INTERLOCKS & SAFETY SYSTEMS

CE Certified ISO 9000

Safety Specialists

- Switching Sequencing
- Machine tools
- Automation
- Sensing & Control
- Process Industry
- Electro Static Precpitators

PSPC interlocks have been serving customers in Europe, Middle East, America, Far East, Asia and Africa for over 30 years.

Range includes:

- Standard Basic lock
- Bolt Interlock
- Door Interlock
- Claw Interlock
- Slam locks
- Key exchange systems
- Miniature interlocks
- Valve interlocks
- Electro mechanical interlocks with Solenoids
- Rotary Switches
- Limit Switches and time delay
- Custom built safety solutions

TRUST PSPC, STAY SAFE

DISRTIBUTORS SOLICITED

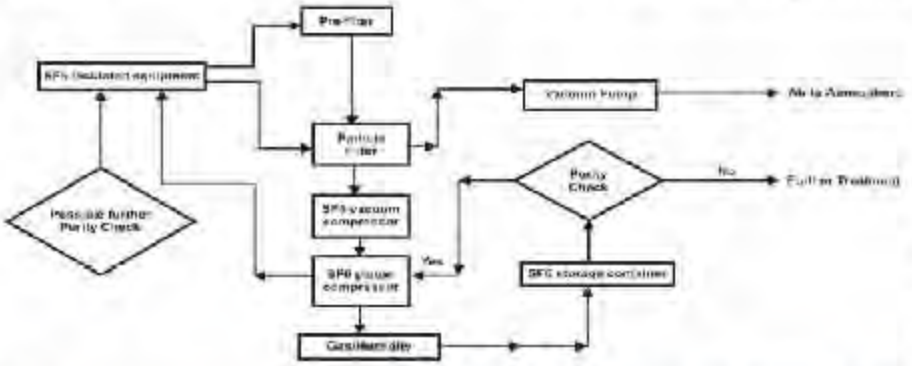
PS Power Controls PSPC Exports (P) Ltd
Office : 53 (NP) Developed Plots, Ekkattuthangal, Chennai - 600 032
Phone : +(91)-44-2225 3684

Works : 163, Mount Poonamalle High Rd, Porur, Chennai - 600 116.
Phone : +91-44-2476 7901, Fax : +91-44-2476 8134
Email : pspc@bsnl.in \ sales@pspc-tkil.com

& range from units that can be hand carried to larger trailer mounted systems. The appropriate type & size of the reclaimer should be chosen according to the gas capacity to be handled.

Block diagram of a reclaimer

The basic functional schemes of a reclaimer are as follows:



Filters

The various types of filters used in reclaiming carts are as follows:

Filter type	Tasks	Major Characteristics
Particle Filter	Removes solid decomposition products and other particles at input of reclaimer	Pore size 1 µm
Gas/Humidity Filter	Removes Gaseous Decomposition Products	Residual Humidity<100ppmv Residual SO_2<10 ppmv Residual Reactive products
Detoxification Filter	Reduces reactive decomposition products	Same as prefilter
Oil Filter**	Removes Oil	Special Filter equipped with Visual Oil Indicators

** will not be required if compressors are oil-free

Adsorbants	Contaminants Removed
Molecular Sieve 4A	Water, SO_2, SOF_2, SF_4
Molecular Sieve 13X	Water, SO_2, SF_2, SF_4(SFn)
Activated Alumina	Water, SO_2, SOF_2, SF_4, HF
Soda-Lime (CaO-NaOH)	Water, SO_2F_2, HF
Activated Charcoal	Oil Vapour

Table 5: Typical adsorbents for various SF_6 impurities

Vacuum Pump

The vacuum pump module is used to extract air from SF_6 insulated equipment and associated piping prior to refilling with SF_6 and for dehydration (removal of residual moisture). It is also used to remove air from various sections of the gas processing system itself, eg, after maintenance work.

SF_6 Vacuum Compressor

The SF_6 vacuum compressor module is used to recover SF_6 from gas insulated equipment and to assist the series connected SF_6 piston compressor.

Gas/Humidity Filter

Filter elements should be adequately sized to remove moisture, gas by-products and particles larger than 1 micron in size (as a second means of trapping and larger particles which may have been transmitted via a non efficient particle filter).

Storage Module

The SF_6 storage module is used to store SF_6 processed by the reclaimer. It must have enough capacity to store the amount of SF_6 to be recovered. It can be an integral part of reclaimer or an external item. If used for liquid storage of SF_6, it should be rated for a pressure of atleast 50 bar.

Refilling

The reclaimer must have the provision to allow refilling of gas, from the storage vessel into an electrical equipment, the refilling procedure requirements will vary according to storage method employed.

Hose Connection

Hose connections should be self sealing to prevent air and moisture from entering the gas reclaiming equipment. As the equipment will often be left in a state of vacuum these SF_6 valves need to be pressure and vacuum tight.

Pipe Work

Gas piping & pipe unions used must be of high quality & preferably use a metal to metal re-usable sealing system, proven in its performance with SF_6 & its decomposition by products. The following characteristics are essential: Pressure and vacuum tight; Vibration proof; Re-usable (indefinite refitting possible) & Temperature change resistant.

All pipe-work should be of copper tubing silver soldered to tube unions and having inline covering of PTFE (Polytetrafluoroethylene). All components (gauges valves, filters, etc.) should be securely mounted to the frame of the gas cart, such that pipe-work does not have to support them. This prevents stress cracks causing either gas losses or inadvertent gas mixtures. Heavy components (i.e. compressors and vacuum pumps) should be "shock-proof" mounted and be connected to the fixed pipe-work via flexible connections. Equipment used to process SF_6 (i.e. compressors) should be oil less, of gas tight construction and should not contain any internal components that can be corroded by decomposition products (e.g. galvanised metal).

Conclusion

SF_6 gas can be reused for electricity utility field purposes by periodic checking of the quality of the gas with a NDIR based instrument. If impurities are found to be beyond permissible limits, one has to do purification of gas for reusing it.

Hrushaabh Mishra

is Technology Resource Head with Syselec Technologies Pvt. Ltd. He is a Gold Medallist in BTech Electrical Engineering from Government College of Engineering, Amravati, M.S. He has been specializing in SF6 Gas Testing services for reputed utilities the past 4 years. His other areas of interests include Partial Discharge testing for GIS, Power Transformer Residual Life Assessment and Switchgear protection testing.

Profile

CONNECTED *with* NOMEX®

CONNECT WITH 50 YEARS OF INDUSTRY LEADING INNOVATION

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

CONNECT WITH THE SOLUTIONS THAT ENERGIZE THE FUTURE

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

CONNECT WITH THE PEOPLE WHO HELP THE TRAINS RUN ON TIME

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

CONNECT WITH DUPONT GLOBAL COLLABORATORY NETWORK

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

To connect with DuPont™ Nomex®, please contact
Tel.: +91 226751500
Fax: +81 2267101835

Nomex.

Solarising Indian Industries

Industrialization has an important role to play in the economic development of the under-developed countries like India with huge man power and large and varied resources. Without industries, economic development is not possible. The industrial sector is one of the main sectors that contribute to the Indian GDP.

Saurabh Upadhyay

The country ranks fourteenth in the factory output in the world. The industrial sector of India is made up of manufacturing, mining and quarrying, and electricity, water supply, and gas sectors. The industrial sector accounts for around 27.6% of the India GDP and it employs over 17% of the total workforce in the country. Industry Growth Rate in India GDP thus has been registering steady growth over the past few years. This has given a major boost to the Indian economy.

Uttar Pradesh is the fourth largest Indian state by area and also the fourth largest Indian state by economy, with a GDP of Rs 7080 billion. Agriculture and service industries are the largest parts of the state's economy. Uttar Pradesh State Industrial Development Corporation (UPSIDC), the premier industrial promotion and infrastructure development undertaking of the State Government has been the driving force behind scores of industrial ventures since 1961.

Recently, there was news that Uttar Pradesh is facing a yawning gap 2,300 MW between the demand and supply of power and this is likely to go up in coming time. The daily demand of power in the state stands at about 13,000 MW per day but the availability is around 10,500

Solar PV is proving to be a viable option for industrial and commercial category of power consumers. As a majority of the Indian industries are located at dry & hot areas with huge space

MW, increasing the demand-supply gap. Industries are by and large being kept off the power cut loop but continuous load shedding is taking place in some industrial zones. This long-standing problem is persisting for last several months, which as a result is hampering the various industrial processes and missing deadline. Looking at this situation, Solar PV is proving to be a viable option for industrial and commercial category of power consumers. As a majority of the Indian industries are located at dry & hot areas with huge space, solar based captive power plants can be set up by the facilities which will be more profitable. Solar energy can be used for preheating boiler feed water in many plants. Industries can also use captive power plants on rooftops or in parks or other open spaces to meet factories' lighting loads and pumping water requirements. Also, solar power has already reached grid parity with commercial and industrial tariffs. In this scenario, the industries of Uttar Pradesh have no other option but to look for alternative sources of energy as the power situation in the state is dismal.

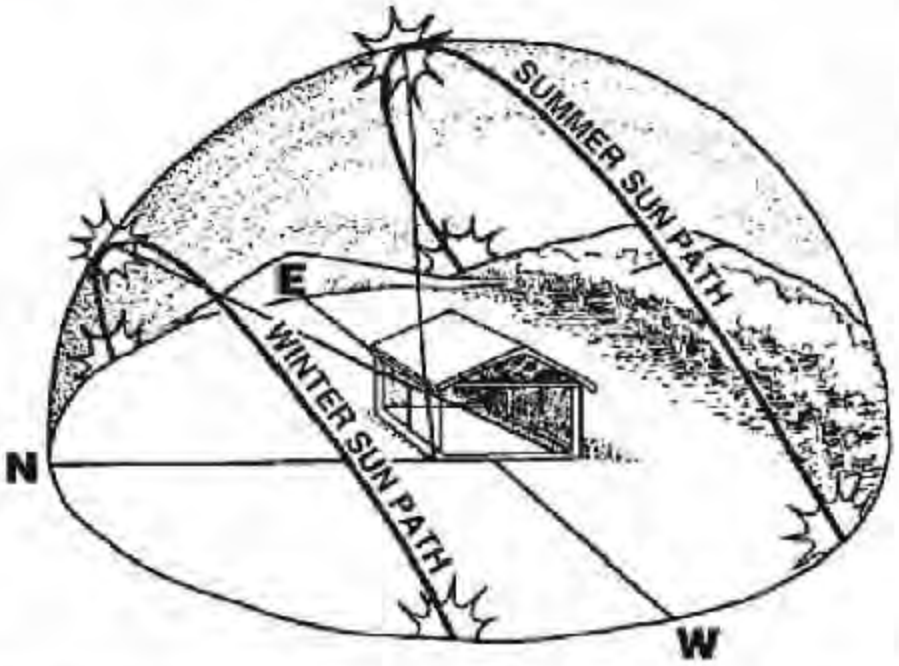
SunSwitch India Private Limited, the Uttar Pradesh based company, that specializes in providing Solar PV Rooftop EPC services, has recently executed a 100 KWp Grid-Connected Solar Power Project at Ambica Steels Limited located in Mohan Nagar, Ghaziabad district of Uttar Pradesh. Ambica Steel is India's biggest specialty stainless steel long products company producing over 80,000 tons stainless steel per year. This project was an initiative where SunSwitch extended its reach to industrial consumer, thereby encouraging the use of solar energy for cleaner environment.

SunSwitch has installed around 500 KWp of Roof top solar power plants in Delhi NCR region. During this journey, we took every new project with enthusiasm and challenge due to the limited availability of suitable rooftop space and residential power demand. Indian Government is also very positive for harnessing solar potential through this technology as many states have announced Net Metering policy. Net-metering allows rooftop solar power generators to feed solar power, which has not been consumed, into the grid and be compensated for that. The compensation per unit is usually the same as the grid tariff (thus the meter might just turn back and only the "net" grid consumption at the end of the month has to be paid to the utility). The subsidy given by the central and state governments, local utilities, and local community regulations and incentives are also some key determinants in the evaluation.

The power output of a rooftop solar system is dependent on several factors such as location, orientation of roof, panel efficiency and ambient temperature. There are some of the factors which are need to be considered before installing a solar power plant on building's rooftop which includes electrical load, current rate, roof size, load capacity and geographic location of the building. Rooftop solar arrays are best installed on a large and flat roof where direct sunlight without shadow from the surrounding structures is available. If there is shadow on a part of the terrace during the day, PV solar panels are unable to harvest the sun's energy for that period of time.

This project was first of its kind because it was going to be installed on the factory shed which was a metallic sheet different from the usual cemented plain roof. Also this shed was slope, facing east west direction. Usually in northern hemisphere, due south is the optimum orientation for panels but if a south-facing roof is not available an east-west facing roof could also be considered as it will cover the sun's movement across the sky from east to west during the day as shown in the diagram next page.

During the course of the day, the sun passes through the sky in a particular arc that varies throughout year due to earth's orbit. The arc is always symmetrical from east to west, measuring out from the Centre point which would be midday. This means that from sunrise to midday (not counting during daylight savings time) and from midday to sunset,



there is an equal number of hours of sunlight on one particular location. Also solar PV plants are not restricted to flat roofs, they can be mounted on sloped roof as well, with a correction in the angle of mounting for the slope of the roof.

The two faced shed of the roof gave us opportunity to utilize the large space of roof for solar generation to meet the large load requirement of the factory. A total 100 Kw capacity of plant was installed while our earlier projects on flat plain roof with the same area didn't allowed us to go for such high capacity. We used specially designed solar structure with accessories so that structure can be easily installed on the metallic sheets like Weebs were used for the earthing protection of the power plant. Weeb is inserted between the module frame and mounting rail, the teeth of the weeb pierce the anodized coating. The result is excellent conductivity without oxidation- bonding the PV module frame with the metal racking structure. Essentially, the module and the rail, become one singular piece of metal, creating electrical path to the ground. Weebs eliminate the need for older, more expensive grounding methods while also significantly reducing the amount of labor and materials used in the installations.

The structure was also tested for all kind of necessary tests like wind speed test. Also, the structure was installed with the help of the self-screw and was well built enough to stand up to the wind speed of about 170 Km/hr. Due to the large space availability over the roof, the panels were mounted in a landscape view which in itself is very cost efficient as it reduces the additional cost of structure. Currently, commercially available silicon-based solar PV panels are made from solar cells encased in a special type of toughened glass. Silicon solar modules have been in the field for more than 50 years and perform quite predictably. These are guaranteed for 25 years of field life but the power yield drops about 0.6 per cent a year. One can use mono-crystalline (made from a single crystal) or polycrystalline (made from multiple crystals) panels. Mono-crystalline panels are a little more efficient but the cost per watt is almost the same. We also used various electrical parameters such as the Junction box which contains the DC isolator and the SPD at the DC side. This complete system can be monitored online using the SCADA system. The consumer was also using DG set as a power back up in the absence of grid electricity. So, in order to reduce fuel cost, this DG set was hybrid with the solar power plant. This solar power capacity is a source of renewable power in a factory's low tension (LT) distribution system, which can replace the costly diesel generation power as well as bring down the grid power consumption depending on the load consumption pattern. Solar system with battery back-up can also store the solar energy for consumption during night. This solar system with battery back-up has received 30% subsidy from the Ministry of New and Renewable Energy (MNRE), Government of India. There were many obstacles as site was placed in remote location, with erratic availability of construction power facility. It took immaculate planning, superb team effort, great strategy implementation & execution to complete the whole project in just over a span of 4 months. We believe that this initiative will open the way for other industries to come up in the vast stretches of land in Uttar Pradesh.

A recent survey report of Bridge to India states that most new industrial and commercial buildings, which will be built till 2024, can structurally accommodate rooftop solar plants. As a result, on an average 75% of commercial and 45% of industrial buildings are structurally sound to accommodate a solar plant on their rooftop. We believe that going solar is not so much a choice but inevitability for country. It will be driven by the increasingly favorable economics of solar and by customer demand. The crippling power supply situation reminds us that there is an urgent need to rethink electricity generation and supply in the country.

Saurabh Upadhyay

BTech (Electronics & Communication) from Uttar Pradesh Technical University and MBA has 8 years experience in Solar Power Plant Designing & Execution. He is presently associated with SunSwitch India Pvt Ltd as Sr. Design Engineer. He has completed many Kilowatts and Megawatt Solar Power Plant Projects in India. His area of specialization are PVSYST, SUNNY Design, Power Plant Designing, Procurement and Vendor finalization.

HV & MV MOTORS AND GENERATORS
WEG INDUSTRIES (INDIA) PRIVATE LIMITED

Our Product Range

Type	Maximum Range	Maximum Voltage Range	Type of Excitation
Induction Motors – Squirrel Cage	50 MW	15 KV	—
Induction Motors – Slip Ring	50 MW		—
Synchronous Motors	50 MW		Brushless & Static
Hydro-generators	50 MVA		Brushless & Static
Turbo-Generators	62.5 MVA		Brushless & Static

WEG MOTORS


Slip Ring Induction Motor


Squirrel Cage Induction Motor


Squirrel Cage Induction Motor


Synchronous Motor-Vertical

WEG GENERATORS


Hydro-generator - Horizontal


Hydro-generator - Vertical

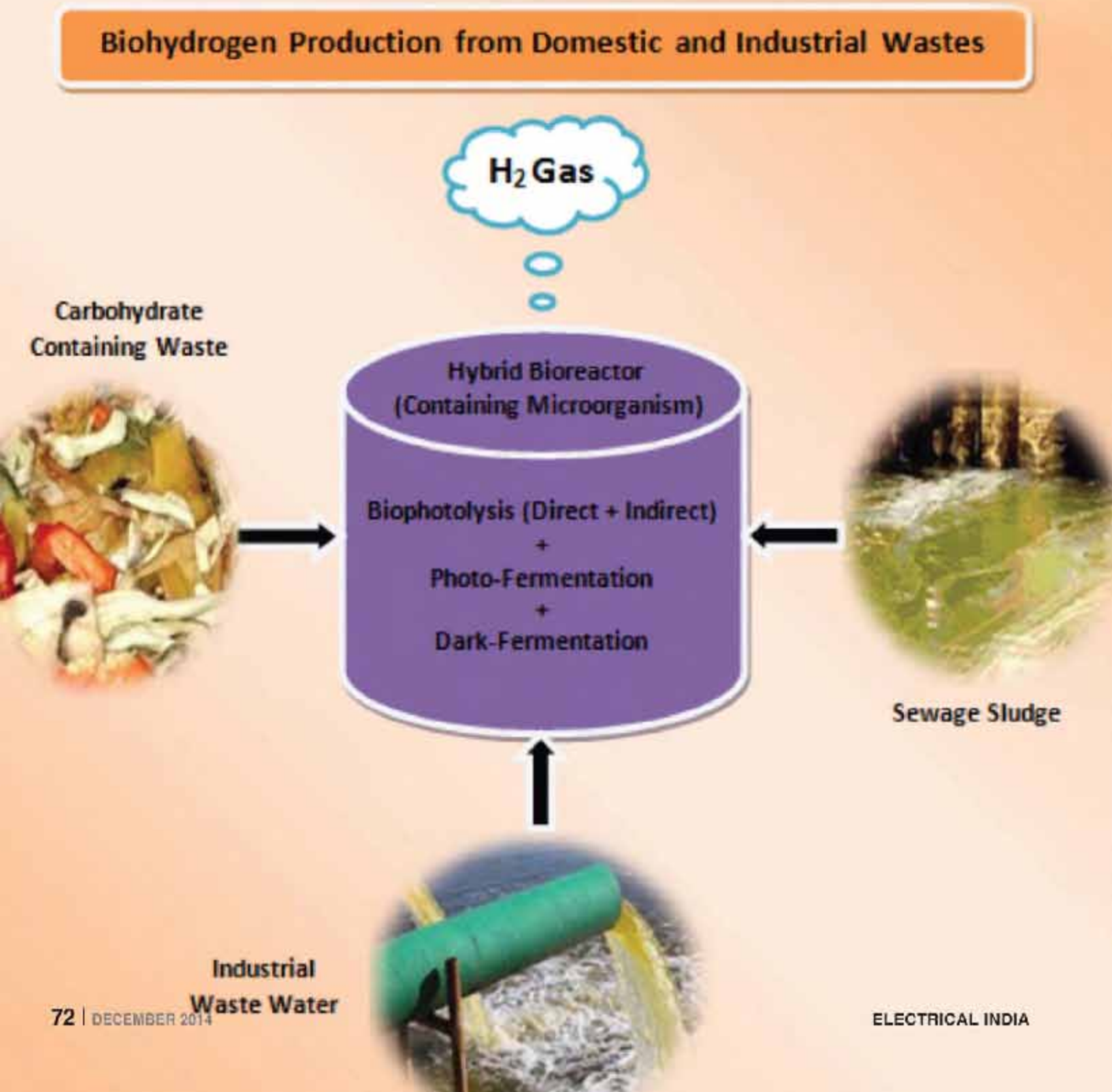

Hydro-generator - Vertical


Turbo-generator

- H.Q BRAZIL: WEG EQUIPAMENTOS ELETRICOS S. A - Av. Prefeito Waldemar Grubba, 3000, 89256-900, Jaragua Do Sul-SC-Brazil
- CORPORATE OFFICE : WEG ELECTRIC (INDIA) PVT. LTD] - No. 38 , Ground Floor , 1st Main Road, Lower Palace Orchards,Bangalore 560 003 INDIA ,Tel: +91 80-4128 2006/2007,Fax: +91 80-2336 7624,E-mail: info-in@weg.net
- FACTORY: WEG INDUSTRIES (INDIA) PVT. LTD - Plot No. 82D(North), SIPCOT Industrial Complex, Phase II ,Exp. II, Mornapalli Village ,Hosur , Tamil Nadu , INDIA ,Tel: +91 4344-301545/301510,Fax: +91 4344-301519/558

Biohydrogen Production from waste material with the help of Microorganism

Improved and Efficient Mechanism



Various gases have been used for production of energy from ancient time. The significant example is methane and ammonia gas. But there are many drawbacks of these gases such as production of hazardous by products etc. To overcome these drawbacks researchers were searching for an alternative source of energy, one of such alternative is Hydrogen gas. Hydrogen gas is a future source of energy and is considered as clean source of energy as it is eco-friendly, doesn't contribute to "green house effect" and harmless for humans and off course other organisms as well. Hydrogen gas produced by means of biological processes with the help of living organisms is known as biohydrogen and their production is called as biohydrogen production. This is also a type of biofuels like the others such as bioethanol, biodiesel, biogas etc. Researchers are working in the field of biohydrogen production for the designing and development of cost effective technologies for the large scale production at industrial level. Biohydrogen is an example of advanced biofuel (or 3rd generation biofuel). In Biohydrogen production, microbes capable of biohydrogen production are provided with energy and nutrient supplements and are allowed to grow in a suitable bioreactor; designed as per their growth needs, these microbes produces biohydrogen. Among the advanced biofuels, biohydrogen is particularly more attractive because of the excellent properties of hydrogen as a fuel and because hydrogen gas can be easily collected from bioreactor. Conversely, biofuels such as bio-oils have to be purified from the microbial cells, which is a complex and expensive procedure. Biohydrogen has several advantages over other fuels as it is eco-friendly, efficient, renewable source of energy and during its production and utilization CO_2 is not produced and negligible amounts of nitrogen oxides (NOx) are generated. Hydrogen gas is not only demanded as a source of energy but also required for several other purposes such as a feedstock for the production of chemicals, as a hydrogenating agent for fats and oils in food industry etc. Biohydrogen can be produced by following methods:

- Biophotolysis (Water splitting) of wastewater by green algae, photosynthetic bacteria & cyanobacteria
- Photo fermentation of carbohydrate rich waste by anaerobic bacteria
- Dark fermentation of carbohydrate and organic acid rich waste by purple-sulphur bacteria.

Several efforts have been made by the scientists worldwide, for improving the biohydrogen production yield both at microorganism level, by improving the quality of microorganism through genetic engineering with an increased capability of hydrogen production, and at technology level, by introducing improved bioreactors and efficient mechanisms by combining the present methods of biohydrogen production. Researchers believe that by combining different microorganisms with different capabilities, the individual strengths of each may be exploited and their weaknesses overcome.

Bioreactors applied in biohydrogen production can be divided in three separate groups on the basis of mechanism involved in H_2 production:

- Photobioreactors based on H_2 photo production, incorporating green algae, cyanobacteria and photosynthetic bacteria.
- Bioreactors based on dark anaerobic H_2 production by bacteria utilizing fermentation and "water-gas shift-reaction"
- Hybrid bioreactors based on photo- and dark-fermentation.

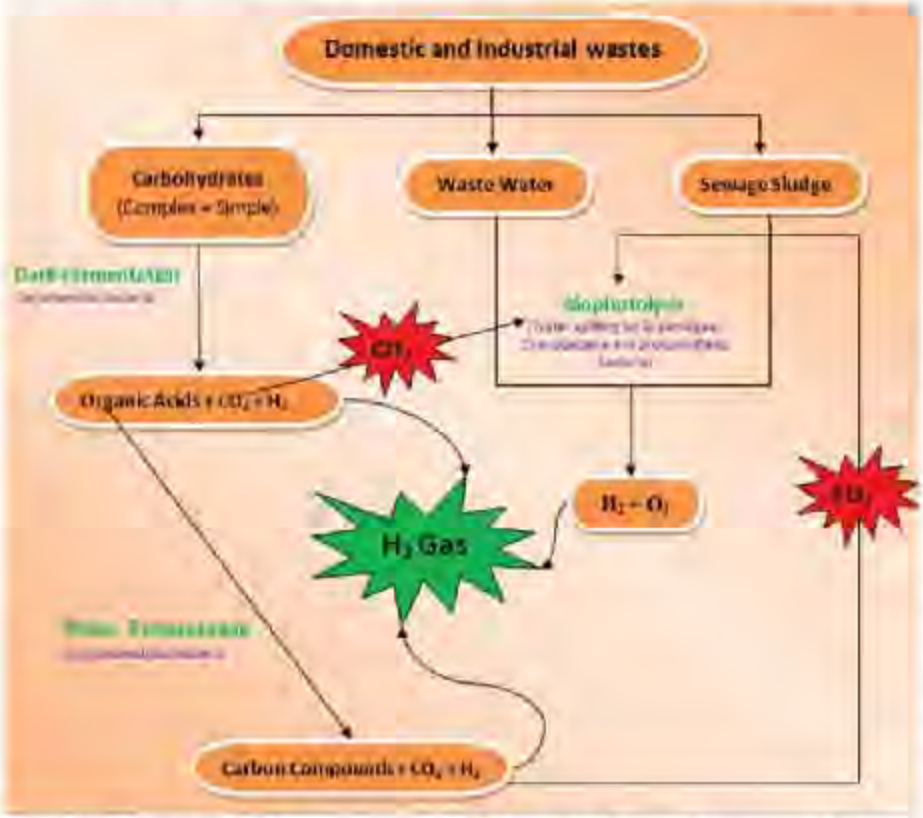


Fig. 1: Hypothetical Model for arrangement of hybrid system (H_2 gas is represented by green colour as it is a clean source of energy and CO_2 gas is represented by red colour as it is harmful for human beings and must be reutilized in the same system up to the maximum possible extent).

Important Parameters for Hydrogen Production

Efficiency and yield of biohydrogen production depends on several factors or parameters. Some of these parameters become more critical when hydrogen production is aimed at a large scale and influence the hydrogen production in different ways. These factors include both extrinsic and intrinsic factors:

- Extrinsic Factors: Extrinsic Factors are either present in the environment or produced as a byproduct during the process of bio-hydrogen production. These factors include Light, temperature, pH, micro nutrients, salinity, carbon, oxygen, nitrogen, sulfur, molecular nitrogen etc.
- Intrinsic Factors: The factors that are present inside the microorganisms itself are known as intrinsic factors and also responsible for low biohydrogen production yield. These factors may be genetic components, sensitive proteins etc. For example: uptake hydrogenase enzyme (present in photo-fermentative bacteria), which limits the yield of biohydrogen production and behaves as an antagonist for nitrogenase enzyme.

Restraints in Biohydrogen Production

Any of the controlling parameters stated above in extrinsic and intrinsic categories could restrain the process of biohydrogen production and can result in low hydrogen yield. These restraints become challenges in the production of biohydrogen at industrial level such as low hydrogen yield, slow rate of hydrogen production, strong inhibitory effect of oxygen on hydrogenase enzyme, no waste utilization are the major limitations of hydrogen production by algae and cyanobacteria. These limitations have made the biohydrogen production as one of the most challenging and interesting area for the researchers who are working in the field of biofuels. The possible challenges in designing the bioreactors, hybrid systems or in selecting the microorganisms for hydrogen production are as follows:

- Understanding the growth environment suitable for hydrogen producing microorganisms.
- In-depth understanding of the biological pathways relevant to hydrogen production.
- Improved bioreactor design and operation parameters to overcome biological limitations.
- Identification, isolation, and enrichment of key hydrogen producing microbes capable of fermenting organic waste/ wastewater efficiently.
- Designing a Bioreactor suitable for hybrid system.

Hypothetical Model: An Advanced and Efficient Hybrid System

In this article we are representing a hypothetical hybrid system for biohydrogen production with better efficiency in terms of hydrogen yield and waste utilization (Figure 1). This model utilizes all the mechanism (Biophotolysis + Dark-fermentation + Photo-Fermentation) involved in biohydrogen production in a single flow at the same time. This model will need a bioreactor which can take domestic and industrial waste material including carbohydrates and water and will perform photo-fermentation of carbohydrates and direct biophotolysis of water in parallel with the help of suitable microorganisms in different chambers of hybrid bioreactor; both of these processes require light and can be performed in parallel without interfering with each other in separate chambers. This parallel process will make the model efficient in waste utilization. Photo-fermentation will result in production of H_2, CO_2 and organic acids and direct biophotolysis of water will produce H_2 and O_2. The O_2 must be quickly removed from the chamber as it will hinder the process of hydrogen production. Organic acids produced in photo-fermentation can be supplied to dark-fermentation in another different chamber to the microorganisms suitable for the process in the absence of light and the process will end with the production of carbon compounds, CO_2 and H_2. CO_2 produced by both, photo-fermentation and dark-fermentation, can be supplied to biophotolysis for the indirect mode of H_2 production. H_2 gas produced by all the three processes can be easily separated and collected. This hybrid system runs in a cyclic manner, where waste materials (unutilized products such as CO_2 and organic acids) of one process will enter as substrates in other processes and will make the model more efficient and advanced with the maximum waste utilization and increased hydrogen yield.

Vinita Mishra

MTech (Bioinformatics) from Indian Institute of Information Technology, Allahabad and MSc (Bioinformatics) from Banaras Hindu University is a research scholar in Department of Cell Biology, University and Institute of Advanced Research (Formerly Indian Institute of Advanced Research), Gujarat. She has published papers in international journals. She has also worked as JRF in Department of Biotechnology, Delhi Technological University, under supervision of Dr. Yasha Hasija, where the present study was carried out. Presently she is working on cancer biology. Her area of expertise is computational drug discovery.

Isha Srivastava

MSc (Bioinformatics) from Banaras Hindu University, is working on computational biology approach in age related disorders for her PhD. She is a research scholar under the supervision of Dr. Yasha Hasija in Department of Biotechnology, Delhi Technological University (formerly Delhi College of Engineering), Delhi. She has worked as research intern in IMTECH, Chandigarh. She has also worked at IIT-DELHI, TIFAC as IPR trainee. Her area of expertise is genome informatics and soft computing.

Dr Yasha Hasija

BTech, MTech, and is PhD from Institute of Genomics and Integrative Biology, CSIR and University of Pune. Currently she is Assistant Professor and Associate Head, Department of Biotechnology, Delhi Technological University. She published several papers in journals and has been awarded several prestigious awards, including Department of Science and Technology Award; Human Gene Nomenclature Award at the Human Genome Meeting held in France. She is the Project Investigator of several sponsored research projects from SERB, CSIR-OSDD, etc. As an invited expert she has delivered technical and memorial talks at several universities. She is supervising MTech and PhD students at DTU.

TOSHIBA

Leading Innovation »»

Toshiba launches global manufacturing hub at Hyderabad, Telangana State, India for T&D business

Toshiba Corporation, Japan has acquired the businesses of Power Transformer, Distribution Transformer, Distribution Transformer & Switchgear from Vijai Electricals Limited, Rudraram works - Hyderabad in December 2013 and thus formed **Toshiba Transmission & Distribution Systems (India) Pvt. Ltd. (TTDI).**

1650MVA, 765kV Class Power Transformers

333MVA,1200kV Single Phase Auto Transformer

Shunt Reactors up to 765kV

Single Phase 25kVA to 2667kVA Three Phase 25kVA to 6000kVA

Three Phase Transformers up to 33kV, 4000kVA CRGO 33Kv, 2500kVA Amorphous

420kV, 63kA Gas Insulated Switchgear

245kV Gas Insulated Switchgear

245kV Live Tank Circuit Breakers

Surge Arrester for GIS

Surge Arrester for Transmission Lines

Prefabricated Substation

Solid Insulated Switchgear up to 36kV

12kV Indoor Vacuum Circuit Breaker

12kV & 36kV Outdoor Vacuum Circuit Breaker

Current Transformers 12kV to 420kV

Voltage Transformers 12kV to 245kV

Condenser Bushings 52kV to 245kV

Vacuum Interrupters up to 84kV

ZnO Elements

Toshiba Transmission & Distribution Systems (India) Pvt. Ltd.

Rudraram Village, Patancheru Mandal, Medak Dist – 502329, Hyderabad, Telangana State, India,

Tel : +91 40 3071 2222 Fax: +91 40 3071 7370

Email : marketing@toshiba-ttdi.com URL: www.toshiba-ttdi.com

Landmark: Located on NH9 (Hyderabad - Mumbai Highway), 12kM from Nehru outer ring road

Interview

"We will be manufacturing and supplying all voltage range of Transformers and switchgears up to 800kV"

Isao Hioki, Director
Toshiba Transmission & Distribution Systems (India) Pvt Ltd

Toshiba Transmission & Distribution Systems group, is a world leader in the supply of integrated solutions for energy Transmission & Distribution. Toshiba has developed its superior technology and innovator in pioneering high technology. TTDI stands to emerge as the global production hub of Toshiba Corporation to cater product and component requirements across the world. In an exclusive interview to **Electrical India, Isao Hioki** states, Toshiba is seeking to secure a 20 per cent share in T & D business of the Indian market by 2018.

What is your perception about the status and scope of T&D industry in India?

The power demand is growing rapidly in India. So I believe this sector is promising in India from the long term point of view because space for the investment on T&D sector is still huge. Electric power supply per person in India is very small and, as compared to China it is only 1/3rd, and so naturally it will increase much more in the future.

For the growth of national economy and for the development of national infrastructure, decision making by the government is vital in all the countries. I feel that the central and state governments are taking appropriate decisions to lead the electrical industry in the proper direction in order to meet the continuous growing power demand in India.

What were the objective in forming TTDI and how beneficial the decision has been for the Toshiba group?

Toshiba Corporation has a long history for T&D business in India. With the acquired local manufacturing capability, Toshiba has additional strength in T&D business in India and will expand the business volumes. We believe that Toshiba (TTDI) can increase the market share by manufacturing and supplying customer focused world class products and services with Japanese quality from the local factory. The knowledge base of Toshiba and the manufacturing capabilities of India will hugely benefit Toshiba in a big way. Also the delivery time will considerably come down reducing the cost of freight and duties giving us the marketing edge.

It has been hardly a year when TTDI came into existence acquiring an Indian company. How enthusiastic do you feel as Director of Toshiba Transmission & Distribution Systems (India) Pvt Ltd?

I am excited to be a part of introduction of new technology for new products along with the existing range of products. I am glad and proud to

work with Indian colleagues. The decades of Japanese expertise combined with Indian manufacturing skills make a unique winning combination in the global arena.

➢ Could you share what product range is more suitable in the Indian context?

Toshiba will position TTDI, the new company as a core production base for expanding its T&D business in India and the global market.

Product range of switchgears in Vijai Electricals Ltd, is below 132kV. Toshiba has plans to enhance the range of medium voltage switchgears apart from adding Extra high voltage switchgear products.

On the medium voltage, we are planning to add Solid Insulated Switchgears and vacuum interrupters up to 84kV. We will add Ring main units upto 36kV and compact substations.

On the high voltage, we will introduce new range switchgears from 132kV up until 765kV to the product line. Furthermore, we expect Gas Insulated Switchgear (GIS) to become much more popular in India. Toshiba's state-of-art GIS technology will be a strong portfolio of TTDI. We will also add Surge arrestors upto 765kV and it's component technologies.

We will extend power transformers upto 765kV. We will also manufacture and supply all voltage range of shunt reactors shortly.

Thus TTDI covers full range of voltages of both transformers and switchgears.

TTDI will also enter other growing markets in India, including power electronics systems, such as high voltage direct current (HVDC) power transmission and static VAR compensators for high voltage networks (SVC), and railway power supply systems.

➢ Could you detail about transformers, switchgears and services available by TTDI in India? Also please elaborate on Toshiba Corporation recent announcement to reinforce its transmission & distribution (T&D) business in India with a 3-billion yen (approx.US$30 million) investment in new production capacity at TTDI in Hyderabad. Could you elaborate on the same?

Toshiba Corporation will invest about $ 30 million for expanding its production capacity in the power transmission and distribution business in India, which is the part of the company's plan to invest $ 100 million in Indian T&D business sector by FY2016.

One objective of this investment is to reinforce the production capability of large power transformers whose demand is expected to rise sharply in India. Other objective is to enable the supply of competitive high- and medium- voltage switchgears by incorporating the core component production in India.

A new facility for large power transformers will come on line in 2015 at Hyderabad at the same time as the full scale launch of a new unit for switchgears.

Alongside its existing production line of small and medium capacity transformers and medium voltage switchgears, the new power transformer line will support production of 765 kV (kilovolt) transformers with a capacity of 500 MVA (mega volt ampere) while the new switchgear line will produce high voltage products up to 800kV.

We will be constructing a new factory for manufacture of Porcelain type and Polymer type Surge Arrestors up to 765kV. Also, we will be manufacturing reactors up to 765kV in the coming years.

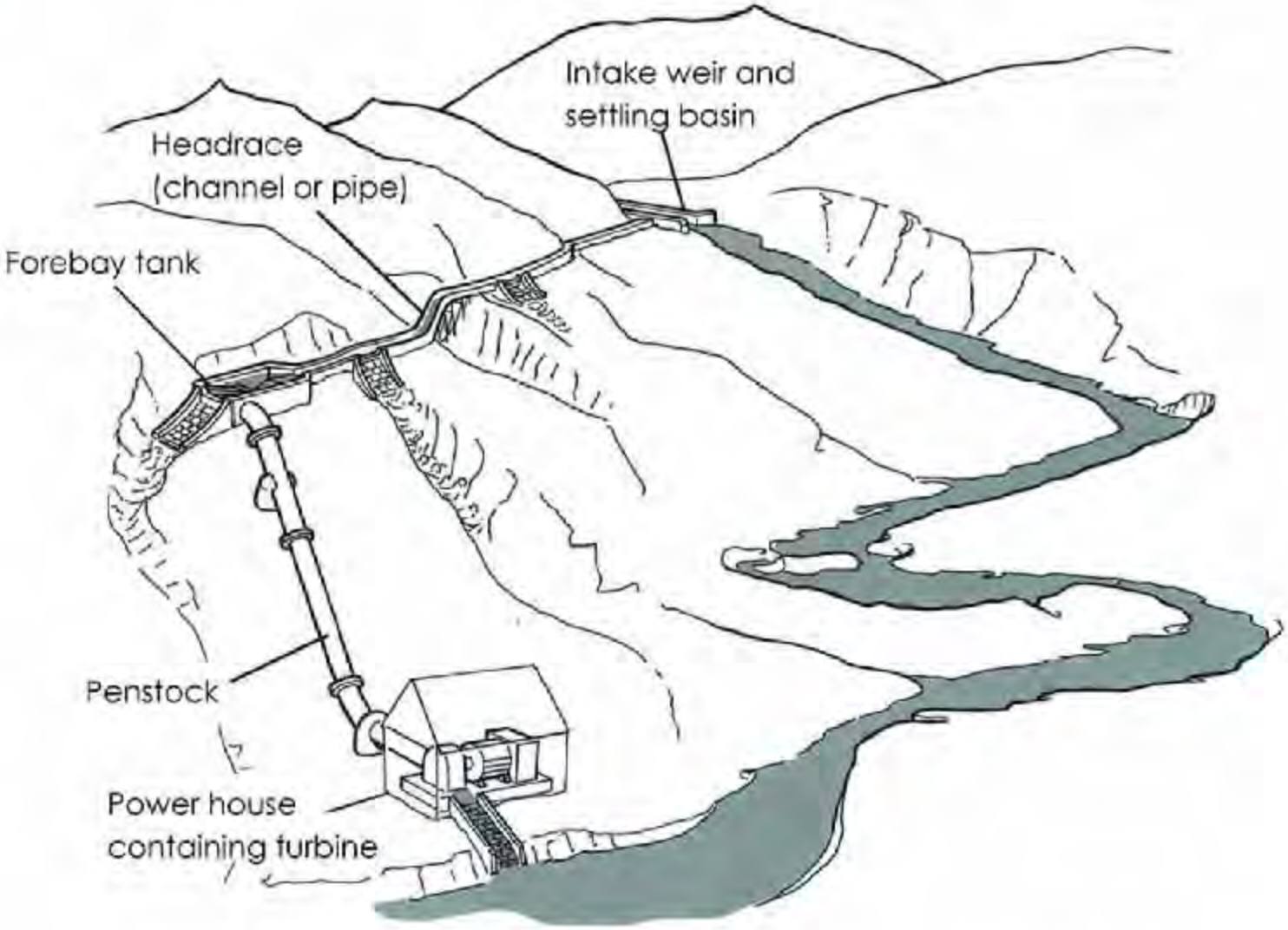
➢ What are the challenges in T&D industry domestically and globally and what strategy do you have to be at distinct edge over other companies in the similar range of products?

Toshiba has decades of manufacturing and supply experience around the world. Our Gas Insulated Transformers and outdoor Gas Insulated Switchgears and solid insulated switchgears will drastically reduce the land requirement for the substations bringing down the overall project cost especially in Metro cities. We can offer many cost effective solution to reduce the transmission losses and to avoid theft of electricity.

➢ What are your priorities and expansion strategies in India?

"India is a high-growth market that Toshiba has positioned as a strategic base for its power-related businesses. Our Hyderabad manufacturing facility will not only cater to Indian customers but will be a global manufacturing center for supply to many customers abroad.

"Toshiba is seeking to secure a 20 per cent share in T & D business of the Indian market by 2016, and also reinforce TTDI as a core T&D production base for other major markets, including Europe, ASEAN, and Africa."



Micro-Hydro Systems
in the Developing World -A Review

In the last decade, problems related to energy factors (oil crisis), ecological aspects (climatic change), electric demand (significant growth) and financial/ regulatory restrictions of wholesale markets have arisen worldwide. These difficulties far from finding effective solutions, are continuously increasing, which suggests the need of technological alternatives to assure their solution.

Dr L Ashok Kumar

One of the technological alternatives is named as Distributed Generation (DG), and consists on generating electricity as near as possible of the consumption site, in fact like it was made in the beginning of the electric industry, but now incorporating the advantages of the modern technology. Here it consolidated the idea of using clean non-conventional technologies of generation that use Renewable Energy Sources (RESs) that do not cause environmental pollution, such as wind, photovoltaic, hydraulic, etc.

Recently, a rising interest on grid integration of Micro-Hydro Power Plants (MHPPs) has emerged, mainly because they are a proven technology with a very good performance and feasible with low investment costs, resulting in the technology based on RESs with smaller costs even when are compared to wind generation. This trend is expected to be increased even more due to the high potential of application of MHPPs in DG and to the large amount of benefits for the use of renewable energy sources. These benefits include favorable incentives in many countries and the retributions coming from trading Carbon Emission Reduction (CER) credits that impact in the commercial acceptance of the technology.

A small-scale hydro power station (from pico to mini-hydro power plants) is usually a run-of-river plant that uses a fixed speed drive with mechanical regulation of the turbine water flow rate through adjustable guide vanes and runner blades for controlling the active power generation. This double-regulated design enables to reach high efficiency over a wide range of water flows but using a complex operating mechanism, which is in consequence expensive and tends to be more affordable for large-scale systems. It is estimated that, around two billion of the world's population have no access to modern forms of energy, such as electricity or fossil fuels. The vast majority lives in rural villages in the developing world, far from existing electrical grids and often scattered around the landscape, making distribution to individual houses difficult and costly. Therefore, the majority of these communities depend on human power and biomass alone, and as a result, time that could be spent on income generating activities is used up on time consuming daily tasks, such as collecting firewood. Such monotonous activities keep these people in poverty. Although monthly costs for electricity may be affordable, grid connection fees in remote areas are often very high. As a result alternative solutions to rural electrification are required. Stand-alone power generation plants can provide an answer since they remove the need for long and inefficient transmission lines. The option of local ownership, which could be financed by a community loan, can take away the need to deal with city-based energy tariffs, allowing flexibility in the supply options to include poorer households in the community. In addition, profits are kept within the local community, thereby contributing to the development of these areas. Where suitable resources are available, renewable energy systems such as micro-hydro, wind and solar are becoming a viable option for supplying sustainable power to rural areas of the developing world. However, to accomplish the objective of sustainably increasing electrification in these areas, the technology needs to be integrated into the local culture. Reliance on expensive imported parts and/or expertise is not a sustainable solution. The key features of a successful technology for increasing rural electrification in the developing world are considered to be

Where a suitable water source is available, micro-hydro is one of the most cost-effective energy technologies to be considered for rural electrification in the developing world

- Simplicity of design – local people should be able to understand the technology.
- Ease of manufacture – local people should be able to manufacture the system with the tools, materials and expertise available to them.
- Robustness – the technology needs to withstand extreme local conditions.
- Ease of maintenance – if it does break, local people should be able to fix it quickly and easily using locally available tools and materials.

Micro-hydro Power

Where a suitable water source is available, micro-hydro is one of the most cost-effective energy technologies to be considered for rural electrification in the developing world. Micro-hydro power is the generally accepted term for hydroelectric systems of 100 kW or smaller. Unlike conventional large-scale hydro, it generally employs run-of-river style techniques that store little or no water but allow the exploitation of the river's hydroelectric potential without significant damming. It is one of the most environmentally benign energy technologies available and has been proven to be extremely robust, with systems lasting for over 50 years whilst requiring little maintenance.

Principles of Micro-hydro

Micro-hydro turbines convert pressurised water into mechanical shaft power which can

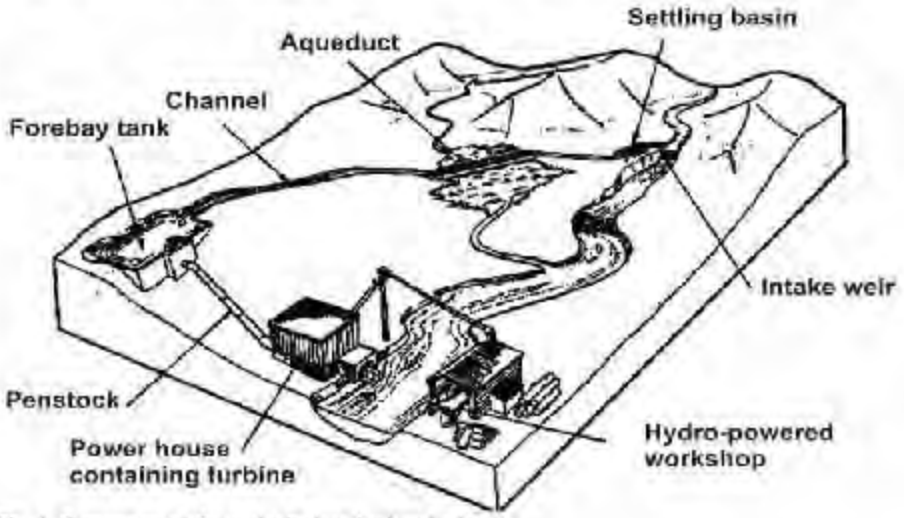


Fig. 1: Components of a typical micro-hydro site layout

then be used to drive other machinery, such as an electrical generator. The power available is proportional to product of pressure head & volume flow-rate of water through the turbine

$$P = QH\eta\rho g$$

Where,

P = Mechanical power produced at the turbine shaft (W)

Q = Volume flow-rate (m^3/s)

H = Effective pressure head (m)

η = Hydraulic efficiency of the turbine

ρ = Density of the water (kg/m^3)

g = Acceleration due to gravity (9.81 m/s).

Figure 1 illustrates a typical micro-hydro scheme. Water is taken from the river by diverting it through an intake at a small weir (a man-made barrier across the river which maintains a continuous flow through the intake). The water goes straight into a settling basin where it is slowed down sufficiently for suspended particles to settle out. A channel or canal then carries it to the forebay tank, which ensures that a constant head of water is maintained going into the penstock (a pressure pipe leading directly to the turbine). Finally, after extracting the energy from the flow, the water discharges from the turbine down a tailrace back into the river.

Micro-hydro System Components

Figure 2 shows how the component parts of a micro-hydro system convert power from one form to another as it flows through the system.

Turbines

A turbine converts the hydraulic power in pressurised water into mechanical power in the form of a rotating shaft. There are many varieties of turbine, each with its own benefits and drawbacks. However, the Pelton and cross flow turbines are the most widely used for micro-hydro power in the developing world, as they are reaction turbines. Unlike impulse turbines, which are the standard for larger scale hydro-power, they don't require expensive pressurised casings or intricately machined blade profiles. They are generally used for the high-head, low/medium flow sites which are commonly found at micro-hydro sites in the developing world. The Pelton turbine is simply a wheel with buckets attached around the circumference so that a jet of water causes it to rotate when it is directed in line with the buckets. Pelton turbines are very efficient, but it is difficult to align them correctly and/or cast good enough quality buckets. As a result, the cross-flow turbine is normally the most popular choice. It can be manufactured very easily by cutting pipe lengthways to make the blades and welding them between a pair of disks to make a drum shape. It operates over a wide range of head and flow rates and has good part-flow efficiency.

Drive Mechanisms

The purpose of the drive system is to take the rotational energy from the turbine and transfer it to the generator at the correct speed for power generation. A direct drive with the generator and turbine mounted on the same shaft (as shown in Figure 2) is the simplest option, but only available if the turbine rotates at the correct speed for the generator. Turbines usually rotate slower and therefore belts and pulleys, chains and sprockets or gears are often required to get the generator rotating at the required speed. As a general rule, the fewer mechanical components the better, as they increase the likelihood of failure from general wear and tear and will also lower the efficiency of the system.

Generators

Generators convert kinetic energy from rotation of the turbine into electrical energy. There are two types of generators suitable for micro hydro systems:

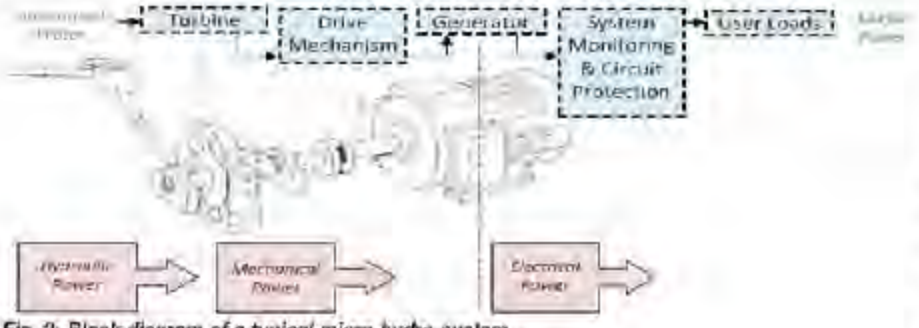


Fig. 2: Block diagram of a typical micro-hydro system

Synchronous Generators (Alternators)

Synchronous generators use permanent or electro-magnets to create the magnetic field required to generate a current in the output coil. Therefore, excitation of synchronous generators is not grid dependent, making them ideal for stand-alone power generation systems. In the case of off-grid use, a voltage regulator (usually built in) maintains a constant voltage irrespective of consumer load variations. The frequency generated by synchronous generators is directly proportional to the shaft speed, meaning that synchronous generators are easier to regulate.

$$rpm = \frac{120f}{p}$$

Where, rpm = shaft speed (rpm)

f = electrical frequency (Hz)

p = number of magnetic poles on the generator windings

Asynchronous (Induction) Generators

Asynchronous generators require external excitation to create the magnetic field required to induce the current in the windings that is necessary for them to start. This can be achieved by the use of a suitably sized capacitor(s) and an external DC source. In spite of this, asynchronous generators are generally the cheapest option for micro-hydro schemes below 30-50 kW, as induction motors (which are widely and cheaply available throughout the developing world) can simply be operated in reverse as induction generators. Above 30-50 kW, the excitation capacitors start to become expensive and synchronous generators become the more attractive option. For induction machines, the shaft speed and electrical frequency are non-linearly related:

$$rpm = \frac{120f}{p}(1 - s)$$

Where,

rpm = shaft speed in rpm

f = frequency

s = slip1 (varies between 0-10% depending on loading and size of the machine).

User Loads

The user loads are, ordinary electrical appliances, that the whole micro-hydro system has been designed to produce power in rural areas of the developing world, they will most commonly include lights, milling or crop processing equipment & perhaps a television or a radio.

We measure it. testo

Triple benefits of using thermography

Lesser Time for faster inspections

Lesser Efforts for efficient maintenance

at just ₹ 1.19* L

CALL NOW FOR FREE DEMO
+91 20 6560 0203

320 X 240* data points

wider angle

focus free imaging

larger display

Testo India Pvt Ltd

Head Office:
Plot No. 23, Sindh Society, Baner Road, Aundh, Pune - 411007, Maharashtra, India
Tel: +91 20 6560 0203 | Fax: +91 20 2585 0080 | Email: info@testoindia.com

Regional Offices / Representatives:
Ahmedabad | Baroda | Bengaluru | Chandigarh | Chennai | Guwahati
Hyderabad | Indore | Kolkata | Lucknow | Mumbai | New Delhi | Raipur

www.testo.in

MADE IN GERMANY

*Detector size 160 x 120 pixels, Upgradeable to 320 x 240 pixels with SuperResolution technology *Terms and Conditions apply

S540006D14ELECTRICALINDIA-DEC

Circuit Protection

Circuit protection devices are required to protect wires, connections and electrical equipment from an over current, e.g. short circuit. Excess current leads to excess heat or leakage current that makes the circuit protection devices open the circuit. This in turn also protects the people operating electrical equipment from electrocution. Circuit protection devices include: fuses, fuse elements, fusible links, circuit breakers, Electrical Surge Protection (ESP) etc.

System Monitoring Equipment

Throughout the operation of the Electronic Load Controller (ELC), its performance ideally needs to be monitored continuously, as in many cases, it would be almost impossible for the operator to know if the ELC is working as specified. Monitoring devices for both voltage & frequency should be used, showing continuous live data, as well as logging results at frequent time intervals to check the performance of the ELC and make sure the voltage or frequency is kept at acceptable levels.

Micro-hydro Control Systems

All electrical equipment is designed to operate at a specific voltage and frequency and operating off of these designed values can cause serious damage and reduce the life of the equipment. For example, an electric motor will over heat if the frequency is too high, or may burn out on starting if the voltage is lower than specified. As previously mentioned, when electricity is generated, its frequency is determined by the shaft speed of the turbine/generator and the number of magnetic poles in the generator (as well as the resistance within the rotor windings, known as slip, in the case of asynchronous machines). Although most synchronous generators have some form of voltage regulation, the voltage output will still be affected by shaft speed variations. Therefore, effective shaft speed regulation & control of real time load variation on the system is important in electricity generating systems to ensure that the voltage and frequency of the electrical power provided to the user loads remain constant and the turbine and generator do not spin dangerously out of control. There are two types of control methods suitable for micro-hydro systems:

- Mechanical Control and Electrical Control.

The Figure herein shows the diagram MHD with the both the controls.

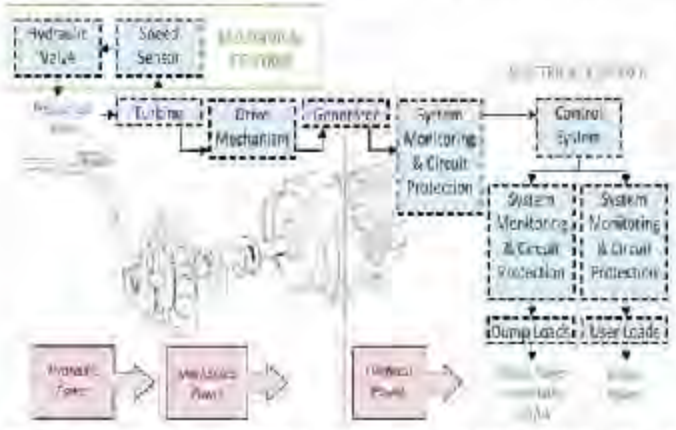


Fig. 3: Diagram of a micro-hydro system showing both mechanical and electronic control

Mechanical Control

A mechanical governor is essentially a valve on the turbine inlet that can be closed to restrict the flow (and therefore the power) going into the turbine to match the current electrical loading. Speed sensors on the turbine can be used to do this automatically, but such devices are expensive and as a result, many micro-hydro schemes in the developing world employ a permanent operator stationed in the power house to do this job by hand. Due to the dull, monotonous nature of this job, it can be very easy to lose focus, which could then obviously cause problems. Mechanical control is undesirable because it controls water flow directly and as a result has a slow reaction to load variations leading to difficulties when using sensitive loads that cannot withstand even short power fluctuations. They also contain many moving parts, which will inevitably require maintenance.

Electrical Control

Control of the voltage and frequency in a micro-hydro system can be achieved more easily by using an Electronic Load Controller (ELC). Electrical control is desired because it responds rapidly to user load fluctuations, can be built from cheap and widely available basic electrical components and it requires virtually no maintenance. On average the cost of an ELC is about 10% that of a mechanical governor.

Electronic Load Controller (ELC)

When equipped with an ELC, the turbine always runs at full power and shaft speed/frequency control is achieved by adjusting the electrical power output rather than the hydraulic power input. An ELC is an electronic governor that functions as a frequency and/or voltage regulator on a generator by diverting surplus electrical energy to a resistive dump load.

Dump Loads

In a micro-hydro system with electronic control, dump loads (also known as ballast loads) are activated by an ELC to dissipate power that is not required by the user loads. Dump loads are electrical resistive loads sized to equal or be slightly greater than the total power output of the generator. Usually ambient air or water heaters are used to get rid of the surplus power, however devices such as food dryers or kettles can make use of it if set up to do so.

Responding to User Load Variation

When the user load decreases, the power consumed reduces, but the power generated is kept constant. As a result, the turbine/generator shaft speed increases and therefore so does the electrical frequency/voltage. This change is detected by the ELC (by comparing the period of the sine waveform to a reference value), which then diverts the surplus power to a dump load. Figure 4 shows how the constant power generated is balanced with the varying user load by the addition of a dump load.

Automatic Control Modes

In the case of an ELC, either frequency or voltage is the variable that needs to be controlled. The difference between the measured value MV, (i.e. actual frequency/voltage generated) and the desired value DV, (i.e. the reference frequency/voltage) gives the error, e: MV – DV = e

The error is used by the controller to decide how much power to send to the dump loads. The PI controller is the preferred method of control for ELCs designed for developing countries, because it is inexpensive (compared to PID) and it returns the process to the DV.

Click to go online

Pioneering India's First Online Cable & Accessories e-shop

Lapp India, the 100% subsidiary of the Lapp Group Germany launches e-Shop – India's first of its kind online cabling solutions e-store. With this move Lapp India's products are now just a click away. Our widest range of cables, connectors, cable glands, conduits, accessories can be ordered from the comfort of your office or institution. With a legacy of over 50 years of trust and innovation, we are sure you would experience the difference when you enter the world of Lapp e-shop.

The e-shop advantage:

- Widest range of cabling solutions
- Order cables, connectors, cable glands, conduits, in small pack sizes
- Faster delivery
- Convenient and hassle free ordering from the comfort of your factory

FREE DELIVERY

www.thelappstore.com

/lappindia | /lappindia | /lappindia | /lappindia

Lapp India Private Limited
Plot No. 98 J & K, Jigani Industrial Area,
Phase II Anekal Taluk, Bangalore South - 560 105.
Customer Service No.: 9243350000.
Email : service@thelappstore.com, Website : www.lappindia.com

LAPP GROUP

Load Regulation Strategies

There are two main techniques employed for regulating how much power is sent to the dump loads.

Phase Angle Regulation

As Figure shows, at a specific moment (phase angle) during each half

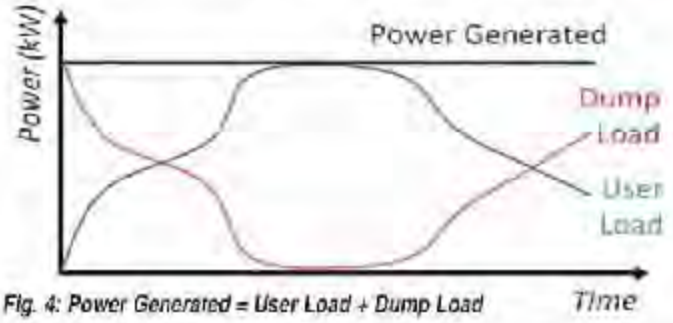


Fig. 4: Power Generated = User Load + Dump Load

period, a trigger signal is sent to a TRIAC, which opens the circuit connecting the dump load/s. The pathway remains open and power flows to the dump load/s until the current flowing through it drops to zero at the end of the AC half period (zero crossing). Calculating the correct phase angle at which the dump loads should be activated is vital, as this governs exactly how much power is sent to the dump load. Any combination of dump loads may be used, opening up the option of using food dryers or battery chargers. However, when a large dump load is switched on part way through the AC half period, serious harmonics are created within the generator current (this is worst when voltage is at its highest, i.e. at a phase angle of 900), thus the generator has to be over sized by approximately 25% to cope.

Binary Load Regulation

This involves using a series of dump loads, in which each subsequent dump load has twice the capacity. With n dump loads, a total of 2n can be activated, with each separate combination representing a different total dump load power. Power is dissipated in small steps by switching on and off different combinations of the dump loads. Thus each dump load is switched either completely on or completely off, avoiding serious harmonics. However, this method requires a large number of dump loads with specific capacities and as a result, it is unlikely that any of the surplus power can be utilized, e.g. by food dryers etc.

Analysis of Existing ELC Designs

ELCs perform quicker, last longer and cost less than their mechanical counter parts. However, they are not without limitations. Electronic systems are rarely well understood at a local level in the developing world. As a result, ELCs generally have to be imported and external expertise sought if any faults occur. Though ELCs are cheaper and better performing than mechanical governors, they are normally the most expensive part of a micro-hydro system. There is a need for robust ELC that can be produced from simple electronic components by local electricians in the developing world. A number of designs are already available.

Hummingbird ELC: is designed for a single phase synchronous generator, but by changing/adding a few components, it's also possible to use an asynchronous generator. Although the Hummingbird ELC closely matches most of the requirements for suitability of use in the developing world, it uses a huge number of components (possibly to address the cost issue, i.e. a number of cheap components in place of a single expensive one). This makes the circuit relatively complicated and as a result, hard to manufacture, install, test and repair by the locals in the developing world.

Homo Luden's (HL) ELC: is a digital development of the Hummingbird, and is designed for up to 25 kW, single-phase synchronous off-grid generators, working at 220-240 V, 50 Hz and using up to eight dump loads. The HL ELC could also be used on 120 V systems by using an appropriate step down transformer, limiting it to half the power. It can also be configured for any other reasonable frequency, simply by changing the parameters within the software. A similar design is marketed by Indonesian based Reconersys as a Digital Load Controller).

The HL ELC also uses frequency as an input signal, and just like the Hummingbird, it uses PI control and phase angle regulation with TRIACs. However, the main component of this ELC is the PIC microcontroller, programmed to undertake most of the tasks within the circuit and thus reducing the number of components required.

ELC design specification: The ELC must -

- Maintain constant frequency/voltage from the load side of the system by constantly measuring the frequency/voltage, instantly recognizing load variations, and then automatically activating the dump loads as required to match the difference between input power from the generator and the output power to the user loads.
- Be robust and inexpensive. Be modular, for easy maintenance.
- Use minimal components with no moving parts to reduce the amount of maintenance.
- Be relatively easy to install, avoiding the need for specialist personnel and equipment.
- Operate with either synchronous or asynchronous generators, at 50 or 60 Hz and with single or three phase systems.
- Use load priorities action during periods of high demand to avoid overloading the generator.
- Have a self-diagnostic function for dump load circuit faults to facilitate maintenance.
- Have system monitoring capabilities that allow real time viewing of the output voltage/frequency.

Dr L Ashok Kumar

BE (EEE), ME (Electrical Machines) MBA and PhD is working as a Professor in the Dept. of EEE, PSG College of Technology, Coimbatore. He has got 16 research projects from various Government funding agencies, published 72 Technical papers & presented 69 research articles in many Conferences. He is a recipient of many National and International Awards. He is a member of various National & International Technical bodies like ISTE, IETE, TSI, BMSI, ISSS, SFSI, SSI, CSI & TAI. His areas of specializations are Wearable Electronics, Power Electronics & Drives and Renewable Energy Systems.

Search Citizen Metalloys Ltd

Web Images Maps More Search tools

About 5,050 results (0.24 seconds)

Citizen Metalloys Ltd
www.citizenmetalloys.com/

We are one of the leading manufacturer of world class quality, **Oxygen free & ETP Grade High Conductivity Copper Components with Machining, Forging, Forming, Punching, Bending, Drilling, Tapping, Plating** in India.

We are the first manufacturer of **Copper extruded products & components** in India having **ISO 9001:2008 :: 14001:2004 & BS OHSAS 18001:2007** and **Government Recognized Export House.**

Personifying Copper

CITIZEN METALLOYS LTD.

Registered Office :
808,Sukh Sagar Complex,
Nr. Hotel Fortune Landmark,
Usmanpura, Ashram Road,
Ahmedabad - 380 013.
Gujarat, INDIA.

Phone : +91- 79 - 275 50 272
+91- 79 - 329 11 875
Fax : +91- 79 - 275 50 240
Email : info@citizenmetalloys.com
sales@citizenmetalloys.com
Visit us : www.citizenmetalloys.com

Benefits / Features of CITIZEN's Product
www.citizenmetalloys.com/products.html/

> Higher Conductivity for current carrying capacity
> Excellent dimensional surface finishing for superior contacts
> Crack - free Bends
> High efficiency with less labour effort.
> Excellent straightness

Government Recognized Export House

ISO Certificate

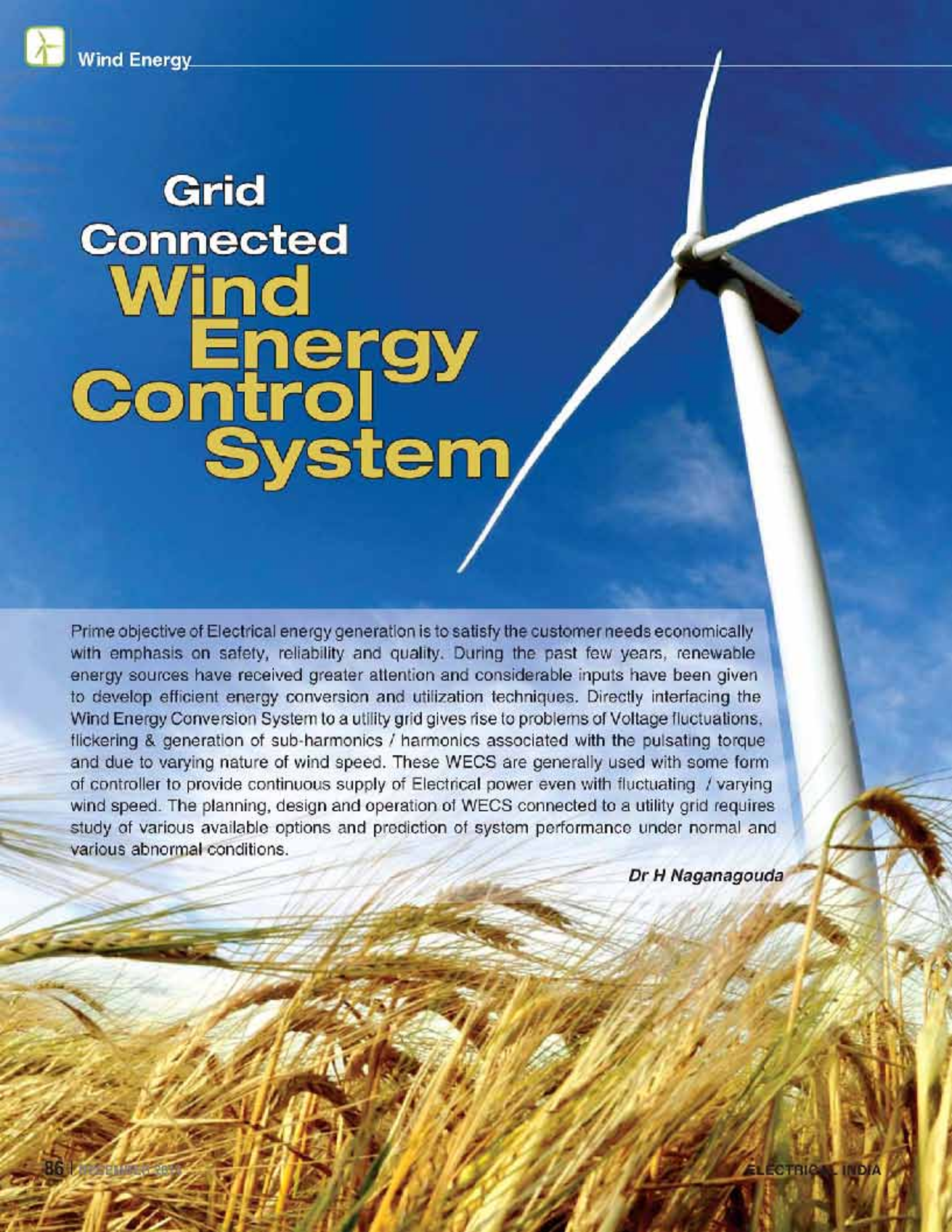
Images for Citizen Products




Seaaaaaaaaarch

1 2 3 4 5 6 7 8 9 10 Next

Grid Connected Wind Energy Control System



Prime objective of Electrical energy generation is to satisfy the customer needs economically with emphasis on safety, reliability and quality. During the past few years, renewable energy sources have received greater attention and considerable inputs have been given to develop efficient energy conversion and utilization techniques. Directly interfacing the Wind Energy Conversion System to a utility grid gives rise to problems of Voltage fluctuations, flickering & generation of sub-harmonics / harmonics associated with the pulsating torque and due to varying nature of wind speed. These WECS are generally used with some form of controller to provide continuous supply of Electrical power even with fluctuating / varying wind speed. The planning, design and operation of WECS connected to a utility grid requires study of various available options and prediction of system performance under normal and various abnormal conditions.

Dr H Naganagouda

Based on the performance requirement & for safer system operation and required control system, the microprocessor based controller programme has been developed in FORTRAN language by developing suitable algorithms incorporating the above requirement. The computer program developed has been used to tap/regulate the unregulated MINI / MICRO Non-conventional power sources. Analysis & simulation has been carried out for the Steady State Analysis Simulation and Simulation With Dynamic Effects.

Wind energy has become a prominent source in the present global energy picture. The average power output of a WEG is very important parameter for an economical viability of the project. Selection of Wind Turbine Generator determines the total energy production and total income and also it demands good knowledge of wind related characteristics such as site selection and energy output. There are many different types of WEG'S commercially available in the market for power generation. Therefore, it is necessary to select a best suited WEG'S for a particular site, regardless of turbine size.

In case of conventional source of energy, we have controllable input, so the amount of power developed can be easily estimated. But for wind power the position is different, neither the performance of the wind did indicate by its efficiency as a power unit, nor its annual output of energy can easily be measured or predicted in advance for two reasons, viz.

- Wind speed and the power input to the machine and
- The annual output of energy.

Is influenced greatly by the precise location (micro siting) of the wind Electric generator installation in a given area, for which, the general value of the annual mean wind speed may be known. The general objective in designing a WECS is to adequately match the wind energy conversion system (WECS) capabilities to the load requirements with a minimum cost of the system to the consumer. The production of electricity by a WEG at a specific site depends on many factors. These factors include the mean wind speed of the site and more importantly, the characteristics of the WEG itself, especially

There are many different types of WEGS commercially available in the market for power generation. Therefore, it is necessary to select a best suited WEG'S for a particular site, regardless of turbine size

the hub height, cut in (UC), rated (UR) and furling (UF) wind speed of the machine.

Microprocessor Based Control System

The planning, design and operation of WECS connected to a utility grid requires study of various available options and prediction of system performance under normal and various abnormal conditions. Such as

- Technical issues.
- Control aspects and
- Wind turbine control systems.

The wind turbine is designed to be a fully automatic piece of power production equipment for use on a utility grid.

Need for Control

Based on performance requirement mentioned in the last section it is clear that certain parameters are needed to be controlled for the desired operation of the system. The term control is widely used to describe variety of control functions to obtain automated operation of industrial systems. The necessity for automated operation can be attributed to various factors mentioned above. Every system is designed to give maximum output at its designed condition only, but if the parameters governing maximum output are controlled in some manner, desired output can be obtained under different operating conditions.

Apart from this, control systems are needed for safer system operation. Further the designers of wind turbines feel the need for control as large variation of wind gives stresses to component like blade, generator system & tower. By suitable controls stresses can be relieved. The block diagram of various control systems and functions as shown in Fig. 1 and brief description of control systems as follows.

Types of Control Systems

Addition of controls to any system means increases in the cost of the system. The cost proportion is significant for smaller systems while it forms a smaller overall cost for bigger systems. Keeping in mind above criteria control systems for WECS is classified as:

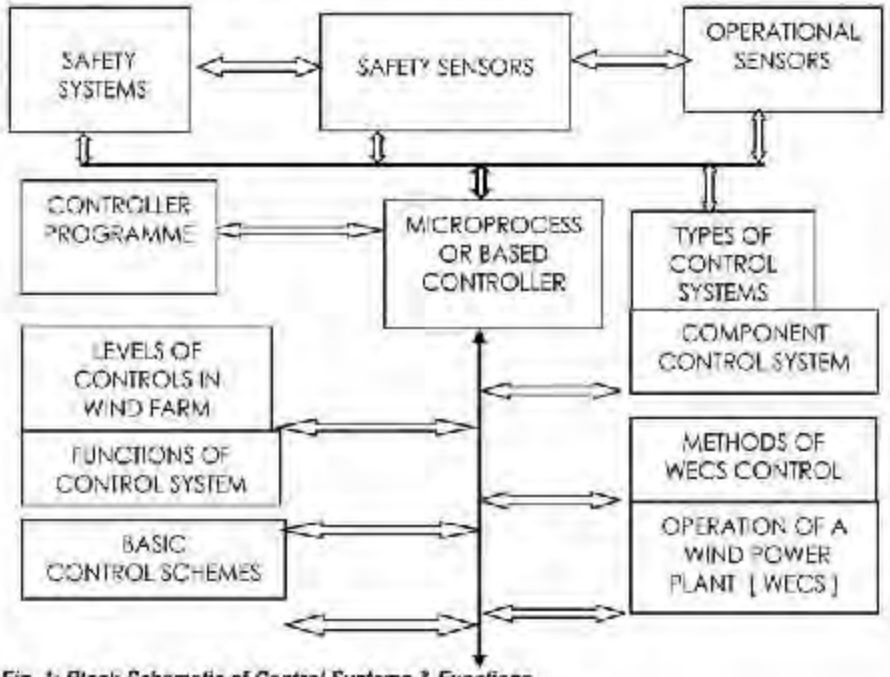


Fig. 1: Block Schematic of Control Systems & Functions

Passive Controls

In this scheme, systems make their own sensing & use natural means for there actuation. Also the controls for smaller systems should be simple and passive. In applications like water pumping, corn grinding etc, passive controls used.

Active Controls

Active controls use transducers to sense the variables to be controlled like wind velocity, wind direction, pitch angle etc. Active controls use electrical, mechanical hydraulic, pneumatic or other means in combination to suit the desired purpose. This allows a great deal of flexibility in control strategies for larger systems. Active controls are complex and expensive, so they must be applied for sophisticated applications only.

Functions of Control System

Requirement of safe and efficient operation of WECS asks for following control functions. To control desired power output from system.

- To regulate speed thus preventing over speeds.
- To protect rotor and other systems from high winds.
- To enable automated systems operation.
- To keep turbine aligned with wind.
- To monitor voltage and frequency conditions of system and utility.
- To protect WECS against electrical surges.
- To protect system against malfunctioning of wind machines and warn the operator for its repair or maintenance.
- To improve quality of power output from system.
- To increase reliability of the system.

Levels of Controls in Wind Farm

A typical turbine will operate under the influence of a number of control systems. The level of these are classified as:

- Wind Farm Control System
- Machine Control System.

Component Control System

The control system for wind turbine is applied to component level in this classification. Typical examples are generator AVR controller, YAW motor controller etc. Parameters to Be Controlled: Based on functions desired from WECS & after analyzing characteristics of wind energy conversion system, parameters desired to be control can be listed as-

Power Output

The maximization of energy capture from available wind is the ultimate aim of any design. The power curve of each generator is traced by certain controls to do this. Popular methods for controlling power are-

- Pitch control and
- Stall control
- Sliding leading edge control
- Flying leading edge control

Speed of Turbine

As wind speed is fluctuating, in order to get stable operating point, speed of turbine is required to be controlled. To maximize energy capture, speed control is required at two speeds.

Cut in speed: The speed at which turbine starts producing useful power is called cut in speed. In low wind sites, low cut in speeds are desirable.

Cut out or Furling speed: The wind velocities above which wind turbines are required to be stopped for safety reasons are called cut out speed. At these speeds, control system comes into play & lock machine either by

- Mechanical braking.
- Aerodynamic feathering.
- Yawing out of wind.

Voltage and Frequency

For grid connected wind electric generators it is essential to meet grid voltage and frequency requirements for synchronization in case of Synchronous generator. Sampling electronic controls does this.

Miscellaneous

Apart from above mentioned controls there are certain parameters required to be controlled from safety point of view. They are listed below.

- Temperature of gearbox, winding of generator., Oil level in gearbox.
- Cable twist., Direction of rotation.
- Hydraulic system operation., Lightening protection.

Controls of above-mentioned parameters are done through various practical control strategies.

Methods of Wecs Control

Based on the fundamentals, following schemes are commonly adopted and broadly classified as:

- Mechanical control methods.
- Aerodynamic control methods
- Electrical control methods
- Yaw control.

Micro Computer

A possible system block diagram of a wind energy conversion system as shown in Fig. 2. In this system, the microcomputer accepts inputs such as wind speed, direction, turbine speed, load requirements, amount of energy and voltage and frequency being delivered to the load. The microcomputer sends signals to the turbine to establish proper yaw (direction control), blade pitch and to set the brakes in high winds. It sends signal to the generator to change the output voltage if the generator has a separate field. It may turn off non-critical loads in times of light loads and it may turn on optimal loads in strong winds. It may adjust the power conditioner to change the load voltage and frequency.

The above system is called an asynchronous system and it has special mode of operation that electric utilities do not have. The turbine speed can be controlled by the load rather than by adjusting the turbine. Electric utilities do have

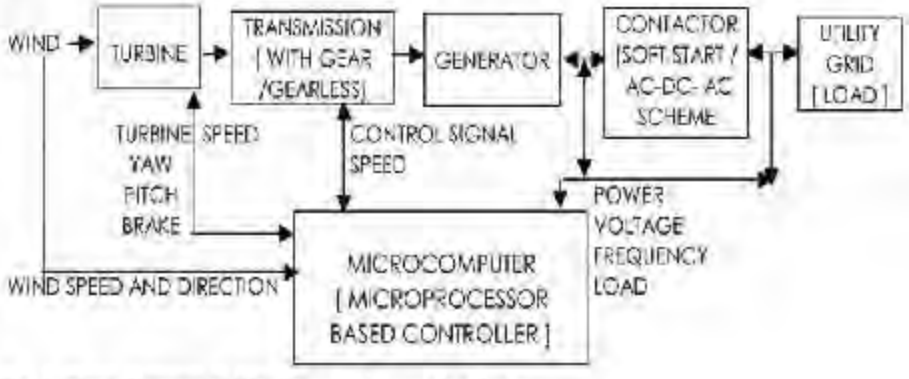


Fig. 2: Block Diagram of Wind Energy Conversion System

Lighting India

SUBSCRIPTION FORM

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

The Subscription In-charge
Lighting India
Chary Publications Pvt. Ltd.
201, Prema aya, Next to Cafe Coffee Day,
Opp. Telecom Factory, Deonar, Mumbai - 400 088.
E-mail: sub@charypublications.in

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

Yes, I would like to subscribe **Lighting India** for.....

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. ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

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

Card Expiry Date: ☐☐ ☐☐☐☐ (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)	3000	700	

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

EI \ December 2014

Contents of the magazine :

- Articles on various subjects related to the Lighting Industry. Eg. LEDs, stage, aquarium, kitchen, garden, bedroom, architechtural, monument, office, hospital etc.
- Articles on energy conservation
- Who is who of the Lighting Industry
- Around the world (international news)
- Automobile lightings
- Design, engineering & consultancy services
- Rural electrification
- Event management & trade shows
- Letter to the Editor
- Interviews
- Advertorials
- Trade Window
- Brochures
- Product News
- Application Oriented
- Opinions and Open Forum
- Lighting Education

... and much more.

Major Industries covered :

- Shopping Plazas, Cinema Halls and Theatres
- Entertainment Industry: eg. Hotels, Restaurants, Gymnasium & Malls
- Stage & Studio Lighting
- Automobile Industry
- Manufacturers
  - Lighting
  - Machine
  - Neon Lamp
  - LED
  - Pole
  - Switch & Switchgear
  - Decorative Luminaire
  - Electric Measuring Instrument
  - Glass & Glass Furnace
- Suppliers
  - Chemical
  - Gas
  - Starter
  - Cable Wire
  - Lighting Products
  - Lamp Component
  - Brass Component
  - Electric Component
  - Plastic Component
  - Steel Component
- Research & Testing Laboratories
- Electronics in Lighting
- Furnace Refractories

... and related accessories

Reach :

- Top industrialists
- Manufacturers
- Lighting Engineers & Designers
- Architects
- Interior designers
- Event Managers
- Consultants, Contractors & Traders, Project Managers
- Plant Engineers Of Large Companies
- Builders & Developers
- Mechanical & Electrical Engineers
- Lighting Products Manufacturers, Suppliers & Distributors
- Entertainment Industry
- Construction Industry
- Hotels & Restaurants
- Fitness Centers
- Hospitals
- Airports Authority Of India
- Importers & Exporters
- Municipal Corporations All Over India
- Government Utilities :
  - Ministry of Power
  - Central Public Works Department
  - Electricity Utilities
- Non-conventional energy providers
- Manufacturers from other allied industries
- Universities, Technical & Research Institutions

Among Several Others.....

Power Transformer
Loss Measurement System

Discover the AccuLoss™ Difference

- Highest Accuracy Available
- Upto >200kV (line-ground), 5000A
- State of the Art Technology
- Exceptional Reliability
- Operator Friendly Software
- Proven in Manufacturing Environments

The measurement of electric power and energy at high voltages and currents at low power factors is becoming increasingly important economically as a way to reduce costs in an ever-growing industrial economy. Today the transformer purchaser subjects the transformer manufacturer to an economic penalty for losses that occur in load and no-load conditions. To keep these penalties as low as possible, it is important that the manufacturer accurately measure these losses.

Our Product Range:

Calibration Test Benches, Winding Resistance Ohmmeters, Micro Ohmmeters, Transformer Turns Ratio Meter, Insulation Testers, Capacitance & Tan Delta Test Kit, Strain Measurement Systems, High Voltage Standard Capacitors, Power Loss Measurement System for Power Transformers & Shunt Reactors, HV Testing Equipments, CT / PT Test Set, AC Power Standard, Temperature Calibrator, Pressure Calibrator, Multifunction Calibrator, Process Calibrators, Reference Temperature Probes, Precision Thermometry Bridges, DC Metrology Standard, Standard Resistors, Calibration software.

Contact us at

sales@milp.co.in

+91-11-64691012/64691074

Measurements International LLP

Metrology is Our Science, Accuracy is Our Business

some load management capability but most of their load is not controllable by the utilities. The utilities therefore adjust the prime mover input (by a valve in a streamline, for example) to follow the variation in load. That is, supply and demand. In case of wind turbines, the turbine-input power is just the power in the wind and is not subject to control. Turbine speed still needs to be controlled for optimum performance, and an electrical load with the proper characteristics can accomplish this. A microcomputer is not essential to this mode of operation, but does allow more flexibility in the choice of load. The basic rule is to not go to any higher form of work than is necessary to do the job. Fixed frequency & fixed voltage system represents a higher form of work than variable - frequency, Variable - voltage systems. so the actual needs of the load need to be examined to determine just how sophisticated the system really needs to be. If a simple system will accomplish the task at less cost, it should be used.

Operation & Monitoring of a Wind Power Plant

After describing each control mechanism individually it will be appropriate to describe operation of wind power plant so as to realize the importance of controls for system operation.

First the system control supply is started to power micro-controller, this controller checks input from anemometer, wind vane, temperature of windings of generator, pressure of hydraulic unit, status of over current relay, line voltage and frequency etc. After getting all clear from farm control loop, machine is yawed in direction of wind, when wind is above cut in brakes are released to accelerate rotor, after which pitch changing mechanism is initiated to get rated rotational speed, voltage is applied to generator through a soft start mechanism at this stage. Once the power generation starts capacitors are brought in circuit by switching mechanism. During the operation all parameters are continuously monitored by micro-controller and desired output is traced by the system. In the event of any abnormality controller displays the fault conditions and warns operator by sounding annunciation, which is required to be reset manually. The common abnormal conditions occur in the WECS operation is;

- Loss of supply, Voltage drop in supply and Frequency variation
- Sudden increase or decrease in wind speed
- Vibration in nacelle
- Short circuit in system and Lightening stroke etc.

In these abnormal conditions, controls should function properly to stop machine safely. Out of these lightening is the most dangerous condition as it leads to surges in micro-controller and sensors, which may lead to damage or malfunctioning of whole system, to prevent this adequate earthing of WECS is a must.

Computer Simulation of Induction Generator Behaviour using the Steady

State Model with Grid Connection

A computer program controller has been developed to track and extract maximum power from the wind energy system (WES) & regulate the unregulated MINI / MICRO Non-Conventional energy sources and /or for the dynamic digital simulation of a Wind Energy Conversion System (WECS) connected to weak utility grid with more realistic representation of terminal components. These simulated results are found good to give power-tracking performance and regulating the voltages under normal and abnormal conditions such as single-phase fault, three-phase fault & unbalanced voltages have been obtained with certain specified system conditions and controller constants & also Computer simulation is carried out to predict these system performances at a given input power from the turbine. Effects of variation in grid voltage, frequency, input power and terminal capacitance on the machine and system performance are studied.

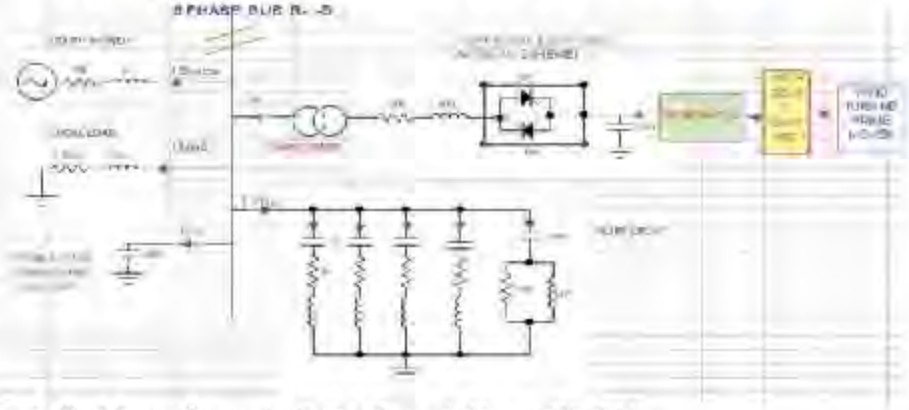


Fig. 3: Wind Energy Conversion System Connected to an utility Grid

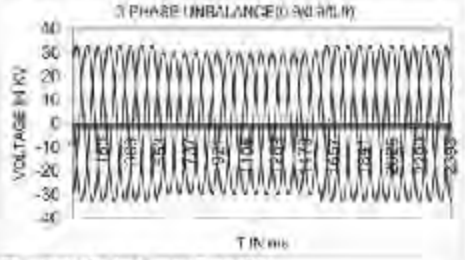


Fig. 4(a): Unbalance Condition

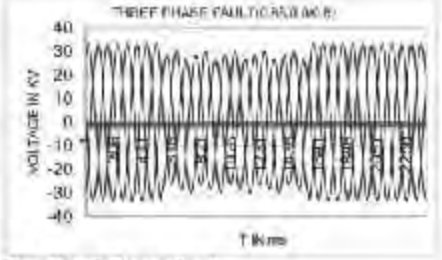


Fig. 4(c): 3 Phase Fault

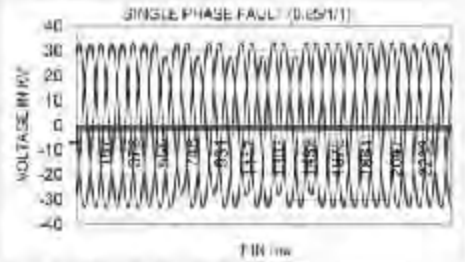


Fig. 4(b): Single Phase Fault

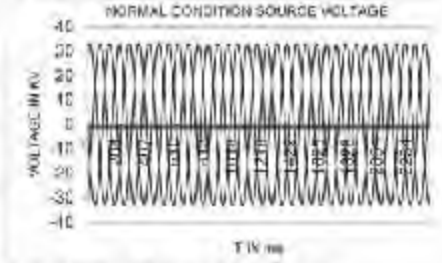
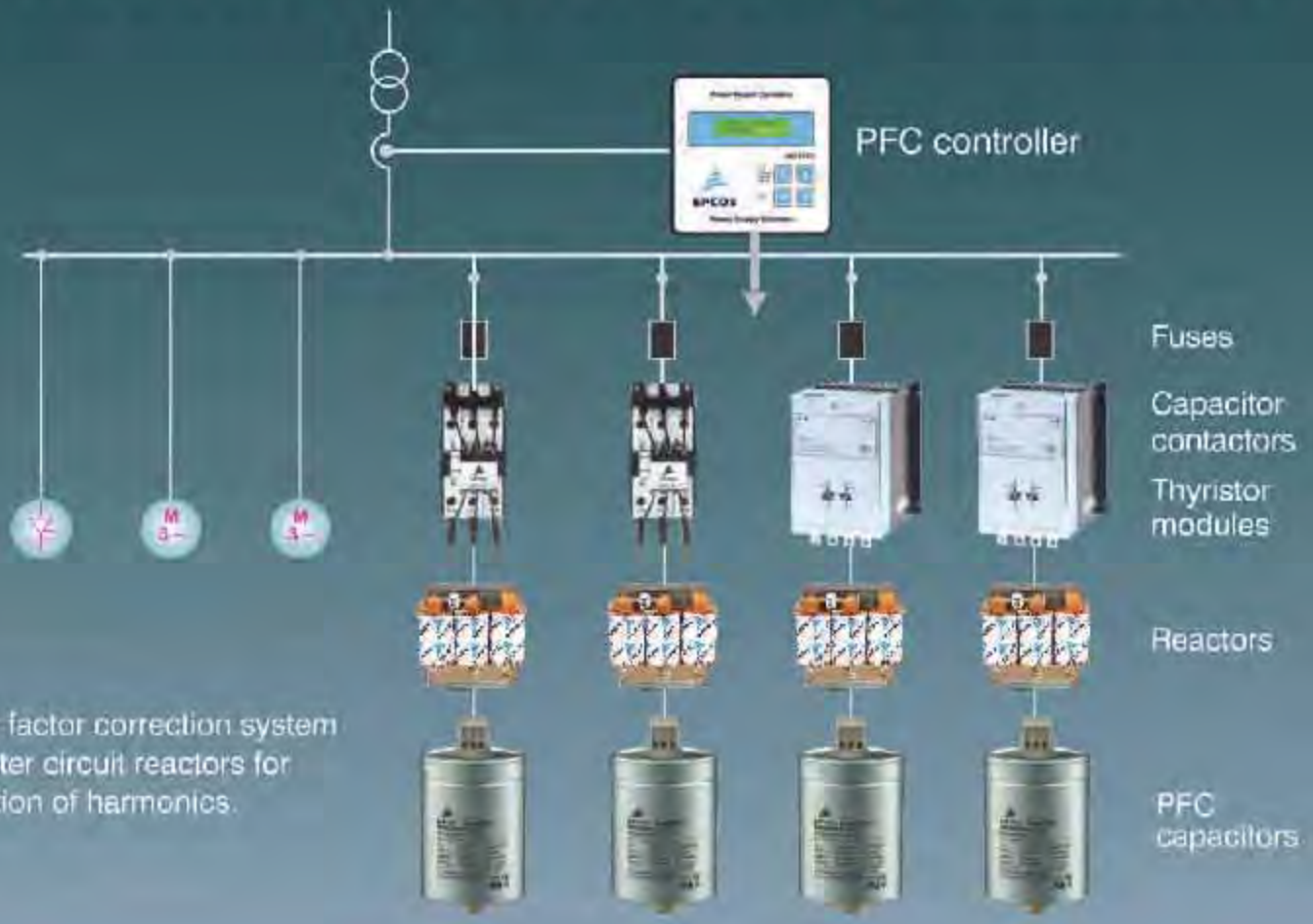


Fig. 4(d): Under Normal Condition

TDK

Superior Solutions for
Reactive Power Compensation.



Power factor correction system with filter circuit reactors for reduction of harmonics.

EPCOS

EPCOS PFC capacitors

- SquareCap: ND, HDLL, SHD
- PhiCap: ND, HD
- PhaseCap: Gas-filled
- APP: LV, MV

EPCOS key components

- PF controllers
- Capacitor contactors
- Thyristor switching modules
- De-tuned filter reactors

EPCOS India Pvt. Ltd. · A Member of TDK-EPC Corporation · www.global.tdk.com

Mumbai: 022-2575 0800 · Noida: 0120-450 5801 · Kolkata: 033-2419 8815 · Bengaluru: 080-4039 0640 · sales.in@epcos.com

A model of the various essential components of a WECS with an asynchronous link connected to a utility grid as shown in Fig. 3 is developed and simulated.

Results of Simulation

Dynamic Digital Simulation

Using the program developed, the results of dynamic digital simulation of a WECS connected to utility grid under normal and a few abnormal conditions such as single-phase fault, three phase fault & unbalanced voltages have been obtained with certain specified system conditions and controller constants. For simulation

- Grid is considered to be weak with AC harmonic filters.
- Equidistant pulse control scheme is used and
- For WECS, the control is such that maximum power is tracked.

In general, the program is run for about five cycles with appropriate initial conditions for the system to attain steady state conditions and then the results for the required disturbance is obtained. Various quantities during before and after the occurrence of fault (magnitude of source voltage are reduced R, Y and B to 0.9 times their normal value for unbalance condition, for single phase fault R-phase reduced to 0.65 times and for three phase fault R, Y and B phase are reduced to 0.65,0.9 and 0.8 times their normal value respectively) & for normal operation waveform for five cycles are shown in Figures (4A, 4B, 4C & 4D). It can be seen that the system is returning to normal conditions rather slowly. If the severity of the fault is increased beyond the set value, it leads to commutation failure.

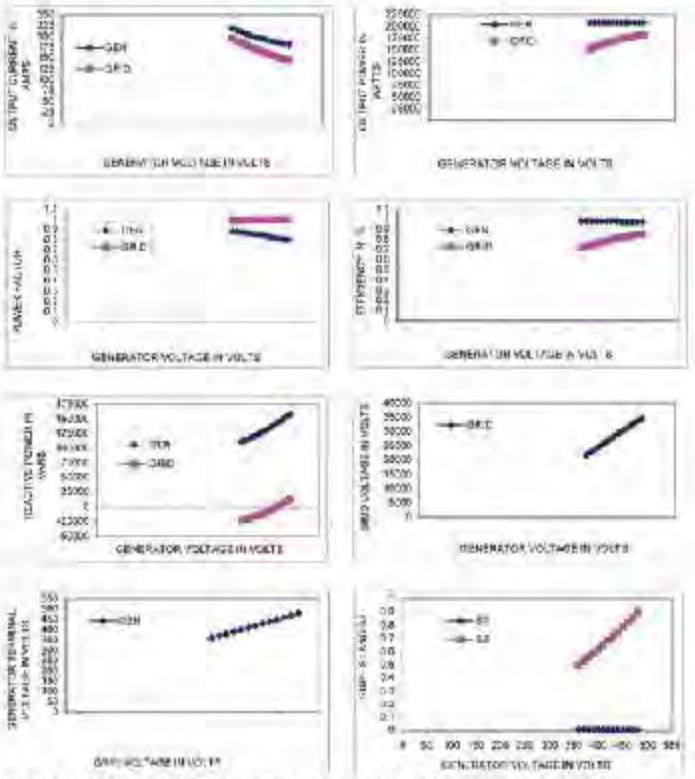


Fig. 5: 225 KW Grid Connected Windelectric Generator at Variable Generator Voltage at Constant Input Wind Power and Frequency

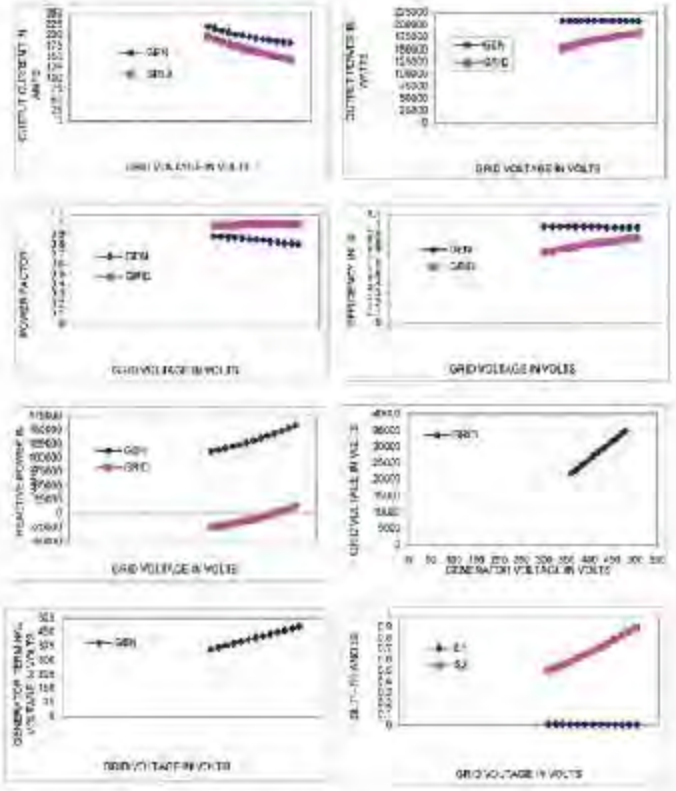


Fig. 6: 225 KW Grid Connected Windelectric Generator at Variable Grid Voltage at Constant Input Wind Power and Frequency

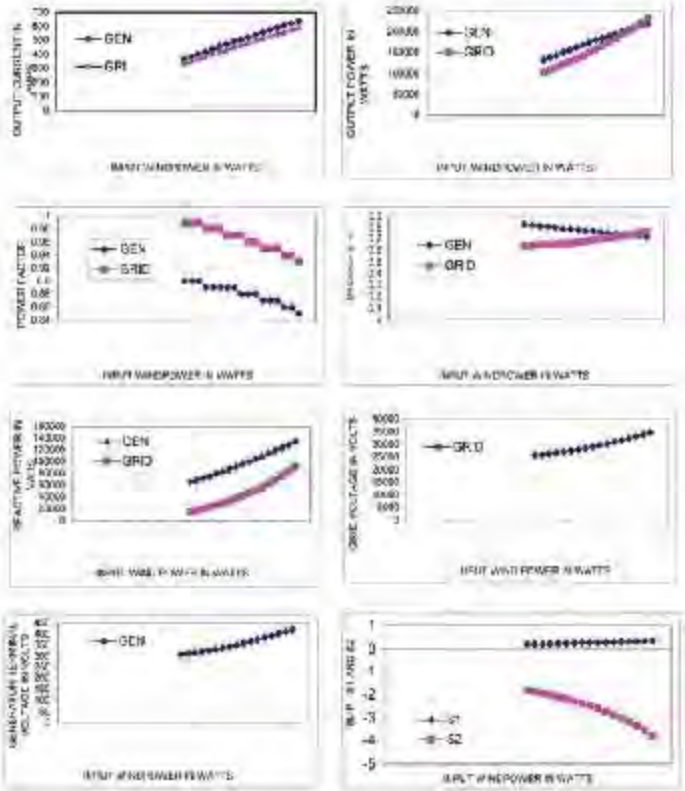


Fig. 7: 225 KW Grid Connected Windelectric Generator at Variable Input Wind Power at Constant Voltage And Frequency

GIANTLOK®

CABLE TIE AND FASTENING SYSTEM

CABLE PROTECTION

CONDUITS AND FITTINGS

WIRE TERMINATION

TOOLS

Leading Wiring Accessories, Cable Ties, & Wiring Management Solution Provider

For more information, please visit us at: www.giantlok.com

Corporate Office India
GIANTLOK INDIA PVT LTD.
#43, 2nd Floor, Community Center
Naraina Industrial Area,
Phase-1, New Delhi-110028, India
Tel.: +91-11-47001540
Fax.: +91-11-47001525

TAIWAN HEAD OFFICE
GIANTLOK CO., LTD.
1, 26th Rd., Taichung Industrial Park,
Taichung, Taiwan
http://www.giantlok.com
Email: service@giantlok.com

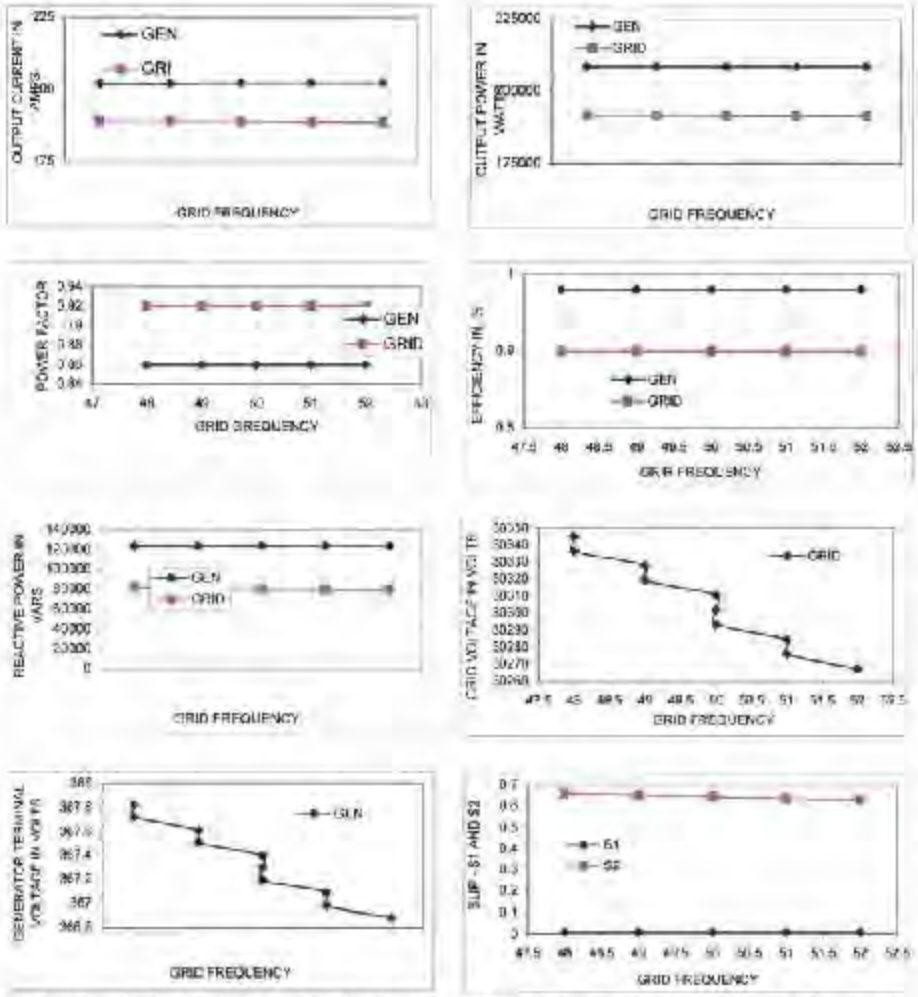


Fig. 8: 225 KW Grid Connected Windelectric Generator at Variable Grid Frequency at Constant Voltage and Input Wind Power

Steady State Condition Simulation

Analysis has been carried out by varying independent variables, the results are as follows.

- Variation of the dependent parameters with change in grid (generator) voltage keeping the input wind power and grid frequency constant. The following behavior is observed and plotted with rise in voltage as shown in Fig. 5 & 6. The Output current, Real power output, Reactive power input and Efficiency increases & Power factor & Slip decreases.
- Variation of the dependant parameters with the input wind power, keeping the generator voltage and grid frequency constant. The following behavior is observed and plotted with rise in input wind power as shown in Fig. 7. As the input wind power rises, the Output current, Real power output, Reactive powers and Power factor increases & Efficiency decreases slightly.
- Variation of the dependant parameters with grid frequency keeping the input wind power and generator voltage constant. The following behavior is observed & plotted with rise in frequency as shown in Fig. 8. As the frequency increases, current decreases, power output slightly increases.. Reactive power reduces and power factor increases and efficiency remains constant.

Conclusion

Dynamic Digital Simulation

The computer program developed has been used to regulate the unregulated MINI / MICRO Non- Conventional power sources and for the dynamic simulation of a WECS connected to a weak utility grid with more realistic representation of terminal components. The capability of this program has been demonstrated by simulating normal and few abnormal conditions on a WECS connected to a weak utility grid. Due to modular structure of the program, any control strategy on the performance of the system can be studied. The program can be easily extended to test new ideas, concepts and control strategies and hence to assess their effects on the system performance.

Steady State Condition Simulation

Behavior of normal Induction motor operating as a generator driven by wind turbine feeding power to a 33 kV grid through a step up transformer is studied. System representation has been made realistic by taking into account actual operating parameters of the machine, transformer and line impedance and short circuit reactance of the grid. A simple computer algorithm has been developed to determine the system response at constant input. Studies are made considering the variations in grid voltage, grid frequency and power input. Following are the major observations based on this analysis.

- A normally designed induction motor can perform well as a generator feeding Power to a 33 kV grid.
- Deterioration in performance due to fluctuations in grid voltage and frequency is not very appreciable for the range of variations. Varying Voltage from 22kV to 34.5 kV & frecuency from 48Hz to 52 Hz.
- Connecting a terminal capacitor of suitable value the system power factor can be improved at nominal output power. This also results in marginal improvement in system efficiency, with reduced losses.
- Induction generator can be effectively used with varying power input (as with a wind turbine), maximum power being limited by machine capacity. Terminal capacitor considerably improves system efficiency.

Dr H Nagaraj Gouda BE, ME, M.I.S.T.E, F.I.E, C.E, PhD is Director National Training Centre for Solar Technology, Karnataka Power Corporation Limited, Bangalore.

HIGH VOLTAGE TEST & MEASURING SOLUTIONS
FOR MULTIPLE APPLICATIONS


Impulse Voltage Test System


Partial Discharge Test Set


Impulse Analyzer


HV AC Series Resonant Test System


Static Frequency Converter

Transformer Loss Measuring System

About Us:

KVTEK is an ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007 Certified Company.

KVTEK Designs and manufacture the technically advanced products for High Voltage, High Current, High Power Testing applications and Electrical Measuring instruments.

We aim to provide the best quality products at most competitive prices and we pride ourselves on providing the best after Sales Support.

KVTEK products are used for wide range of electrical applications which include the following:

- Routine and type testing by electrical equipment manufacturers like Power and Instrument Transformer, Cable, Switchgear, Motors and Generators.
- Test Labs for conducting third party testing.
- Utilities for conducting residual life assessment tests and regular maintenance tests.
- Educational Institutes.

KVTEK also undertakes consultancy for designing HV Labs suitable for PD & Impulse Testing.

We offer the following services:

- Upgrade, update and refurbishment of existing Test Systems.
- Erection, commissioning, repair and re-commissioning.
- Operational training of Test Systems and Measuring Instruments.
- Design of High Voltage and High Current components and Devices.

Product Range:

- Impulse Voltage Test System
- Partial Discharge Detector
- Digital Impulse Analyzer
- Recurrent Impulse Generator
- HV AC Series Resonant Test Set
- AC Dielectric Test Set
- RF Shielded Room
- Capacitance & Tan Delta Test System
- Transformer Loss Measuring System
- AC/ DC Kilovoltmeter
- AC/ DC Hipot Tester
- CT/ PT/CVT Test System
- Insulation Oil Dielectric Test Set
- Online Transformer Moisture Absorption System
- Transformer Winding Resistance Meter
- Transformer Turns Ratio Meter
- Micro Ohm Meter
- Online DGA

KVTEK Power Systems Pvt. Ltd.
283-286, Sector - 8, IMT Manesar, Gurgaon - 122050
Ph. : +91 124 4971300 (Multiple Lines) ; Fax : +91 124 4971301 ; Email : sales@kvtek.in ; Website : www.kvtek.in

Interview

Hydro projects are non-polluting & environment friendly source of energy

Krishna Narayan Garg, Member (Hydro)
Central Electricity Authority

Central Electricity Authority, besides many other functions, sees overall hydro power development in the country; integrated planning for utilization of water resources; assessment of hydro potential; assistance to states on investigation and project evaluation of hydro technologies; quality assurance plans & standardization; renovation, modernisation & uprating of hydro stations; co-operation with neighbouring countries of Nepal, Bhutan and Myanmar for development of water resources for mutual benefits etc. In an exclusive interview to **Electrical India, K N Garg** states, upto October 2014, hydro electric projects with total installed capacity of 1826.33 MW have been commissioned.

➢ According to your perception what is the scope of hydroelectric potential in the country?

The identified hydro potential as assessed by CEA during 1978-1987, is 1,48,701 MW out of which 1,45,320 MW is from projects above 25 MW. Of this, presently about 36,013 MW capacity in under operation from 179 projects.

In addition, 9 pumped storage plants with aggregate installed capacity of 4785 MW are also under operation. Hydro projects are non-polluting and environment friendly source of energy.

➢ Could you highlight upon current status of the hydro schemes in the country? And what are your priorities and future plans?

Presently 49 hydro power projects including two pumped storage plants aggregating to 14286.6 MW are under construction in the country. Detailed project reports of 40 HE Projects with total installed capacity of 26062 MW have been concurred by CEA since 2002-03 which are yet to be taken up for construction.

➢ What are your responsibilities as member (Hydro) at CEA? After the change of government at the center what development you foresee and what emphasis would you suggest for utilizing and evolving the hydropower production as coal is not the permanent solution for power generation?

The duties and responsibilities of Member (Hydro), CEA are as under:

Overall hydro power development in the country; concurrence of hydro-electric schemes; integrated planning for utilisation of water resources; assessment of hydro potential; assistance to states on investigation and project report preparation; construction and investigation monitoring of hydro projects and suggesting remedial measures to problems involved; updating, development & evaluation of hydro technologies; environmental

aspects of hydro projects; renovation, modernisation & uprating of hydro stations; cooperation with neighbouring countries of Nepal, Bhutan and Myanmar for development of water resources for mutual benefits; etc.

➢ **Could you detail about the Hydro electric projects commissioned in 12th plan?**

During the 12th Plan period upto October 2014, hydro electric projects with total installed capacity of 1826.33 MW have been commissioned, out of this 1555.33 MW is in Central sector, 102 MW is in state sector and 169 MW is in private sector.

➢ **Which of the region has the highest installed capacity of hydro electric stations and how many MW of installed capacity is in the offing?**

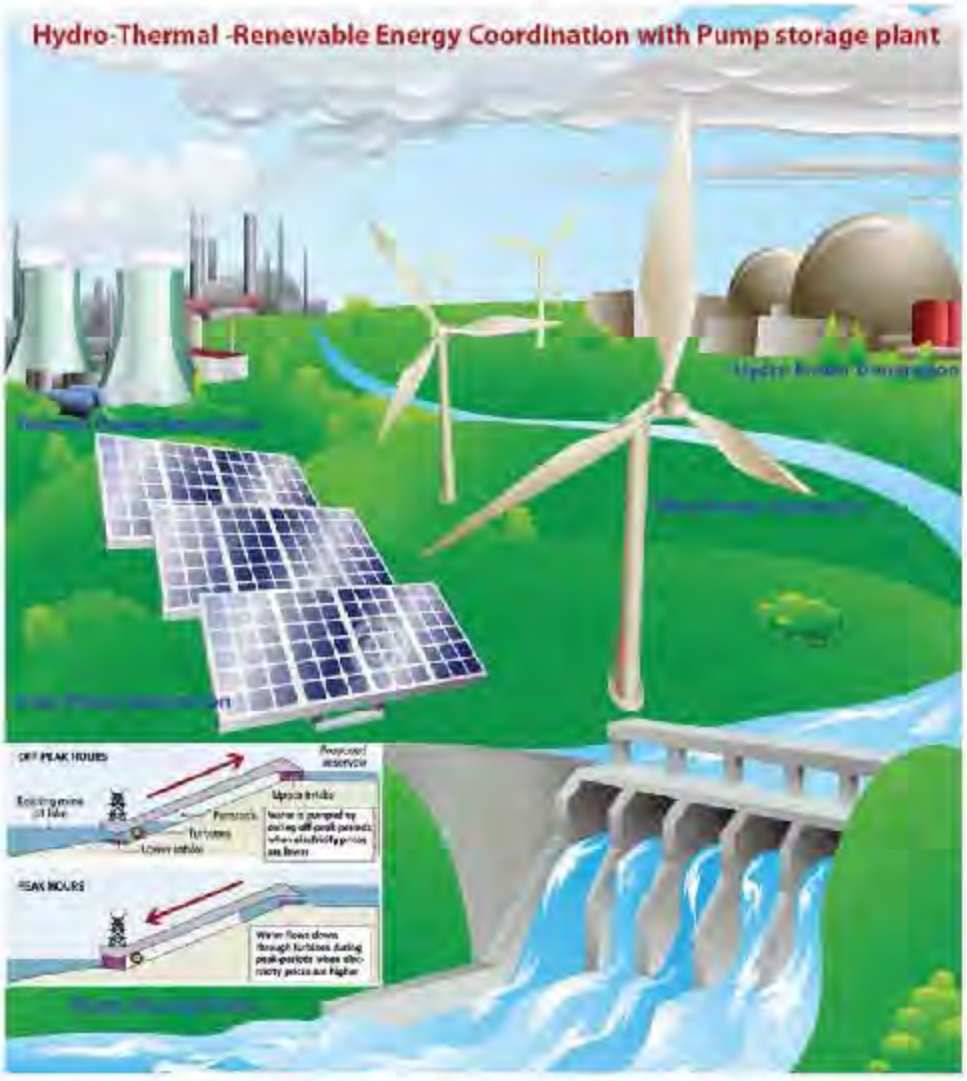
With 16884.93 MW, Northern Region has the highest installed capacity of hydro electric stations. At present, 49 hydroelectric projects with aggregate installed capacity of about 14287 MW are under construction and another 40 HE Projects with total installed capacity of about 26062 MW, for which detailed project reports have been concurred by CEA, are awaiting other statutory clearances to be taken up for construction.

➢ **Recently, there was spate of events involving hydropower projects dedication to the nation. One of which, PM dedicated to the nation was a 45MW capacity Nimmo-Bazgo hydropower project. How much advantageous will this Hydro Power Station at Leh, Ladakh be for the nation?**

Ladakh region does not have any significant generation capacity and relies mainly on D. G. sets. Nimmo-Bazgo hydropower project in Leh district of J&K is proposed to meet the local load as well as the load of defence establishments which will save precious diesel and will lead to improve the environment. This will lead to faster development of the region.

➢ **Could you elaborate upon Chutak Hydro Power Station at Kargil, meant for power requirement of Ladakh?**

Kargil region does not have any significant generation capacity and relies mainly on D. G. sets. Chutak Hydro Power Station of J&K is proposed to meet the local load as well as the load of defence establishments which will save precious diesel and will lead to improve the environment. This will lead to faster development of the Kargil region.



PSO for Solving Unit Commitment Problem Including Renewable Energy Sources

This article proposes a methodology for solving the generation scheduling problem considering, hydro, pump storage, wind & solar energy systems with and without ramp rate. Renewable energy sources are being considered in power system to minimize the total thermal unit fuel cost. Particle Swarm Optimization technique is used for solving renewable hydro-thermal coordination problem. A pseudo code based algorithm is suggested to deal with the equality constraints of the problem for accelerating the optimization process. The simulation results conducted on several cases show that the proposed method is capable of obtaining higher quality solutions efficiently in hydro-thermal-renewable energy coordination problem.

Anup Shukla and Dr S N Singh

In a vertically integrated system, the primary objective of power system operation is to ensure that users demand is met at the least cost without having competition in generation and distribution businesses. This objective explicitly specifies an optimization problem with a cost function to be minimized and a variety of constraints describing the operating limits to be satisfied. Meeting this objective by properly controlling the individual components of the power system is a complex task. One of the difficulties associated with electricity planning is the physical size of the system. The network may have several thousand nodes (buses), lines and the generation system may include a large number of hydro-plants, thermal plants and renewable energy based plants (wind, solar, biomass and tidal). Another major difficulty in dealing with electrical power systems is the vast range of time intervals over which various processes need to be controlled.

Unit commitment (UC) in a power system involves determining start-up and shutdown schedules of units to meet the forecasted demand, over a short-term period. In solving the unit commitment problem, generally two basic decisions are involved; namely the "unit commitment" decision and "economic dispatch" decision. The "unit commitment" decision involves determination of the generating units to be running each hour, considering system capacity requirement, including the reserve, and constraints on the start-up and shutdown of the units. Economic load dispatch means that the generator's real and reactive powers are allowed to vary within certain limits, so as to meet a particular load demand with minimum fuel cost.

Due to the population growth and increasing industrialization, urbanization, modernization and income growth, the electricity consumption is expected to continue to increase significantly in years to come. Thus, rise of environmental protection and the progressive exhaustion of traditional fossil energy sources have increased the interests in integrating renewable energy sources into existing power systems. Integration of renewable energy in power

system not only minimizes the emission (NO_x, CO_2, SO_2, small quantities of toxic metals, etc.) but it also decreases total operating cost.

Available Unit Commitment Approaches

UC problem has commonly been formulated as a nonlinear large scale, mixed-integer combinatorial optimization problem with constraints. The exact solution to the problem can be obtained only by complete enumeration, methods often at the cost of prohibitively computation time requirement for realistic power systems. Research endeavors, therefore, have been focused on efficient, near-optimal UC solution algorithms which can be applied to large scale power systems and have reasonable storage and computation time requirements.

A bibliographical survey on UC methods reveals that various numerical optimization techniques have been employed. Specifically, these are priority list method, dynamic programming, integer programming, branch and bound method and lagrangian relaxation method etc. Among these methods, the priority list method is simple and faster but the quality of final solution is not good. Priority listing method initially arranges the generating units based on the lowest operational cost characteristics. The predetermined order is then used for UC such that the system load is satisfied. Dynamic programming was the earliest optimization-based method to be applied to the UC problem. It has the advantage of being able to solve problems of a variety of sizes and to be easily modified to model characteristics of specific utilities. The biggest limitation on using dynamic programming is the number of partial solutions to be tracked of.

Dillon et al. developed an integer programming method for practical size scheduling problem based on the extension and modification of the branch-and-bound method. The UC problem can be partitioned into a nonlinear economic dispatch problem and a pure integer nonlinear UC problem based on benders approach. The mixed integer programming approach solves the UC problem by reducing the solution search space through rejecting infeasible subsets. A linear programming UC problem can be solved either by decomposing the whole problem into sub-problems with help of Dantzig–Wolfe decomposition principle and then each sub-problem is solved using linear programming or the problem can be solved directly by revised simplex technique. Lauer et al. and Cohen et al. presented a new approach for solving UC problem based on branch-and-bound method, which incorporates all time-dependent constraints and does not require any priority ordering of units. Huang et al. proposed a constraint logic programming along with the branch-and-bound technique to provide an efficient & flexible approach to the UC problem.

Dynamic programming was the earliest optimization-based method to be applied to the UC problem. It has the advantage of being able to solve problems of a variety of sizes and to be easily modified to model characteristics of specific utilities

Aoki et al. applied Lagrangian Relaxation method for a large-scale optimal UC problem, which includes three types of units such as usual thermal units, fuel-constrained thermal units and pumped storage hydro units. A three-phase new Lagrangian Relaxation algorithm for UC is proposed by Zhuang et al. In the first phase, the Lagrangian dual of the UC is maximized with standard sub-gradient technique & the second phase finds a reserve feasible dual solution, followed by a third phase of economic dispatch. The lagrangian relaxation method provides a fast solution but it may suffer from numerical convergence & solution quality problems.

Aside from the above methods, there is another class of numerical techniques applied to the UC problem. These are artificial neural network, simulated annealing and genetic algorithms etc. These methods can accommodate more complicated constraints and are claimed to have better solution quality. Artificial neural networks (ANNs) are intended to model the behavior of biological neural networks. Sasaki et al. explored the possibility of solving the combinatorial optimization problem, in particular to UC applying the Hopfield neural network. C. Wang et al. proposed an ANN model for UC with ramp-rate constraints. It has been found that UC problem cannot be handled accurately within the framework of the conventional Hopfield network. Therefore, Walsh et al. presented augmented network architecture with a new form of interconnection between neurons, giving a more general energy function containing both discrete and continuous terms. Liang et al. successfully solved the UC problem using an extended mean field annealing neural network approach.

Simulated annealing (SA) is a recently developed optimization technique, proposed by Kirkpatrick, Gelatt, and Vecchi in 1983, which takes advantage of the analogy between the minimization of the cost function of an optimization problem and the slow procedure of gradually cooling a metal, until it reaches its "freezing" point, where the energy of the system has acquired the globally minimal value. The algorithm is based on the iterative method, proposed by Metropolis et al. which simulates the transition of atoms in equilibrium at a given temperature. SA serves for solving difficult combinatorial optimization problems without specific structure. Mantawy et al. presented a SA algorithm to solve the UC problem and concluded that even though SA algorithm has the disadvantage of taking long CPU time; it has other strong features like being independent of the initial solution and mathematical complexity.

Sheble et al. applied the genetic algorithm to solve the UC problem for one to seven days. The feasibility of genetic algorithms application for UC problems has been examined for both small- and large-size problems. Genetic algorithms are general purpose stochastic and parallel search method based on the natural selection and natural genetics. There is no absolute assurance that a genetic algorithm will find a global optimum.

Problem Formulation

A simplified generation system under study is given in Fig. 1. It is comprised of thermal system, hydro system, pumped storage plant, wind and solar energy system. The problem model does not consider network topology. The objective of the short-term generation scheduling problem considering wind and solar energy system is to determine the optimal

amounts of generation power from the hydro units, pumped storage unit, thermal units, wind and solar energy system over the study period, so that the total thermal unit fuel cost is minimized subject to power balance equations, spinning reserve requirements and other constraints. To do this, the study period is divided into T time intervals and the short-term generation scheduling problem can be formulated as follows:

$$F_T = \sum_{t=1}^{T}\sum_{i=1}^{NT}[I_i(t) \times F_i(P_i(t) + I_i(t) \times (1 - I_i(t-1) \times STC_i] \quad (1)$$

Where,

F_T: Total operation cost over the scheduling horizon.

$F_i(P_i(t))$: Fuel cost function of i^{th} thermal unit at hour t.

$I_i(t)$: Schedule state of i^{th} thermal unit at hour t.

NT: Number of thermal units

$P_i(t)$: Generation of i^{th} thermal unit at hour t.

STC_i: Startup cost of i^{th} thermal unit.

T: Number of time interval (hours).

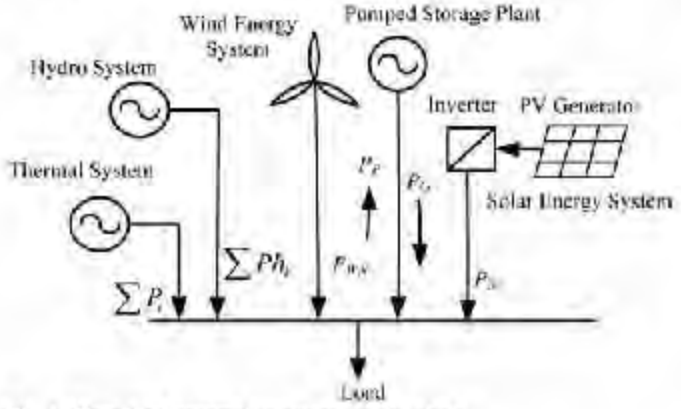


Fig. 1: Simplified generation system under study

Subjected to following constraints:

Power balance equations

$$\sum_{i=1}^{NT} I_i(t) \times P_i(t) + P_{WT}(t) + \sum_{k=1}^{NH} Ph_k(t) + P_s(t) + P_{PG}(t) = D_L(t) + P_L(t) + P_r(t) \quad (4)$$

D_L (t): System load demand at hour t.

NH: Number of hydro units

$Ph_k(t)$: Generation of k^{th} hydro unit at hour t.

$P_{PG}(t)$: Pumping & Generation of PSP unit at hour t.

$P_L(t)$: Power network losses at hour t.

$P_s(t)$: Power output from solar energy system at hour t.

$P_{WT}(t)$: Total actual wind generation at hour t.

Thermal constraints

- System spinning reserve requirements
- Generation limit
- Unit minimum up/down time
- Ramp constraint
- Startup cost and shutdown cost.

Hydro constraints

- Hydraulic balance constraint.
- Initial and final reservoir constraints.
- Hydroelectric power generation.
- Storage and turbine volume limit.

Pumped storage plant

- Upper and lower limits of pumped storage unit output i.e. pumping and generation.
- Reservoir constraints

Power output limits on wind energy system

The power output function with respect to the wind speed is given by

$$P_{WT}(t) = \begin{cases} 0 & ; v_w(t) \le v_1 \quad v_w(t) \ge v_3 \\ \Psi(v_w(t)) & ; v_1 \le v_w(t) \le v_2 \quad t = 1, 2, ...r \\ P_{WN} & ; v_2 \le v_w(t) \le v_3 \end{cases} \quad (5)$$

Where,

$v_w(t)$: Forecasted wind speed at hour t.

v_1, v_2, v_3: Cut-in wind turbine speed, rated wind turbine speed, cut-out wind turbine speed.

$(v_W(t))$: Wind-to-energy conversion function for wind power generation;

P_{WN}: Rated wind power output.

Power output limits on solar energy system

Power output from solar energy system is expressed as the following equation

$P_{pv}(G_t)$-$P_b(t)$-$P_g(t)$=0 t=1, 2,.....T

$P_b(t) = 0$, because battery is not taken in to consideration.

Solar radiation-to-energy conversion functions of the PV generator given by

$$P_{pv}(G_t) = \begin{cases} P_{sr}\dfrac{(G_t)^2}{G_{std}R_c} & 0 < G_t < R_c \\ & t = 1, 2, 3...T \\ P_{sr}\dfrac{G_t}{G_{std}} & G_t > R_c \end{cases} \quad (6)$$

Where,

G_t: Forecast solar radiation at hour t.

G_{std}: Solar radiation in the standard environment.

R_c: Certain radiation point

P_{sr}: Rated power output of the PV generator.

Generation Scheduling by Proposed Approach

This work proposes a short-term generation scheduling problem considering renewable energy sources (solar and wind) with and without ramp rate solved by a pseudo operated particle swarm optimization. In this model, a pumped storage system is also incorporated with hydro energy to supply power in case of peak load shaving and also to smooth out the load leveling. PSO is a popular swarm inspired optimization method which usually refines a population by extending and sharing its knowledge within a given search space. The effectiveness of the proposed method is tested on a power system having ten thermal units, two hydro units (with one pumped storage unit), one equivalent wind energy system and one solar energy system.

VENTURE LIGHTING
An Advanced Lighting Technologies Company, USA

Bright Ideas Bold Innovations

LED

INDUSTRIAL LED LUMINAIRES

Award Winner
Best Export Performance
2006, 2007 & 2011

Venture Lighting India Limited, Plot No. A30, D5, Phase II, Zone B, MEPZ, Tambaram, Chennai 600045.
Tel : 91-44-2262 3094 Fax : 91-44-2262 5589 E-mail : marketing@vlindia.com

International Approvals

Thermal unit scheduling with renewable energy sources is divided into I time interval so that the total fuel cost is minimized subject to the equality and inequality constraints. The system load demand, water discharge, wind speed and solar radiation must be known before the generation scheduling problem can be performed.

Particle Swarm Optimization (PSO)

A PSO is a population-based meta-heuristic search algorithm which is inspired by the movement of a flock of birds searching for food. In PSO, swarm of particles are represented as potential solutions, and each particle i is associated with two vectors, i.e. velocity vector $V_i = (v_{i1}, v_{i2}, v_{id})$ and the position vector $X_i = (x_{i1}, x_{i2}, \ldots, x_{id})$, where, d stands for dimension of the search space. The velocity and the position of each particle are initialized by random vectors within the corresponding ranges. During the evolutionary process, the velocity and position of ith particle on dimension d are updated as:

$$v_{id}^{k+1} = w \times v_{id}^{k} + c_1 \times rand_1 \times (Pbest_{id} - x_{id}^{k}) + c_2 \times rand_2 \times (Gbest_{gd} - x_{id}^{k}) \quad (7)$$

$$x_{id}^{k+1} = x_{id}^{k} + v_{id}^{k+1} \quad (8)$$

Where, is the inertia weight parameter, which controls the global and local exploration capabilities of the particle. c_1, c_2 are acceleration coefficients (cognitive and social); $rand_1$ and $rand_2$ are uniform random numbers between (0, 1). $Pbest_{id}$ is the position with the best fitness found so far for i^{th} particle, and $Gbest_{gd}$ is the best position in the neighborhood. A large inertia weight is used during initial exploration and its value is gradually reduced as the search proceeds. The concept of Time-Varying Inertial Weight (TVIW) is given by

$$w = (w_{max} - w_{min}) \times \frac{iter_{max} - iter}{iter_{max}} + w_{min} \quad (9)$$

w_{max} = 0.9 and w_{min} = 0.4 where, c_1=2 and c_2=2. $iter_{max}$ (=100) is the maximum number of iterations.

A pseudo code based algorithm is developed to deal with equality constraints other than penalty function methods. The main disadvantage of penalty function method is reduction of the search space. When the problem is highly constrained, the algorithm may spend a lot of time to find the feasible solutions.

Results and Discussions

The study system shown in Fig. 1 comprises ten thermal units, two hydro units (with one pumped storage unit), one equivalent wind power generation & one PV system. Pumped storage data are given in Table 1. The spinning reserve is assumed to be 10% of the load demand. The generator ramp rate constraints are set at 60% of its rated capacity. The proposed method has been developed in MATLAB and executed on a computer with Intel Core of 3.40 GHz. The setting of different versions of PSO is as follows:

- Population Size = 20.
- Maximum Velocity = P_i^{max}, Minimum Velocity = P_i^{min}
- Acceleration Constant c_1=2 and c_2 =2.
- Iterations =100.

Plant	P_{Hyk} min	P_{Hyk} max	V_{psp} min	V_{psp} max	V_{psp} begin	V_{psp} end	P
PSP	25	300	250	1500	1000	1000	253

Table 1: Data for Pumped Storage Plant

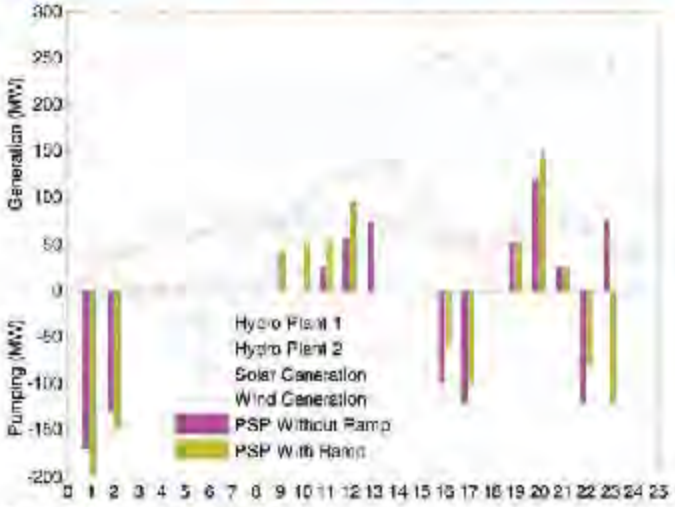


Fig. 2: Power output from different sources

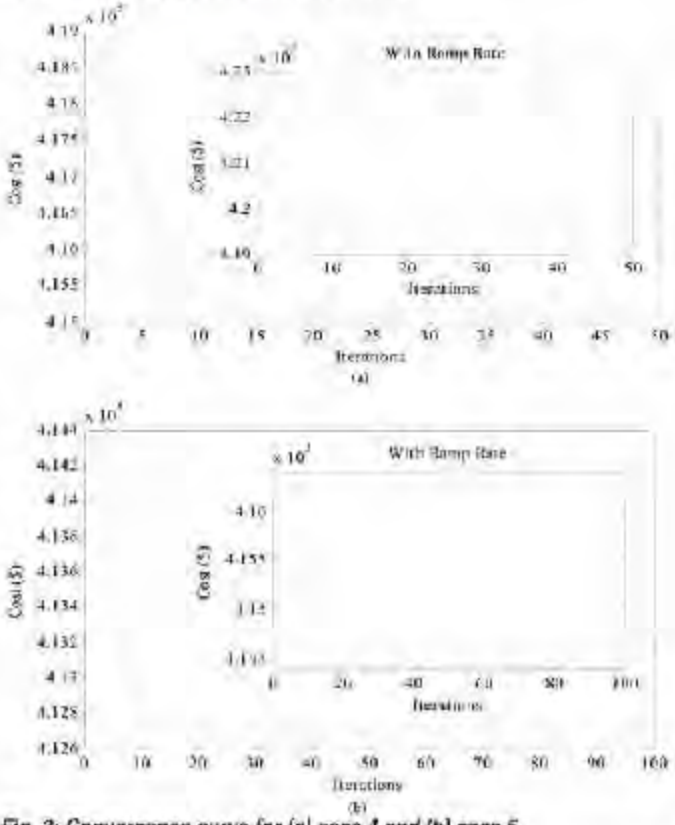


Fig. 3: Convergence curve for (a) case 4 and (b) case 5

The simulation is performed for the following five different cases with and without ramp. Comparison of cost in all the five cases is shown in Table 2. It can be observed from Table 2 that the generating cost is increased due to the incorporation of unit ramp-rate characteristic in the UC problem. Also it is noticed that by efficiently utilizing the renewable

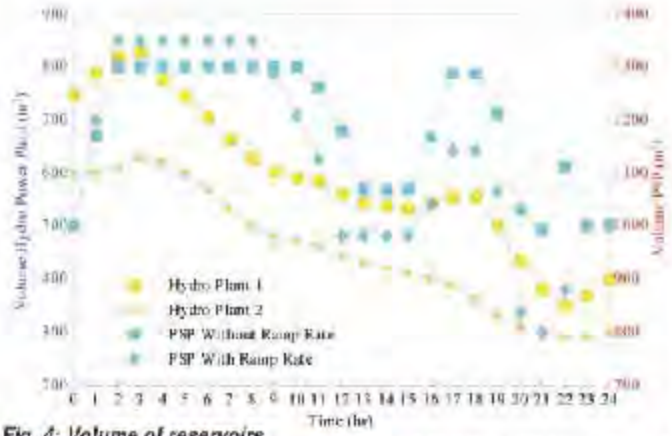


Fig. 4: Volume of reservoirs

Cases	Without Ramp Total Cost ($)	With Ramp Total Cost ($)
Case 1	563,938	564,733
Case 2	494,719	501,404
Case 3	439,962	444,269
Case 4	417,747	419,894
Case 5	412,704	417,710

Table 2: Cost Comparison

energy sources, the total operating cost of the system is reduced significantly. Fig. 2 shows the power output from the renewable energy sources and pumped storage plant. Convergence curve for case 4 & case 5 with and without ramp rate are shown in Fig. 3 (a) & (b). Volume of reservoir for hydro power plant & pump storage plant in a 24 hour scheduling horizon is shown in Fig. 4.

Conclusion

In this work, particle swarm optimization technique is proposed for solving thermal UC problem considering, hydro, pump storage, wind and solar energy systems with and without ramp rate. A pseudo code based algorithm is suggested to deal with the equality constraints of the problem for accelerating the optimization process. The feasibility and performance of the proposed approach is demonstrated by various test studies. The results reveal, the proposed optimization approach is very effective in reaching an optimal generation. Also, it is noticed that by efficiently utilizing the renewable energy sources, the total operating cost of the system is reduced significantly.

Profile

Anup Shukla

ME (Power System) from Punjab Engineering College, Chandigarh (presently PEC University of Technology), is pursuing PhD from the Department of Electrical Engineering, Indian Institute of Technology Kanpur. His research interest includes power system optimization & control. He is student member of IEEE.

Dr S N Singh

MTech and PhD from the Indian Institute of Technology Kanpur, is currently a Professor in the Department of Electrical Engineering, Indian Institute of Technology Kanpur. His research interests include FACTS, power system restructuring, optimization & control, distributed generation, wind power, etc. He is a Fellow of IE (India) and IETE (India) & IET (U.K.), and Senior Member of IEEE.

Moisture effects on coal for Indian Thermal Power Plants

Coal popularly known as black diamond is a national resource which needs to be used efficiently for energy security. By 2016, the percentage of coal requirement for power generation is likely to go to 82% of the total coal production (520 million tonnes/year) and the import is likely to go to 38% (200 million tonnes/year). The increase in coal consumption is not only because of new capacity addition but also because of deterioration of coal quality (in terms of its heating value). Presence of surface moisture, its liability and control needs to be understood on a broader national perspective.

M Siddhartha Bhatt & N Rajkumar

Great importance must be given during the transportation, receipt and storage of coal to ensure that its heating value is preserved and there is no deterioration on account of moisture addition enroute to the power plant or in the coal yard storage prior to its entry into the furnace of the boilers. In the case of imported coals higher moisture coals are cheaper and the increased generation cost due to moisture is offset by the cost advantage. The same is not true for Indian coals where there is no provision for cost accounting of total moisture except for upper limits.

Coal (popularly known as black diamond) is the primary energy source of the thermal power stations (TPS) which is the back bone of the Indian power sector. The installed capacity of the country is ~250 GW out of which ~140 GW is the share of coal based power generation (~57%). The power generation growth rate represented by compound annual growth rate (CAGR) is 8%.

Coal is contributing to ~1.5% of the GDP as it is the main energy source for power generation with a reserves of 275 billion tonnes (production capacity over 10 million t/y and up to a depth of 600 m) of which nearly 115 billion tonnes are proven. Coal will continue to dominate the electrical energy generation scenario for the next 20-30 years. Most of the indigenous coal is from government owned mines which account for 90% of the indigenous production. Out of this 88% is mined through open cast processes. Shaft mining is restricted to only high quality coals.

Coal follows a long route from the time it is mined till it is ultimately combusted in the utility boilers. The mechanism of supply of coal to the power plants is through the fuel linkage system based on fuel supply agreement between the colliery and the power utility. Nearly 60% of the coal is transferred from the mine to the power plant through Indian railways. 25% through trucks & the balance through dedicated transfer systems such as merry-go-round-systems, etc.

Coals and most other solid fuels being of variable heating value are priced based on the product of the quantity (tonnes) and the quality (gross heating value in kcal/kg).

Indian coals being of drift origin are of high ash (25-50%) with gross calorific values (GCV) in the range of 2300-4500 kcal/kg. Sulphur

Coal (popularly known as black diamond) is the primary energy source of the thermal power stations (TPS) which is the back bone of the Indian power sector

(<0.6%) is not a problem except in very few specific mines. Coals & most other solid fuels being of variable heating value are priced based on the product of the quantity (tonnes) and the quality (gross heating value-GCV in kcal/kg). For the purpose of computing quantities, the average coal GCV of indigenous coal is taken as 3500 kcal/kg and that of imported coal is taken as 6500 kcal/kg.

With the import of high GCV coal to sustain power generation on the rise, energy efficient utilization of coal resources is essential. Efficient use of coal calls for effective transfer, storage, monitoring and management to ensure that there are minimal losses in quantity or quality in the process of transfer from the mine to the boilers. Coal utilization efficiency (before it is used in the boilers,i.e. from mills till bunkers) is in the range of 90-98%.

Figure 1 shows the gradual rise in cost (FOB (freight on board)) of imported coal over the year.

Fig. 1: Rise in cost of imported coal

The main non chemically reactive ingredients in coal which result in the drop in GCV are ash and moisture.

Coal Quality- ASH & Total Moisture Content In Coal

Ash is technically the solid residual end product of combustion of coal and is realized only on combustion since it is an integral part of the overall coal lump. But due to the open cast mining process, besides the inherent ash the extraneous mineral matter (clay, sand, and stones generally referred as mud) also gets mixed up with the coal. This extraneous mineral matter is called as extraneous ash. Even though scientifically it is not ash, techno commercially it is called as extraneous ash because it is an incombustible component. Thus ash implies inherent ash which is the product of combustion & externally mixed earth. Extraneous mineral matter can be removed through washing processes typically the run of mine jig wet washing process. Inherent ash cannot be removed except by complex and cost chemical methods in small sample sizes at the laboratory scale.

Moisture in coal consists of inherent moisture (IM) and surface moisture (SM). Then total moisture (TM) is a sum of IM and SM. Inherent moisture is moisture which is an integral part of the coal seam in its natural state, including water in pores but excluding that in macroscopically visible fractures. Equilibrated moisture (in chemically equilibrated condition) or chemical moisture is taken as inherent moisture though it can be different for low grade coals. As per IS:1350 Part I – 1984) for moisture Equilibrated Moisture means the moisture

content as determined after equilibrating at 60% relative humidity (RH) & 40°C as per the relevant provisions (relating to determination of equilibrated moisture at 60% RH and 40°C) of BIS 1350 of 1959).

Surface moisture is the difference between total moisture and inherent moisture and is also called as excess moisture (EM).

TM= IM + SM

Total Moisture implies the total moisture content (including surface moisture) expressed as percentage present in Coal and determined on as-delivered basis. IM or equilibrated moisture is not in our control as it is governed by the thermodynamics of liquid-vapour equilibrium. SM is an added quantity and can vary in any range. Hence TM is affected by the criticality of SM. This brings down the GCV of coal (thermal content of coal) which reduces the output it delivers, reduced boiler efficiency and unit overall efficiency. Also, wet coal is difficult to handle & its movement in conveyors, chutes, hoppers, bunkers and pipes is considerably hindered making its grinding, milling and flow into the boiler very difficult.

As the coal quality decreases (ash and moisture increase) the cost of coal (Rs./Gcal) is likely to decrease as indicated in Table 1. However, the cost of energy generation increases as the boiler efficiency and hence the unit efficiency decreases (unit heat rate increases). Hence on the overall there is trade off between increased cost of generation and decreased cost of coal leading to lower overall cost of energy produced.

Coals as mined are classified on the basis of the sum total of ash and moisture in equilibrium as in Figure 2.

The coal payments for indigenous collieries are being made on the basis of equilibrated moisture (inherent moisture at 60% RH & 40°C).

Grade of coal	Gross calorific Value per kilo calories/ per kilogram			Run of Mine Coal price (in Rs.)	Cost of heat (FOB) (Rs./Gcal)
	min	max	mean		
G1	7000		7000	3542	506
G2	6700	7000	6850	3393	495.33
G3	6400	6700	6550	3244	495.27
G4	6100	6400	6250	3032	485.12
G5	5800	6100	5950	2888	485.04
G6	5500	5800	5650	2380	417.70
G7	5200	5500	5350	1840	343.93
G8	4900	5200	5050	1700	336.63
G9	4600	4900	4750	1500	315.79
G10	4300	4600	4450	1400	314.61
G11	4000	4300	4150	1130	272.29
G12	3700	4000	3850	910	236.36
G13	3400	3700	3550	690	194.37
G14	3100	3400	3250	610	187.69
G15	2800	3100	2950	510	172.88
G16	2500	2800	2650	474	178.87
G17	2200	2500	2350	420	178.72

Table 1: Cost of coal (Rs./Gcal) as per Coal India prices

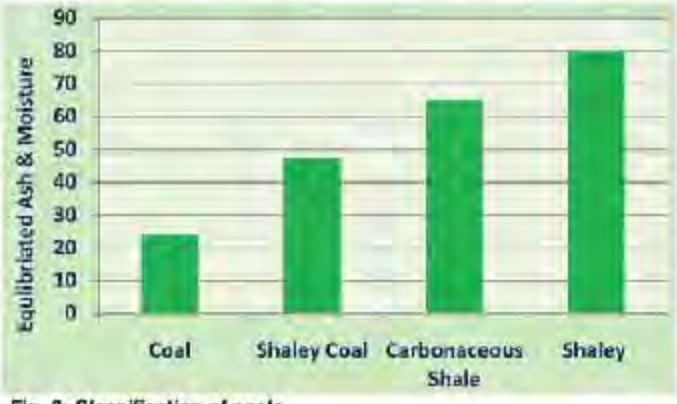


Fig. 2: Classification of coals

Effect of Moisture In Coal

Effect on heating value of coal

Figure 3 gives the decrease in GCV with moisture for a sample Indian coal of GCV of 2,000 to 7,000 kcal/kg. Figure 4 gives the drop in GCV of coal for 1% moisture increase.

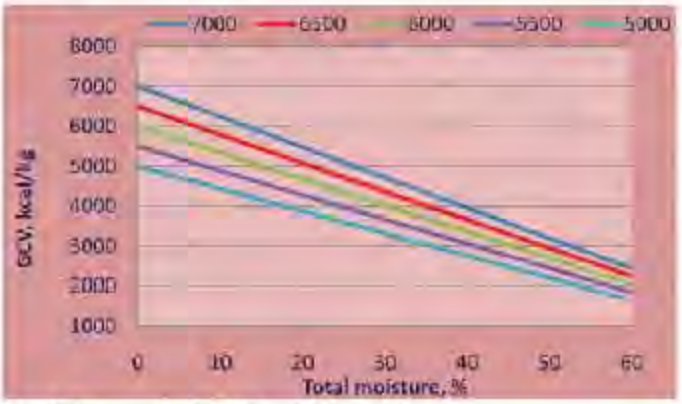


Fig. 3: Decrease in GCV of coal with moisture

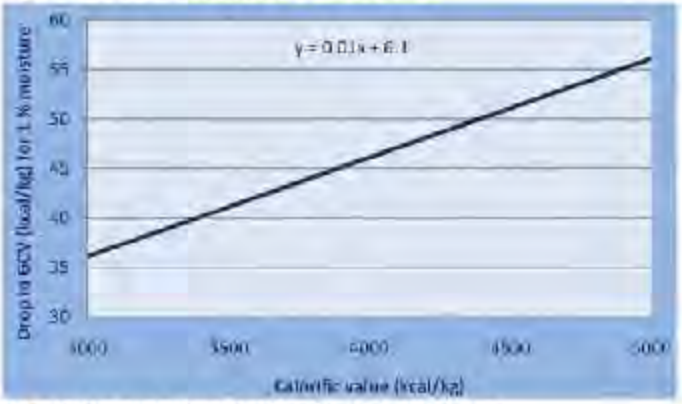


Fig. 4: Drop in GCV of coal for 1% moisture increase

Effect on coal movement and handling in the coal yard

While internal moisture affects the coal combustion process, external (mechanical) moisture gives rise to difficulties in handling (transfer and flow ability) of coal with severe capacity reduction of all equipment in the coal plant ranging from crushers to conveyors. External moisture also creates combustion difficulties by creating thermal lag during the combustion process.

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
■ +91-9442165044
✉ 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 / 846 / 878 email: infotas@titan.co.in Website: www.titanautomation.in

Units tripping on mill choke up, load hunting due to insufficient flow from bunkers, raw coal feeder jam, etc, are quite common during this period.

Even though the bunker level may be full, only 30% of the bunker capacity can be utilized due to bonding of coal at the bunker periphery and flow is only through rat hole in the bunker centre. When there is a choke up, the procedure is usually to remove the blockage by poking through the bottom opening. Air blasters are sometimes being used. If the level of coal is over 30-40%, a through hole cannot be established to remove the choke up. The bunker level under this condition needs to be filled continuously to the optimal level of 30% to 50% depending on the coal wetness and risk of choke up. Full filling of the bunker can be resorted to only when there is no risk of choke up. Choke up on full level can be quite difficult to release.

Rainy season restricts the plant load ability due to the movement of sticky coal which contains clayey mineral matter. Retardation of coal flow through the systems results in capacity reduction. When the surface moisture of coal exceeds 6%, it becomes sticky in addition to the stickiness created by the clay content of the mineral matter leading to severe capacity restriction in the tipplers, conveyors, crushers, bunkers and mills. The effective flow able coal through bunkers gets restricted to only 20% of the bunker volume in its centre.

The effect of moisture on bulk density of coal is given in Figure 5 for various coal finenesses (% passing through 200 mesh or 75 µm).

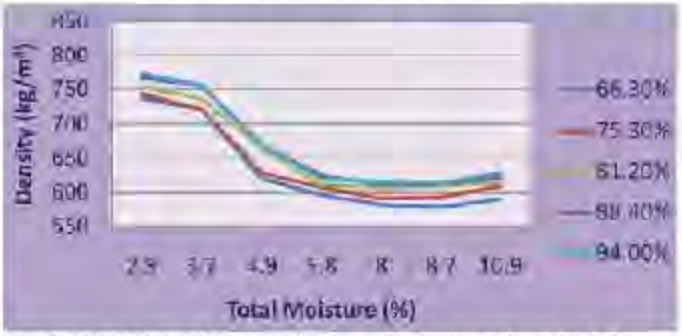


Fig. 5: Effect of coal fineness (% through 75 microns) on the bulk density of coal

The stations need to gear up to the demands of the rainy season through several measures such as the following:

- Stocking of sufficient coals of sandy background which do not have serious sticky properties as compared to coals of clayey background.
- Use of washed coals of sandy background.
- Blending of raw coal (GCV=14.5 GJ/kg) with washed coals (GCV=17.6 GJ/kg) or imported coals (GCV=21 GJ/kg).
- Optimal (partial) filling of bunker levels.

Some of the solutions for wet coal handling are:

Management of coal yard

- Rain guards for conveyors
- Tarpaulins to cover wagons
- Providing slopes for drainage of water
- Concreting of storage yards and providing retaining walls
- Rain water channeling, dredging and cleaning of flow passages
- Compacting by special compactors instead of bull dozers.
- Storage pile design improvement through compacting. Pyramidal shapes with drains on either side lead to low water absorption.
- Further the piles must not have surface depressions or pits.
- Used oil may be sprayed on coal yard instead of reselling. Alternatively it can be blended with fuel oil.
- Dome for storage of coal
- Provision for ground level tippling (non-pit type) of wagons.

Management of conveyors

- Increased conveyor angles
- Multi bladed cleaners
- Reduction in belt speeds
- Skirt board seals, baffle plates and centering plates at loading points
- Self cleaning screening system
- Well designed wash down drainage system
- Management of carry over return
- Conveyor belt sealing between chute and pan of vibratory feeder to prevent spillage.

Management of chutes and bunkers

- Deflector plates of Stainless steel (SS 304) to chutes
- Vibratory feeders/thumpers/rappers in place of static feeders
- Air blasters
- Chute modification to increase angle
- Widening of passages
- Water jet cleaning.

Many of the solutions described above are add-ons or modifications (to the already supplied coal handling and conveying equipment) done at the level of the power station. The coal handling and conveying technology needs to viewed holistically and specific products for handling wet coal need to be designed as the rainy season in India lasts for almost one third of the year in several regions. Figure 6 shows the bonding of wet coal with clayey mineral background.

Fig. 6: Bonding of high moisture coal in a coal yard

Basis for Sale of Coal

Indian collieries

Figures 7 & 8 show the experimental correlation between total moisture and surface moisture with inherent moisture in Indian coals mined in India. It can be seen that there is SM of 4-7% in Indian coals.

In the case of indigenous coals, the heating value for commercial purposes is based on equilibrated moisture which is equivalent to inherent moisture and the total moisture does not get reflected in the commercial heating value. In other words, surface moisture does not get accounted in the costing. The basis for payment at the collieries is the GCV on the basis of equilibrated moisture and the GCV drop due to surface moisture does not figure. The actual heating value of coal received for power generation will be lower than the commercial heating value as indicated in the graphs on equilibrated moisture and total moisture.

DCM Shriram and Axiall Corporation USA have joined forces to produce path breaking polymer compounds and color concentrates for Wires and Cables

- Count on DCM Shriram's fifty years experience in PVC compounding and Axiall's technological strengths
- A range of value-added customized solutions for Electrical, House wiring, Telecom and Automobile cables
- Color concentrates available in RAL, Pantone Shades and custom colours

Get the power of two to work for you

Blaze new trails with professionals who do nothing else. Put down your specifications and performance parameters. If the solution you seek has yet to be invented, you can be sure it will be.

Shriram Axiall Pvt. Ltd.

An Indo-US Joint Venture between DCM Shriram Ltd. & Axiall Corporation

Shriram Axiall

THE GLOBAL CUTTING EDGE NOW IN INDIA

Head Office: Shriram Axiall Pvt Ltd., 2nd Floor, Plot No. 52, Sector-32, Institutional Area, Gurgaon - 122003, Haryana, India, Tel.: +91 124 4632112. **Register Office:** 5th Floor, Kanchenjunga Building, 18, Barakhamba Road, New Delhi - 110 001, India. **Phone:** +91-11-23316301/8 Fax: +91-11-23318251. **Works:** Shriram Nagar, Kota – 324 004, Rajasthan, India. Phone: +91-744-2480011-16, 2480210 Fax: +91-744-2488139. **Divisional Sales Offices:** Mumbai: Phone: –91 22 23512152–54, Fax: +91-22-23515531, Chennai: Phone: +91-44-28203433/3231, Fax: +91 44 28204020, Kolkata: Phone (Fax: +91-33-22821185, Bangalore: Phone: +91-80-41231562/63 Fax: +91-80-41231554, Jaipur: Phone: +91 141 4040011/12/14/18, Fax: +91-141-4040013, Ludhiana: Phone: +91-161-2431908, 2405813, Fax: +91-161-2431907

www.shriramaxiall.com

This matter must be taken up by the thermal power plants with the coal authorities. Hence, the realistic basis for payment would be the total moisture at the mining point. Addition of surface moisture enroute to the thermal power plant or moisture addition in the coal yard of the power plant must be to the account of the user.

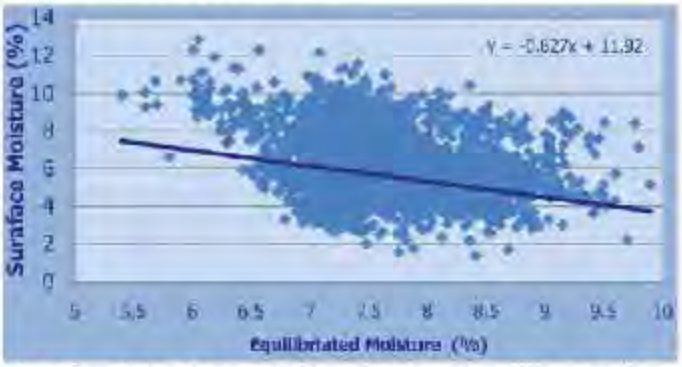


Fig. 7: Correlation between surface moisture and equilibrated moisture in mined coal

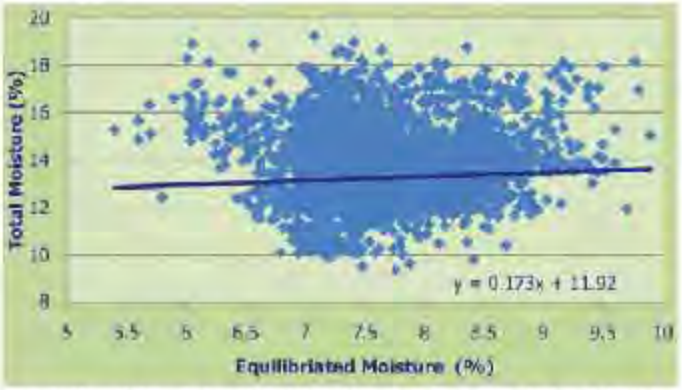


Fig. 8: Correlation between total moisture and equilibrated moisture in mined coal

Imported coal

In the case of imported coal the basis for payment is defined on the basis of either equilibrated moisture or total moisture as per the agreement. The cost of imported coal decreases with increase in total moisture. Figure 9 gives the drop in GCV due to increase in total moisture of imported coals.

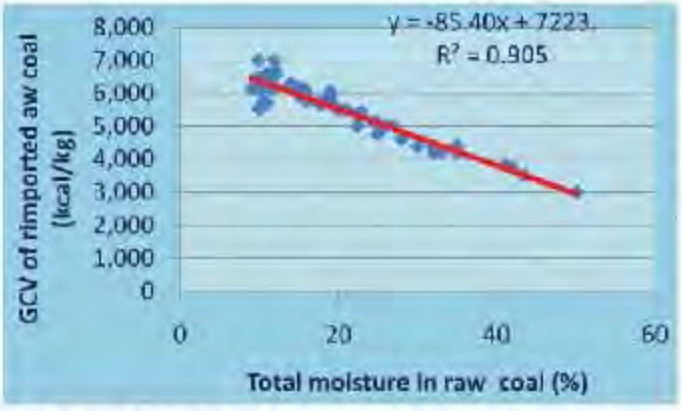


Fig. 9: Drop in GCV due to increase in total moisture of imported coals

Effects of Moisture in Coal on Power Station Performance

There are three cost effects of moisture in coal:

- Increase operation costs due to decreased boiler efficiency (Fig. 10) & decreased overall unit efficiency (increase in heat rate) (Fig. 11).
- Increase in operation and maintenance costs attributed to handling of wet coal.
- Decrease purchase cost of coal due to higher moisture and hence lower GCV.

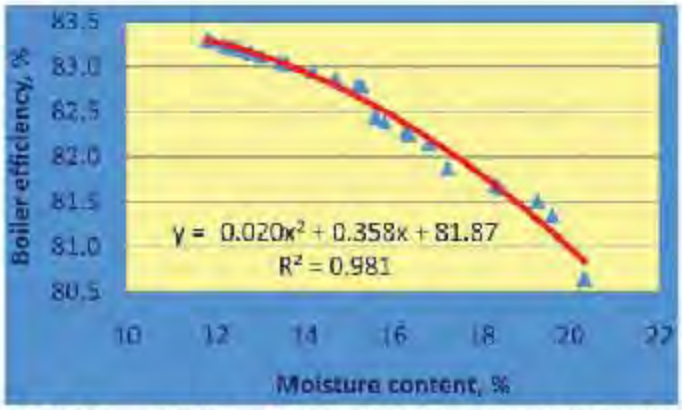


Fig. 10: Decrease in boiler efficiency due to increased moisture content

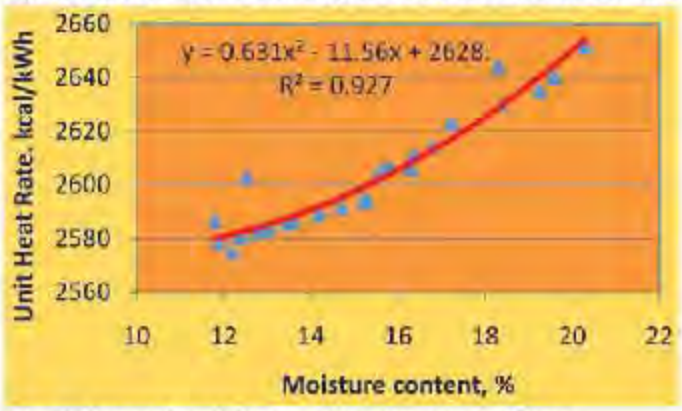


Fig. 11: Increase in unit heat rate due to increased moisture

The boiler efficiency decreases due to increase in moisture and the unit heat rate increases. This results in increased cost of generation.

Cost Sensitivity of Moisture in Coal

Indian coal

The fuel supply agreements for Indian coals do not have any provision for accounting the effect of total moisture. Only equilibrated moisture (IM) gets factored in the pricing. The surface moisture and hence the total moisture (T M) does not get factored into the agreement. The only relief for indigenous coal users is that In the event that monthly weighted average surface moisture in coal exceeds 7% during the months from October to May and 9% during the months from June to September, the coal quantities delivered to the power plants will be adjusted for the resultant excess surface moisture, which shall be calculated in percentage by which the surface moisture exceeds the foregoing limits. This corresponds to a TM of approximately 12% in summer & 14% in rainy season which rarely happens. Hence, it can be said that the surface

FRP INSTITUTE

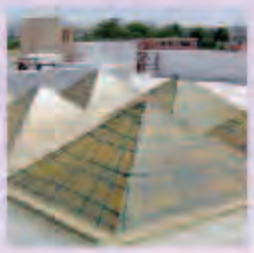
ICERP 2015

International Conference and Exhibition on Reinforced Plastics

INDIA'S LARGEST EVENT ON COMPOSITES SINCE 2002





The 7th Mega Event of the Indian Composites Industry Organised by FRP Institute

29TH TO 31ST JANUARY 2015

HITEX EXHIBITION CENTER

HYDERABAD

- Exhibition • Conference Programme
- Business Meetings
- ICERP-JEC Innovation Award Programme
- Product Display • Process Demonstrations
- Technical Sales Presentations

Visit our website www.icerpshow.com

Organised by:

FRP INSTITUTE
FRP Institute, Chennai, India

Main Supporters:

Owens Corning (India) Pvt. Ltd

DRDO Hyderabad

Govt. of Telangana

Joint Organiser:

FIAAP Hyderabad

Co Supporter:

JEC COMPOSITES
JEC France

China Composites Expo China

Supporting Organizations

TIFAC

AIPMA

KAFI

FRPTODAY

ICERP 2015 Contact:
Dr. A. Selvam, Executive Secretary - FRP Institute
NP 23/24 Developed Plot, Ekkattuthangal, Chennai-600032, India
Tel : +91-44-42900325 / 22250359 Fax: +91-44-22250349
Mobile: +91-9841426644
Email: exhibition@icerpshow.com, drselvam@frpinstitute.org
Website: www.icerpshow.com / www.frpinstitute.org

Dr. K. Narayana Reddy,
Fibreglass Industries Association of Andhra Pradesh (FIAAP),
#304, Veena Apartments, 7-1-60, Dharam Karam Road,
Ameerpet, Hyderabad - 500 016, India
Phone : + 91 40-2373 2930/2373 2931 FAX: + 91 40-27260154
Email : info@fibreglass-ap.com, Mobile: +91 9848033618
Website: www.fibreglass-ap.com

moisture effect is virtually not factored in the cost calculations. On this account Indian coal costs do not show sensitivity to total moisture as indicated in Figures 12 and 13.

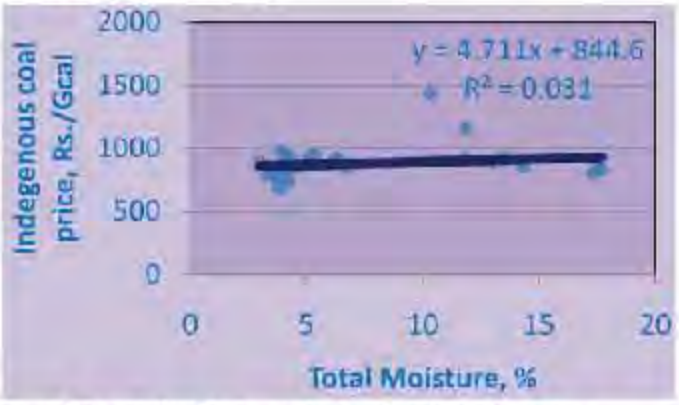


Fig. 12: Sensitivity of Indian coal price (Rs./t) to total moisture

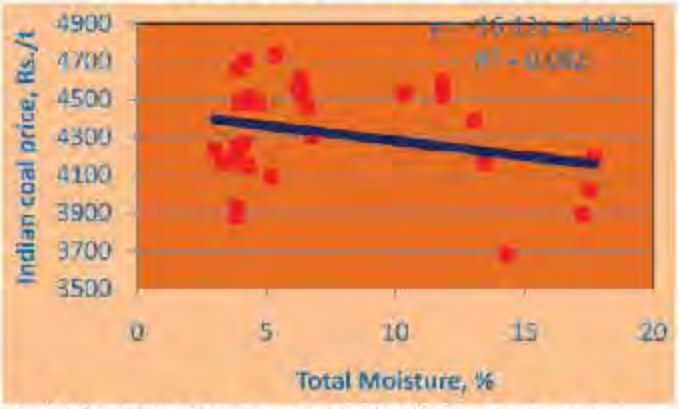


Fig. 13: Sensitivity of Indian coal price (Rs./Gcal) to total moisture

Sl. No.	Particular	Design/ operating	Units	Value
01	Boiler efficiency	Design	% per 1% increase in moisture	-0.123
02	Boiler efficiency	Operating		-0.270
03	Unit heat rate	Design	kcal/kWh per 1% increase in moisture	3.1
04	Unit heat rate	Operating		8.2
05	Impact on cost of energy generated due to decreased performance of boiler	Design	Rs./kWh	0.010
06	Impact on cost of energy generated due to decreased performance of boiler	Operating	Rs./kWh	0.015
07	Impact on cost of energy generation due to lower purchase price of high moisture Indian coal	Design	Rs./kWh	0.36
08	Impact on cost of energy generation due to lower purchase price of high moisture Indian coal	Operating	Rs./kWh	0.38

Table 2: Cost sensitivity of coals to generation cost and fuel cost

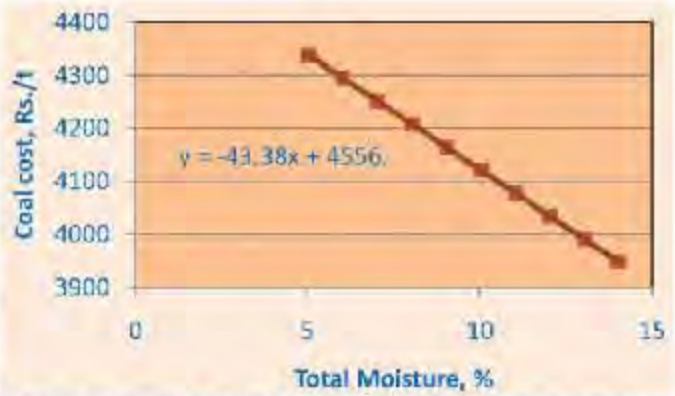


Fig. 14: Sensitivity of Indian coal price (Rs./t) to total moisture if the moisture effect is considered

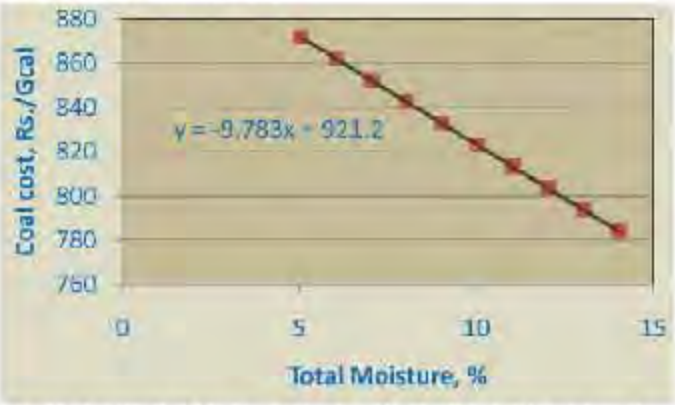


Fig. 15: Sensitivity of Indian coal price (Rs./Gcal) to total moisture if moisture effect is considered

However, if the moisture effect is considered the price should decrease as given in Figures 14 and 15.

The coal pricing should be on the basis of TM as it gives a realistic picture of the energy content in the coal available for end use.

Imported coal

Figures 16 & 17 give the cost sensitivity of imported coals to moisture in terms of Rs./t and Rs./Gcal.

The cost sensitivity of moisture in coal to generation cost and fuel cost component:

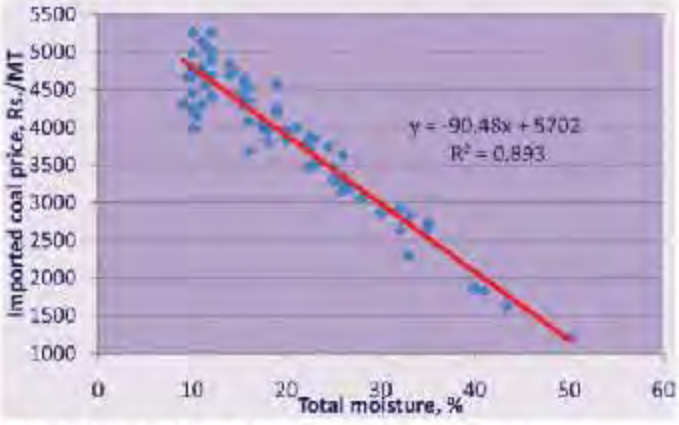


Fig. 16: Cost sensitivity of imported coals to moisture

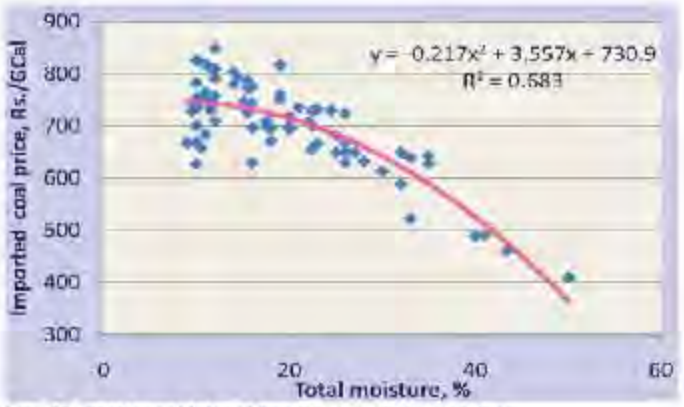


Fig. 17: Cost sensitivity of imported coals to moisture

It is clearly seen that the cost impact due to actual decrease in energy efficiency is very small (Rs. 0.01 to 0.015/kWh) as compared to reduced fuel purchase cost component of generation cost (Rs. 0.36/kWh) because as the TM increases the price of coals decrease.

Conclusions

- Major capacity addition has been based on assumed coal supplies from indigenous sources. The decreasing quality as well as difficulties in mobilization for a CAGR of 8% has resulted in turning to imports (15-20%) for supplementing of the primary fuel requirements which is a good short term measure.
- Moisture in coal has a negative impact on the energy performance and all efforts are required from the mine till the coal is fired into the boilers, to ensure that moisture does not get added to the coal and its heating value is preserved.
- If the boilers are designed for operating on high moisture coals, the high moisture imported coals can be successfully fired in an economical fashion as the open market price of coals with higher moisture will be lower than coals with lower moisture. The overall cost of generation will be lower for coals with higher moisture contents. The increased generation cost due to lower boiler efficiency & unit overall efficiency (Rs. 0.015/kWh) will be completely offset by the component due to decreased purchase price of higher moisture coals (Rs. 0.38/kWh). Therefore, for imported coals the economics is in favour of operating on higher moisture coals based on the coal pricing.
- In the case of indigenous coals, the heating value for commercial purposes is based on equilibrated moisture which is equivalent to inherent moisture and the total moisture does not get reflected in the commercial heating value. In other words, surface moisture does not get accounted in the costing. The actual heating value of coal received for power generation will be lower than the commercial heating value as indicated in the graphs on equilibrated moisture and total moisture. This matter must be taken up by the thermal power plants with the coal authorities. Hence, the realistic basis for payment would be the total moisture at the mining point.
- However, in the case of both imported coals and indigenous coals, addition of surface moisture or moisture addition/deterioration in heating value in the coal yard of the power plant is to the account of the user and must be minimized. Besides just the heating value the difficulties in flow ability, crushing, pulverizing and injection of coal into the furnace of the boiler present.

M Siddhartha Bhatt

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

N Rajkumar

presently working in Energy Efficiency & Renewable Energy Division of CPRI as Engineering Officer has vast experience at CPRI at its Centres in Bangalore and Thiruvananthapuram. He is MSc in Energy Science from Madurai & MTech in Energy Management from Indore. He carried out energy audit in thermal power stations, buildings and process industries, designed and developed solar thermal systems. He has published over 40 technical papers in journals, conferences and seminars. He is a life member of Solar Energy Society of India and Society of Energy Engineers and Managers. He is an accredited Energy auditor by BEE, New Delhi. He is a trained ISO 9000:2000 series lead auditor.

Large Scale Global Adoption of Nuclear Power - A Climate Imperative

Historically, the debate on energy has been primarily focused on economic aspirations. While that still remains the case, in today's world the environmental consequences of power generation simply cannot be ignored.

Pratap M Anam

Nuclear power, a proven and mature greenhouse emissions-free power-generation technology, is an environment-friendly option that has undeniable role to play in mankind's fight against global warming.

The global imperative has changed the way we look at the cost-benefit scenarios of power generation in a fundamentally different way. Thus, decisions related to power production must be seen in the context of cost as well as social and environmental impact. In other words, it is not only 'how much' energy is produced but also 'how' it is produced that will deeply impact our collective future and the health of the planet.

The United Nation's IPCC in its most recent report (Fifth Assessment Report), has clearly enunciated the urgent need to decouple energy use and carbon emissions and further made an emphatic recommendation for nearly quadrupling clean, low-carbon power generation technologies, including nuclear power in the short term, to rein in carbon emissions in some tangible manner. But even that would not suffice in the coming decades. In the long term, however, the world must deploy clean energy technologies on an increasingly greater scale to decisively and rapidly move away from carbon-intensive power generation and towards achieving zero greenhouse-gas (GHG) emissions. And that means progressively slashing down the use of fossil fuel-based energy sources, which burn carbon-based fuels to produce electricity, and thus, in the process, release billions of tons of carbon dioxide gas (CO_2) - a major greenhouse gas- into the earth's atmosphere each year - with total disregard for the very atmosphere that sustains us.

If the world doesn't want to stop its massive CO_2 emissions, then it can perhaps follow a much more costly and untested, path – that is to capture the CO_2 emitted from a thermal (coal, gas, or oil-based) power plant and bury all of it in deep underground repositories in the earth's crust. This convoluted process, termed as carbon sequestration, or simply, carbon capture, has only been tested on experimental basis and not yet tried out on a large scale for widespread commercial scale use globally. And it is very much likely to be a costly and complex affair. In essence, failure to end carbon emissions will entail an unimaginable cost for our species and for our planet.

Also notable here is the fact that the use of fossil fuels is often fraught with global geopolitical issues and uncertainties in today's world. Economic stability of nation and sustained resource availability go hand in hand. Fortunately, there are ways available to address these issues.

Nuclear power, a proven and mature greenhouse emissions-free power-generation technology is an environment-friendly option that has an undeniable role to play in the mankind's fight against global warming in order to avoid serious climate change that has the real potential to cause large-scale disruption to the way of life for millions of people as well as the biosphere at large. Coal has the lion's share in electrical power generation in India as well as globally. However, burning coal for power has drastic climatic consequences due to the unfettered CO_2 emissions involved. Make no mistake; the effects of climate change have already begun to appear globally. The more time we lose, the greater would be the environmental penalty. The biggest worry, indeed, is that many of the effects of climate change would be catastrophic and irreversible.

Even at local level, the effects of coal-fired electricity generation are unacceptable. Fly ash - the fine residual dust resulting from coal combustion in a thermal power plant - is laden with heavy metals like chromium, cadmium, nickel, arsenic, lead, etc. The toxicity and harmful effects of heavy metals on human health are well documented globally. The gigantic amount of ash generated at each thermal power plant contaminates air, soil and water bodies like rivers, ponds, etc. Have you ever wondered how much coal does a thermal power plant require? A large-sized thermal power plant requires several truckloads of coal 'each' day. This humungous fuel requirement puts extraordinary pressure on transportation infrastructure in the country. In contrast, nuclear waste generated from a power plant in a day is only the size of two construction bricks for a metropolitan city like Mumbai or Delhi. The carbon-fuel-based power-generation industry does not take responsibility of the waste it generates, whereas nuclear power is pollution-free and the very tiny amount of waste generated is handled, treated and managed responsibly, scientifically and professionally. In fact, India has a closed-cycle policy for nuclear-fuel utilization, which means that the waste generated in a nuclear power is not waste at all, but is actually fuel for the next-stage reactors.

There is a current movement for pursuing renewable energy aggressively, but this move must also be critically examined. Renewable energy has steeply increased the cost of power for the end users unless it is heavily subsidized (which it often is), and even in advanced economies, this is proving problematic. The steep cost escalation is something that rich nations can perhaps afford, but even there, there has been a growing dissatisfaction over the cost increases. This kind of scenario is not an economically practical option for large-scale use in developing and emerging economies, especially like our country, where hundreds of millions of people (nearly one-third of the population) still do not have access to electricity.

The non-continuous nature of renewable resources (like wind and solar) results in a far lower plant load factor (capacity utilization) in comparison to the plant's rated nameplate capacity. And because of this intermittency, these renewable resources are neither reliable nor suitable for large-scale nation-wide grid use. Renewables also occupy a lot of land space, as they are diffuse sources of energy. Despite these limiting factors, renewables certainly have a role to play in the energy mix of a nation like ours – especially in far-flung areas that are not connected to electrical grid. In future, renewable energy can play a greater role if the cost per unit & other relevant metrics improve substantially.

Nuclear Power: Global Scenario

The USA continues to be the largest producer and consumer of nuclear power, which constitutes 20% of all electricity generated in the country. It is presently constructing 5 new nuclear reactors, while it already has 100 in operation. China is racing ahead with nuclear power. Right now, it is constructing as many as 26 new nuclear reactors, with plans to build another 60. The Russian Federation has 33

It is not only 'how much' energy is produced but also 'how' it is produced that will deeply impact our collective future and the health of the planet.

operating reactors and is constructing 10 new ones, with 24 more planned. Ukraine has 15 reactors generating about half of its electricity, and it has plans to add more. South Korea operates 23 reactors and is building 5 more, while the 58 reactors in France generate 73% of its electricity. Currently, UK has 16 nuclear power reactors in operation, while it has launched a strategy for setting up new nuclear power capacity over the next several years. Here I am quoting only some prominent examples and the list is by no means exhaustive.

Japan, too, recognizes nuclear power to be one of the pillars of its energy policy and is now re-starting reactors after Fukushima.

A host of new entrants are on their way to join the 30 nuclear-power-producing countries in the world. There are dozens of countries that are seriously considering nuclear power or are already implementing their respective nuclear power programs, like Turkey, UAE, Jordan, Poland, Belarus, and Vietnam, to name a few. The Baltic states of Lithuania, Latvia and Estonia have joined hands to set up a new reactor in Lithuania. Poland is yet another European country that also has plans to embark on nuclear power. Actually, Poland is endowed with the largest coal reserves in the European Union (EU), and in 2011, coal-fired generation accounted for nearly 87% of the country's electricity production. However, Poland needs to diversify from coal and imported natural gas in order to meet the European Union's (EU) climate policy targets for reducing carbon dioxide as well sulfur dioxide emissions. Naturally, clean, emissions-free electricity generation from nuclear will go a long way in helping the nation to achieve those goals.

There has been the initiation of Middle East states into nuclear power. In 2011, Iran connected its first nuclear-power reactor to the grid and wants to build more. United Arab Emirates (UAE), an oil-rich nation, has embraced nuclear power whole-heartedly. There the construction of three nuclear reactor units is already underway, with work on a fourth one scheduled to begin soon, which will take the reactor tally for the country to four. These four reactors are planned to be commissioned successively, one each year, from 2017 to 2020. Likewise, Saudi Arabia, the nation that has the largest proven petroleum reserves in the world, desires to build 16 nuclear-power reactors over the next two decades. The interest of the Gulf states in nuclear energy stems from the need to desalinate water, to provide for future energy demand and to reduce the current reliance on hydrocarbon-based power generation. Jordan is another Middle East nation that has set in motion the process of establishing nuclear power in the country. It currently imports more than 95% of its energy – as fuel and through electricity imports. Nuclear power will play a significant role in providing for the country's long-term energy requirements and energy security. In the meanwhile, it is building a research reactor at the Jordan University for Science & Technology. The reactor would be commissioned in 2015 and would allow research activities as well as production of radioisotopes for use in medicine, agriculture and industry.

Burning coal for power has drastic climatic consequences due to the unfettered CO_2 emissions involved. Make no mistake; the effects of climate change have already begun to appear globally. The more time we lose, the greater would be the environmental penalty.

Likewise, Turkey depends significantly on imports for its power needs. It is moving ahead towards setting up a VVER-type reactor and also one Atmea1-type PWR reactor initially, with proposal to set up more reactors subsequently. Vietnam is experiencing a sharp rise in electricity demand and is planning to establish nuclear-power capacity in the country, for which it has signed nuclear cooperation agreements with Russia, France, South Korea, Japan, USA & Canada. Most recently, Russia has agreed to build up to 8 new nuclear power reactor units in Iran. Similarly, South Africa has also signed an intergovernmental agreement with Russia to build up to 8 new nuclear reactor units. Indeed, worldwide, currently there are 437 commercial nuclear power reactors in operation and 71 more are under construction.

Proven safety and reliability of nuclear

Nuclear power generation in India has an impeccable safety record. Nuclear power has been providing clean, green, safe and reliable grid electricity for the nation ever since the very first commercial nuclear power plant (Tarapur Atomic Power Station-1&2, or TAPS-1&2) began commercial operation way back in 1969. Unlike solar or wind, nuclear power provides electricity continuously on 24x7 basis and is a mainstream source of grid electricity. Presently, the average cost of a unit of nuclear-powered electricity in India is below Rs 3.00.

All power plants undergo brief planned shutdowns (planned outages) periodically. Recently, unit-5 of Rajasthan Atomic Power Station (RAPS-5) reached a historical milestone by operating nonstop for 755 days between two planned shutdowns, thereby claiming the second spot for longest continuous operation by a nuclear power plant globally. By virtue of this achievement, it also became Asia's first.

The optimal energy mix for different nations varies. Nuclear power is an appropriate power-generation technology for India. India's three-stage nuclear power program, currently using natural uranium fuel, is designed in a way to eventually unlock the vast potential of nuclear power in the country based on large-scale thorium utilization. With its large thorium-mineral reserves (about 30% of the world's reserves), India can, and should, utilize this abundant nuclear fuel in the coming years to achieve long-term energy security in a truly sustainable & environment-friendly manner – for centuries.

Pratap M Aram
is a writer and media consultant. He writes about various issues related to science and technology, including energy, environment, human development and Nature conservation.

Profile

VISHAY

Vishay ESTA - A Specialist in Power Capacitors

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

Wide Range of Heavy Current Capacitors

- Low Voltage
- High Voltage
- Power Electronics
- Automatic Power Factor Controllers
- Unbalanced Protection Relay

One of the World's Largest Manufacturers of
Discrete Semiconductors and Passive Components

Vishay Components India Private Limited
Loni-Kalbhor, Near Pune (C Rly) Pune 412201, India • T: +91 20 26913285/39215500 • Email: ESTAsales@vishay.com
http://www.vishay.com/capacitors/power-heavy-current

Competition in Electricity Distribution in India

Issues and Challenges

Electricity distribution is the weakest link in the power sector. Delicensing of generation has resulted in substantial capacity addition by private sector. In the 12th five year plan, more than 52% of total capacity addition is expected from the private sector. However, there is no competition in distribution. It is seen that internationally, consumers have benefited from competition in distribution. In India, amendment of the Electricity Act, 2003 is being considered to bring in competition in distribution. This article focuses on policy, regulatory and institutional changes that will be required to be carried out before competition in electricity distribution can be rolled out.

Gurudeo Sinha

Round the clock availability of electricity to all segments of society is essential for growth of the economy and providing a minimum sustainable level of livelihood. Although this aim is universally recognized, even 67 years after independence, we have not been able to achieve this aim. The Electricity Act, 2003 envisaged a new era in the power sector with unshackling of the sector from government controls, establishment of independent regulatory institutions, delicensing of thermal generation and establishment of unbundled power generating, transmission and distribution companies operating on commercial principles for making available good quality power to all.

Distribution continues to be Achilles heel of

In the 12th Plan, against a target of 88,537 MW capacity additions, 46,825 MW (amounting to 52.9%) is planned to be added by the private sector

the power sector with high level of operational inefficiency, power theft, aging infrastructure, fuel shortages, network constraint, rising cost of supply, & much higher AT&C losses than that reported as losses are often hid as unmetered consumption of agriculture. The accumulated financial losses of state distribution utilities being Rs 1.9 lakh crores as on 31st March 2011. As a result, Central Government announcing its Financial Restructuring of the loans vide its notification dated October 5, 2012 to bail out the beleaguered utilities.

Clearly, there is a need for competition in electricity distribution so as to attract private investments, bring in operational and financial efficiency, ensure round the clock supply to all, distance the government from the sector and to support Government's initiative to achieve a high GDP growth rate. This has led the Government to consider amending the Electricity Act, 2003 and introduce competition in distribution by separating the wire and electricity supply business. The proposed amendment aims to separate wire and electricity supply business of distribution. This implies that a distribution utility will be restructured so that there is a separate entity for setting up, expanding, modernizing and maintaining the distribution network and a separate entity (s) for supplying the electricity.

This article will focus on policy, regulatory and institutional changes that will be required to be carried out before competition in electricity distribution can be rolled out.

Existing legal Provisions regarding Distribution

The Electricity Act, 2003 has been very restrictive as regards competition in the distribution sector. It envisages that there can be multiple distribution licensee in an area with each distribution licensee using its own wires for distribution of electricity, a provision which has effectively shut off competition in retail distribution. Large consumers i.e. consumers with demand 1 MW or more can procure electricity through open access. However, open access has not been a success due a plethora of reasons including pancaking of charges, resistance by distribution utilities and state governments as the tariff being paid by these consumers has been without exception greater than the average cost of supply. Cash strapped utilities would not like to lose its high paying consumers.

Experience in India regarding introduction of competition in the electricity sector

Electricity generation has been delicensed in accordance with the provisions of the Electricity Act, 2003, bringing competition in the generation sector. Delicensing of generation has had the desired effect of attracting substantial investments in generation so much so that out of 54,963.9 MW of total generation capacity added in the 11th Plan, 23,011.5 MW (amounting to 41.9%) was added by the private sector. In the 12th Plan, against a target of 88,537 MW capacity additions, 46,825 MW (amounting to 52.9%) is planned to be added by the private sector.

Two power exchanges (IEX and PXI) provide demutualized, transparent platform for sale and purchase of power. As a result of increase in generation capacity, the sale of power through the power exchanges has increased dramatically from 99.8 BU out of a total generation of 764 BU in FY 2009-10 to 170.42 BU out of a total generation of 962.9 BU in FY 2013-14. The weighted average price of electricity transacted through traders and power exchanges has declined from Rs 7.29/kWh & Rs 7.49/kWh respectively in 2008-09 to Rs 4.29/kWh & Rs 2.90/kWh respectively in 2013-14. Power exchanges are emerging as a powerful platform for making available power to all as well as encouraging generation capacity addition on the basis of market demand.

Ministry of Power has formulated guidelines for competitive bidding for supply of power. Under Case-I bidding process, distribution utilities can issue tenders for supply of power by generator/trader. Under Case-II, four ultra-mega power plants have been awarded and are in various stages of completion. The levelised tariff proposed by Reliance for its SASAN UMPP was Rs 1.19/kWh & that by Tata's for Tata Power's Mundra Ultra Mega Power Project was Rs 2.26/unit which was considered to be very attractive tariff. Although tariff of Mundra UMPP has been mired in controversy due to request by Tata Power for enhanced tariff due to increased cost of Indonesian coal following a change in law. Indonesia, the competitive bidding process has proved its efficacy in bringing down the price of electricity generated.

International experience of privatization and competition in electricity sector

Privatisation & introduction of competition in most countries was preceded by restructuring of the vertically integrated utilities along functional lines. In most of the countries a wholesale electricity market (power pool) was created. The supply side of the wholesale electricity market is composed of power producers and demand side is composed of distribution companies, large users and retail users. Wire business (both transmission and distribution) has been considered as monopoly business and hence regulated. All suppliers /buyers of electricity are provided non

discriminate access to the transmission and/or distribution system. Pricing of the regulated services was carried out by Regulators either through price cap regulation and or through rate of return regulation. Price of electricity supplied to power pool has been left to market forces and intervention carried out only in case of high fluctuations.

The process of introduction of retail competition in distribution generally has been carried out over a period extending years, e.g. although privatization of electricity industry in UK was initiated in 1979, market was opened up to consumers with demand greater than 1 MW in 1990. In 994, the market was opened up for consumers with demand greater than 400 KW & retail completion was introduced in 1999.

Privatization and competition in electricity industry is internationally widespread. It has placed greater reliance on market forces and less dependence on government in the allocation of resources. The results of privatization and competition have been quite encouraging. Countries such as UK and Argentina have experienced substantial drop in prices of electricity. In UK the drop in prices following retail market opening was to the tune of 15%, while in Argentina, following privatization, wholesale electricity prices fell about 50% from the pre-privatization level of $60 per megawatt hour in August 1992 . As of 1997 Argentina's wholesale power rates stabilized at about 40% below the pre-privatization level. In February 1997, the New South Wales Independent Pricing and Regulatory Tribunal reported that wholesale electricity prices in Australia have steadily decreased since 1993, representing a 32% drop in real terms over a four-year period . The decrease in prices of electricity has been the result of greater operational and financial efficiency. Substantial foreign investments also flowed in as a result of privatization. The sale of government utilities to private participants helped in improving government finances. And to top it all, it has provided choice to consumers regarding their source of supply.

Issues and Challenges in transition to competitive environment in Distribution

Currently distribution of electricity is a licensed monopoly business as a second licensee cannot come in without laying his own wires. Hence, in order to bring in competition in the distribution sector, the wires and energy supply business will have to be separated and suppliers of energy will be provided non discriminate access to the wire system. An entirely different set of business environment will emerge. Issues that will have to addressed are:

- Reorganisation of Incumbent Distribution Licensee
- Zoning or Demarcation of Different Supply Areas
- Phased introduction of Competition
- Framework for Tariff structure
- Creation and operation of power pool
- Changes in Policy framework
- Changes in Regulatory Framework

Reorganisation of Incumbent Distribution Licensee

The incumbent distribution licensee is owner of the wire business and the energy supply business. The incumbent distribution licensee will be reorganized and subdivided into two distinct organizations, one solely looking after the wire business and the other solely looking after the energy supply business. Framework for subdivision of assets, liabilities, manpower functional responsibilities, etc. will have to be established so that it can be smoothly carried out.

Wire Business operator shall be responsible for planning /modernizing/ upgrading/ maintaining/ running the distribution network, providing connections, carrying out disconnections, etc. There shall be only one wire business operator in a particular area. The existing distribution licensee can become the wire business operator. The wire business shall be a regulated business and its Annual Revenue Requirement, capital expenditure plans and tariff shall be approved by the Appropriate Regulatory Commission.

The retail supplier shall be responsible for supply of energy to all consumers. It shall arrange for power, carry out wholesale trading, charge tariff in accordance with cross subsidy and subsidy programmes (at least in the initial phase), consumer billing and collection etc. A supplier of last resort will have to be decided. The incumbent retail supplier can be supplier of last resort.

In a competitive environment, the role of the Commission shall also change. It shall now be responsible for tariff determination only of the wire business. With respect to the supply business, its role shall be that of arriving at suitable tariff structures and maximum tariff of each category and slab keeping in view historical background of electricity tariffs and need of flexibility to promote efficiency and competition.

Zoning or Demarcation of Different Supply Areas

The physical area covered by the existing distribution licensee is generally very large and covers many districts. In order to encourage competition, it would be appropriate to subdivide the license area of the existing distribution licensee into a number of supply zones. This subdivision should be carried out in such a manner that cherry picking is not allowed. Further the current organization structure of distribution licensees i.e. divisions and circles are not in consonance with physical boundaries of districts, zila parishads, etc. Hence, each state will have to undertake zoning exercise so that appropriate, clearly demarcated physical supply zones with corresponding electricity supply divisions and circles are created.

Energy supplier for each zone can be selected on the basis of a transparent bidding process. A prospective supplier can bid for one or more supply zones. Each of the suppliers of energy will be bound by Universal Supply Obligation.

Phased Introduction of Competition

As per the EA 2003, open access is allowed for consumers having contact demand greater than one MW. Open access has not been successful. Introduction of full scale retail competition in supply business may not be feasible right from the beginning. However, with separation of wire and energy business, consumers with demand one MW or more should be allowed to choose their own supplier of electricity our source it themselves either through power exchange or a generator or a trader. Subsequently, with success, this facility can be allowed for

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

consumers with lesser demand for example for consumers with demand of 500 kW or then to consumers with 100 kW or more and finally to all consumers. This will ensure a smooth transition from the current system of only one supplier of electricity to an environment where there are multiple supplier and the consumers has a choice regarding his source of supply. It will also provide the existing utilities sufficient time and experience to mould their working from a monopolistic supplier to a competitive environment.

Framework for Tariff structure

At the present, Multi Year Tariff Regulations have been notified in most states by State Electricity Regulatory Commissions (SERC) and multiyear tariff for the state are being decided in accordance to the said Regulations. The tariff is decided for the ensuing year by the Appropriate SERC. True up is carried out after audited accounts are provided to the SERC. Even after introduction of competition there will be only one wire business operator in an area and hence it will be regulated business. Annual Revenue Requirement of the wire business, its tariff and subsequent true up will be carried out by the Appropriate SERC. Energy supply and billing, collection for energy supply shall be carried out by the Retail Supplier. The energy bill of the Retail Supplier shall include the tariff of the wire business, which after collection form the consumers shall be reimbursed to the Wire Business supplier.

A number of issues arise which shall need deliberation. The earlier tariff structure had element of subsidy and cross subsidy built into it. What shall be the tariff structure for the consumer which shall depend on the tariff structure of the wire business and the tariff structure of the retail supplier? What shall be the guideline for subsidy and cross subsidy? This is especially important as around 80% of the total cost of distribution is on account of cost of electricity. What sort of pricing freedom will be allowed to the Retail Supplier? Issues of smooth transition from current tariff regime to proposed tariff regime will require extensive deliberation considering:

- Trajectory of retail tariffs from regulated to competitive regime
- Cross subsidy and subsidy
- Supply to BPL category of consumer
- Supply to agriculture
- Time of Use tariff
- Mechanisms to promote demand side management & demand response systems

The change must be smooth. Tariff shocks are unsustainable and liable to cause political turmoil. A period of transition for regulated prices for all or some consumers may have to be considered. Transparent and effective mechanisms to meter customers and to assign losses to different voltage levels will have to be devised. More than one energy supplier will be there in one area. The mechanism for allocation of distribution loss to each supplier will have to be devised.

Creation and Operation of Power Pool

Utilities are obligated to supply electricity to all consumers under Universal Supply Obligation. In order to meet its obligation, utilities procure most of its power through long term Power Purchase Agreements with generators (NTPC/NHPC/NPC/ private generators). A small part of its requirement is purchased through bilateral agreements and/ or through power exchanges. To meet its Renewable Portfolio Obligations, the utilities purchase solar/non solar renewable energy from generators of renewable energy. Alternately, they purchase Renewable Energy Certificate from Energy Exchanges.

When competition is introduced in distribution, there will be multiple licensed suppliers of electricity in each area. However, as most of the electricity generation would already have been tied up in long term power purchase agreements with existing utilities, the only power that would be available to the new suppliers would be through traders or through energy exchanges. It is obvious that in such a situation, new suppliers of electricity cannot function. Hence, when competition is introduced, the first action that would be required would be to annul all the existing power purchase agreements and create a power pool (maybe the existing energy exchanges) into which all generators can supply and all users of energy (suppliers, consumers) can procure energy. An entirely new mechanism for pricing electricity made available to the power pool will have to be devised keeping in view availability of electricity from different sources, generating plants of different vintage and efficiency, fuel supply arrangements of different generating units, variations in demand across time of day, weather, season, etc. This will require close monitoring in the beginning to ensure that gaming/cartelization do occur and price of electricity do not move up beyond a certain cap. The power pool will encourage more efficient/ less expensive generation to be dispatched first.

Renewable Portfolio Obligation

Each supplier of energy will be required to fulfil his Renewable Purchase Obligation. The existing Power Purchase Agreements of Renewable Energy generators may have to be recast in view of change of energy requirement of existing distribution utility and requirement of new energy supply licensee to meet its RPO Obligation.

Changes in Policy framework

The Policy regimes reflect the vision of the Act. Introduction of competition will require substantive changes to be made in the National Electricity Policy and Tariff Policy. National Electricity Policy will have to reflect the requirements arising out of separation of carriage and content. This shall include creation of power pool, mechanisms for meeting RPO, issues of demand side management and demand response, etc.

The framework for tariff determination will undergo a sea change in view of the requirement to separately determine tariff for wire business and provide a frame work of energy supply to power pool and of energy purchase from power pool, etc.

Changes in Regulatory Framework

Electricity sector in India has evolved from being government controlled to a regulated sector and it functions as per Regulations of the Appropriate Commission. Regulations have force of subordinate legislation. New Regulations have to be formulated to reflect the introduction of competition in electricity supply business. A broad list of new regulations which will be required to be formulated is given below:

- Creation and operation of Power Pool
- Framework of Tariff Regulation for energy supply business
- Regulations for determination of tariff to be charged by wire business operator from different energy suppliers

- Grant of energy supply license
- Apportioning of losses to different energy suppliers
- Supplier of last resort

In addition to the formulation of fresh Regulations, existing Regulations will require substantive changes. Some the Regulations which will require a relook are given below:

- Multi Year tariff Regulations for wire business
- Renewable Purchase Obligations
- Supply Code: Distribution Code
- Allocation of distribution loss between different suppliers
- Switching from one supplier to another within incumbent wire business operator or outside it
- Standards of performance for wire business operator and retail energy supplier
- Communication linkages between meters of wire business operator and IT system of Retail Energy Supplier so that on line monitoring of power flows can be done.

Conclusion

Introduction of competition in the distribution sector has the potential of being the game changer for the electricity sector as well for the economy of the country. Availability of affordable good quality electricity is essential for economic and social progress, especially of the underprivileged sections of society. The fundamental as well as aspirational need of the country that every citizen is entitled to 24 7, good quality electricity can only be achieved if economy and efficiency is achieved through introduction of competition.

Managing transition from regulated industry to competition in retail supply of electricity will be challenging task. This is made all the more difficult due to electricity being in the concurrent list as per the Constitution due to which, distribution is in the state sector. The success of introduction of competition in electricity distribution will be closely linked to prices of power to end consumer and this will depend on the prices of electricity in the power pool. It will be essential to evolve a sustainable business model for both the wire business operator as well as the retail supplier considering the changes envisages in computation of revenue requirement, trajectory of tariff structure, cross subsidy and subsidy regime.

Gurudeo Sinha

Senior Fellow, Energy Regulations and Practice, The Energy and Resources Institute (TERI) is a senior professional with TERI having wide and in-depth experience and knowledge of the various issues facing the energy sector. An engineer from National Institute of Technology, Jamshedpur has MBA, post Graduate Degree in Industrial Engineering and a degree as Certified Energy Auditor from Bureau of Energy Efficiency. He has more than ten years of experience in electricity regulations and practice.

Cost Effective Strategy

Implementation of efficiency enhancement schemes in captive power plants in India

This article discusses the approach, methodology of the energy efficiency enhancement and benchmarking study conducted in the coal based power plants '<100 MW' in India and highlights the result. Benchmarking analysis with energy performance in the industry sector level have been performed in the past, but some recent studies on power plant equipment performance and benchmarking are also available.

Dr Debashis Pramanik

Furthermore benchmarks for 80-100 MW range power plants (including captive power units) are not available. The median size of individual power generating unit is 100 MW.

Following steps are followed to benchmark the figures on boiler efficiency/ η, specific coal/ energy consumption (SCC/ SEC for equipment) in a power plant

- Collection of design data and selective test reports/ characteristics curves
- Extensive field measurement of operating parameter/ data using the portable or on-line instruments/ data logger
- Analysis of data and performance (η, SEC/ SCC) evaluation of the boiler and other equipment
- Comparison of operating parameter and design data
- Comparison of analysed data with the design performance data
- Selection of most consistent benchmark level in boiler/ equipment and evaluation of energy saving possibility
- Consultation of energy audit reports of other equivalent capacity power plants
- Comparison of power plant parameter/ data with the data of other power plants

The efficiency of the boiler and turbine has a marked effect on Auxiliary Power Consumption. Heat consumption reduces with an increase in boiler efficiency. Some cases the power plant equipment revamping is done for 5-10% additional power generation and improve the performance level. The study covering 5-7 states reveals the components/ systems where modifications have to be made to conserve energy. It presents generic recommendations to be implemented to make power plant energy efficient. The generation rate would be improved by adopting these measures. The benchmarks developed based on such equipment basis data are considered to have acceptable accuracy and reliability. Control of energy related parameters and their benchmarking enable the system/ equipment/ plant operation at highest efficiency.

The operating range of specific coal consumption (SCC), heat rate (HR), APC in some of the 80-100 MW thermal power plants is 0.84-0.85 kg/ kWh, 2150-2700 kCal/ kWh and 9.12-12.27% respectively. The present focus of

Benchmarking analysis with energy performance in the industry sector level have been performed in the past, but some recent studies on power plant equipment performance and benchmarking are also available

power plants is to achieve improvement in operating HR by about 10-12% and APC to 7.5-8.5% respectively. The design SCC, HR is in the range of 0.77-1.03 kg/ kWh and 2330-2520 kCal/kWh respectively. The operating HR is either equivalent (close level) to or higher than the operating HR for northern region (weighted average opn. HR 2608.2 kCal/ kWh) 110-500 MW power stations also. The heat rate of 14 Indian power plants (Central Electricity Authority document source) & world's 9 power plants (International Energy Agency document source) is between 2279-2383 kCal/ kWh and 2261-3607 kCal/kWh respectively. However, the DTPS, Dahanu HR is observed to be lowest (2261 kCal/ kWh in 2004/05) throughout all the previous years. Now the DTPS is the first ever utility in the World to be certified for ISO 50001:2011 for its strong commitment for energy use and conservation.

The present methodology with CEA/ Central Electricity Regulatory Commission (CERC) guideline is acceptable/ adopted to most of the public/ private sector efficient power plants and norms are being met by them. The norms must, therefore, reflect higher levels of efficiency to induce a sense of inter-plants competition and promote efficient operation. Essentially, a World Class Energy Efficient power generating unit will be operating with the world's lowest SEC/ SCC (electrical & thermal) for similar power plants. More efficient operation would also lead to less CO_2 emission which is the current focus of global efforts for lower GHG emissions.

The worldwide highly competitive energy market is demanding the power generation companies/ plants for a critical look on their business policy. Re-orientation of the thermal power plants/ captive power sub-sector has progressed and has put pressure on heat and power production cost with the additional power generation from the existing systems with some modification possible or sale the surplus electricity. Nowadays, power plants (PPs) generally operate as commercial enterprises/ units that need to create a profit. This means that a positive margin should result from the gap between the benefits from the electricity despatched/ sold on one hand and the expenses for running the power plant on the other. In this context, many PPs and captive power plants (CPPs) have been taking up several projects/ programs on efficiency and performance improvement (including strategic review for cost reduction and benchmarking).

In today's generation business, optimizing the operation of boiler, steam turbine and other equipment is no longer a goal but, rather, a necessity for power producers to remain competitive. The benchmarking also plays a role in PP regulation in several jurisdictions. It is undertaken by the competitive PPs/ utilities/ regulators for improving operational efficiency and cost control/cutting. It means technically the cost efficient power and heat generation. In many CPPs, steam extractions during turbine operation are taken in the production process stages/ equipment. The aim of steam turbine and turbine generator (TG) design is an optimum efficiency operation characterizing an optimal energy conversion. Moreover, the operational performance of modern generating equipment has to match the rated value, under almost all circumstances. Thus any improvement in boiler, turbine & associated power generating equipment/ system, however slight, can increase power availability, decrease equipment/ component operating costs, and generate significant cost savings. Consequently, keeping a PP in optimum condition requires the professional maintenance & operation approach.

The term "Benchmark" originally meant a surveyor's mark-out in a target used as a reference point. It has come to mean any parameter taken as a point of reference or comparison. Benchmarking of PP/ CPP involves development of essential technical and organizational elements for the long-term commercial sustainability of the plant operation. "Benchmarking" provides a chance to compare a generation unit at maximum/ full (or beyond

peak level) load with another or a "Best Practice"- PP / unit or CPP/system, to find out its own indicators and ranking in a competitive market. The own position in the competitive market will be given by means of indicators, which will be defined at the beginning of the process. In today's business environment, it is recognised as an effective approach towards improvement in efficiency, productivity, quality and other dimensions of performance that are determinants of competitiveness.

The generating capacity in India can be divided into utility power sector and captive power sector. The utility sector capacity is 170 GW of which nearly 50% comes from the state share. The private sector share which is presently 20% is like to go up in near future because of the active major dependence on coal based generation (about 54%). Individual CPPs have sizes in the range of 1 MW to 1 GW with the median size of individual unit of 100 MW. Power generation in CPPs would be either from external fuels like coal or from process generated fuels like bagasse or rice husk. Following subjects are preconditions in thermal power plants: Low operation and maintenance cost, High technical efficiency in PP operation, Effective management organization and Compliance with surrounding regulations.

Basis of Energy Efficiency Benchmarking

The PP performance can be expressed through some common factors as heat rate (HR/ energy efficiency); thermal efficiency; capacity factor; load factor; economic efficiency and operational efficiency. HR is an important index for efficiency assessment of a PP. The PP efficiency mainly centers around temperature (heat derived through coal combustion) & pressure (steam derived through water) optimization for a given technology. Superior technologies provide better efficiency over subcritical pulverized coal power generation.

Unit operation efficiency (or HR) is a function of unit technology, equipment, design, size, capacity factor, fuel quality fired, maintenance condition of the unit, and operating and ambient conditions. As is the case with optimizing the plant HR at peak/ maximum load, enhancing the PP output can be best approached by balancing boiler and steam turbine performance. The factors that affect operating HR and are beyond the control of PPs are coal quality, grid frequency, cooling water temperature and unit loading or dispatch instructions. The detailed energy performance (DEP) analysis in PP is the first step for the study of efficiency and equipment performance. Attempt is made to explore the best operating PPs equipment performance, HR and compare with HR of the target plant. Consequent to review of performance of all the equipment, energy benchmarking is undertaken.

In order to be useful in its underlying aim of encouraging best practice in equipment efficient performance, fuel use, power generation and understanding the potential for further improvement, an agreed view of participating PPs on best practice performance and maximum generation is required by the plants, to become one of the 10-15 most efficient plants in the country or among the top 20% of the most energy-efficient PPs in the world. After the thorough study, plant management is normally given the key data (including specific energy consumption/ SEC) of a typical/ reference PP/ CPP using similar capacity range boilers, turbines and associated equipment. The best performance key data of any efficiently operating typical reference plant is also used as comparative levels & benchmarks, providing a basis for units/ plants to consult and determine appropriate future development strategies that consider the plant level constraints.

Separate benchmarking indicators are calculated for energy efficiency of PP equipment, based on Weighted Average Energy Efficiencies. It can be categorised in many different ways, according to various criteria:

- Result benchmarking (inter plant comparison)
- Product benchmarking (quality improving),
- Process benchmarking, and
- Strategic benchmarking (Business processes).

Statistical benchmarking has in recent years become an accepted tool in the PP/ CPP performance assessment. Energy conservation (ECS) through benchmarking can be broadly categorised as 'process benchmarking'. ECS measures for a better economic efficiency of the PP focused on, are to be derived from the results.

Power generating process benchmarking involves the following basic steps:

- Identification of the equipment/ control mechanism for the plant/ unit
- Collection of information to thoroughly understand the process and identification of key/ controlling parameters
- Determination of energy performance
- Analysis of the gap between the existing and the bench marked efficiency levels.

Benchmarking of EC internally (trend analysis) and externally (across similar equivalent generating units) are two powerful tools for performance assessment and logical evolution of avenues for improvement. Historical data well documented helps to bring out EC and month-wise / day-wise cost trends. The analysis of EC, cost, relevant generation systems/ features, SEC, help to understand effects of capacity utilization on energy use efficiency and costs in regular basis.

External benchmarking relates to inter-unit comparison across a group of similar units. However, it would be important to ascertain similarities, as otherwise findings can not be appropriate. Few comparative factors, which need to be looked into while benchmarking externally are: Scale of operation, Vintage of technology, Fuel specifications and quality, and Steam supply configuration and quality.

Energy performance benchmarking permits the following parameters:

- Quantification of fixed and variable EC trends vis-à-vis generation levels
- Comparison of Penergy performance (PPEP) with respect to various generation levels (capacity utilization)
- Identification of best practices (based on the external benchmarking data)
- Scope and margin available for EC and cost reduction
- Basis for monitoring and target setting exercises.

The benchmark parameters can be:

- Electricity generation related

  e.g. % thermal efficiency of a boiler

  e.g. Sp. Coal consumption (kg/kWh)

  e.g. Auxiliary power consumption (%)

  e.g. % cooling tower effectiveness in a cooling tower

  e.g. kWh/Nm^3 of compressed air generated.

  While such benchmarks are referred to,

Suitable connection always!

With us you always find the suitable connection for...

Signals
In the field of measuring, control and regulation signals.

Data
In the range of all established fieldbuses, networks, FireWire, and USB.

Power
In the field of power electronics.

PHOENIX CONTACT
INSPIRING INNOVATIONS

HEAD OFFICE
Phoenix Contact (India) Pvt. Ltd.
F-26/2, Okhla Industrial Area, Phase-II
New Delhi 110 020 INDIA
Tel: +91-11-30262700/800
Fax: +91-11-41611070/71
E-mail: adverts@phoenixcontact.co.in
Website: www.phoenixcontact.co.in

SOUTHERN INDIA OFFICE
411, Barton Centre
84, M.G. Road, Bengaluru 560 001
Tel.: +91-80-30577399 to 403
Telefax: +91-80-25581312

WESTERN INDIA OFFICES
30, Shaswat Bungalow, 1st Floor
Ceaser Road, Amboli
Andheri (W), Mumbai 400 058
Tel.: +91-22-31901500 / 2772 / 3334

404-405, City Point
Dhole Patil Road, Pune 411 001
Tel.: +91-20-30581224-33
Fax: +91-20-30523637

www.facebook.com/PhoenixContactIndia

related crucial process parameters need mentioning for meaningful comparison among participating PPs. For instance, in the above case:

- For a CPP – fuel quality, type, steam pressure, temperature, flow, are useful comparators alongside thermal efficiency and more importantly, whether thermal efficiency is on GCV/ NCV basis or whether the computation is by direct method or indirect heat loss method may mean a lot in benchmarking exercise for meaningful comparison.
- Cooling tower effectiveness – ambient air wet/dry bulb temperature, relative humidity, air and circulating water flows are required to be reported to make meaningful sense.
- Compressed air specific power consumption – is to be compared at similar inlet air temperature and pressure of generation.

Equipment Energy Performance and Efficiency Degradation

PPEP is the measure of whether a PP equipment is now using more or less energy to generate electricity than it did in the past. It is a measure of how well the energy management programme is doing. It indicates the year-wise change in EC considering generation output. Power plant performance monitoring compares plant energy use at a reference year with the subsequent years to determine the improvement achieved. However, the PP's year-wise generation output would vary and the output has a significant bearing on its energy use. For a meaningful comparison, it is necessary to determine the energy that would have been required to produce this year production output, if the PP had operated in the same way as it did during the reference year. This calculated performance level/ value can then be compared with the actual value to determine the improvement or deterioration that has taken place since the reference year based on the available documented data from plant.

Following equipment tests are conducted in the energy performance/ audit study in PPs/ CPPs:

- Boiler efficiency test
- Air heater leakage test
- Mill performance test
- Furnace efficiency test
- Turbine performance test
- Condenser performance test
- HP cylinder efficiency test
- Regenerative system performance test
- Lighting illumination test
- CW water flow study
- Fans and pumps (BFP, CEP & CWP) performance test
- Tests in air compressors & compressed air distribution systems
- Ash / coal handling plant study (optimum coal path)
- Cooling tower performance test
- Transformers/ motors performance test
- Test of electro-static precipitator (ESP).

The efficiency of the boiler and turbine has a marked effect on auxiliary power consumption (APC). Heat consumption reduces with an increase in boiler efficiency. The benchmarks developed based on such equipment-wise data are considered to have acceptable accuracy & reliability. However, the efficiency degradation of the equipment/ plant is a normal process, but a continuous challenge to minimise the degree of degradation. State of the art of power plant/ equipment operation and maintenance is to keep the degradation level between the ranges of +/- 0.1% net efficiency. This impressive figure is the outcome of a well equipped energy efficient plant in developed country in terms of monitoring and maintenance system. The backbone of these systems is a state of the art process control and instrumentation system allowing the record of any relevant data.

The targeted system indicators are heat transfer decrease in the boiler caused by ash deposits, condenser caused by fouling effects,air control of the boiler system, avoidance of corrosion in the boiler and pipe system by the well suited operation of the ESP and turbine system – vibration and frequency control.

Thermal Power Plants Up-gradation and Benchmarking

The weighted average efficiency of the coal fired PPs is about 35%, against 45% for natural gas and 38% for oil fired. The greatest attention has been steadily changing the HR and total operating cost in PPs/ CPPs.

Following are the key points attended by many PPs management for improving HR:

- Preparation and execution of the detailed plan listing specific activities those are to be undertaken to make improvements every year, & review it periodically (quarterly) to ensure that the plan/ scheme is implemented.
- Heat rate improvement is a continuing process in the PP. It must become a part of the normal work activities. It must be considered along with, and at par with, reliability, safety, environmental concern, etc. when operating the unit, scheduling maintenance, and all other routine activities.

The present focus of PPs is to achieve improvement in operating HR by about 10-12% and APC to 7.5-8.5% respectively. However, the typical thirteen (1977-1990) years historical trend of design HR in Indian power plants is also given in the Table 1.

Period	Steam pressure	Unit size (MW)	Turbine HR (Kcal/kWh)	Calculated Unit Heat Rate (Kcal/kWh)
1977-82	130 ata 535/ 535^{0}C	210 (Russian)	2060	2423
1983 +	150 ata 535/ 535^{0}C	210 (Siemens)	2024	2335
1984 +	170 ata 535/ 535^{0}C	500	1950 (TDBFP)	2294
1990+	150 ata 535/ 535^{0}C	210/ 250	1950 (MDBFP)	2294
	170 ata 538/ 538^{0}C	250/500	1950 (TDBFP)	2294

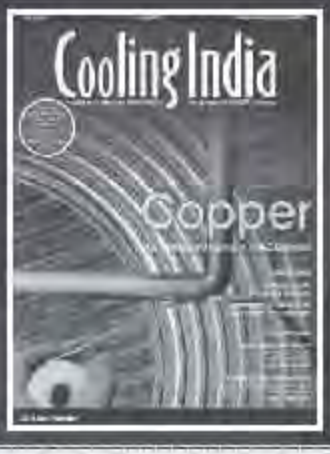
Table 1: Indian scenario (1977-1990): Design Heat rate
*Above are best design values – design rates of individual unit varies based on reference ambient, coal quality, design and supply rates

It has been also observed that the APC on % basis would be high, when the PPs generation is on the lower side. Thus it can be reduced simply by generating at maximum power and beyond the peak level up to the permissible level. Low load operation is also avoided as the efficiency of main equipment and associated auxiliaries undergo variations, vibration increase.

Cooling India

India's foremost Monthly dedicated to the growth of HVAC/R Industry

SUBSCRIPTION FORM



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

The Subscription In-charge
Cooling India
Chary Publications Pvt. Ltd.
201, Prema aya, Next to Cafe Coffee Day,
Opp. Telecom Factory, Deonar, Mumbai - 400 088.
E-mail: sub@charypublications.in

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. ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Date of Birth ☐☐ ☐☐ ☐☐☐☐ (D D M M Y Y Y Y) Card Expiry Date: ☐☐ ☐☐☐☐ (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 \ December 2014

Contents of the magazine :

- Latest news and views from the HVAC & R industry
- Interviews with eminent people from the industry
- Case studies and analytical reports
- Technical articles
- Book reviews on the industry
- Events on the happenings on the cooling industry around the world
- New technologies that breaks world wide

... and much more.

Major Industries covered :

- Absorbers
- Air Distribution
- Air Handling Units
- Air Conditioners
- Boilers
- Building Automation
- Chemicals
- Chillers
- Cold Stores
- Compressors
- Condensers
- Condensing Unit
- Contractors
- Controls
- Cooling Towers & Parts
- Dampers & Parts
- Ducts & Accessories
- Energy Saving
- Environmental
- Evaporators
- Exhaust
- Fan-Coil Units
- Fans
- Fire
- Freezers
- Instruments
- Insulated Doors
- Insulation
- Pumps
- Refrigerants
- Refrigerators
- Solar
- Thermal Storage Systems
- Transport Refrigeration
- Valves
- Water Coolers
- Water Treatment

... and related accessories

Reach :

Professionals like :

- Top industrialists
- Manufacturers
- Consultants
- Architects
- Interior designers
- Process Engineers
- Importers & Exporters
- Traders

Industries like :

- Pharmaceuticals
- Biotech
- Process Industries
- Printing & Packaging
- Hospitals
- Cold chains
- Food processing
- Storages
- Entertainment
- Other allied Industries
- Institutions

mecc alte

Bigger. Better. On Demand.

At Mecc Alte we're totally focused on bringing you the world-class alternators you need. Being totally independent means we can also respond to new demands quickly and effectively. That's how we've been able to increase our manufacturing capacity, especially on our large alternator range.

The world is moving fast. At Mecc Alte, we're totally ready to keep pace.

Totally Focused.
Totally Independent.

www.meccalte.com

MECC ALTE INDIA PVT LTD
Plot No. 1, Gate No. 3363 3364, 3365/Part, 3366/Part & 3367, Talegaon Dhamdhere S. O.
Taluka Shirur, District Pune - 412208, India. Tel: + 91 2137 619600 Fax: + 91 2737 619699

Many PPs have been revamping the steam turbine (its earlier capacity and steam flow regulation), addition of 1st stage 5% generation & 2nd another 4-5% by increasing the steam input to the turbine. Addition of power generation required existing valves new opening/ level with manufacturers/ suppliers assistance for additional/ extra amount of HP steam flow with the existing turbine rating. Overall efficiency of a steam turbine and PP, however, strongly depends on the turbines' performance. Conventionally, the design operation limit of the turbine was basically efficiency and reliability centric investment and SEC/ benchmarking was not the top most priority.

Generally, the turbines design margin remains unused with the test for performance guarantee (PG) and Boiler Maximum Continuous Rating (BMCR) before revamping. First level key changes are the requirement for greater heat input and regulatory pressure to maintain or optimize emissions (within limits). These issues are economically analysed and addressed through improved performance of the existing fans and fuel preparation systems. In the boiler next change from the normal operation is also typically encountered. Reheat changes are more complex and typically would have involved new tube surface to increase heat absorption with minimal effect on system pressure drop. In most cases, electrical generators also has sufficient design margin to accommodate the extra MW generation. The methods of increasing the capacity by fitting a new design of coil to remove the extra heat generated. Similarly the generator transformer also has adequate design margin to accommodate a minor increase in output.

Numerous other measures to improve efficiency and generation cost is also to be described,evaluated, compared and finally best options need to be introduced. The total cost is divided into different groups of cost and then analyzed and compared with other, similar PPs/ CPPs. This gives the advantage to the PPs to judge and benchmark key indicators versus the background of practical operations and approach to become an energy efficient plant. Essentially, a World Class Energy Efficient power plant/unit will be operating with the world's lowest SEC (electrical & thermal) for similar PPs.

A World Class Energy Efficient Power Generating Unit is:

- A trend setter in SEC norms – the lowest in the world for similar industries
- A leader in implementing the latest technologies
- Unit has practically 'nil' Energy Wastage
- Unit has made ENCON an 'On-going activity' and incorporated as a part of the management system.

Benchmarking Methodology and Guideline/ Norm

Benchmarking process uses the design characteristics and operational factors of the target unit equipment group as its starting point. The methodology involves the analysis of equipment monitored/ collected data and discussion with the plant personnel in PP followed by the consultation of the following documents published by Central Electricity Authority (CEA) & Central Electricity Regulatory Commission (CERC) to explore the best performing plants benchmark data/ level:

- Performance Review of Thermal Power Stations/ Plants 2007-2008
- Recommendations on Operation Norms for Thermal Power Stations/ Plants for Tariff Period beginning 1stApril 2009

For the energy performance evaluation, the efficiency of individual equipment is calculated, which broadly covers the energy efficiency comparison of operating and design/ guideline.

In order to supplement the plant data monitored and information collected (including design/ logbook data) on the equipment, calculated efficiency and SEC, the CEA and CERC documents are consulted after the site measurements. This methodology with guideline is acceptable/ adopted to most of the PPs and norms are being met by them.

Collected data/ information and characteristics curves would cover various aspects related to steam generation at steady load, turbine loading and power generation, their fluctuation, associated equipment performance and maintenance quality, reliability besides seeking information on energy loss incurred due to efficiency related problems. The plant information/ data is broadly divided in four different sections, viz.

- general information (equipment used, production, energy cost/ consumption, process, energy/ fuel usage);
- details on equipment peak load performance and its impact on the PP;
- problems due to maintenance/ quality, reliability and its impacts on plant and generation; and
- issues related to coal handling/ feeding.

The CEA document based available data/ information would be divided in four sections viz.

- all India WA design heat rate (ADHR) and average operating HR (AOHR);
- region-wise WA of design HR (RDHR) and region-wise operating HR (ROHR); and
- most efficiently operating power plants/ units WA design HR (EDHR) and operating HR (EOHR).

The CERC document based data/ information would be categorized for the prevailing norms and "Normative value for units of equivalent capacity and above 110 MW units". The tables are mentioning the data/ practices of coal fired PPs, which are always in line and maintain the trend for wide capacity range.

It is pertinent to note that the issues related to quantity/ supply of coal available to the Indian power industry is not directly related to quality of power, but poor coal quality does impact the generation efficiency of boilers, steam quality and associated power plant equipment.

Norms specifying approach of CERC

Utilities performance benchmarking is facilitated by the extensive data that they report to regulating commission. Possible approaches for specifying operation norms could be

- Uniform single value norm for all stations
- Norm in terms of % of design value.

Uniform single value norm for all power plants

CERC has prescribed the single value norms for power station/ plant HR and APC. The single value may be expressed as either as absolute number as done in case of station HR or as a % as done for APC. Such norms are appropriate for APC data which do not vary significantly with the unit size or other technological parameters. However, the single value concept has limitations when applied to operating parameters like the unit HR.

A large variation in HR exists due to

LIGHTNING & SURGE PROTECTION FOR ELECTRICAL & ELECTRONIC EQUIPMENTS

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

ALLIED POWER SOLUTIONS
C-301, Delhi Rajdhani Apts
80, I.P. Extn. Patparganj
Delhi - 110 092 (INDIA)
Mobile: +91 99993 01007, +91 96500 44992
Tel: + 91 11 2223 6074
Email: info@alliedpowersolutions.com
Web: www.alliedpowersolutions.com

different equipment design, steam parameters, and design fuel quality etc. Thus, considerations are invariably required to be made to accommodate the worst combinations of turbine cycle HR, boiler efficiency. This leads to considerable variation in the margin available to different PPs between the operating HR and design HR. Even for same unit size & steam parameters, the HRs vary due to improvements affected by the suppliers progress over time and therefore, considerable HR variations offered by different manufacturers for same unit size/ steam parameters.

Also even with the same TG, the unit HR could vary significantly at two different sites due to large variations in coal quality, cooling water temperature, etc. Thus even with the same equipment efficiency, a PP/ CPP could have considerably higher design HR due to site specific factors beyond his control and the normative HR based on single value concept would provide much lower operational margin to such a plant.

This concept provides very high cushion for operational variation (or to high savings to units with lower design HRs) and leads to undue penalty to those with higher design HRs which could be for reasons beyond the plant/ utility control, like coal quality and cooling water temperature. Thus, instead of rewarding operational efficiency, which should be the aim of any good benchmarking exercise, it rewards better designs or better site inputs where the operator reaps the benefits of intrinsic advantages of the equipment or site environment or coal quality without major operational efforts. However, this approach provides incentive to the PP management to go for more efficient design and technologies which may result in higher capital cost. In the cost plus approach this would result in higher fixed charges for such PPs which would be passed on to the beneficiaries of the project. However the benefit of higher efficiency in operation may not be passed on to the beneficiaries and may be retained by the management.

Norms in terms of % of design value

The other approach could be to specify the normative parameter as a certain percentage above the design parameters of the unit. The design HR indicates the intrinsic capability or the best achievable efficiency of any generating unit. Such an approach automatically provides for consideration of variations in design/ technology, ambient conditions and fuel quality in the norms and thus provides more rational basis for operation norms specially in the developing scenario with large variations in design of the PPs/ units. It also provides for incentive to the plant management members to achieve better operational efficiencies. However, in this approach there is no incentive to the management to adopt more efficient designs/ technologies as the entire benefit of having more efficient designs/technologies is passed on to the beneficiaries. Thus, it is suggested that while single value approach may be continued for specifying norms for APC, the % over design approach may be followed for specifying Unit HR with some benchmark values for different unit sizes to ensure minimum efficiency standards in the future units by the management.

Recommended normative HR and APC

There is a strong case for change over from the conventional single value norm system for PPsHR to % margin over the design HR system with a view to accommodate large range of unit HRs likely to be seen in future for reasons discussed in the CERC document. Thus, the normative HR would remain at the low level with the operating margin practically available, notwithstanding numerous technological developments in equipment design & operation.

The present norms of APC are comfortable being met by most of the PPs. Further, there seems to be no major technical development in recent past leading to significant lowering of APC barring minor/ slight reduction in APC for units using superior/ imported coal. However, most of the stations with 200-500 MW rating have shown appreciably low power consumption as compared to the normative APC and PPs and with 100-200 MW rating shown slightly high consumption as compared to the normative APC.

Degree of accuracy of benchmarking

- Each PP adopts packages for equipment procurement based on prevailing conditions and considers the package and procedure most suited for the project.
- Degree of accuracy and benchmarks reliability rests on data relied upon and stage-wise methodology followed.
- Data relied upon is from the sources of central technical office and division/ state power plants/ units.
- Data, documents, records and registers available with the above PPs/ CPPs/utilities are maintained as per applicable rules, regulations, accounting standards and are subject to audit as per those rules and regulations.
- The benchmarks developed based on such available data are considered to have acceptable accuracy and reliability.

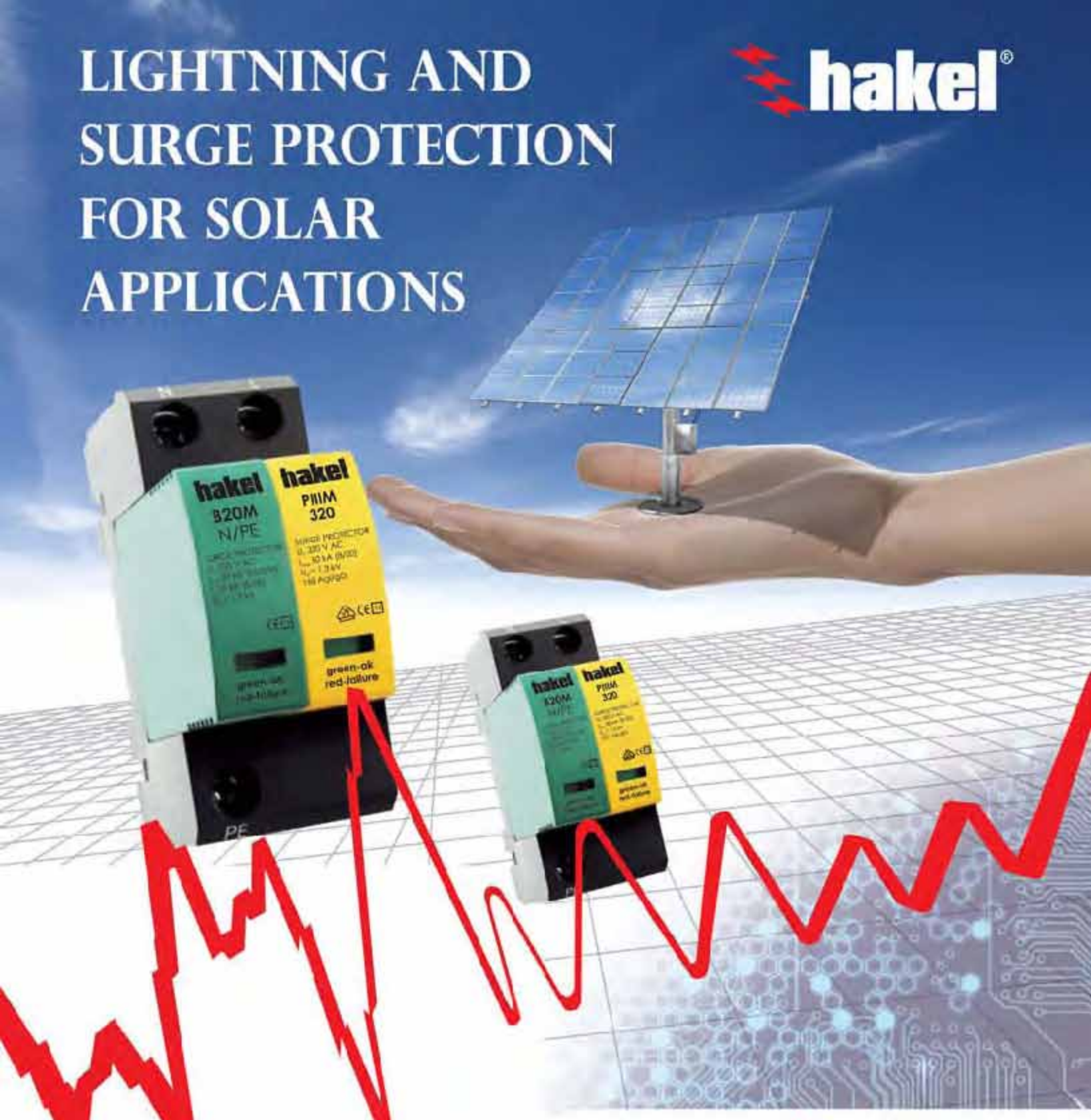
Energy benchmarking and effect of variable/ over load on equipment design/ operating performance in power plant

The time series data on generation and coal quality of the individual PP is consulted. Moreover, the personnel indicate that weather the plant had undergone through the fluctuation of power generation load. In each PP, the turbine is to generate base load electricity, operate with over capacity due to high and fluctuating/ de-rated load or steam generation in the complex. Therefore, the design and operating performance of all the equipment get severely effected due to variable load and benchmark data happened not to be matched with the occasionally minimum achieved level.

The benchmarking data (including SEC) of a typical coal fired 100 MW PP's boiler efficiency, turbine HR, condenser/ cooling tower effectiveness, BFP/ CEP/ CW/ ACW pumps efficiency, forced draft (FD)/ primary air (PA)/ induced draft (ID) fans efficiency, reciprocating compressors free air delivery & ESP efficiency are given in the Table 2. At present the operating range of specific coal consumption (SCC), HR, APC in some of the 80-100 MW thermal power plants is observed to be 0.64-0.85 kg/ kWh, 2150-2165-2610-2700 kCal/ kWh and 9.12-12.27% respectively. The design SCC, HR is in the range of 0.77-1.03 kg/ kWh and 2330-2520 kCal/ kWh respectively. TERI 2011, TERI 2010, TERI 2009 Report on "Energy Performance and Benchmarking Study" in 4 states is the source of this data. The operating HR is either equivalent (close level) to or higher than the operating HR for northern region (WA operating HR 2603.2 kCal/ kWh) 110-500 MW power stations/ plants also.

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

Parameter	Unit	Benchmark level
Boiler Efficiency	%	84.0
Turbine Heat rate	kCal/ kWh	2470 (Source: NTPCdata)
Turbine rated terminal output	MW	
Cooling tower, Effectiveness	%	60.0
Boiler feed water pumps, Efficiency	%	85.0
BFPs, SEC	kW/ TPH of feed water	3.61
Condensate extraction pumps, Efficiency	%	75.0
CEPs, SEC	kW/ m^3 of water	0.70
Cooling water pumps, Efficiency	%	85.0
Cooling water pumps, SEC	kW/ m^3 of water	0.08
Auxiliary cooling water pumps, SEC	kW/ m^3 of water	
FD fans, SEC	kW/ ton of FD	2.95
PA fans, SEC	kW/ ton of PA	7.82
ID fans, SEC	kW/ ton of flue gases	3.78
RCs-SAC, SEC	kW/ m^3/ min	6.73
RCs-CAC, SEC	kW/ m^3/ min	5.03-8.75
ESP	%	99.88

Table 2: Benchmarking data of major equipment of a typical 100 MW power plant
(Source - TERI 2011 Report on 'Energy Performance and Benchmarking Study'); SEC - Specific energy consumption, SAC/ CAC - Service/ Conveying air compressors
* Improved level 2261 kCal/ kWh (from DTPS data source) in 2004-05 against CERC norm of 2500 kCal/kWh in last 5 years

Parameter	Unit	Design level
Boiler type		Pulverized coal firing
Steam generation (MCR)	t/h	375
Steam pressure	ata	140
Steam temperature	^0C	540
Fuel		Coal
Boiler efficiency	%	89.73
Turbine rated terminal output	MW	110
Steam inlet pressure	ata	140
Steam inlet temperature	^0C	540
Sp. Coal consumption	Kg/ kWh	0.556
TG heat rate	kCal/ kWh	2153
Boiler feed pumps, Avg. efficiency	%	72.0
BFPs, Avg. SEC	kW/ T of water	6.74
Condensate extraction pumps, Avg. efficiency	%	75.0
CEPs, Avg. SEC	kW/ m^3 of water	1.08
Cooling water pumps Avg. efficiency	%	90.0
CWPs, Avg. SEC	kW/ m^3 of water	0.093
FD fans, Avg. efficiency	%	80.0
FD fans, Avg. SEC	kW/ ton of FD	N.A.
PA fans, Avg. efficiency	%	76.0
PA fans, Avg. SEC	kW/ ton of PA	N.A.
ID fans, Avg. efficiency	%	85.0
ID fans, Avg. SEC	kW/ ton of flue gases	N.A.

Table 3: Reference power plant's (110 MW) design parameters
N.A. Not available (Source - TERI 2008-09 Report on 'Energy Audit and Performance Study')

Parameter	Unit	Operating level
Turbine rated terminal output	MW	75
Boiler feed pumps, Avg. efficiency	%	64.0
BFPs, Avg. SEC	kW/ m^3 of water	5.94
Condensate extraction pumps, Avg. efficiency	%	67.5
CEPs, Avg. SEC	kW/ m^3 of water	0.96
Cooling water pumps Avg. efficiency	%	85.0
CWPs, Avg. SEC	kW/ m^3 of water	0.032
Auxiliary boiler cooling water pumps Avg. efficiency	%	80.0
ABCWPs, Avg. SEC	kW/ m^3 of water	0.083
FD fans, Avg. efficiency	%	69.0
FD fans, Avg. SEC	kW/ ton of FD	3.66
PA fans, Avg. efficiency	%	66.5
PA fans, Avg. SEC	kW/ ton of PA	4.15
ID fans, Avg. efficiency	%	72.0
ID fans, Avg. SEC	kW/ ton of flue gases	3.69

Table 4: Reference power plant's (75 MW) associated equipment operating parameters
(Source - TERI 2007-08 Report on 'Energy Audit Study')

The public/ private/ Govt. industry sector and Bureau of Energy Efficiency (BEE) in India would jointly work out on the capacity-wise applicability and compile the successful case studies of energy efficient motors (about 100 models), boilers, fans and other equipment in power plants, update the India's energy efficient products directory and recommend for the extensive use.

The characteristics and method of use of large/ medium size boiler (including FBC type) and large size steam turbine is largely influenced by the extent of steam over load (above design level) on the generation load in PP. Most of the time, the steam load on the turbine would be higher (above design level) or increasing.

Effect of variable over load on power plant equipment design performance

In the present situation, the governor comes into action operating a steam valve and increases steam flow (admitting above the peak level) to turbine and increase the turbine speed well above the normal level. The governor response from the load to turbine is quite prompt, but further above the optimum point, the governing response would be slower. The reason is explained as given below:

- In most automatic combustion control systems, steam pressure variation is the primary signal used. The boiler must operate with unbalance between heat transfer and steam demand long enough to suffer a slight but definite increase in steam pressure. The controller must then increase fuel, air and water flow in the proper amount. This will affect the operation of practically every component of auxiliary equipment. Thus, there is a certain time lag element present in combustion control. Due to this, the control components should be of

PRECISION WIRES INDIA LIMITED

SOUTH ASIA'S LARGEST MANUFACTURER OF WINDING WIRES


Enamelled Round Winding Wires


Enamelled Strips


Continuously Transposed Conductors (CTC)


Rectangular Taped Conductors

- State of the art plant and equipment
- Stringent quality and process control
- ISO 9001, ISO 14001, TS 16949 and various UL certifications
- Approved by PGCIL, NTPC, RDSO and others
- Wide range of prestigious clients in India and abroad

PRECISION

MILAN
WINDING WIRES

Phone:+91-22-2436 0089 Fax:+91-22-2437 0687
Email : mumbai@pwil.net Website: www.precisionwires.com

most efficient design so that they are quick to cope with the variable demand around peak load.

- The peak level/ progressively fluctuating generation load results in higher (above peak level) and fluctuating steam demand. Due to this it becomes, very difficult to secure excellent combustion since it requires the co-ordination of so many various services/ activities. However, the efficient combustion is readily attained under steady steaming conditions.
- The higher level variable load requirements also modify the operating characteristics built into equipment. Due to non-steady overload on the plant, the overloaded equipment cannot operate smoothly at the designed load points. Hence for the equipment, a flat-topped load efficiency curve is more desirable than a peaked one.
- Regarding the retrofitted PPs, since their number and sizes are selected to fit a known or a correctly predicted load curve, therefore, it would be possible to operate them at or near the point of maximum efficiency (considering revamped condition). However, to follow the variable load curve very closely, the total PP capacity is usually sub-divided into several PPs of same/ different sizes. Many times, the total PP capacity would more nearly coincide with the variable load curve, if some similar/ higher size units (boiler, TG) are employed than a few units of slightly smaller unit size. Also, it will be possible to load the similar/ revamped units somewhere near their most efficient operating points. However, the same size/ duplicate units and equally balanced steam load may not fit the load curve as closely as units of unequal power generation capacities or unbalanced steam load. If identical units are installed, there is a benefit in the operational advantage at maximum/ optimum efficiency level and saving in first cost because of the duplication of sizes/ pipes dimensions, foundations, wires insulations etc, and also because spare parts required are less.

When the load on the PP decreases, the situation would increase the rotational speed of the TG. The governor would come into action operating a steam valve & restricting steam and decreasing the turbine speed to its higher value. In non-revamped units, the governor response from the load to turbine is quite prompt but after this point (beyond maximum level), the governing response would be quite slower.

Effect of variable over load on power plant equipment operating performance

In addition to the affect of progressively higher/ variable load on PP design performance level, the higher/ variable load conditions impose operation problems also, when the PP is stabilized and continuously operated. In a PP, the variable load on electric generation plant ultimately gets reflected on the variable steam demand on the boiler and on electricity consumption in other auxiliary equipment. The operation characteristics of such equipment are not linear with load, so, their operation becomes quite complicated. As the load on electrical supply systems fluctuate, a number of PPs are interconnected to meet the load. The load would be divided among various power generating units to achieve the utmost economy in the whole system. When the system consists of one base load plant and one or more peak load plants, the load in excess of base load plant capacity is dispatched to the best peak system, all of which are nearly equally efficient. The best load distribution needs detailed study.

Optimum operating efficiency, generic ECMs & implementing criteria

Power plant optimum operational efficiency is dependent on the following:

- Proper air and fuel distribution, temperature and mixing with O_2 (air) and adequate fuel quantity and velocity, i.e. 3 Ts (time, temperature & turbulence) help swings,
- Use of low-excess air burners to save in NOx and unburnt O_2 and optimum heat recovery in the air preheater & economizer, as a 4.5^{O}C rise in flue gas temperature would reduce boiler efficiency by about 1%.
- Minimization of unburnt carbon loss in flue gas and bottom ash by a stipulated fineness of coal, which is not to be off-set by "coal mill/ handling unit & fan power" consumption.
- Minimization of radiation and unaccounted loss like casing radiation, sensible heat in refuse, ash hopper evaporation & bottom water seal evaporation.

Following are the basis for computing the energy efficiency schemes implementation and benchmark level:

- Estimates are based on design/ rated operating parameter and EC level.
- Payback period 3 years for cost benefit analysis.

Following generic Energy Conservation Measures are recommended to improve the operational efficiency of systems in the CPP.

Excess air reduction

The amount of excess air used depends on the type of boiler and on the nature/quality of the fuel. Typically, 12-20 % excess air is used for a pulverised coal-fired boiler with a dry bottom. For reasons of combustion quality (related to CO and unburned carbon formation), and for corrosion and safety reasons (e.g. risk of explosion in the boiler) it is often not possible to reduce the excess air levels further.

Flue gas temperature reduction

The flue-gas temperature leaving the boiler (depends on the fuel type) is traditionally between 120-135^{O}C, due to risks of acid corrosion by the condensation of sulphuric acid. However, some designs sometimes incorporate a second stage of air heaters to lower this temperature below 100^{O}C, but with special claddings on the air heater and the stack, which makes this reduction economically unprofitable.

Optimum level combustion

It is not possible to obtain an ideal mix between the fuel/ coal and air, and therefore, more air than is necessary for stoichiometric combustion is supplied to the boiler. Furthermore, a small percentage of the fuel does not fully combust. The flue-gas temperature must be kept high enough to prevent condensation of acid substances on the heating surfaces.

Reduction in unburnt carbon in ash

Optimization of the combustion leads to less unburned carbon-in-ash. Increased unburned carbon could also worsen and harm the quality of the fly ash and make it difficult, with the risk that they may not comply with the relevant national standards.

Minimization of vacuum in condenser

After leaving the low-pressure section of the steam turbine, the steam is condensed in surface condensers and the heat released into the cooling water. In order to ensure the

Go wireless for a smarter living!

Switch to a new world of savings

with ElMeasure's Wireless Energy management. A proven system with an impressive array of tools, guides the user to discover a world of possibilities to save power, reduce the carbon footprint and contribute to a greener environment.

Join our growing list of customers across the globe, to achieve unparalleled benefits like higher productivity, substantial savings and greater profits with a typical return on investment (ROI) of less than 12 months.

ElMeasure's EMS, the green answer to rising energy costs!

Visit us at

2015 AHR EXPO

Industrial Automation INDIA

10 ANNIVERSARY

ELMEASURE™
Possibilities...Infinite

ELECON MEASUREMENTS
A Group of **ELMEASURE INDIA PRIVATE LIMITED**
#764, 4th Phase, 707, Yelahanka New Town, Bangalore - 560064 Karnataka INDIA
Ph: | 91 80 28461777 Fax: | 91 80 41272481 | e-mail : marketing@elmeasure.com
www.elmeasure.com

maximum pressure drop over the steam turbines, it is desirable to reduce the vacuum to a minimum. In general, the temperature of the cooling water dictates the vacuum, which is lower with once-through cooling systems than with a cooling tower. Installation of properly designed inserts also on the tube side (i.e. water side) of an existing steam condenser sometime increases the turbine's power output between 0.5-2.0%. The best electrical efficiency is possible by water-cooling and a condenser-pressure at optimum level. The thermal energy saving thumb rule for a PP (up to 100 MW) is that the saving of 0.5 kCal/ kWh is achievable for every 1 mm Hg vacuum reduction in condenser.

The dry cooling air cooled steam condenser (ACSC) system has made it possible to build the few CPPs without adequate cooling water resources also in some of the northern states. For dry cooling in ACSC, the sensible heat transfer is the only form of heat rejection, so performance depends on the ambient dry-bulb temperature (DBT). For ACSC's optimum performance, power generation, air flow through fans and initial temperature difference (ITD, difference between condensing steam temperature and inlet air temperature/ DBT) across modules should be as high and low as possible and pressure drop should be as low as possible.

Variable pressure and fixed pressure operation

In fixed pressure operations, the pressure before the turbines at all load levels is kept more or less constant by changes in the flow cross-section at the turbine inlet. In variable pressure operations with the turbine inlet cross-section at its maximum, the power output is regulated by changes in the pressure before the turbines.

Condensate and feed water preheating

The condensate coming out of the condenser and the boiler feed-water are heated by steam to just under the saturation temperature of the extracted steam. The thermal energy from the condensing process thus feeds back into the system, reducing the amount of heat otherwise released from the condenser, therefore improving the efficiency.

Replacing high speed impactor/ ring granulator with a pair of low speed roll crusher

Installation of a pair of low speed roll crushers (primary & secondary) in series replacing one high speed impactor/ ring granulator crusher would result in reduced combustibles in fly ash (or coal fines generation) in coal handling plant (CHP). Installation of the low speed roll crushers result in reducing fines generation thus improves crusher efficiency and reduces combustibles in fly ash and motor input power in ESP.

Coal mills appropriate in number run by reviewing the requirement of steam/ plant output, furnace temperature, and the condition of the mills. The critical parameters are to be monitored with change in load.

Development & best practices in Indian power plants

Success in this endeavour requires a comprehensive plan to implement key technology advancements (including selective design improvements), which have occurred over last many decades, while successfully accounting for the complex interaction of the various system elements. Industry 'best practices' often associate performance with various types of ranking.

Recent experience with a number of units upgrade also indicates that the greatest value can frequently be obtained by component upgrade instead of replacement where availability, performance, or cost can be improved by the use of cutting edge technology to gain a cost advantage.

Huge thermal capacity additions/ expansions/ modifications are envisaged in the next decade. The existing thermal capacity in public/ private sector and CPPs is expected to be more than doubled in the next 10 years. Thus the implication of norms becomes even more important at this stage as the CERC norms would either directly or indirectly be applicable to this huge capacity and number of plants being inducted. Thus it is imperative that better efficiency norms are adopted with a view to conserve scarce fuel resource & infuse efficiency in power generation.

The CERC norms would also be applicable to the private sector stations, albeit indirectly and must, therefore, reflect the reasonable efficiency levels achievable. The sector-wise APC in India PPs for the year 2009-10 reported by CEA in April 2011 is given in Fig. 1.

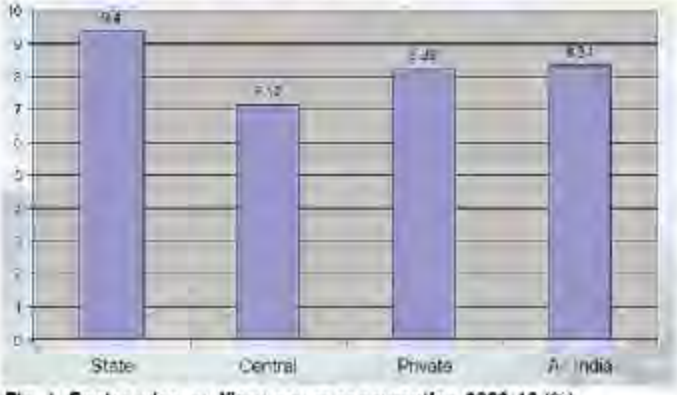


Fig. 1: Sector-wise auxiliary power consumption 2009-10 (%)

The norms must, therefore, reflect higher levels of efficiency to induce a sense of inter-plants competition and promote efficient operation. More efficient operation would also lead to less CO_2 emission which is the current focus of global efforts for lower GHG emissions.

The top five power stations/ plants (above 110 MW) in India, whose operating PLF and operating HR falls in the range of 96.64-102.33% and 2288-2389 kCal/kWh are given in Table 5 for the years 2009-2010 and 2008-09 respectively.

The HR of 14 power plants (CEA document source for national level data) & 9 power plants (International Energy Agency document source for international level data) is between 2279-2393 kCal/ kWh & 2261-3607 kCal/kWh respectively. Some examples of systems/components implemented in Indian power plants between 2004-2006 are in Table 6.

Sr No	Plant Name	PLF (%)	Heat Rate (kCal/kWh)
Benchmarking: 2009-10			
1)	DTPS	102.33	2288
2)	Korba	97.61	2375
3)	Unchahar	97.33	2384
4)	Simhadri	97.27	2349
5)	Dadari	96.64	2366
Benchmarking: 2008-09			
6)	DTPS	100.93	2300
7)	Simhadri	97.41	2351
8)	Dadari	99.36	2369
9)	Ramagundam	94.45	2372
10)	Vindhyachal	98.15	2376

Table 5: Top 5plants PLF and HR benchmarking for last 2 years (2009-2010)
Source: CEA website

www.Lntecc.com

The impossible, is often the untried

Clarity08/2014/RP

At L&T Construction, we have never let lack of precedent stand in the way of accomplishment.

Our specialized Power Transmission and Distribution business have set benchmarks in capacity, complexity and speed of execution. The integrated packages we offer extend from EHV transmission lines and substations (GIS / AIS) to plant and infrastructure electrification covering E-BoP and instrumentation.

L&T's international track record in this sector covers over 19000 ckm of transmission lines of various voltage levels up to 765kV, more than 475 AIS / GIS substations including India's first 1200 kV AIS and 765 kV GIS as well as 15000 MW of E-BoP for thermal power plants.

Apart from its own advanced facility for manufacturing transmission lines, L&T has in-house tower testing facilities and an exclusive substation automation system simulation lab.

Helping us every step of the way are our people. The numbers say it all. 3500+ designers, 3500+ engineers, and a workforce of over 50,000. For them, making the impossible possible is all in a day's work.

Larsen & Toubro Limited
Construction-Power Transmission & Distribution, 7th Floor, D-Wing, TC-3, Tower-B, Mount Poonamallee Road, Manapakkam, P.B.No. 579, Chennai - 600 089
Email: info@Lntecc.com Tel. +91 44 2252 6000, 2252 8000

L&T Construction
Power Transmission & Distribution

A brand of Larsen & Toubro Limited

Regd. Office: L&T House, N. M. Marg, Ballard Estate, Mumbai - 400 001, INDIA. Tel: +91 22 6752 5797/841 CIN: L99999MH1946PLC004768

Measure
Performance improvement – heat rate & auxiliary power consumption
• Smart wall blowing system for optimizing wall blowing and improving heat rate • Improvement in hot reheat temperature in Boiler Modification in auto furnace draft control logic in ID fan vane scoop combination control • Utilization of PADO and the benefits for the thermal power plant • Latest techniques for heat rate improvement of power plant Continuous improvement of heat rate of combined cycle power plant
Performance improvement – reliability & availability
• Reliability improvement by avoiding inadvertent errors
Operation & maintenance
• Equipment criticality analysis • Introduction of super cleaning of turbine oil Innovative boiler maintenance techniques for minimizing boiler tube failure Life extension of coal mill gear box lube oil by electrostatic liquid cleaning method • High concentration slurry system for ash handling • Benchmarking in reduction in start-up time of the power plant • Innovative methods for reducing capital overhaul time • Replacement of aero derivative turbine in very minimal time • LOTO-Lockout and tagout system Innovative techniques to minimize the cold start-up time of a combined cycle plant
Environment improvement
• Flue gas conditioning by auto controlled dosing of ammonia gas and improving performance of ESP • Initiatives towards achieving zero effluent discharge • Flue gas desulphurization system for reducing SOX level

Table 6: List of theimplemented systems/ components in Indian power plants (above 110 MW)

Table 7 gives the energy efficient product-wise technology source being used in India for more than a decade.

Product	Technology Source
Industrial Steam Generators	Combustion Engineering, USA
CFB Boilers	LLB-LurgiLentjes, Germany
Air-Preheaters	CE Airpreheaters, USA
Electro-static Precipitators	Flakt AB, Sweden
Fans	KKK Germany., TLT, Germany

Table 7: Energy efficient product-wise technology source in India

Conclusions

The EC in thermal power plants, as in any PP constitutes a major operating cost component. Targeting and benchmarking are recognised attributes globally employed to remain more competitive and can also be used as management tools for improvement in performance and criteria for technology selection for new plants.

Major constrains in PPs in improving EC and benchmarking are:

- Comparatively small size of power generating units, vintage equipment especially boilers, turbines, condensers, cooling towers, and compressors etc.
- Old plants having very high energy consumption.
- Available space constraints for envisaged modifications.
- Boilers and TGs are loaded to the normal level and operated for moderate electricity generation, which is much lower than the optimum level. It leads to the higher SEC.
- Suggested approach for optimizing EC and benchmarking - Compare key parameters/ identify potential areas throughout the plant and improve them to the design level. Irrespective of the number of boilers, TGs in operation, it must be noted that the boilers, TG sets should be loaded to the optimum level (95%). This will ensure the best operating condition of the boilers, TG sets with the maximum electricity generation and minimum SEC. Follow the gradation of potential areas in terms of savings and payback. Implement the economically viable listed schemes.

The public/ private industry sector and BEE would jointly work out on the applicability and compile the successful case studies of energy efficient motors, boilers, fans & other equipment in power plants, update the India's energy efficient products directory and recommend for the extensive use. The report fixing target for individual equipment and benchmark for the steam generating boiler, turbine, condenser, cooling tower, and power systems and energy targets for individual equipment should be written in details for plants' further perusal.

The HR data of some of the 60-100 MW Units is either less than or equivalent (similar level) to the HR for northern region (WA operating SHR 2603.2 kCal/ kWh) PPs in 2007-08 as given in CEA document. However, the Dahanu TPS heat rate is observed to be lowest throughout all these years. The DTPS achieved the lowest HR 2261 kCal/ kWh in 2004-05 against CERC norm of 2500 KCal/kwh in eight years. Now, the DTPS is the first ever utility in the World to be certified for ISO 50001:2011 for its strong commitment for energy use and conservation.

It is always recommended that all the EC measures identified be implemented in PP and operate the boiler, TG and associated equipment at the maximum load (as per revamped condition). The EE motors should also be installed selectively, wherever the VFDs not commercially viable and its long term benefit should also be derived. The on-going heat rate of the many inefficient PPs would be further reduced after implementation of EC measures. The present methodology with CEA/ CERC guideline is acceptable/ adopted to most of the power plants in India and norms are being met by them. The targets and benchmark should also be regularly updated which will help the individual plant management to judge their performance as well as to achieve higher profitability level and remain competitive locally and globally.

Dr Debashis Pramanik

presently working as Fellow in the industrial energy efficiency and division of the The Energy and Resources Institute (TERI) is involved in various energy efficiency/ audit/ conservation, energy efficient and environment technology upgradation projects and in the studies on the energy intensive and polluting sectors. He is PhD in Mechanical Engineering from Bengal Engineering and Science University, Howrah, MTech in Energy Studies from IIT, New Delhi, and BTech from Ranchi University.

Best Quality for Excellent Performance. High Voltage Cable Systems up to 550 kV

Brugg Cables is your partner for the engineering, manufacturing, installation and maintenance of high voltage cable systems up to 550 kV. Combining Swiss quality and experience, we will support your initial idea all the way to project completion.

Brugg Cables Turkey, T +90 532 734 90 77
Brugg Cables Headquarter, T +41 56 460 33 33
info@brugg.com, www.bruggcables.com

BRUGG CABLES
Well connected.

Interview

"We are not only a product manufacturing company, but also a solution providing company"

Mayukh Banerjee, CEO
Brugg Cables India Pvt Ltd

Brugg Cables India Pvt Ltd, is a wholly owned subsidiary of the BRUGG Group having an annual turnover of 675 Mn CHF with headquarters in Brugg, Switzerland. In their in-house research and development department Company work on new innovative products. In an exclusive interview to **Electrical India, Mayukh Banerjee** points out, in India, our concentration as of now, is only from 132 KV & upwards. We are not concentrating on the fiber optic cables or low voltage cables in India as of now.

➢ According to you what is the status and scope of Indian cable industry and how it is distinct globally?

The cable industry has moved from being a small industry 25 years back to a very large industry over the last decade. Although it is a volume-driven product, it has a lot of quality and technical particulars. Over a period of time, the industry has moved from the unorganised to the organised sector. However, about 35% of this industry is still in the unorganised sector. Requirements like brand and quality perception are key in this Rs 25,000 crore industry. The Indian cables industry predominantly provides challenging opportunities in the field of manufacturing, supply chain, procurement, marketing and HR. The cable industry comprises 45% of the entire electrical industry, which is expected to double in size over the next five years. The industry is growing at a CAGR of 15-17% as a result of growth in the power and infrastructure segments. It is expected to grow at similar rate for the next five years. The government's emphasis on the power sector reforms and infrastructure will further drive growth.

In the power cables arena, the high voltage (HV) and extra high voltage (EHV) cable industry will witness growth mainly due to acceleration in implementation of ongoing projects in the pipeline. In addition to this, demand for HV and EHV cables is steadily rising in densely populated metropolitan cities, where installation of overhead transmission towers is expensive as well as hazardous. Added to it is getting the ROW. Over the past five years or so, lot of established Indian cable manufacturers have entered the coveted EHV cable segment with an objective of getting the first-mover advantage. In time, India will need to deploy EHV cables for its sub-transmission and distribution projects given that the advantages of EHV cables over conventional overhead lines are tremendous. It has been a slow start but future is bright. The state of the industry is going to be critical extremely in the next 10 years because not only it has to cater to growing domestic demand but also establish itself as a proven player in the global arena.

➢ Could you brief us about Brugg Cables and its product range?

BRUGG Cables is primarily into manufacturing of Power cables from low voltage

grade upto extra high voltage which is 550KV. Along with cables we produce accessories (joints & terminations) for the same also in our state-of-the-art manufacturing unit at Brugg Switzerland. Apart from these we are also into manufacturing of fiber optic cables, metallic cables, defence cables & systems, sensing cables, special industrial cables and systems & coated transmission products. But apart from being a product supplier only, we are more into turnkey solution provider.

➢ Could you share with us some of the large scale project accomplished so far? Could you elaborate upon some major projects in pipe-line?

BRUGG cables introduction in India is dated quite some time back, however, we started operating out of India with our first set-up in Gurgaon from 2012 onwards.

So far, we have executed several EHV projects with KEI, Maharashtra State Power, Areva, Siemens, Alstom, Brigade Industries etc. to name a few.

At present, we are executing a turnkey project of 400KV 1C x 630 sq mm, 9 km at Tata Steel, Kalinganar which involves supply, civil, laying, erection, installation on a turnkey basis.

We are simultaneously executing two projects at Reliance Industries, Jamnagar for J2 & J3 projects where we will be installing Fire Resistant Explosion Proof Outdoor Terminations for the first time in India.

Simultaneously, we will also be working at Reliance Corporate Park, Mumbai shortly.

➢ Your company is producing fiber optic cables, low voltage cables and power supplies for construction. Which ones' command major market share?

In India, our concentration as of now, is only from 132 KV & upwards. We are not concentrating on the fiber optic cables or low voltage cables in India as of now.

➢ Tell us something about Brugg cable manufacturing & R&D activities?

We have our manufacturing setup in Brugg, Switzerland.

➢ Tell us something about and customized solutions? Can you share with us what are the solutions that Brugg Cable has for power supply system?

I really like this question. It may please be noted that we are not only a product manufacturing company, but also a solution providing company. We provide following solutions on a turn key basis.

➢ What would you suggest for improving the cable network in India?

GIS mapping for individual utilities is a must for identification of cable network. Emphasis should be given on Healthy & periodic monitoring of the cable network for every utility thereby to enhance reliability of the system.

Utilities should look for outsourcing partners for preventive maintenance of their existing cable network.

➢ What do you envision for Brugg Cables India in the next two years?

My first priority today will be to reach out to the customer at the shortest possible time frame. As I mentioned, we started this setup in India only in Sept 2012, till now lot of people in India may not be knowing that we have a setup in place in India. We are quite optimistic with respect to our performance in India within this short span and I look forward to an exponential growth in the next two years with decent profits.

Cabling Solutions for Steel Industry

India is slated to become the second-largest steel producer in the world by 2015. The level of per capita consumption of steel is treated as one of the important indicators of socio-economic development and living standard of the people in any country. All major industrial economies are characterized by the existence of a strong steel industry and the growth of many of these economies has been largely shaped by the strength of their steel industries in their initial stages of development.

Presently, steel contributes to nearly two per cent of the gross domestic product (GDP) and employs over 500,000 people. Around 480 billion INR is invested in steel sector for this fiscal year and this would increase significantly. The crude steel production is expected to be 89 billion INR in 2014 and is expected to grow to 165 billion INR by 2020 at CAGR of 10.8% by 2020. Being a core sector, steel industry tracks the overall economic growth in the long term.

The sudden rise in the imports from various countries especially China has been posing a threat to the domestic stainless industry, primarily because of the current import duty which is considered to be on the lower side in comparison to other nations. The recent announcement made by the Finance Minister to increase import duty on flat-rolled products from 5 percent to 7.5 percent came as a major relief to the steel industry reeling under severe under-utilization of capacity. High prices of raw materials owing to the inflationary impact, regulatory pressures and subsequent delay of projects, land acquisition, subdued demand and decreasing profitability have adversely affected the productivity of the mining sector in India.

The positive measures announced in the Union Budget 2014, ranging from emphasis on new 'smart cities' to reduction in threshold limit for investment allowance, prioritizing creation of roads, waterways, new airports, metro rails will fuel the demand for steel and boost the investment cycle. Increasing demand by sectors such as infrastructure, real estate and automobiles at home and abroad has put India on the world map.

As per reports, Ministry of Steel, Government of India, is considering setting up a strong research and development (R&D) mission/centre, virtual or otherwise, to step up innovative research and technology development in the country's steel industry.

Key Growth Drivers

Some of the key growth drivers that will facilitate in the growth of the Steel industry will be

- Increase in infrastructure spend from 5% of GDP to 10% of GDP by 2017.
- Increasing industrialization and economic development helps in driving demand of steel from engineering sector.
- Urbanization and increase in disposable income drives demand for houses and automobiles and hence demand for steel.

The diverse requirements of steel factories need high end cabling solutions which are cost and energy efficient, offering high tensile strength, flexibility and perennial wear-resistance.

Cable Requirements

As far as Cable requirements for the New installation and MRO's is concerned, more than half of this is taken by Aluminum cables and rest is by Power, Control and Data Communication Cables. Low tension

The cables have to be heat resistant, halogen free, flame retardant, and corrosion resistant. The cables should address space constraint issues without compromising on the quality of the cables.

Control Cables specifics range from 1.5 sq mm to 4 sq mm and the number of core would range from 4 to 19 cores. Consultants in Steel Industry play an important role in deciding the make of the cable. Some of the key consultants are M N Dastur, Shaporji, Pallonji, Mecon and many others.

Characteristics of the Cable used in Steel Industry

There is a constant requirement of a wide variety of power and control cables and data communication cables for two purposes:

- On-field maintenance
- Project demand

The cables, irrespective of the purpose, have to be flexible, durable and robust. They will continuously be exposed to harsh environmental and working conditions, and the entire process can't be repeatedly halted for maintenance and replacement.

The cables have to be heat resistant, halogen free, flame retardant, and corrosion resistant. The cables should address space constraint issues without compromising on the quality of the cables.

For some applications, the cables have to pass International standardization. In addition, the cables have to be cost efficient.

Special braiding to resist repeated tensile and torsion stress.

Benefits/Value added by Lapp solutions

Lapp has been fulfilling cabling requirements of steel industry supplying large orders of high quality cables for the plant expansion projects. Lapp India recently catered to the cabling requirements for the expansion of a steel factory with highly durable specialized cables to suit varied applications.

Lapp supplies different varieties of power, control and instrument cables under the brand name of OLFLEX® depending on the application. For wiring in control cabinets: these cables are color coded for easy distinction in case they need to be replaced or rewired in future.

To supply power to heavy machinery Lapp provided armoured cables that are easy to install due to compact design and has high capacity to withstand high mechanical stresses. These cables represent no electromagnetic interference.

For applications meant specifically for control, Lapp provided cables that are suitable for open wiring. These cables are made up of fine wire strand made up of bare copper wires and possess aluminium coated foil and are capable of interconnecting cable in signal and control equipment. And these cables are highly flexible and durable.

Fully automated factories need constant, seamless signal transfer from PLC at all times, to cater to this requirement Lapp provided data communication cables. These cables have PVC based core insulation and consist of tin-copper braiding. The cables also prevent screening against electromagnetic interference. The additional insulation provided to the cables minimizes data attenuation.

To supply power to different analytical instruments and process controllers, used in control and instrumentation systems. Lapp offered specially designed cables for specific industrial protocols and are equipped with shielding to prevent electrostatic interference between the enclosed wires and external fields. For lighting applications, Lapp supplied single core cables that are ideal for the application and can also be implemented for providing internal wiring of the control panels of he machines. The cables comprise fine strands of bare copper wires and have halogen-free, HF compound insulated outer sheath. The copper used in manufacturing the cables is highly pure with low oxygen content which not only helps increase the current rating but also reduce the corrosive effects.

For more critical and taxing operations such as crane operation and material movement, Lapp provided cables and customized special purpose cables with larger cross-sectional area and increased control and flexibility. These cables are designed for an increased heat range and have high resistance against all types of chemicals including toxic and corrosive fumes which are produced in the process. These cables are also abrasion resistant, water and dirt resistant. They are coated with adhesive free insulation which is difficult to inflame. Additionally, Lapp cables have the advantage of high current carrying capacities ideal for low transmission and high transmission applications. The cables are HFFR compliant, flame retardant, halogen free and chemically inert.

Attributed to Lapp India

Interview

"PDMG–R system is designed for large EHV GIS installations"

Shailesh Meisuria, Sales Director
Qualitrol, Division of DHR Holding India Pvt Ltd

Qualitrol, is an independent subsidiary of Danaher with corporate headquarters located in Fairport, NY, USA. Qualitrol operates manufacturing sites at the corporate office, Glasgow Scotland, Toronto Canada, Quebec Canada, Belfast Northern Ireland and Beaverton Scotland. Qualitrol Company is a well known name in the electric utility industry capitalizing on the products and reputation of our line of Qualitrol products and those of our acquisitions: AKM, Hathaway, LEM Instruments, DMS, PDTech, Neoptix, Iris Power and Serveron. In an exclusive interview to **Electrical India, Shailesh Meisuria** says, we believe in continuous improvement 'kaizen' and innovation.

Could you detail about your journey; now sales Director in Qualitrol?

My journey started as a product design engineer based out of a company in UK. After gaining experience in engineering and product design, I entered into commercial side of the business and spent six years based out of Bangalore looking after the sales and marketing of the condition monitoring products and services of the critical assets in power industry. I was in charge of the complete operations in India. After spending 16 years in power industry in UK and India, I got the opportunity to join Qualitrol as their sales director looking after the customers in the Indian Market.

What is your perception about power and energy sector in India?

Power is one of the most critical components affecting economic growth and well-being of the nation. Power requirement in India is growing every year and this is stretching existing infrastructure. Currently, there is a positive climate for investment in the power sector and the policies are supporting this. There are many projects in the pipeline for generation and Transmission and these will improve the power scenarios in India.

Could you brief about Qualitrol product range, specifically solution on Condition based monitoring?

Condition Based Monitoring (CBM) within a Substation or Power plant environment is the process of using either online or offline tools to capture one or several parameters on an asset and use data analytics to diagnose and trend its health condition over time, predict imminent failure and calculate remaining operational life.

Qualitrol provide a robust array of condition based monitoring product and services that can be used for monitoring Generators, Motors, Transformers, Circuit Breakers and Cables so you always stay plugged in to the essential details. Our products afford a full-picture view of the condition of your station, give you a clear idea of the equipments status, and help identify potential

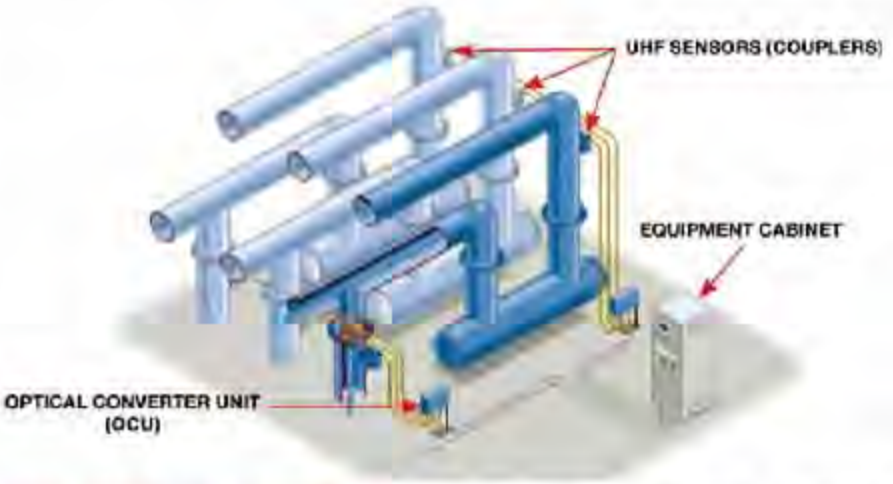
problems so you can implement solutions and continue to operate at full capacity.

➢ Qualitrol is the largest global supplier of partial discharge monitoring on GIS and Transformer. Which of you products are more in demand in India?

DMS is a Qualitrol company and one of the pioneer in advanced UHF technology for detecting partial discharge in Gas insulated Switchgear (GIS). Our PDMG-R system is designed for large EHV GIS installations. It collects PD data from UHF sensors (couplers) installed on the GIS and transmits the information to software for automatic interpretation and analysis by propriety HQ Software – allowing incipient faults to be avoided and the condition of the long term health of the insulation system to be simply and effectively monitored over the life of the GIS.

UHF couplers installed throughout the gas insulated switchgear (GIS) detect partial discharge events and transmit these to an Optical Converter Unit (OCU) where the signal is conditioned and digitized before being transmitted to the Equipment Cabinet. Here proprietary algorithms are applied to correctly identify partial discharge events and reject interference from broadcast signals or discharges in adjacent air-insulated equipment. Detected partial discharge events are stored, flagged and alarmed allowing for timely corrective actions to be initiated. Remote access to all data allows GIS experts to assist in analysis and planning of actions at short notice. Same technology is used for detecting and locating PD in Transformer as well.

➢ Serveron is the latest addition to Qualitrol company. Can you tell us about Serveron and its products?



Serveron is a leading company who provides products for on-line Dissolved Gas Analysis (DGA) monitors and TM View™ software for monitoring generation, transmission and distribution power transformers worldwide. DGA of transformer oil is the single best indicator of a transformer's overall condition. Now with three models, the Serveron TM8™, TM3™ and TM1™, Qualitrol offers electric utilities on-line DGA solutions across the entire power transformer fleet. Serveron DGA transformer monitors provide the important and timely information needed to maintain the reliability and safety of transformer fleets. Benefits of Transformer DGA Monitoring are Avoid transformer failures. Lower costs through condition based maintenance, Extend transformer life and defer capital expenditures.

➢ Could you explain the features of the Qualitrol STB Series Smart transformer breather that removes moisture from air entering oil-filled transformers?

Qualitrol Smart Breather (STB) helps trap excess humidity from the atmosphere that can degrade a transformer bladder, oil and insulation system over time. This degradation causes unnecessary aging to the asset, reducing the overall life and performance. This can lead to additional maintenance or even premature and unexpected asset failure in the future. Using a STB reduces maintenance costs with learned transformer breathing patterns and self regenerating desiccant. It extend asset life by continuously protecting against atmospheric moisture on transformer inhale cycles, reduce unnecessary maintenance through self regenerating silica gel desiccant on transformer exhale cycles and color changing desiccant gives visual assurance on breather regeneration process.

➢ What is your vision in the next two years?

At Qualitrol, a Danaher company, we believe in continuous improvement (kaizen) and innovation. We always put customers at forefront and we are always looking at ways to improve our support to customer. In the next two years, we plan to grow our team in India which can provide service to customers with higher accuracy and speed.

A smart Zigbee based AMR of household Energy-meter with harmonic consideration

The continual implementation of new technologies, in the household appliances using power electronics like inverter air conditioners, personal computers, LED lighting, result in a rapid growth of the nonlinear domestic loads. The power demand of a single household device is low and does not cause problem in the grid, however the very big number of such devices and the very large number of households will have a significant negative influence causing distortion, dips, non-active/distortion powers and other different types of disturbances in the electricity network.

H H Kulkarni & Dr D G Bharadwaj

One of the major cause of Power quality disturbance is harmonic currents and voltages. Hence it is necessary to correctly measure consumed total linear and nonlinear power and its best possible communication with the central billing authorities.

All Industrial systems are based on wireless communication, due to its many advantages. This paper presents the design and implementation of Automatic Meter Reading (AMR) and Energy meter control using Zigbee communication. The AMR is implemented using Zigbee Based power meter Communication Module. The design presents a new methodology to control the power consumption and controlling of the meters. This system avoids the human intervention in power management. If the consumer doesn't pay the bill in time, the user is informed through sms system on mobile as well as through the mail. If still user does not pay the bill then after the designed late consideration, the power connection will be disconnected from the remote server automatically. It displays the corresponding billing information on LCD and sends data to the server through the Zigbee Module. The entire

Many different all-round instruments such as voltmeters, oscilloscopes and wattmeters are used in these situations. Specialised instruments, such as power analysers.

programming is based on Embedded C Language. The proposed mechanism provides efficient meter reading, power control mechanism, avoiding the billing error and reduces the maintenance cost.

Much of the problems associated with power quality are due to (fast or slow) voltage fluctuations or high levels of harmonics. Many different all-round instruments such as voltmeters, oscilloscopes and wattmeters are used in these situations. Specialised instruments, such as power analysers combine the functions of all these instruments and are increasingly being used to determine the power quality. The measured quantities are mainly voltage, current and power spectra, but active and reactive power and total harmonic distortion THD can also be of interest in a problem-solving situation. In current trends the measurement of power consumption and its Control is an important task. In present scenario the human operator goes to the consumer's house and produces the bill as per the meter reading. If the consumer is not available, the billing process will be pending and human operator again needs to re-visit the pending houses. Going to each and every consumer's house and generating the bill is a laborious task and requires lot of time.

It becomes very difficult especially in rainy season. If any consumer did not pay the bill the operator needs to go to their houses to disconnect the power supply. Automatic meter reading, or AMR, is the technology of automatically collecting consumption, diagnostic, and status data from energy metering devices and transferring that data to a central database for billing, troubleshooting, and analyzing. This technology mainly saves power supply providers to reduce the expenses of periodic trips to each physical location to read a meter. Another advantage as mentioned is that billing can be based on near real-time consumption rather than on estimates based on past or predicted consumption. This timely information coupled with analysis can help both utility providers and customers better control the use of Electrical energy. AMR technologies include handheld, mobile and network technologies based on telephony platforms (wired and wireless), radio frequency (RF), or power line transmission. Various AMR methods and technologies are proposed using SCADA (supervisory control and data acquisition), Zigbee, GPRS and GPS etc. The main drawback of AMR or automatic meter reading is controlling. The goal involved in drawing up the specification was the primary wish to find a maximally simple structure suitable for implementation. The operator in the control room is not able to control the power consumption, and also not able to control the devices manually, i.e. tripping of the power to the consumers those who were not paid any bill for a long time, displaying the amount. Thus this paper provides a solution to reach the above constraints.

Wireless Communication Technology

Choosing an appropriate Wireless Communication System is one of main task in this work. At present, most AMR systems are generally based on media such as RF (Radio Frequency), PLCC (power line carrier communication), GPRS (General Packet Radio Service), HFC (Hybrid Fiber-Coaxial) and so on, to transfer data between power meter and manage center. All the above communication media have both merits and shortcomings as well in many aspects like short transmission distance, high transmission cost, maintenance difficulty and unsafe data transmission. Shortcomings of PLCC's are that its communication signals cannot go through the transformer directly and the low-voltage power line carrier is vulnerable to be impacted by the environment. It is real-time, wireless and extensive to use GPRS meter reading, but the cost of current GPRS module and the communications-cost are high. Until the cost reduces to the extent that ordinary people can accept, it cannot be used widely. Reading power meter by wire is costly too, for in forepart it is hard to make net-line beyond the wall and make hole in the wall and in later period the maintenance cost is also high in network connection and security.

Why Zigbee!

Zigbee is a recently developed two-way wireless communications protocol designed to meet very low power consumption and low cost. The higher protocol layers are being defined by the Zigbee Alliance group while interests in the lower layers of the stack (MAC, PHY) are being defined by the IEEE 802.15 working group 4 (802.15.4) which is aimed at achieving data throughput of 250kbps in the 2.4GHz band and Signees can be implemented in Network layer and Application layer. Zigbee has been developed to meet the growing demand for capable wireless networking between numerous low-power devices. In order to solve these problems, we can consider applying Zigbee Wireless communication system, which is popularly used in the world, to transmit power data. Here, Zigbee based wireless communication subsystem is responsible for receiving and transferring data. Zigbee wireless open standard technology is being selected around the world as the energy management and efficiency technology of choice in terms of reliably and timing.

ZigBee vs Bluetooth

Bluetooth

- targets medium data rate continuous duty

- 1 Mbps over the air, ~700 kbps best case data transfer
- Battery life in days only
- File transfer, streaming telecom audio
- Point to multipoint networking
- Network latency (typical)
- New slave enumeration-20s
- Sleeping slave changing to active-3s
- Uses frequency hopping technique
- 8 devices per network
- Complexity is higher.

Zigbee

- targets low data rate, low duty cycle
- 250 kbps over the air 60-115 kbps typical data transfer
- Long battery life (in years)
- More sophisticated networking best for mesh networking
- Network latency (typical)
- New slave enumeration
- Sleeping slave changing to active
- Mesh networking allows very reliable data transfer
- Uses direct spread spectrum technique
- 2 to 65535 devices per network
- Simple protocol.

Proposed Control Mechanism

This proposed control mechanism of AMR gives a solution to power transfer control and visualization of power units consumed. The AMR system requires means of communication for transmitting and receiving their data.

The information collected from each meter must arrive reliably and securely to the utility provider, for billing and analyzing. In another way any command from provider office that addresses each node and each meter must arrive reliably and securely to its destination.

- **Transmitter Section:** The functionality of power supply is to drive the electric meter. It supplies the electric power to the electric load. The power variations in electric meter are in accordance with electric load. The electric meter/energy meter is integrated with electric load and which produces the analog signal can be converted into digital signal and that digital signal in the form of pulses and outputs average real power information based on the load. The electric load refers to the power consumed by a circuit. The outputs are interfaced with Zigbee Transmitter module to communicate with the Receiver. High degree of immunity to false triggering from noisy supplies is attained due to built in hysteresis and filtering operations in power supply. Communication Module consists of Zigbee wireless communication module. It is used to transfer the data of the user meter through Zigbee wireless module. The user can monitor power consumption details and mount to be paid on LCD.
- **Receiver Section:** Depending on the data received from the Zigbee Transmitter module, it sends information of the user meter to Control unit through wireless communication module. In addition to that, the same information is sent to the user through LCD. Depending on the information received from the Zigbee Receiver module, control unit to shut off or resume the electric power supply. The controlling can be done by tripping, i.e. power supply is going to on/off automatically without visiting the consumer's pending houses again and again. This control unit also helpful in displaying the amount. The automatic meter reading o/p seen in PC if it is interfaced with the transmitter section. While bill not paid within the given period of time the load will disconnected by the electricity board by pressing switch in the control unit of Receiver Section.

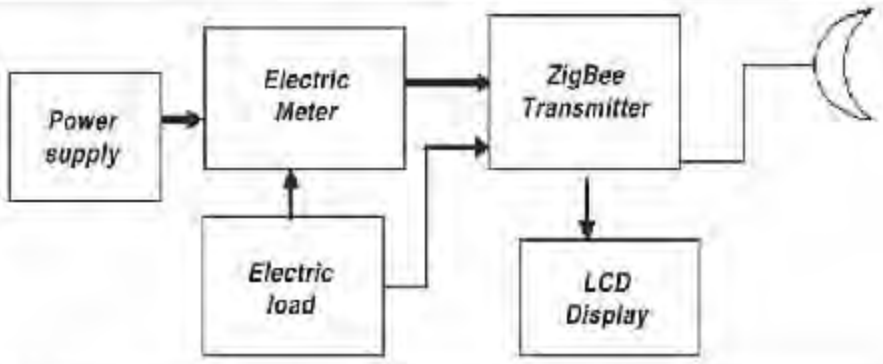


Fig. 1: Transmitter Block Diagram

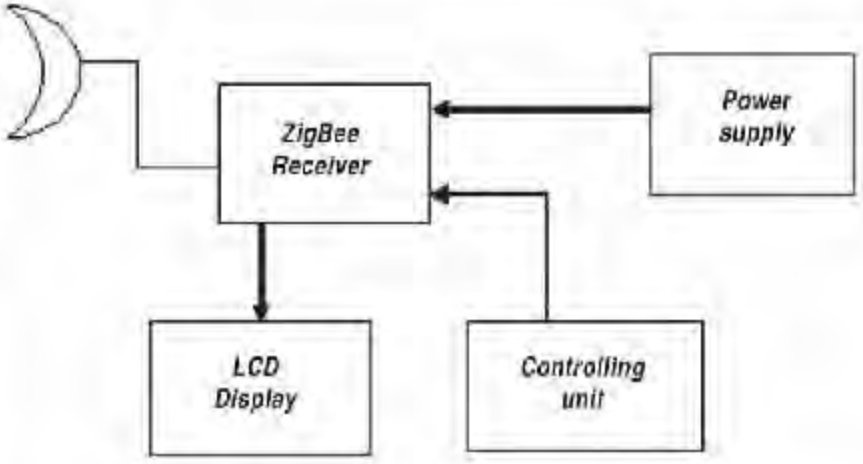


Fig. 2: Receiver Block Diagram

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
- R,L,A 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 PO,
PB. No. 8066, Bangalore - 560 080, INDIA
PH: +91-80-2360 2521 FAX: +91-80-2360 1213
E-mail: hegde@cpri.in / kamsali@cpri.in / shivani@cpri.in / menonharinagpur@cpri.in
Website: www.cpri.in

2500MVA Short Circuit Generator

HVDC Gererator 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

Architecture and Operational Description

Automatic Meter Reading is a process that the meter data is read and processed automatically via special equipment using wireless communication and computer network technology. Compared with the Existing meter reading, it effectively saves human resources and can get real-time consumption of every user, helping the management. The communication data rate is set 250 kbps and the frequency band is 9.6GZ. The proposed AMR system is divided into two sections i.e. transmitter section and receiver section. The working of AMR can be explained through AMR below flowcharts.

Architecture of the Proposed System

Micro-controller based hardware unit is developed with Zigbee module of wireless communication. Data is collected with the zigbee module and then it is transferred to central computer using GSM communication module. The software is developed in Visual basic 6.0 to display

Fig. 5: PCB before mounting

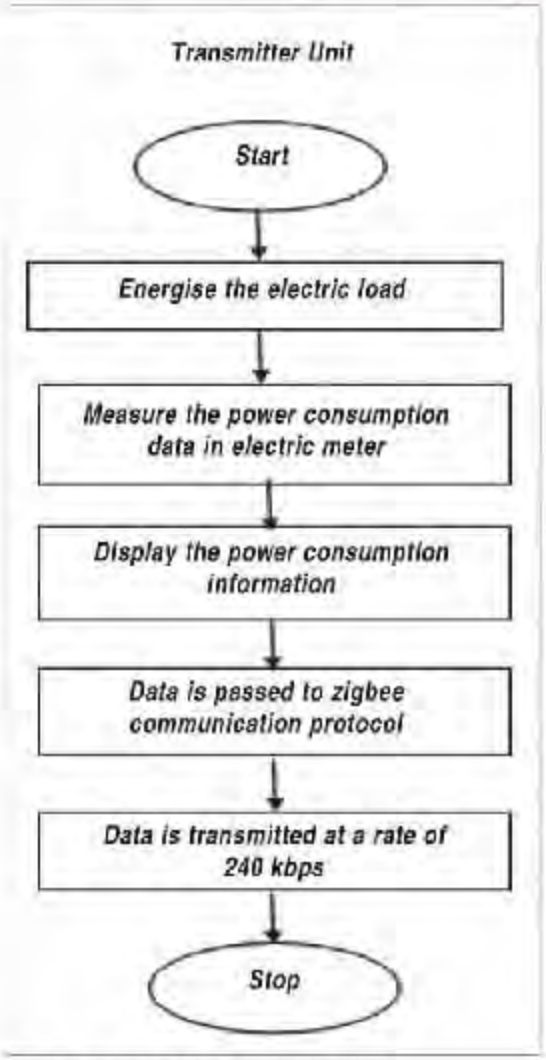


Fig. 3: Flowchart for Transmitter Unit

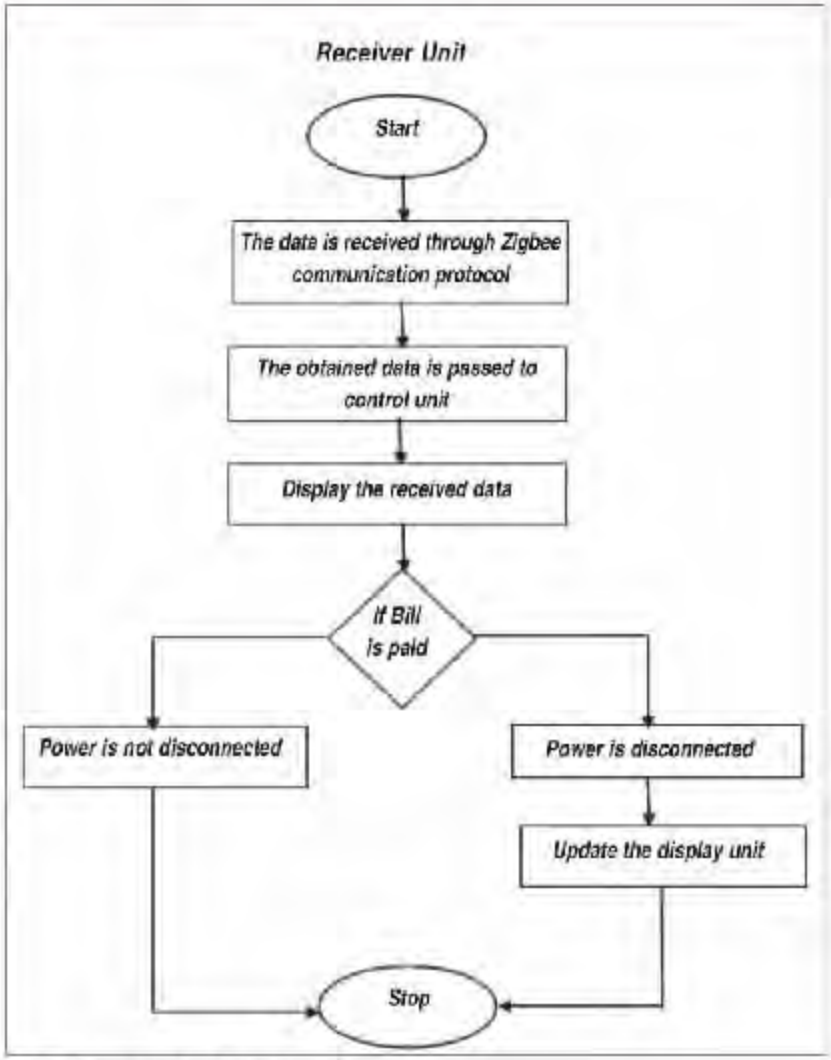


Fig. 4: Flowchart for Receiver Unit

JINDAL INSTITUTE OF POWER TECHNOLOGY

Tamnar, Raigarh, Chhattisgarh

JINDAL POWER

Invitation for Campus Recruitment

Jindal Institute of Power Technology (JIPT) is recognized by the Central Electricity Authority (CEA), Ministry of Power, Government of India as a Category – 1 Institute, as per the provisions of Sub Rule 2A of Rule 3 of Indian Electricity Rules 1956. It is promoted by the Jindal Education and Welfare Society and is a part of the US$ 18 billion OP Jindal Group. JIPT is located inside the 4x250 MW and 4x600 MW O P Jindal Super Thermal Power Plant in Tamnar, Raigarh, Chhattisgarh. The Institute aims to produce technically trained professionals for power utilities in India and abroad and prepares them to operate or undertake maintenance of Power Generating Stations of 100 MW and above capacity.

Academic Programs

Post Graduate Programme in Thermal Power Plant Technology

Eligibility: A full time 4 year BE / B. Tech. degree or equivalent in Mechanical / Electrical / Electronics / EEE / C & I with 60% or above marks in Class X, XII & BE / B. Tech.

Duration: 1 year

Selection Process: Selection is based on Written Test and Personal Interview.

Placements

Following companies have conducted Campus Interviews at the Institute to hire Graduate Engineer Trainees (GETs) in their respective organizations:

Adhunik Power & Natural Resources, Athena Chhattisgarh Power, Bajaj Energy, Bhushan Power & Steel, Coastal Projects, DB Power, Essar Power, Jindal India Thermal Power, Jindal Power, Jindal Steel & Power, SKS Power, Sokeo Power, Vedanta, Wartsila, etc.

Teaching Methodology

- Class Room Lectures for Imparting Theoretical and Technical Knowledge.
- Case Studies, Group Discussions, Experience Sharing, Panel Discussion and CBT Packages.
- Practical Training: Exposure to 4X135 MW, 4X250 MW, 4X600 MW Capacities of Jindal Power Plant.
- Laboratories: Mechanical, Electrical, C&I and Chemistry Labs.
- Simulator Training (4X250 MW & 4X300 MW) Honeywell Make Replica Simulators.

Training Programs

We provice Need Based Customized Training to Power Plant Professionals at all levels including Power Plant Familiarization, Operation & Maintenance of Power Plant, 250 MW / 600 MW Simulator Training, etc.

Power Utilities like – Abhijeet Power, ACB (India), Alstom India, Athena Chhattisgarh Power, DB Power, GVK Power & Infrastructure, R. K. M. Powergen & NPTI to name a few have trained their GETs / Senior Level Executives at our Institute on various aspects of O&M and Simulator of Thermal Power Plant.

For Placement / Training requirements please contact:
Mr. D.K. Dey, Head – Training & Placement
Jindal Institute of Power Technology
OP Jindal Super Thermal Power Plant
Tamnar, Raigarh, Chhattisgarh - 496108
Mobile: 9893101255 / 7898905504
E-mail: dkdey@jindalpower.com, Website: www.jipt.org

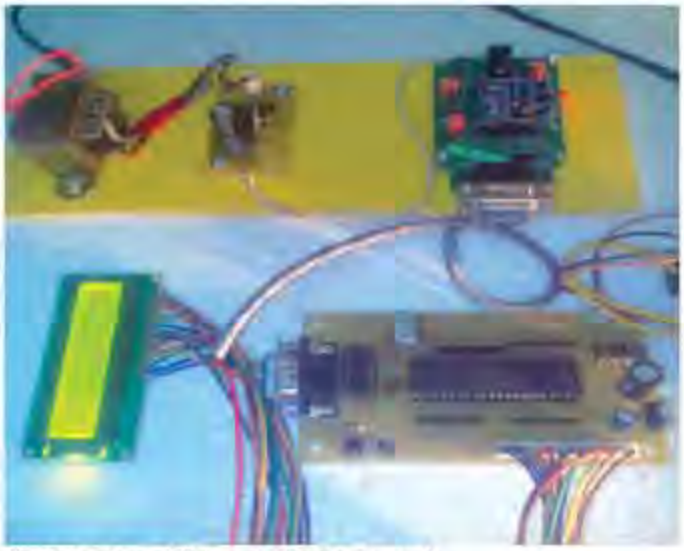


Fig. 6: hardware Microcontroller based circuit

Fig. 7: Energy Meter, central computer and microprocessor with zigbee based hardware

the proposed billing procedure. LCD display is also provided on household energymeter which considers power consumption due to both linear and nonlinear loding.

Software Developed

Fig. 8: Database Generation

Database can be generated to store the details of the consumers and then whole system can be operated as fully automatic system.

Pages are created in VB for billing information

Fig. 9: Online billing system

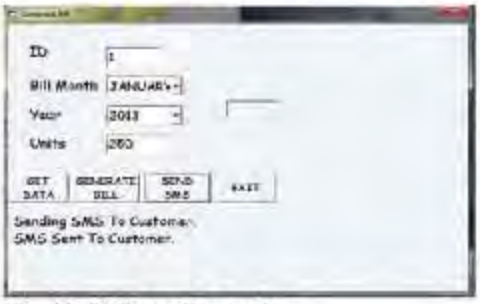


Fig. 10: SMS sending system.

and smart communication with the consumer. This detailed information is then send on E-Mail and also via SMS to give reminder of cut-off date of billing.

Conclusion

In the present work Zigbee based Automatic Meter Reading (AMR) unit is designed to continuously monitor the meter reading and to shut down the power supply remotely whenever the consumer fails to pay the bill after the warning period is lapsed. It avoids the human intervention, provides efficient meter reading, avoid the billing error and reduce the maintenance cost. It displays the corresponding information on LCD for user notification.

Acknowledgement

The authors wish to thank authorities of Bharti Vidyapeeth's Deemed University College of Engineering, Pune and PES's Modern college of Engineering for granting the permission to publish the work.

H H Kulkarni

Assistant professor in Electrical Engineering Department at PES's Modern College of Engineering, Pune is pursuing PhD in the Department of Electrical Engineering BVDUCOE,Pune.

Dr D G Bharadwaj

Graduated from VRCE, Nagpur and ME and PhD from University of Roorkee. He retired as Principal of government college of engineering Maharashtra state and now working as Emeritus professor in BVDUCOE, Pune.

Profile

Personifying Energy Saving & Power Quality Management

NEPTUNE (INDIA) LTD.
Corporate & Mktg. Office:
Neptune House, A 11, II nd Floor, Sector 59, Noida - 201301 (INDIA)
Tel.: 0120-3069000/40/42 Fax: 0120-3069041
e-mail: enquiry@neptuneindia.com
www.neptuneindia.com

Power Scenario in Bihar

Bihar in North India is the 12th largest state in terms of geographical size at 38,202 sq mile (98,940 km^2) and 3rd largest by population. It is bounded by Uttar Pradesh to its west, Nepal to the north, Northern part of West Bengal to the east and by Jharkhand to the south.

Sidhant Chhabra & Dr Dheeraj Joshi

Situation of power availability in Bihar was never rosy, but with the separation of Jharkhand in the year 2000, it became particularly critical because most of the power generation plants fell into the newly formed state. With Jharkhand, went the bounty of natural resources and mines which minimized the chances of Bihar generating its own electricity using coal. Currently, Bihar is dependent on National Thermal Power Corporation Plants and Jharkhand Electricity Board for power supply. But there is still a wide demand- supply gap that needs to be bridged, one glaring proof of the same is the fact that Bihar's power system has a peak of about 1500 MW under the constrained demand scenario and the availability is about 950 MW. Only 52.8% of villages and 6% of households of the state are electrified, leaving about 85% of the population with no access to electricity.

A Figure comparing historical growth of installed power generation capacity in Bihar versus all other Indian states is shown here.

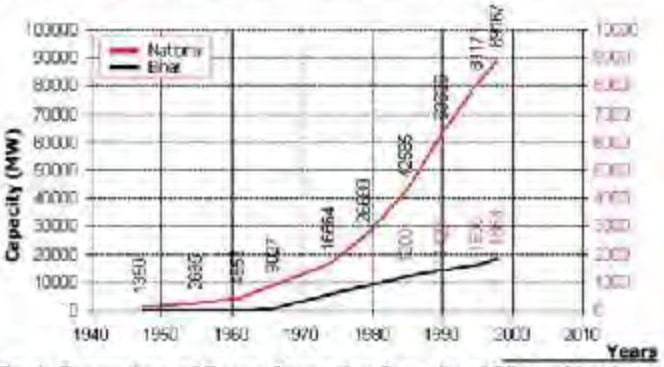


Fig. 1: Comparison of Power Generation Capacity of Bihar with other states

Current Electricity Scenario of Bihar	
Attribute	**Value**
State Installed Capacity	590 MW
Total Thermal	540 MW
Barauani (Thermal)	320 MW
Muzaffarpur (Thermal)	220 MW
Kosi (Hydro)	50 MW
Share of Chhattisgarh Stations	1379 MW
AT&C Losses	14.45%
Energy Shortage	16.6%
Peak Deficit	27.6%
Per Capita Consumption	93 kWh
National Consumption	850 kWh

Table 1: Current Electricity Scenario
(Source: 3rd North East & East Power Summit 2010, CEA & PFC)

Energy Capacity

Bihar gets an allocated share of 1233 MW of power from the central sector projects & draws an un-allocated share of 28 MW. The state owned existing power stations generate only 584.6 MW. Looking at the able below, it is clear that majority of this comes from thermal power stations.

	Thermal	Hydro	RES*	Total
Central	1131.7	129.4	0	1261.1
State	330.0	0	54.6	584.6
Private	0	0	9.5	9.5
Total	1861.7	129.0	64.1	1855.0

Table 2: Power Capacity in Bihar (As of December 2010; in MW)
RES: Renewable Energy Sources (mainly small hydro)
(Source: Power Crisis in Bihar, Electrical Monitor, EM News Bureau, August 01, 2011)

Energy Supply

Bihar ranks second on the list of least electrified states with 50% of its villages still in the dark due to the absence of transmission wires there

Year	Requirement (MW)	Availability (MW)	Deficit (MW)	Deficit (%)
2002-03	1389	1325	64	14.6
2003-04	973	788	185	19.0
2004-05	980	980	0	0
2005-06	1314	1116	198	15.1
2006-07	1399	1162	237	16.9
2007-08	1882	1243	639	34.0
2008-09	1842	1333	509	27.0
2009-10	2249	1509	740	32.0

Table 3: Energy supply Position- Peak
Source: Road map for development of power sector in Bihar, Government of India, 2007; Power Crisis in Bihar, Electrical Monitor, EM News Bureau, August 01, 2011

Energy Consumption

The annual per capita consumption in Bihar is currently at 95 units against a national average of 717, according to the CEA general review 2009. As per the statistics provided by the Energy Department, Government of Bihar on its website:energy.bih.nic.in, per capita energy consumption in pre-division Bihar was 152 units per year which came down to 60 units per year in the post- division period.

Institutions Involved

The following are the various institutions involved all of which are part of Bihar Energy Department -

- Bihar State Power Holding Company Ltd
- Bihar State Hydroelectric Power Corporation
- Bihar Renewable Energy Development Agency and
- Tenughat Vidyut Nigam Limited.

The department through its Electric Works Department carries out and maintains the internal electricity system in the government buildings of the State. Under the provisions of the Electricity Act, 2003 and Indian Electricity Rules, 1956 the department has established the Electrical Inspectorate to carry out inspection of electrical installations and oversee public safety with regard to electricity and settle disputes regarding electricity supply system.

Description about their work is given below.

- **Bihar State Power Holding Company Ltd**: Under the plan activities, the BSPHCL prepares schemes on electricity generation, transmission & distribution. The state government provides funds for implementation of the scheme from its plan allocation & also obtains central allocation/ funding from the Government of India.

Fig. 2: Power Map of Bihar

- **Bihar State Hydroelectric Power Corporation:** BHPC has been established to harness the hydroelectric potential in the State. The BHPC conducts survey for this purpose and prepares the schemes on hydroelectric power generation. The State Govt. provides funds from its plan allocation and also facilitates funding, from the Central Government and Govt. of India Financial institutions.
- **Bihar Renewable Energy Development Agency:** BREDA has been established to promote development of schemes on non-conventional energy sources. It has been nominated as nodal agency to carry out the remote village electrification program. The State Govt. provides plan funds to BREDA for expenditure on subsidies for the schemes and also for the expenditures on establishment.
- **Tenughat Vidyut Nigam Limited:** TVNL was established by the Govt. of Bihar by 1987 for establishment of thermal power station at Lalpania in the district of Bokaro, now in the state of Jharkhand. The registered office of the company is situated at Patna. The TVNL has been transferred to the Govt. of Jharkhand by the Govt. of India. However the State Govt. of Bihar has raised the issue of dispute of ownership with the Govt. of India and has also petitioned the Supreme Court under provisions of the Bihar Re-organization Act, 2000.

Brief Report on the Status of Various Important Programs of Bihar Energy Department

Rural Electrification

As per the Govt. of India program for electrification of all villages by 2009, in the State of Bihar schemes for village electrification are being carried out under different programs.

Electrification of 2,600 villages in the districts of Vaishali and Muzaffarpur under the Minimum Needs Program on the occasion of the 2,600 Birth Anniversary of Lord Mahavir.

Under the Pradhan Mantri Gramodaya Yojana 340 virgin villages are being electrified and rehabilitation of electricity system is being done in 210 villages. In each of these villages one Dalit Basti is to be provided by electricity connections.

To take up cent percent of the electrification in the State, the State Govt. has entered into a quadripartite agreement with Rural Electrification Corporation (REC), BSPHCL and the GOI power sector undertakings of Power Grid Corporation of India Ltd. (PGCIL) and National Hydroelectric Power Corporation (NHPC). This program is being implemented under the GOI scheme for "Electrification of one lakh villages and one crore households". The funding for this scheme is being made by REC as grant and loan components. The central undertakings are implementing the rural electrification works in the 36 districts, with NHPC taking up works in West Champaran, East Champaran, Sitamarhi, Sheohar, Darbhanga, Samastipur and Madhubani. The remaining districts are being taken up by PGCIL.

Transmission

Different schemes/activities have been taken up to improve transmission of electrical energy.

To improve the transmission system in the State with particular reference to North Bihar, transmission scheme has been taken up under the Rashtriya Sam Vikas Yojana. Presently the scheme is estimated at Rs 365 crores. Under this scheme, 16 grid sub-stations and 1100 km. transmission lines (22 lines) are to be erected. The State Govt. has made a quadripartite agreement with the MOP, BSPHCL & PGCIL for implementation of this scheme. It is to be implemented in 18 months. The scheme is implemented by PGCIL.

To improve the transmission system for transfer of power from South Bihar to North Bihar, a 132 KV cable line transmission system is being implemented through the Mahatma Gandhi Setu at Patna. The estimated cost of this scheme is Rs 40 crores. It is to be implemented in 18 months. The scheme is implemented by PGCIL.

In the second phase of the improvement of transmission system, it has been proposed to the Planning Commission for transmission schemes of South Bihar under funding of Rastriya Sam Vikas Yojna. The estimated cost of this scheme is Rs 597 crores.

Generation

BSPHCL: The program for renovation and modernization of the power generating units at Muzaffarpur Thermal Power Station and Barauni Thermal Power Station has been posed to the Govt. of India under the Rastriya Sam Vikas Yojna. The estimated cost of the project

report for both the thermal power stations is Rs 643 crores.

Muzaffarpur Thermal Power Station of BSPHCL has been under consideration for transfer on long term lease basis to NTPC. The decision in this regard has not yet been taken.

A project for combined cycle gas-based thermal power station has been posed to the Govt. of India for funding under Rastriya Sam Vikas Yojna. The capacity plan in the first stage is 400-450 MW. The estimated cost for this project would be around Rs 1100-1200 crores. The Gas Authority of India is extending the HBJ Gas Pipeline of Bombay off-shore to Haldia. This pipeline is to pass through Bihar from Mohania-Sasaram-Dehri-Gaya route. The NTPC has been entrusted the work of preparation of DPR.

BHPC: The BHPC has obtained sanction for implementation of 17 Small Hydroelectric Project Schemes under funding from NABARD. The estimated cost of these schemes is Rs. 98 crores out of which the funding by NABARD will be Rs 60.15 crores and the balance will come as grant by the Ministry of Non-conventional Energy Sources. Presently work order has been placed and work has been taken up for the following projects: BHPC is implementing a 1 MW hydel project at Agnoor at an estimated cost of Rs 7.97 crores. This project is in an advance stage of completion. The Kataiya hydel power station (19.2 MW) of BSPHCL has been transferred to BHPC in 2003. Presently BHPC has been making generation of 5-6 MW from this power station. There is proposal to take up R&M works.

Trivani	(3 MW)	Rs. 13.9 Crores
Jainagra	(1 MW)	Rs. 5.31 Crores
Nasrigarj	(1 MW)	Rs. 5.68 Crores
Dhelabagh	(1 MW)	Rs. 6.70 Crores

Profile

Sidhant Chhabra

He has degree in Electrical Engineering and doing his Master of Engineering (C&I) from Delhi College of Engineering. His area of interest are power system and electrical machines.

Dr Dheeraj Joshi

BE (Electrical) from University of Rajasthan is ME from University of Roorkee, and PhD from NIT Kurukshetra. Currently, he is Associate Professor in Electrical and Electronics Deptt in Delhi Technological University. His areas of interest are distributed generation, artificial intelligence, power electronics and electric drives. He has 86 publications to his credit. He is reviewer/editor of international journals like IEEE Trans on Energy Conversion, Power Delivery, Industrial Electronics, etc.

Hydro Power Scenario in Arunachal Pradesh

Nature has blessed Arunachal Pradesh with a huge hydropower potential of over 50,000 MW, which corresponds to 1/3rd of the total estimated hydropower potential of India. Only 0.81% of this potential has been harnessed and another 5.7% is under implementation. Thus, a huge potential of about 93.5% of Arunachal Pradesh remains to be taken under execution. Faster development of hydro power in Arunachal Pradesh would play an important role in reducing the gap between energy/ peak power demand and supply.

MP Singh

Arunachal Pradesh translates to 'land of the dawn-lit mountains'. Bio-geographically, it is situated in the Eastern Himalayan province, the richest bio-geographical province of the Himalayan zone. It is also known as the Orchid State of India or the Paradise of Botanists. Geographically, it is the largest among the north-east Indian States commonly known as the Seven Sister States. It borders Assam and Nagaland States to south and shares international borders of 160 km with Bhutan in west, 440 km with Myanmar in east and 1080 km with China in north and north-east. Its capital is Itanagar.

Arunachal Pradesh attained its statehood on 20th February 1987.Its geographical area is 83,743 km and population is 1.255 million. Its most of the parts are covered by the Himalayas ranges running north-south. However, parts of Lohit, Changlang and Tirap are covered by Patkihills. Kangto, Nyegi Kangsang, main Gorichen peak and Eastern Gorichen peak are some of the highest peaks of Himalayas in this region.

The mountainous divide AP into five river valleys, namely Kameng, Subansiri, Siang, Lohit & Tirap. All these river systems are fed by snow from the Himalayas and countless rivers and rivulets. The mightiest of these rivers is Siang (also called the Tsangpo in Tibet), which becomes the Brahmaputra after it is joined by Dibang & Lohit in the plains of Assam.

The entire territory forms a complex hill system with varying elevations ranging from 50m in the foot-hills and gradually ascending to about 7000m. Annual rainfall varies from 1000mm in higher reaches to 5750mm in the foot-hill areas spread over 6 to 9 months excepting the drier days in winter. A good network of river system available in Arunachal Pradesh has provided it an enormous hydro power potential of more than 50,000 MW, which is an important renewable source of power generation. The paper deals with the river system in Arunachal Pradesh, estimated hydropower potential and its status of development, hydropower projects in operation, projects in execution and projects under survey & investigation.

River System

Arunachal Pradesh is drained by innumerable rivers and a number of streams that drain the area almost throughout the year. However, five major rivers of this State are Siang, Kameng, Subansiri, Kamla, Siyom, Dibang, Lohit, Noa - Dihing, Kamlang and Tirap.

Main rivers in Siang district are Siang and Siyom flowing in a north-south direction. Siangriver (also called Dihang) is known as Tsangpo in its upper course in Tibet

In Kameng district of Arunachal Pradesh, the river Nyamjang Chu (also called Dargong) starts from west and draws the waters of Mela ridge. River Namka Chuassumes the name of Tawang Chu. Kameng River (fed by Dirang River) starts at the Kameng range at a height of about 3000 m and flows through the Se La Pass. Other important rivers of Kameng district are Bhorelli, Bichom and Tengapani rivers. The long and narrow valley at the foot of Bomdila range is intersected by many streams. Important river is the DaphlaKho. It flows into the basin ofBhoreli river, the largest river of Kameng. River Ruparuns from south-west direction through the Sherdukpen Hills and joins the Kamengriver. Rivers of eastern Kameng hills flow in south-west direction and the rivers in western flow in south-east direction.

Main rivers in Siang district are Siang and Siyom flowing in a north-south direction. Siangriver (also called Dihang) is known as Tsangpo in its upper course in Tibet. It originates in Tibet and makes its way into Indian Territory east of Gelling in Arunachal, it covers a length of about 250 km and is fed by many tributaries like Siyom, Yarne and Yang Sang Chu. Siyom river rises from Pari mountains in Mechuka area and flow east through areas of Membas, Ramos, Pailbos and Bokars. It merges with Siang river near Pangin. Another major river of Kameng district is Simen, which emerges from high hills of Basar, flows southwards and merges with Brahmaputra.

Major rivers of Lohit district are Lohit, Dibang, Kamlang and Nao-Dihing rivers. River Lohit (called Telu by Mishmis) originates from mountains across the north-east border (from China where it is called Zayul Chu).It has a course of about 190 km. It passes through steep hills and valleys before it reaches the plains at ParsuramKund. Dibang is the main river of western part of Lohit district. It originates from southern flank of Great Himalayan Ranges and flows from north to south and finally meets river Lohit near Sadiya. It changes its course very often in the foothill region, thereby making it almost impossible to bridge it. Plains towards the south of the district are drained by Kamlang and Nao-Dihing rivers. Main tributaries of Nao-Dihing are Dirak on left bank and Tengapani on right bank. Kamlang rises from Galo in Wakro and flows in an east-west direction and finally meets the Lohitriver.

Most of the rivers in Tirap district flow east to west and major ones are Nao-Dihing, Burhi-Dihing,Tirap, Namsang, Namphuk andNampha. Noa-Dihing flows east-west through the entire north-eastern and northern stretch of Tirap district and meets Lohit river near Namsai in Lohit district. One of its major tributary is Daphariver. River Burhi-Dihingflows south-west and joins Brahmaputra near Borgohaingaon in Assam. Namphuk, Namchik,Namsang, Namphai and the Tirap rivers are its main tributaries. Tirapriver originates from a high peak between Laju and Wakka in the south-western region. It flows from south-west to north-east through Tirap district and then turns north and due west in the plains to join Burhi-Dihing near Ledo. Some other rivers in the district are the Tisa, the Taken, The Tiking, the Tisingu and Tewai.

Main rivers of Subansiri district are Subansiri, Kamla, Khru, Panior, Par and Dikrang. Subansiririver is life-line of river system of district, which makes its way across the entire length of the territory. Its headwater in Tibet is formed by Char Chu, Chaya Chu & Yume Chu rivers. Kamlariverforms an important part of the Subansiri drainage system. It emerges from the confluence of a number of small rivers cascading down from north-west snowy heights of district. Khrula a turbulent river & like Kamla, it cuts through precipitous gorges. River Dikrang is formed by Par, Norochi and Pachin rivers.

Power Supply Position

Power demand during last decade has increased a lot, but its production has not been able to keep up pace with it. Arunachal Pradesh is experiencing a shortage in energy supplied as well as peak met. Requirements vis-à-vis availabilities of electricity and peak power demands in Arunachal Pradesh during the period April, 2014 to October, 2014 is given in next page.

Hydropower Potential

Estimated Potential

From the point of estimation of hydropower potential, Arunachal Pradesh has been divided in to seven basins. These basins are Tirap Basin, Lohit Basin, Dibang Basin, Siang Basin, Subansiri Basin, Kameng Basin and Tawang Basin.

In terms of installed capacity, the total hydro power potential identified for Arunachal Pradesh as per reassessment studies is 50328 MW including station capacity up to 25 MW and is 50064 MW excuding station installed capacity of 25 MW. This potential is about 34% of the total hydropower potential estimated in the country.

Status of Development

Out of the estimated hydro power potential of 50064 MW (excluding schemes with individual station installed capacity up to 25 MW), 405 MW (about 0.81%) has been developed another 2854.05 MW (5.7%) is under construction. The total capacity in operation and under construction works out to 3259 MW (6.51%). Thus, a huge hydro power potential of 46805 MW (93.49%) remains to be taken under the process of development.

Projects Allotted to Developers for Implementation

A total of 94 HE Schemes (above 25 MW Capacity) with an aggregate capacity of 37650.5 MW were allotted by Arunachal Pradesh Government for implementation during the period 2006-2011. Three schemes were allotted in Central Sector and remaining 91 schemes in Private Sector.

Sector-wise break-up is given below

Sector	Number of Projects	Installed Capacity (MW)
Centre	3	4400
Private	91	33250.5
Total	94	37650.5

Hydro Schemes In Operation

Presently, only one hydroelectric project (Station capacity over 25 MW) namely Ranganadi Stage-I HEP of 405 MW is in operation in Arunachal Pradesh. In addition, some small/mini/micro hydroelectric schemes are in operation with individual station capacity up to 25 MW.

Year/Period	Energy Supply Position (MU)				Peak Demand/Peak Met (MW)			
	Requirement	Availability	Deficit (-)	Deficit (%)	Peak demand	Peak Met	Deficit (-)	Deficit (-)(%)
April-Oct. 14	397	348	-43	-11.0	139	126	-13	-9.4
Oct., 2014	70	53	-17	-24.3	136	120	-10	-7.4

Hydro Schemes Under Execution

At present, following 3 hydroelectric projects with an aggregate capacity of 2710 MW are under construction in Arunachal Pradesh. These schemes have individual station installed capacities above 25 MW and do not include schemes under execution under Ministry of New & Renewable Energy with individual station capacity up to 25 MW.

- Lower Subansiri (2000 MW) by NHPC
- Kameng (600 MW) by NEEPCO
- Pare (110 MW) by NEEPCO.

Problems being faced in Execution of Projects

- In case of Subansiri Project, construction works stopped due to agitation by anti-dam activists since 16.12.2011 and law & order problem. The issues regarding to foundation competency, downstream impact assessment during operation stage and feasibility of reducing height of dam are being resolved.
- In case of Kameng Project, there was shortage of aggregate due to non-receipt of clearance from Forest Department for quarry. There was slow progress in Dam & HRT due to bad geology, heavy seepage, floods of September, 2012, inadequate machinery at site and poor approach roads etc. Contractual issues were also there.
- In case of Pare Project, the works suffered due to poor geology and flood encountered during September, 2012.

Future Schemes

Projects for which DPRs Concurred and Work to be started

DPRs of 15 hydroelectric schemes (station installed capacity over 25 MW) aggregating to an installed capacity of 16536 MW have been accorded concurrence by Central Electricity Authority and they are to be taken for implementation after taking up clearance from Ministry of Environment and Forest and after completion of pre-construction activities. In addition to these, another 3 schemes of total installed capacity of 337 MW (station installed capacity less than 25 MW) have been concurred by State Government. These are also to be taken up for implementation.

Detailed Project under Examination

At present detailed project reports (DPRs) of 5 hydroelectric schemes with an aggregate installed capacity of 2402 MW (individual station installed capacity over 25 MW) are under examination in CEA and CWC for accord of concurrence.

In addition to these, DPRs of 7 other hydroelectric schemes having individual station

Brief details of these three hydroelectric schemes are given below					
S. No.	Project Name	Units x MW	IC (MW)	Agency	Year of Commissioning
1	Subansri Lower	8x250	2000	NHPC	2016-18
		Project envisages construction of 116m high concrete gravity dam, 1.45 m long HRT, Surface PHand Francis Turbines.			
2	Kameng	4x150	600	NEEPCO	2016-17
		Project envisages construction of 75m 247.3 m Bichom & 25m high 183m long Tenga dams, 4.477 Km long HRT, 3.64 Km long high pressure tunnel, 25 m dia 70m high surge shaft, semi-underground PH, Francis turbines			
3	Pare	2x55	110		10-15-16
		Project envisages construction of 78 m high concrete spillway, 3 intake gates, 7.5 m dia, 2.81 Km long HRT, 6.4m dia, 220 m long pressure shaft bifurcated to 4.5m dia., surface PH, Francis turbine			
	Total		2710		

capacity less than 25 MW and total installed capacity of 359 MW are under examination at State Government level. These schemes include Lachung (40 MW), TarangWarang (36 MW), Pakke Bung-I (40 MW), Pachuk-II Lower (45 MW), Manjingla Lower (45 MW), Manjingla (60 MW) and Jarong (90 MW).

Detailed project reports of 9 hydroelectric schemes of total installed capacity of 3257 MW were examined in CEA for concurrence and returned to the project authorities for resubmission after compliance of comments of CEA/CWC/ Geological Survey of India.

Schemes under Survey & Investigation

48 hydroelectric schemes of Arunachal Pradesh (with individual station installed capacity above 25 MW) aggregating in an installed capacity of 12497 MW are under various stages of survey and investigation.

Preparation of PFRs under 50,000 MW Hydroelectric Initiative

Pre-Feasibility Reports (PFRs) were prepared for 162 hydroelectric schemes of 16 Indian States under the programme 50 000 MW Hydro Initiative launched by Prime Minister on India on 24.06.2003 for the purpose of fixing the inter-se priority for implementation of the schemes and also as a basis and reference for taking up on Survey & Investigations and preparation of DPRs of Hydroelectric Schemes. These schemes include 42 hydro schemes of aggregate installed capacity of 27293 MW of Arunachal Pradesh. Out of 42 PFRs of Arunachal Pradesh, 25 PFRs were prepared by NHPC, 15 PFRs by WAPCOs and remaining two PFRs by NEEPCO.

Major Issues

Several problems are being faced by the hydro power developers during hydro power project developmental stage. Some of the major issues responsible are given below:

- At present Ministry of Environment and Forest is enforcing environmental flows (e-flows) up to 30% of monsoon flow in monsoon period, 20% lean months flow in lean season and 20-30% in the balance period. 30% e-flows in monsoon period and 20-30% in intervening periods would have impact on power potential of project leading to reduction in installed capacity, energy generation & peaking power availability. In some cases, projects may become unviable.
- Cumulative Basin Environment Impact Assessment (EIA) Studies have impact on downstream projects. Based on such studies, some of the projects are being dropped, some of them are being clubbed together and in some other cases installed capacities are getting reduced.
- Most of the hydro schemes in Arunachal Pradesh are run-of-river type, while a few are storage type. Therefore, sub-basin-wise cumulative Environmental Impact Assessment (EIA) studies need to be carried out in order to assess their impact on downstream projects. EIA Studies are being carried out in Bichom, Lohit, Subansiri, Siang and Tawang basins. Nazong and Dimjin projects in Bichom Basin have been proposed to be dropped.
- Free flows Stretch left between two projects in succession may reduce the hydro potential of the projects due to reduction in head.
- Projects involving submergence area falling within Wild Life Sanctuary/ Tiger Reserve Forest may result in change in site features which could lead dropping of project. For hydro power projects having submergence area falling within Tiger Reserve Forest, permission of Hon'ble Supreme Court is required.
- Acquisition of land for various components of the project and issues relating to law & order takes a long time and delays commencement/ implementation of the project.
- Lack of infrastructural facilities like strengthening/ widening of existing roads connecting the project sites, construction of new roads, conversion of single roads in to double roads, construction of bridges/ highways delay the implementation of hydro power projects.

Government of India's Package To Arunachal Pradesh

In order to oversee, co-ordinate and monitor the development of hydro power in the State of Arunachal Pradesh, the State Government has created a separate department namely Department of Hydro Power Development (DHPD). Prime Minister of India has announced a package of Rs. 550 crores embarked for Power Sector to spend to achieve the ultimate goal of electrification of all households in Arunachal Pradesh. Money has been distributed as follows:

- Rs 416 crores to DHPD for completion of certain existing incomplete schemes and construction of new small/ mini/ micro hydel stations.
- Rs 86 crores to Department of Power (T&D) (DOP) for evacuation of power generated from small/ mini/ micro hydel stations constructed by DHPD.
- Rs 48 crores to Arunachal Pradesh Energy Development Agency (APEDA) for construction of microhydel stations and providing solar photo voltaic system in inaccessible areas.

Conclusions

Hydropower is one of the most important renewable energy resources in Arunachal Pradesh. Arunachal Pradesh has enormous hydropower potential of the order of 50,000 MW and there is an urgent need to explore it. Local issues & law and order problems being faced in construction and survey & investigations for various hydropower projects need to be sorted out for their speedy implementation. There is an urgent need to enhance the infrastructure facilities like strengthening/ widening of existing roads, construction of new roads/ bridges in Arunachal Pradesh in close coordination between State Government and Ministry of Road transport and Highways.

M P Singh

BSc Engineering (Electrical) from AMU, Aligarh and MBA (Operation Research) from IGNOU has over three decade experience in planning, to monitoring of hydroelectric stations, worked as Director and Chief Engineer (I/C) in Central Electricity Authority and as DGM at Koldam HPP of NTPC. Presently he is working as a consultant in WAPCOS. He published/ presented over 50 articles in various magazines/ Seminars and 6 technical books (in Hindi). 5 awarded by Ministry of Power, Ministry of Renewable Energy Sources, Ministry of Science & Technology.

Profile

Interview

"WNA's 180 plus members are the Who's Who of nuclear industry"

Shah Nawaz Ahmad, Senior Adviser,
India, Middle East and South-East Asia,
World Nuclear Association

World Nuclear Association, is the international organization that promotes nuclear energy and supports the many companies that comprise the global nuclear industry. A fundamental WNA role is to act as a global forum, & commercial meeting place for leaders and specialist representing all aspects of the nuclear industry. The WNA Information Library consists of nearly 150 frequently-updated information papers. **Shah Nawaz Ahmad,** having five decades of experience in nuclear power sector, in an exclusive interview to **Electrical India,** observes, technically, a major lesson of Fukushima is the need for more effective mitigation and better remote monitoring & retrieval capabilities.

➢ **What is your perception about Global scenario of Nuclear power?**

Post Fukushima, there were fears that nuclear power may go into the same freeze that occurred after Chernobyl. But it has not been so. Within three years of the event, nuclear generation is on par with that of pre Fukushima Figures. Also, in Japan, we are close to restart of the reactors. All this was made possible through the robust response of the industry to examine the safety of the nuclear power plants, perform stress tests and ensure that the reactors are safe.

Almost all countries have recommitted to nuclear power, with Germany as an exception, that proves the rule. New build programmes are on course with China leading the way. We also need to remember, that countries have spoken about phasing out nuclear power but have not phased out any yet! So I would say, Fukushima was a temporary setback that has now been almost overcome.

➢ **You are engaged with the World Nuclear Association (WNA) and have done significant assignments for the IAEA. You were attached to NPCIL, ECIL, and WANO etc., Could you describe your journey to WNA and what purposes it serves?**

Whilst working for DAE/NPCIL, our generation was lucky that it was given a considerably free hand in technical work, and the trust and responsibility reposed in us, helped us to grow fast and bolstered our confidence. Also I was lucky to be given the opportunity to work on many aspects of nuclear technology. These covered Design and Development, Site construction, commissioning and management, operation review, Life Extension and Public Awareness and Media; as well as foreign assignments.

Also, we were encouraged to publish papers. Having our papers reviewed, and being able to defend our work face-to-face with eminent authorities in India and abroad, was incredibly reassuring. I am incredibly thankful to my superiors for reposing such confidence in me.

This experience has stood me in good stead, as in WNA, in addition to technical work, I am working with Many nations in Asia and Middle East, as they embark on building nuclear power plants. The vast international know-how in WNA, and My Indian experience as a bonus, (as India's example is a confidence booster to many newcomer countries.) has made my work considerably easier.

➢ **What are the real fundamental benefits and challenges of nuclear power? How is WNA helping in these aspects.**

The three international organisations, with nuclear as the core business are International Atomic Energy Agency (IAEA), World Association of Nuclear Operators (WANO) and World Nuclear Association (WNA). IAEA is an agency of the United Nations. It has governments as members and is principally concerned with safety, security and proliferation.

WANO is an association of nuclear power plant operators. It's members are nuclear power plants and it is principally concerned with safe and reliable operation of nuclear power plants.

WNA is an association of the world-wide nuclear industry, and in a way covers all, aspects of work. WNA's 180 plus members are the who's who of the nuclear industry. These comprise all uranium miners, fuel fabricators, all technology vendors (WNA members generate nearly 90% of the world's nuclear electricity); Principal equipment manufacturers, EPC contractors and nuclear services providers. Other members include transporters, Bankers, Lawyers etc.

To mention a few, WNA works in the area of facilitating business contacts and in many technical areas such as, communication, law, supply chain, Harmonisation of standards.

WNA maintains one of the world's best established nuclear web-site, a news service, as well as through the World Nuclear University, an extensive and reputable training programme.

➢ **Whether nuclear power is affordable, clean and reliable energy on large scale. Could you highlight the formidable challenges besides waste management?**

Nuclear power plants have been delivering clean and safe power for many decades now. There are over 400 power reactors operating world -wide. The average load factor of nuclear reactors is in the high eighties.

There has been no fatality related to radiation for many decades, in fact it is the safest mode of power production. Carbon is not amongst its waste, so it can be an asset in beating climate change.

Yes, the capital cost of NPPs is high, but running cost is low. Also plants come with a life of 60 plus years now.

With appropriate financial structuring, shorter construction times, increased modularity, simplification of designs, over time these reactors should become more affordable.

WNA is working towards a greater harmonisation of standards as welll as greater clarity in law. These would help accelerate international nuclear commerce, and lead to all round benefits.

➢ **Where did the nuclear industry failure occur? What we could learn from Fukushima disaster?**

Failure is a very strong word, but yes Fukushima has created great concern.

There is a need for perspective. Fukushima Daichi was an old reactor which saw an earthquake and tsunami, much beyond the design basis. Still, there were no fatalities due to radiation.

And what the press did not emphasise, that not very far away, the Onagawa nuclear power plant saw an earthquake and tsunami higher than Fukushima and survived. So there was no problem with nuclear technology per se. Nevertheless, the nuclear community took the event with great seriousness.

All reactors around the world, including in India, underwent intensive reviews and stress tests. In these exercises too, the robustness, if the existing plants was recognised. Only then were they allowed to continue operation.

The world would perhaps have not taken much note of Fukushima; if the consequences of the accident had remained within the plant. Technically, a major lesson of Fukushima is the need for more effective mitigation and better remote monitoring & retrieval capabilities.

➢ **While evidence exists that no enough radiation; what steps could be taken for mitigation of it and capability to handle waste?**

Normal reactor operation contributes very little radiation. Most often, the natural back ground radiation is magnitudes higher than that contributed by the plant. This is true not only for India, but for nuclear plants worldwide.

Radiation protection standards are built on the ALARA - As low as reasonably chives le- principle. And even these standards are continuously being made more stringent, as technology advances.

Waste remains an area of considerable research.

Separation of actinides, can lead to so much smaller volume of long lived waste. Burning of actinides in reactors, or accelerator driven systems is the object of research.

The point to remember is that the high level waste, which is of main concern, is minuscule in quantity as compared to fossil fuel plants, and can therefore be secured and contained more easily.

➢ **What according to you is the principle of communication? What you have to say about nuclear awareness campaigning towards nuclear option?**

More than almost any other industry, the adage "An accident anywhere, is an accident everywhere" applies to the nuclear industry. Since Chernobyl, the industry has been sensitive to this, and has greatly increased its transparency and information flow. However much of this communication has been in technical jargon and in traditional format.

Executive summary of Target and Achievement of Transmission Lines during 2014-15

As on 31.10.2014 (All figures in circuit kms.)

Programme / Achievement		HVDC			765 kV		400 kV					220 kV					Total Central, State & JV Private Sector				
		±800 kV		±500 kV			Central Sector			State/ Private Sector		Central Sector			State/ Private Sector		Central Sector			State/ Private Sector	Grand Total
		Central Sector	State Sector	JV/Private Sector	Central Sector	State Sector	JV/Private Sector	PGCIL	DVC	Total CS	State Sector	JV/Private Sector	PGCIL	DVC	Total CS	State Sector	JV/Private Sector	PGCIL	DVC	Total CS	State Sector	JV/Private Sector	
Programme 2014-15		0	0	0	4088	0	2463	6551	2955	0	2955	4307	1442	8764	381	0	381	5166	0	5547	9553	3905	20682
Oct, 2014	Programme	0	0	0	0	0	0	0	0	0	0	312	0	312	0	0	0	364	0	364	1276	0	1276
	Achievement	0	0	0	862	0	841	970	672	0	672	0	81	753	0	0	0	75	0	78	78	149	1001
Upto Oct, 2014	Programme	0	0	0	1990	0	1703	2793	786	0	786	3930	1442	6158	381	0	381	3166	0	3166	7096	3145	12417
	Achievement	0	0	0	2852	3	795	3750	2350	0	2350	2373	729	6082	74	0	74	1788	20	1883	4765	1584	11715

The industry needs to be as communication savvy: as it is techno-savvy. In WNA, we have initiated efforts for greater precision of the use of language in communication, bringing out a volume in nuclear english. Also greater use is made of social media. WNA is also making its web-site multilingual, so that local communities are apprised of aspects of nuclear power and the vernacular press has material available that it can readily use. The nuclear community needs to fine tune its message to the various stake holders, and bring the "Technology of communication, to the communication of technology".

Development and deployment of effective communicators in the local vernacular is becoming essential, and should be a priority. In our communication we should package nuclear power as a whole. We should emphasise its role in medicine, agriculture, industry, space etc. so that we give the audience a world-view. We need to point out that nuclear reactors are needed to produce the radio-isotopes necessary for medical and other sectors.

➢ What are the various opportunities available for India in the nuclear power field and when we can see nuclear energy advancement, coming out of Apprehensions of safety hitch & radiation health concerns?

India has acquired great all round competence in all, aspects of PHWR technology ranging from design to manufacture of equipment, operation and maintenance, and project management. Should a policy decision be taken!

India can market and supply its PHWRS. For imported reactors too, Indian industry is in a position to contribute towards substantial localization. This could eventually lead to India becoming a manufacturing and services resource for these technologies world-wide. I have great hopes for nuclear commerce from India.

MedicalEquipment & Automation

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

SUBSCRIPTION FORM

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

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

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. ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Date of Birth ☐☐ ☐☐ ☐☐☐☐ (D D M M Y Y Y Y) Card Expiry Date: ☐☐ ☐☐☐☐ (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 \ December 2014

Contents of the magazine :

- News and views from the medical equipment industry
- Interviews and Opinions of eminent professional from the medical field
- Events
- Technical articles related to disease, product equipment
- Book reviews on the industry
- Product write-up
- New Products/ Product Launch

... and much more.

Major Industries covered :

- Pharmaceutical machineries
- Medical implements & implants
- Oxygen setup
- Dental equipments
- Hearing aids
- Pathological equipments
- Ophthalmologic equipments, devices & solutions
- Ambulance
- Air sterilization
- Surgical equipments
- Electro medical equipments / Medical technology
- Rescue & Emergency equipments
- Medical Diagnostic & hospital supplies
- Physiotherapy / Orthopedic equipments & technology
- Communication & IT
- Medical furnitures & equipments
- Cardiology equipments
- Radiology & Imaging equipment technology
- Medical disposable disinfection
- Hospital utilities & supplies
- Neonatal / Pediatric equipments & patient monitoring equipments
- Electromechanical linear actuator system for hospitals, beds, O.T tables, O.T lights
- Dental chairs, Blood donor coach
- Power backup systems (UPS, Inverters & SMF batteries)
- Rehabilitation aids

... and related accessories

Reach :

Professionals like :

- Medical Professional / Doctors
- Surgeons
- Paramedical Professionals
- Hospital Administrators
- Pathologists
- Radiologists
- Physiotherapists

Industries like :

- Medical and Surgical Equipment & Supplies
- Pharmaceutical & Bulk Drugs
- Disposable Supplies
- Diagnostics & Laboratory Instruments
- Hospital Furnishing & Related computer software
- Rehab. & Therapeutic aids
- Ophthalmic Instruments
- Oral & Dental Equipment
- Optical Equipment and supplies
- Institutions
- Other allied industries

NATIONAL POWER TRAINING INSTITUTE

on an Accelerated Growth Path

National Power Training Institute (NPTI), an ISO 9001 & ISO 14001 organization under Ministry of Power, Govt. of India is a National Apex body for Training & Human Resources Development in Power Sector with its Corporate Office at Faridabad.

NPTI operates on an all India basis through its nine Institutes in the different zones of the country viz., **Northern Region:** NPTI Corporate Office Faridabad, NPTI's Regional Institute at New Delhi, NPTI's Hydro Power Training Centre at Nangal; **Southern Region:** NPTI's Power System Training Institute and Hot Line Training Centre at Bengaluru, NPTI's Southern Region Institute at Neyveli; **Eastern & North Eastern Region:** NPTI's Eastern Region Institute at Durgapur and North Eastern Region Institute at Guwahati; and **Western Region:** NPTI's Western Region Institute at Nagpur.

For daily update of Power news in media, visit our website: www.npti.in

NPTI conducts following industry interfaced academic programs with the objective to create a pool of committed and competent professionals equipped with appropriate technical skills to steer the Indian Power Sector:-

- Two-Year MBA in Power Management approved by AICTE
- Four-Year B.E./B.Tech. Degree in Power Engineering approved by AICTE
- One-Year Post Graduate Diploma Course in Thermal Power Plant Engineering
- One-Year Post Graduate Diploma Course in Sub-Transmission and Distribution Systems
- One-Year Post Diploma Course in Thermal Power Plant Engineering
- Nine Months Post Graduate Diploma Course in Hydro Power Plant Engg.
- Six Months Post Graduate Diploma Course in O & M of Transmission and Distribution Systems for Engineers
- Six Months Post Diploma Course in Hydro Power Plant Engineering
- 12 Weeks Post Graduate Certification Course in Thermal Power Plant Engineering.

NPTI has been conducting Induction Training, long-term, medium-term and short-term training programs to ersonnel of various Public Sector Undertakings, State and Private Sector organizations.

Our students are finding placement in reputed Power Sector Organizations. Power Sector Organizations are invited to visit our campus for placement of students.

NPTI Complex, Sector-33, Faridabad-121003 (Haryana)
Tel.: 0129-2274916 | Fax: 0129-227 7412

For further details contact: J.S.S. Rao, Principal Director, Business Development Department
Tel.: 0129-2255213 | E-mail: jssrao@npti.in, jssrao_npti@yahoo.com

FOUR DECADES OF SERVICE TO THE POWER SECTOR

Interview

"To increase our T&M range by adding 4 to 5 new generic products"

Balasaheb Doiphode, CEO
SCOPE T&M Pvt Ltd

SCOPE T&M Pvt Ltd, is a pioneer in developing portable Testing & Measuring instruments for power sector in India and specializes in offering measuring solutions for users as well as manufacturers of equipments used in generation, transmission and distribution of power. We offer a range of Field Testing Instruments capable of working in live switchyards and solutions for improving efficiency of capital equipment in power industry. In an exclusive interview to **Electrical India, Balasaheb Doiphode** states, our products are developed or refined due to challenges thrown to us by our customers.

➢ **What is your perspective about the scope of testing and measurement instruments?**

Power sector in India is growing rapidly. Government has set forth ambitious targets to add generation capacity and associated transmission & distribution network. Due to continuous increase in both industrial & domestic power consumption there is still gap between demand and supply. Our T&D losses are still very high. Average age of population of substation power equipment like transformers, circuit breakers, CTs, PTs, protection relays etc, is increasing. Hence it is important to assess the efficiency & healthiness and to enhance balance life of these equipment to save on capital expenses. And here is role for testing & measuring instruments.

Continuous or periodical assessment of healthiness of major power equipment is of paramount importance to ensure uptime of power system & to avoid expensive break-downs. The routine or diagnostic Test & Measurement instruments help assess this healthiness. There is increased awareness amongst Utilities to use various instruments for measuring those parameters which were hitherto ignored. The use of microelectronics, latest communication modes & reduction in power consumption of instruments making them battery operated had made new generation T&M instruments more portable, convenient & useful. Powerful analysis software having tools like comparison & trend analysis are making condition monitoring easy. Considering that various State Utilities are still at various levels of exposure to these instruments there is still lot of untapped potential. This T&M market will grow hand in hand with power sector.

➢ **Would you share with us your journey and contributions to accelerate the SCOPE growth since you are working for 20 years with the company?**

I joined SCOPE as Trainee Sale Engineer way back in 1994, and was lucky to work with the founder members of the company. The journey has been

very exciting, full of new challenges & associated learning. In career spanning 2 decades I had handled various responsibilities including Head of Marketing, Head of Works & Service and was posted at various locations like Delhi, Mumbai & Pune.

SCOPE has grown from a start-up having ambition of making those instruments in India which are required to be imported from abroad to a global brand which is now exporting to almost 40 countries under the dynamic leadership of our Chairman, Sanjay Kulkarni. This progression of SCOPE has thrown many challenges which were ably handled by an excellent team that SCOPE has. I had contributed initially in establishing the SCOPE business in Northern Region & then overall expansion of SCOPE business, expanding business verticals, streamlining manufacturing & service operations, expansion of Pune factory, implementation of ISO in SCOPE & also in systematically promoting export activities.

➢ **What are the specific demands of the customers in the power sector and challenges faced during business expansion dealings in view of the similar line of product availability in the market?**

As most of the testing instruments are used in live switchyard environment, reliability of kits to work in such environment is must for customers. Similarly portability, transport worthiness, use friendliness, communication with PC and most importantly quick & on-site after sales & calibration support is important for customers.

For many of the T&M instruments there do not exist well laid down standards that will define its technical specifications. As the Utility engineers are required to deal with many such T&M instruments, they cannot be experts of each & every technical specification of instrument. Here comes the challenge of convincing User about what he really needs. He needs to be ethically educated about a useable feature & kind of entry barrier being put by competitors for sake of it. Other generic challenges are delays in project completion, significant delays in payment recoveries & also recoveries of other outstanding like C Forms, BGs, EMD/SD etc. Here more Supplier friendly approach from government customers is essential for financial healthiness of instrument manufactures.

➢ **SCOPE has pioneered in manufacturing field testing instruments and software solutions for variety of equipment used in power sector. Could you brief the range of testing instruments that help in detecting and improving the efficiency of power related activities?**

SCOPE is offering following testing instruments and software solutions that test or measure important parameters and help assessing present condition & future trend of various substation equipment.

- For Circuit Breakers – CB Time Interval Meters, CB Operational Analysers, Dynamic Contact Resistance Meters, On-Line CB Monitors
- For Transformers – Winding Resistance Meters, Turns Ratio Meters, Insulation Testers
- For Surge Arresters – On-Line SA Leakage Current Analysers, Continuous SA Monitors
- For underground Cables – Full range of Cable Fault Locators
- For CT/PT – CT/PT Testing Kits for comprehensive testing, Polarity Testers
- For Protection Relays – Automatic Numerical Relay Test Kits
- For Battery Banks – Battery Resistance Testers, Battery Loading Units
- Contact Resistance Meters for micro-ohm measurement for CB, Isolators etc.
- DC Earth Fault Locators
- Earth Resistance, Soil Resistivity & Tower Footing Resistance Meters
- Meter Test Kits
- Partial Discharge Measurement solutions
- SCHELOG – Web based Maintenance Management Software that allows management of testing, maintenance & data sharing for all substation equipment.

➢ **Could you detail about online monitoring instruments technologically necessary for the power and energy sector in India?**

On one hand, the need of near 100% availability of power supply is requiring equipment to be healthy; on the other hand shutdown for periodical testing is becoming more & more difficult. This has necessitated rise of on-line monitoring techniques that will indicate in real time, deviation from expected performance. Then one can bring off line diagnostic instruments and conduct detailed testing to avert any possible break-down. Such monitors typically have front end parameter measurement, a processing unit and communication options with local or remote computer that runs monitoring software. The status of each parameter of each equipment being monitored can be accessed remotely. This will be future trend in Indian power sector. SCOPE is already offering such on-line monitoring solutions for circuit breakers & surge arresters.

➢ **What are the operational activities of Substation Maintenance Management?**

Substation Maintenance Management software, SCHELOG is a web based software that allows user to do following activities.

- Create single line diagram for substation including location & details of each equipment in software graphics
- Create plan for tests to be conducted on each equipment along-with its frequency. Scheduling / rescheduling of these tests.
- Conduct test, enter test data in software
- Analyse data. See trend analysis of

important parameters for a equipment or for similar equipment at other location.
- Decide roles, rights & access control.
- Create formats, reports, automatically share data with remote authorities.
- Record maintenance history & spare/ equipment replacement record.

➢ In what respect SCOPE T&M is different than other business units of SCOPE?

SCOPE started with T&M development & manufacturing as its core activity. SCOPE has dedicated R&D which is doing fundamental R&D work in this area. SCOPE is also lucky to have received very good support from Indian Transmission Utilities during product development & proving. Our products are developed or refined due to challenges thrown to us by our customers hence the end specifications are highly usable. We have privilege of installing our on-line monitors for circuit breaker & surge arrester at world's first 1200kV Test Station of Powergrid at Bina. All this has happened within T&M division of SCOPE. T&M division is also a major contributor in export revenues. Even though SCOPE has expanded in Protection & Service segments where the volumes are high, SCOPE remains a core T&M company.

➢ What is your vision about the company in the next two years?

In short term of next two years we intent to increase our T&M range by adding 4 to 5 new generic products. We will be aggressively participating in various technical conferences & exhibitions abroad to increase our visibility & increase export business. We intend to take to more customers the awareness of significant work we had done in on-line measurements.

We also will be focusing on consolidating the areas in which we had recently diversified. Internally, we are putting systems in place & doing some reorganising so that company copes up with the significant growth that we foresee.

We want to be a major force globally in the field of T&M, Protection & Substation Automation and T&C.

Status of 50,000 MW Hydro Electric Initiative

Central Electricity Authority scheme launched for preparation of Preliminary Feasibility Report (PFRs) of 162 New Hydro Electric Schemes totalling to over 50,000 MW.

- Preparation of PFRs involved conceptual planning, preparation of project and equipment layouts, infrastructure requirement, preliminary environmental and geological studies, power evacuation arrangement, cost estimates and economic evaluation.
- PFRs of all the 162 schemes have been prepared ahead of schedule. The schemes are located in 16 states as under.

Sl. No.	State	Number of Schemes	Installed Capacity (MW)
1	Andhra Pradesh	1	81
2	Arunachal Pradesh	42	27293
3	Chhattisgarh	5	848
4	Himachal Pradesh	15	3328
5	Jammu & Kashmir	13	2675
6	Karnataka	5	1900
7	Kerala	2	126
8	Madhya Pradesh	3	205
9	Maharashtra	9	411
10	Manipur	3	362
11	Meghalaya	11	931
12	Mizoram	3	1500
13	Nagaland	3	330
14	Orissa	4	1189
15	Sikkim	10	1469
16	Uttaranchal	33	5282
Total		**162**	**47930**

Source: CEA

World of Electrical Testing Equipment

RE
Since 1970

PRODUCT TESTING

QUALITY CONTROL

RESEARCH & DEVELOPMENT

CALIBRATION

www.re-india.com


AC High Voltage Test Set


DC High Voltage Test Set


DC High Voltage Test Set


Secondary Injection Test Set


Primary Current Injection Test Set


Fully Automatic Oil Test Set


Kilo Volt Meter


RLC LOAD TEST SETS

and many more

Catering to the needs of testing for the past four decades...

Rectifiers & Electronics

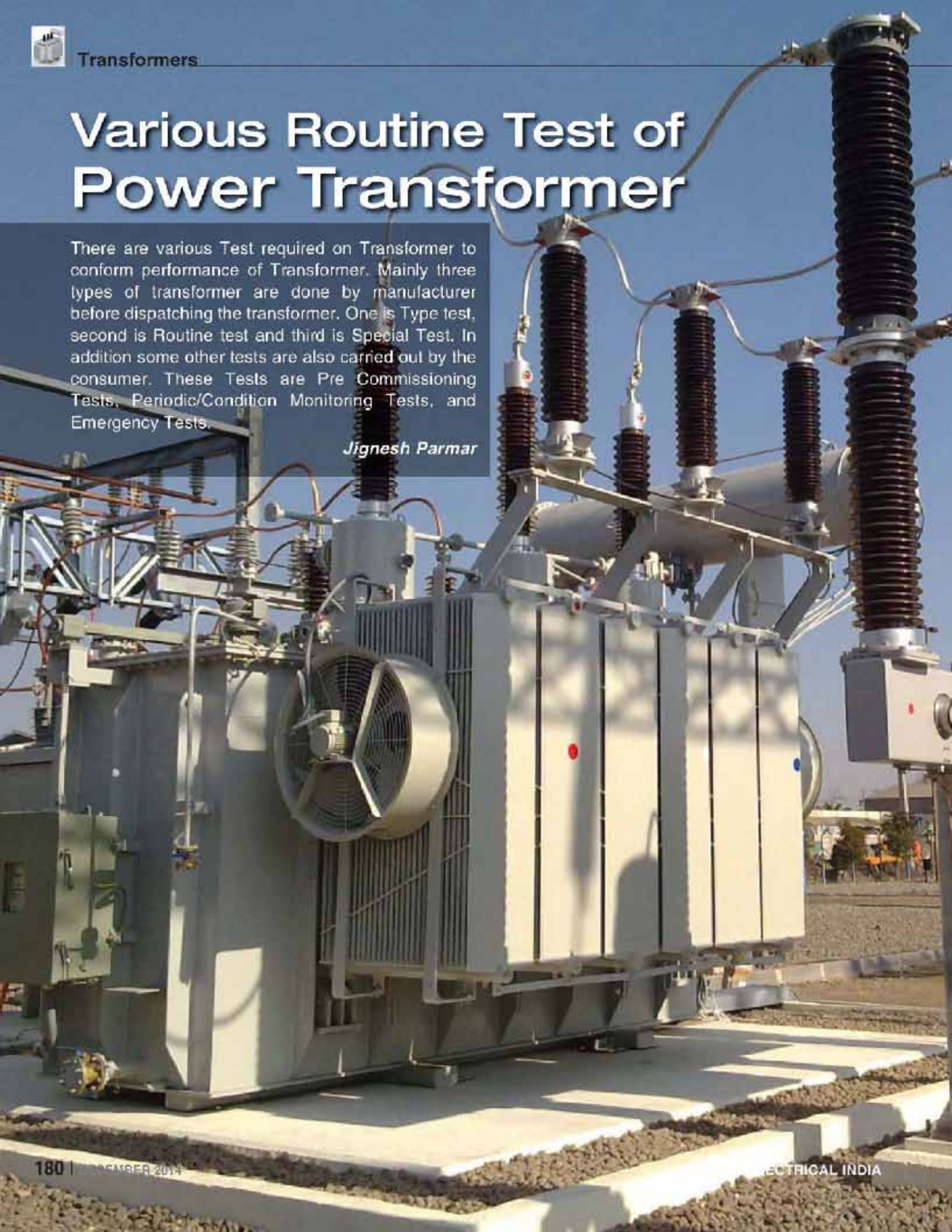
AN ISO 9001: 2000 & ISO 14000 COMPANY

HO & Mfg division: 10/3, DLF Industrial Area, Moti Nagar, New Delhi, India - 110015 • Mfg unit: 296, IMT Manesar, Haryana, India - 122050
Tel: +91-11-41425851/52, 43680100 • Fax: +91-11-25438460 • E-mail: info@re-india.com, reimt@re-india.com

Various Routine Test of Power Transformer

There are various Test required on Transformer to conform performance of Transformer. Mainly three types of transformer are done by manufacturer before dispatching the transformer. One is Type test, second is Routine test and third is Special Test. In addition some other tests are also carried out by the consumer. These Tests are Pre Commissioning Tests, Periodic/Condition Monitoring Tests, and Emergency Tests.

Jignesh Parmar



A Routine test of transformer is mainly for confirming operational performance of individual unit in a production lot. Routine tests are carried out on every unit manufactured. All transformers are subjected to the following Routine tests:

- Insulation resistance Test.
- Winding resistance Test.
- Turns Ration / Voltage ratio Test
- Polarity / Vector group Test.
- No-load losses and current Test.
- Short-circuit impedance and load loss Test.
- Continuity Test.
- Magnetizing Current Test.
- Magnetic Balance Test.
- High Voltage Test.
- Dielectric tests (Separate source AC voltage/ Induced overvoltage/ Lightning impulse tests).
- Test on On-load tap changers, where appropriate.

Type tests

Type tests are tests made on a transformer which is representative of other transformers to demonstrate that they comply with specified requirements not covered by routine tests:

- Temperature rise test (IEC 60076-2).
- Dielectric type tests (IEC 60076-3).

Special tests

Special tests are tests, other than routine or type tests, agreed between manufacturer and purchaser.

- Dielectric special tests.
- Zero-sequence impedance on three-phase transformers.
- Short-circuit test.
- Harmonics on the no-load current.
- Power taken by fan and oil-pump motors.
- Determination of sound levels.
- Determination of capacitances between windings and earth, and between windings.
- Determination of transient voltage transfer between windings.
- Tests intended to be repeated in the field to confirm no damage during shipment, for example Frequency Response Analysis.

Pre commissioning Tests

The Test performed before commissioning the transformer at site is called pre commissioning test of transformer. These tests are done to assess the condition of transformer after installation and compare the test results of all the low voltage tests with the factory test reports. All transformers are subjected to the following Pre commissioning tests:

- IR value of transformer and cables
- Winding Resistance
- Transformer Turns Ratio
- Polarity Test
- Magnetizing Current
- Vector Group
- Magnetic Balance
- Bushing & Winding Tan Delta (HV)
- Protective relay testing
- Transformer oil testing
- Hipot test.

Routine Tests of Transformer

Insulation Resistance Test

Test Purpose

Insulation resistance test of transformer is essential to ensure the healthiness of overall insulation of an electrical power transformer.

Test Instruments

LT System: 500V / 1000V Megger. & MV / HV System: 2500V / 5000V Megger.

Test Procedure

First disconnect all the line and neutral terminals of the transformer. Megger leads to be connected to LV and HV bushing studs to measure Insulation Resistance value in between the LV & HV windings. Megger leads to be connected to HV bushing studs & transformer tank earth point to measure Insulation Resistance IR value in between the HV windings & earth. Megger leads to be connected to LV bushing studs & transformer tank earth point to measure Insulation Resistance IR value in between the LV windings and earth.

NB: It is unnecessary to perform insulation resistance test of transformer per phase wise in three phase transformer. IR values are taken between the windings collectively as because all the windings on HV side are internally connected together to form either star or delta and also all the windings on LV side are internally connected together to form either star or delta. Measurements are to be taken as follows:

Type of Transformer	Testing 1	Testing 2	Testing 3
Auto Transformer	HV-LV to E	HV-LV to E	LV to E
Two Winding Transformer	HV to LV	HV to E	LV to E
Three Winding Transformers	HV to LV	LV to LV	HV to E & LV to E

Oil temperature should be noted at the time of insulation resistance test of transformer. Since the IR value of transformer insulating oil may vary with temperature. IR values to be recorded at intervals of 15 seconds, 1 minute and 10 minutes. With the duration of application of voltage, IR value increases. The increase in IR is an indication of dryness of insulation.

Absorption Coefficient = 1 minute value/ 15 second value.

Polarization Index = 10 minutes value / 1 minute value

Tests can detect: Weakness of Insulation.

DC Resistance or Winding Resistance Test

Test Purpose

Transformer winding resistance is measured. To check any abnormalities like Loose connections, broken strands and High contact resistance in tap changers. To Calculation of the I2R losses in transformer. To Calculation of winding temperature at the end of temperature rise test of transformer.

Test Instrument

The Resistance of HV winding LV winding between their terminals is to be measured with

Precision milliohm meter/ micro ohm meter/ Transformer Ohmmeter / Wheatstone bridge / DC resistance meter.

Method No: 1 (Kelvin Bridge Method for measurement of winding resistance)

Test Procedure

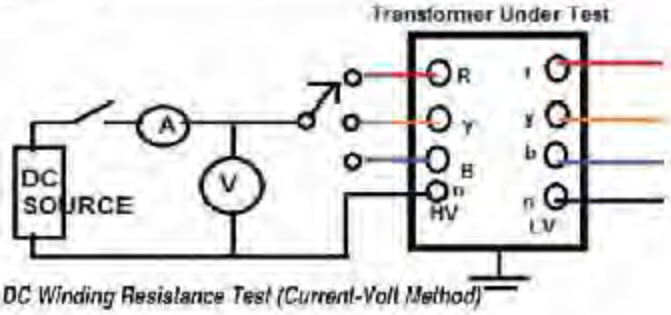
The main principle of bridge method is based on comparing an unknown resistance with a known resistance. When electric currents flowing through the arms of bridge circuit

Kelvin Bridge

become balanced, the reading of galvanometer shows zero deflection that means at balanced condition no electric current will flow through the galvanometer.

Very small value of resistance (in milliohms range) can be accurately measured by Kelvin Bridge method whereas for higher value Wheatstone bridge method of resistance measurement is applied. In bridge method of measurement of winding resistance, the error is minimized. All other steps to be taken during transformer winding resistance measurement in these methods are similar to that of current voltage method of measurement of winding resistance of transformer.

Method No: 2 (current voltage method of measurement of winding resistance)



DC Winding Resistance Test (Current-Volt Method)

Test Procedure

The resistance of each transformer winding is measured using DC current and recorded at a ambient temp. In this test resistance of winding is measurement by applying a small DC voltage to the winding and measuring the current through the same. The measured resistance should be corrected to a common temperature such as 75^{0}C or 85^{0}C using the formula: RC=RM x ((CF+CT)/(CF+WT)) where RC is the corrected resistance, RM is the measured resistance, CF is the correction factor for copper (234.5) or aluminum (225) windings, CT is the corrected temperature (75^{0}C or 85^{0}C)

WT is the winding temperature (^{0}C) at time of test. Before measurement the transformer should be kept in OFF condition at least for 3 to 4 hours so in this time the winding temperature will become equal to its oil temperature. To minimize observation errors, polarity of the core magnetization shall be kept constant during all resistance readings.

Voltmeter leads shall be independent of the current leads to protect it from high voltages which may occur during switching on and off the current circuit. The readings shall be taken after the electric current and voltage have reached steady state values. In some cases this may take several minutes depending upon the winding impedance.

The test current shall not exceed 15% of the rated current of the winding. Large values may cause inaccuracy by heating the winding and thereby changing its resistance. For Calculating resistance, the corresponding temperature of the winding at the time of measurement must be taken along with resistance value.

Required Precaution

According to IEC 60076-1, in order to reduce measurement errors due to changes in temperature, some precautions should be taken before the measurement is made.

For Delta connected Winding: for delta-connected transformer, the resistance should be measured for each phase (i.e. R-Y, Y-B & B-R). Delta is composed of parallel combination of the winding under test and the series combination of the remaining winding. It is therefore recommended to make three measurements for each phase-to-phase winding in order obtain the most accurate results. For Delta connected windings, such tertiary winding of auto-transformers measurement shall be done between pairs of line terminals and resistance per winding shall be calculated as per the formula: Resistance per Winding = 1.5 X Measured Value

For Star connected winding: the neutral brought out, the resistance shall be measured between the line and neutral terminal (i.e. R-N, Y-N, B-N) and average of three sets of reading shall be the tested value. For Star connected auto transformers the resistance of the HV side is measured between HV terminal and IV terminal, then between IV terminal and the neutral.

For Dry type transformers: the transformer shall be at rest in a constant ambient temperature for at least three hours.

For Oil immersed transformers: the transformers should be under oil and without excitation for at least three hours. In case of tapped windings, above readings are recorded at each tap. In addition, it is important to ensure that the average oil temperature (average of the top and bottom oil temperatures) is approximately the same as the winding temperature. Average oil temperature is to be recorded. Measured values are to be corrected to required temperatures. As the measurement current increases, the core will be saturated and inductance will decrease. In this way, the current will reach the saturation value in a shorter time. After the current is applied to the circuit, it should be waited until the current becomes stationary (complete saturation) before taking measurements, otherwise, there will be measurement errors. The values shall be compared with original test an result which varies with the transformer ratings.

Test Acceptance criteria

DC Resistance Should be <=2% Factory Test or

Test Current <10% Rated Current

Test can detect

Short Turns, Loose Connection of bushing, Loose Connection or High Contact Resistance on Tap Changer and Broken winding stands.

Turns Ratio / Voltage Ratio Test

Test Purpose

Turns Ratio Test / Voltage Ratio Test are done in Transformer to find out Open Circuited turns, Short Circuited turns in Transformer winding. The voltage ratio is equal to the turn's ratio in a transformer (V1/V2=N1/N2). Using this principle, the turn's ratio is measured with the help of a turn's ratio meter. If it is correct, then the voltage ratio is assumed to be correct. This test should be made for any new high-voltage power transformer at the time it is being installed. With use of Turns Ratio meter (TTR), turns Ratio between HV & LV windings at various taps to be measured & recorded. The turn's ratio is measure of the RMS voltage applied to the primary terminals to the RMS Voltage measured at the secondary terminals. R = Np / Ns

Where, R=Voltage ratio, Np=Number of turns at primary winding, Ns= Number of turns at secondary Winding. The voltage ratio shall be

Genset Controllers

ComAp

ComAp is a leading manufacturer of generating set controllers delivering innovative solutions for power generation applications in over 100 countries worldwide

- Engine, generator & mains measurements : Oil pressure, temperature, speed, V / I / Hz / kW / kVA / PF / kWh
- Reliable & accurate synchronizing, active & reactive load sharing
- Communication through RS 232 / RS 485, MODBUS, CAN BUS, GSM, CDMA,TCP / IP
- Power management with load dependent-Stop
- Remote Monitoring & Control through Internet
- Analogue / GSM Modem support
- ECU Engine (J1939) Support

Controllers for single Genset applications

Controllers for paralleling applications

Apply to become System Integrator

MADHURA SINCE 1994

Exclusive Distributors of India :

Madhura International

A - 202, ICC Trade Tower, S. B. Road, Pune 411016, India
Tel : 020 - 25632783/8494 E-mail : info@madhura.net
Web : www.madhura.net

---

pla

Millions of Relays in use

LARGEST SELLING RELAY

Pla Power Relays (30 Amp , 40Amp) Available at Unbelievable Prices

Quality, Reliability Unmatched

Application:

- Air Conditioner
- Agriculture panel Submersible
- Pump Panel
- Stabilizer
- UPS
- Invertors

CE

Multiply Contacts with Pla CMR & HDR

We Have expertise to Design & **Manufacture Relays** as per Custromer's odd Requirement

PAC 80/40 | MS-PMC-5-8 | SCR 5/10 | PCC

PMY-2/4 | MCC | PMC | PLE

Our Clients Include:

- NTPC
- NCFL
- PGCIL
- DEFENCE
- RAILWAYS
- L&T
- SIEMENS
- ABB
- JYOTI
- CROMPTON
- GREAVES
- ALSTOM
- SCHNEIDER
- BHEL
- BEL
- L.T.I
- CHEMTROLS

Manufactured By: PLA COMPONENTS

Thakor Estate, Vidyavihar (W), Mumbai - 400 086. | Tel: 022-2510 6104 / 05 | Fax: 022-2509 3811
E-mail: sales@plarelays.com | Website: www.plarelays.com

Dealers Distributors Enquiries Solicited

measured on each tapping in the no-load condition.

Test Instruments

Turns Ratio meter (TTR) to energies the transformer from a low-voltage supply and measure the HV and LV voltages. Wheatstone Bridge Circuit.

Method No 1 Turns Ratio Testing

Test Procedure

Transformer Turns Ratio Meter (TTR)

Transformer ratio test can be done by Transformer Turns Ratio (TTR) Meter. It has in built power supply, with the voltages commonly used being very low, such as 8, 10 V and 50 Hz. The HV and LV windings of one phase of a transformer (i.e. R-Y & r-n) are connected to the instrument, and the internal bridge elements are varied to produce a null indication on the detector.

Values are recorded at each tap in case of tapped windings & then compared to calculated ratio at the same tap.

The ratio meter gives accuracy of 0.1 per cent over a ratio range up to 1110:1. The ratio meter is used in a 'bridge' circuit where the voltages of the windings of the transformer under test are balanced against the voltages developed across the fixed & variable resistors of the ratio meter.

Adjustment of the calibrated variable resistor until zero deflection is obtained on the galvanometer then gives the ratio to unity of the transformer windings from the ratio of the resistors.

Bridge Circuit

A phase voltage is applied to the one of the windings by means of a bridge circuit and the ratio of induced voltage is measured at the bridge. The accuracy of the measuring instrument is < 0.1 %.

This theoretical turn ratio is adjusted on the transformer turn ratio tested or TTR by the adjustable transformer as shown in the figure above and it should be changed until a balance occurs in the percentage error indicator. The reading on this indicator implies the deviation of measured turn ratio from expected turn ratio in percentage.

Theoretical Turns Ratio = HV winding Voltage / LV Winding Voltage

% Deviation = (Measured Turn Ratio - Expected Turns Ration) / Expected Turns Ration

Out-of-tolerance, ratio test of transformer can be due to shorted turns, especially if there is an associated high excitation current. Open turns in HV winding will indicate very low exciting current and no output voltage since open turns in HV winding causes no excitation current in the winding means no flux hence no induced voltage. But open turn in LV winding causes, low fluctuating LV voltage but normal excitation current in HV winding. Hence open turns in LV winding will be indicated by normal levels of exciting current, but very low levels of unstable output voltage. The turn ratio test of transformer also detects high resistance connections in the lead circuitry or high contact resistance in tap changers by higher excitation current and a difficulty in balancing the bridge.

Test Caution

Disconnect all transformer terminals from line or load. Neutrals directly grounded to the grid can remain connected.

Method No 2 Voltage Ratio Testing

This test is done to check both the transformer voltage ratio and tap changer. When "Turns Ratio meter" is not available. Voltage Ratio Test is done at various tap position by applying 3 phases LT (415V) supply on HT side of Power transformer. In order to obtain the required accuracy it is usual to use a ratio meter rather than to energies the transformer from a low-voltage supply and measure the HV and LV voltages. At Various taps applied voltage and Resultant voltages LV side between various Phases and phases and neutral measured with precision voltmeter and noted.

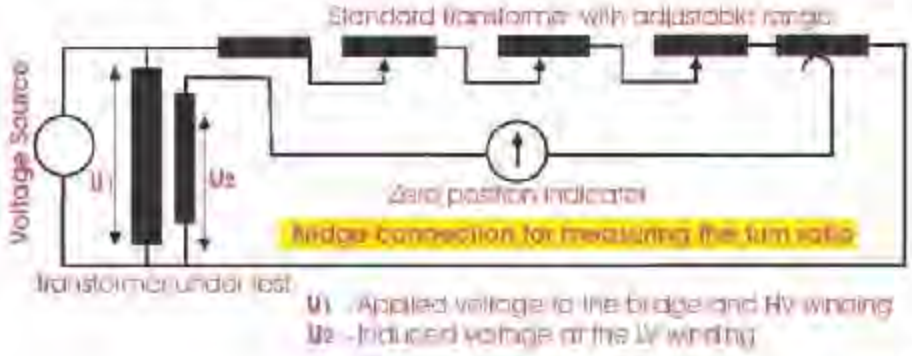
Test Procedure

With 415 V applied on high voltage side measure the voltage between all phases on the low voltage side for every tap position. First, the tap changer of transformer is kept in the lowest position and LV terminals are kept open. Then apply 3-phase 415 V supply on HV terminals. Measure the voltages applied on each phase (Phase-Phase) on HV and induced voltages at LV terminals simultaneously. After measuring the voltages at HV and LV terminals, the tap changer of transformer should be raised by one position and repeat test. Repeat the same for each of the tap position separately. At other taps values will be as per the percentage raise or lower at the respective tap positions. In case of Delta/Star transformers the ratio measure between RY-rn, YB-yn and BR-bn.

Being Delta/Star transformers the voltage ratio between HV winding and LV winding in each phase limb at normal tap is 33 KV OR 33x 3 – 5.196 ,11 KV / 3 11. At higher taps (i.e high voltage steps) less number of turns is in circuit than normal. Hence ratio values increase by a value equal to.5.196 + {5.196 x (no. of steps above normal) x (% rise per each tap)} 100. Similarly for lower taps than normal the ratio is equal to 5.196 - {5.196 x (no. of steps above normal) x (% rise per each tap)}100

Test Acceptance Criteria

Range of measured ratio shall be equal to the calculated ratio ±0.5%. Phase displacement is identical to approved arrangement and transformer's nameplate. The IEEE standard (IEEE Standard 62) states that when rated voltage is applied to one winding of the transformer, all other rated voltages at no load shall be correct within one half of one percent of the nameplate readings. It also states that all tap voltages shall be correct to the nearest turn if the volts per turn exceed one half of one percent desired voltage. The ratio test verifies that these conditions are met. The IEC600/6-1 standard defines the permissible deviation of



the actual to declared ratio. Principal tapping for a specified first winding pair: the lesser ±0.5% of the declared voltage ratio or 0.1 times the actual short circuit impedance. Other taps on the first winding pair and other winding pair must be agreed upon, and must be lower than the smaller of the two values stated above. Measurements are typically made by applying a known low voltage across the high voltage winding so that the induced voltage on the secondary is lower, thereby reducing hazards while performing the test. For three phase delta/wye or wyes/delta transformer, a three phase equivalency test is performed, i.e. the test is performed across corresponding single winding.

Test can detect

Shorted turns or open circuits in the windings, incorrect winding connections, and other internal faults or defects in tap changer.

Polarity / Vector group Test

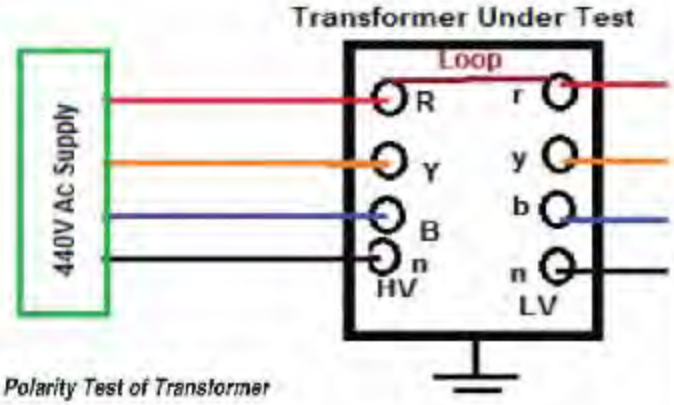
Purpose of Test

The vector group of transformer is an essential property for successful parallel operation of transformers. Hence every electrical power transformer must undergo through vector group test of transformer at factory site for ensuring the customer specified vector group of transformer.

Test Instruments

Ratio meter, Volt Meter. A Ratio meter may not always be available and this is usually the case on site so that the polarity may be checked by voltmeter.

Test Circuit Diagram



Polarity Test of Transformer

Test Procedure

The primary and secondary windings are connected together at one point. Connect neutral point of star connected winding with earth. Low-voltage three-phase supply (415 V) is then applied to the HV terminals. Voltage measurements are then taken between various pairs of terminals as indicated in the diagram and the readings obtained should be the phasor sum of the separate voltages of each winding under consideration.

Condition: (HV side R-Y-B-N and LV Side r-y-b-n). R and r should be shorted. Apply 415 Volt to R-Y-B. Measure Voltage between Following Phase and Satisfy Following Condition.

Short Circuit Test

Test Purpose

The value of the short circuit impedance Z% and the load (cooper)

Vector Group	Satisfied Following Condition
Dyn1	Rb=Rn+Bn
	Bb=By
	Yy<Yb
Dyn11	Ry=Rn+Yn
	Yb=Yy
	Bb<By
Ynd1	RN=Ry+Yn
	By=Yy
	Yy<Yb
Ynyn0	Bb=Yy
	Bn=Yn
	RN=Rn+Nn

losses (I2R) are obtained. This test should be performed before the impulse test-if the later will be performed as a routine test- in order to avoid readings errors.

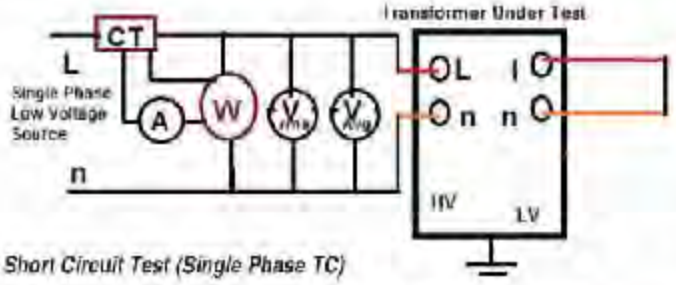
Test Instrument

Megger, Multi meter, CT, PT

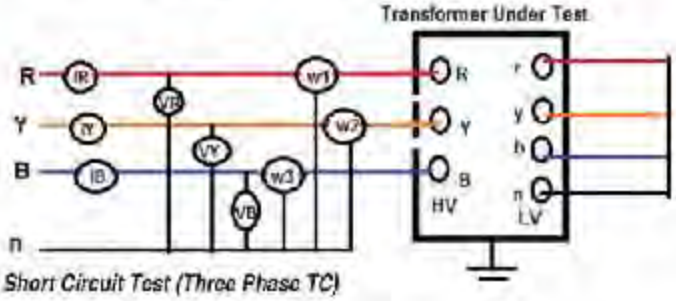
Test Procedure

Suitable Low Voltage (3-phase 415V, 50Hz) will be applied to the terminals of one winding (usually the H.V.) with the other winding short circuited with 50 sq. mm. Copper cable. (Usually the L.V.) The applied voltage is adjusted to pass the needed current in the primary/secondary. In order to simulate conditions nearest to full load, it is customary to pass 100%, 50% or at least 25% of full load current.

Voltage to be increased gradually till the current in the energized winding reaches the required value (50% to 100% rated current). Measure the 3 Phase line currents at all tap position. If the tap-switch is an Off-Circuit tap-switch, the supply has to be disconnected before changing the tap.



Short Circuit Test (Single Phase TC)



Short Circuit Test (Three Phase TC)

A consistent trend in the increase or decrease of current, as the case may be, confirms the healthiness of the transformer. If transformer is equipped with a tap changer, tapping regulations are applied.

- If tapping range within ±5% and rated power less than 2500kAV, load loss guarantee refer to the principal tap only.
- If tapping range exceeds ±5% or rated power above 2500kAV, it shall be stated for which tapping beside the principal tap the load losses will be guaranteed by the manufacturer.

Three phase LT supply is applied on HV side of power transformer at normal tap with rated current on HV side and currents measured in all the phases on HV side and phases & neutral on LV side values noted. Readings to be taken as quickly as possible as the windings warm up and the winding resistance increases. Hence, the losses value will increase accordingly. Using appropriate instruments (conventional three wattmeter method or digital wattmeter with ammeters & voltmeters) measurements of voltage, currents and power can be recorded.

Short Circuit Test (Without using CT, PT)

To avoid CT's and PT's, this method can be used at current levels of 2 to 5 A and measurement of load losses is done at this condition. This measured load loss is then extrapolated to actual load currents to obtain load losses at the operating current.

Example: 11 kV/433 V, 1000 kVA transformer with 5% Impedance, the voltage to be applied on H.V. side during load test is estimated below.

HV side full load current (I1) = (KVAx1000/1.732xLine Voltage)

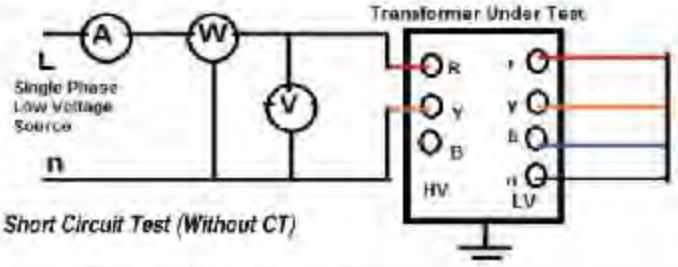
HV side full load current (I1) = (1000x1000/1.732x11000)=52.5 Amp

Line to line voltage to be applied on H.V side for getting 5 A on HV side,

Line to line voltage to be applied on H.V side Visc = (Line Voltage x 1000 x Z x 5/0.866 x I1 x100)

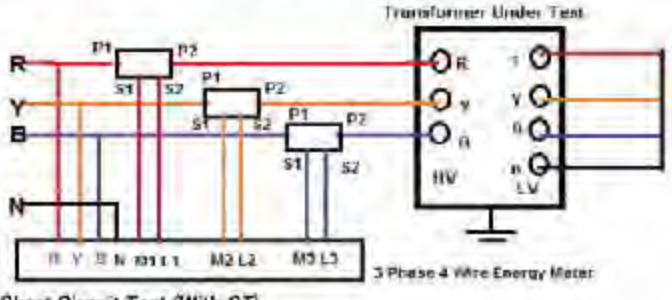
Line to line voltage to be applied on H.V side Visc = (11 x 1000 x 5 x x x 0.866 x 52.5 x 100) = 60.5 volts.

Since the current drawn on H.V side is only about 5A in this test, CT's can be avoided and hence phase angle error is not applicable.



Short Circuit Test (Without CT)

Short Circuit Test (With using CT, PT)



Short Circuit Test (With CT)

Acceptance Criteria

Measured impedance to be within guaranteed value and nameplate value. Load losses to be within guaranteed values.

Test can detect

Winding deformation. Deviation in name plate value.

Open Circuit / No Load Test

Test Purpose

In this test, the value of No-Load power (Po) & the No-Load current (Io) are measured at rated voltage & frequency.

Test Instruments

Watt meters, Ammeter, Voltmeter or Power analyser

Test Procedure

Test is performed at rated frequency. Three phase LT Voltage of 415V applied on HV side of Power transformer keeping LT open. Two voltmeters are connected to the energized winding, one is measuring the voltage mean value and the other is for the Voltage R.M.S value. Voltage applied to winding (usually to H.V. windings), it will be in a range from 90% of winding rated voltage to 110% of the same in steps, each of 5% (i.e. for a 33/11kV transformer, applied voltage values will be 29.7kV, 31.35kV, 36.3kV).

Readings of watt meters, Voltmeters & Ammeters are recorded to obtain the values of V (r.m.s), Vmean, Po and Io at each voltage step. Test results are considered satisfactory if the readings of the two are equal within 3%. If it's more than 3%, the validity of the test is subjected to agreement. Measured value of power loss is corrected according to the following formula: Pc = Pm (1+d) and D = (Vmean - Vr.m.s) / Vmean

Measure the loss in all the three phases with the help of 3 watt meter method. Total no load loss or iron loss of the trf = W1 + W2 + W3

Test Caution

This test should be performed before the impulse test-if the later will be performed as a routine test- in order to avoid readings errors.

Acceptance Criteria

No Load losses to be within guaranteed values.

Continuity test

Purpose of Test

To know the continuity of windings of the transformer

Test Instruments

Megger or Multi meter

Test Procedure

Check Continuity of Transformer by using multi meter or by Megger between following Terminals.

Transformer	P-P	P-P	P-P	Result
HV Side	R-Y	Y-B	B-R	Zero Mega ohm or continuity
LV Side	r-y	y-b	b-r	Zero Mega ohm or continuity

Test can detect

Open circuit / loose connection of winding.

Magnetic Current Test

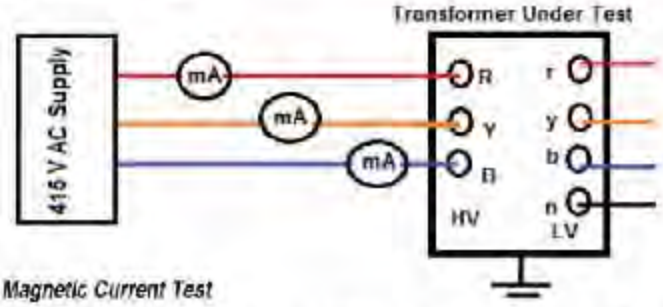
Test Purpose

Magnetizing current test of transformer locates the defects in the magnetic core structure, shifting of windings, failure in turn to turn insulation or problem in tap changers. These conditions change the effective reluctance of the magnetic circuit, thus affecting the electric current required to establish flux in the core.

Test Instrument

Multi meter or Mill Ammeter.

Test Circuit Diagram



Magnetic Current Test

Three phases LT Voltage of 415 V applied on HV side of Power transformer and currents are to be measured with mill ammeter. The value shall be = (1 to 2 percent of rated full load current of TC / HT KV) X Voltage Applied

Test Procedure

First of all keep the tap changer in the lowest position and open all IV & LV terminals. Then apply three phase 415V supply on the line terminals for three phase transformers and single phase 230V supply on single phase transformers. Measure the supply voltage and electric current in each phase. Now repeat the magnetizing current test of transformer test with keeping tap changer in normal position and repeat the test with keeping the tap at highest position.

Generally there are two similar higher readings on two outer limb phases on transformer core and one lower reading on the centre limb phase, in case of three phase transformers. An agreement to within 30 % of the measured exciting current with the previous test is usually considered satisfactory. If the measured exciting current value is 50 times higher than the value measured during factory test, there is likelihood of a fault in the winding which needs further analysis.

Test Caution

This magnetizing current test of transformer is to be carried out before DC resistance measurement.

Magnetic Balance Test

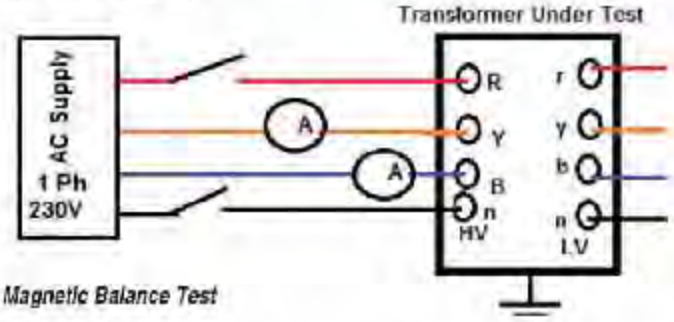
Test Purpose

Magnetic balance test of transformer is conducted only on three phase transformers to check the imbalance in the magnetic circuit.

Test Instrument

Multi meter or Mill Ammeter.

Test Circuit Diagram



Magnetic Balance Test

Test Procedure

First keep the tap changer of transformer in normal position. Now disconnect the transformer neutral from ground. Then apply single phase 230V AC supply across one of the HV winding terminals and neutral terminal. Measure the voltage in two other HV terminals in respect of neutral terminal. Repeat the test for each of the three phases. In case of auto transformer, magnetic balance test of transformer should be repeated for IV winding also. There are three limbs side by side in a core of transformer. One phase winding is wound in one limb. The voltage induced in different phases depends upon the respective position of the limb in the core.

The voltage induced in different phases of transformer in respect to neutral terminals given in the table below. 415V, Two phase supply is to be applied to any two phases terminals on HV side of Power transformer and voltages in other two phase combination are to be measured with LT open. Sum of the Resultant two values shall be equal to the voltage applied.

Applied Voltage (415V)	Measured Voltage (V1)	Measured Voltage (V2)	Result
RY	YB	BR	V=V1+V2
YB	RY	BR	V=V1+V2
BR	YB	RY	V=V1+V2

High Voltage tests on HV & LV Winding

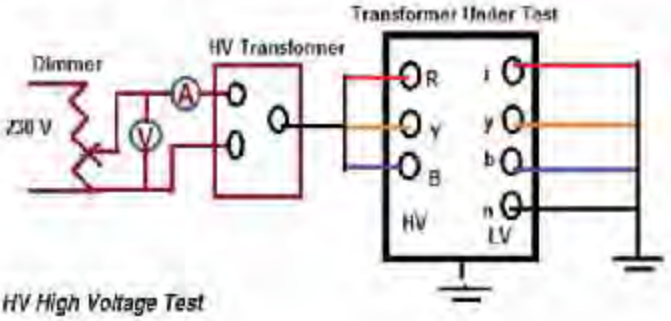
Purpose

To checks the insulation property between Primary to earth, Secondary to earth and between Primary & Secondary.

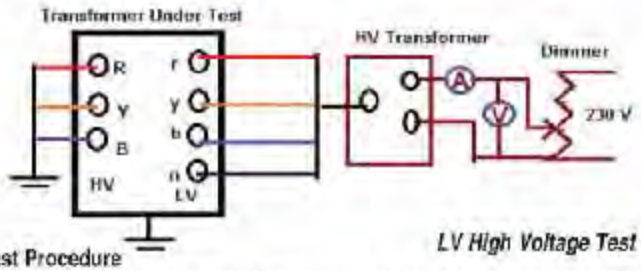
Test Instrument

High Voltage tester (100KV & 3KV)

Test Circuit Diagram



HV High Voltage Test



LV High Voltage Test

Test Procedure

HV high voltage test: LV winding connected together and earthed. HV winding connected together & given Following HV Supply for 1 minute.

LV high Voltage test: HV winding connected together and earthed. LV winding connected together and given Following HV Supply for 1 minute.

433V Winding – 3KV High Voltage
11KV Winding = 28KV High Voltage
22KV Winding = 50KV High Voltage
33KV Winding – 70KV High Voltage.

Dielectrical Test

Test Purpose

To check the ability of main insulation to earth and between winding

To checks the insulation property between Primary to earth, Secondary to earth and between Primary & Secondary

Test Instruments

3 Phase Variable Voltage, Frequency Source & Auto Transformer.

Test Procedure

The following Dielectric tests are performed in order to meet the transformer insulation strength expectations.

Switching impulse test: to confirm the insulation of the transformer terminals and windings to the earthed parts and other windings, and to confirm the insulation strength in the windings and through the windings.

Lightning impulse test: to confirm the transformer insulation strength in case of a lightning hitting the connection terminals

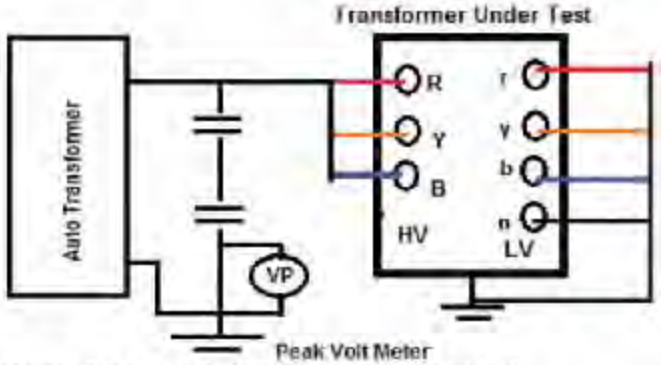
Separate source AC withstand voltage test: to confirm the insulation strength of the transformer line and neutral connection terminals and the connected windings to the earthed parts and other windings.

Induced AC voltage test: (short duration ACSD and long duration ACLD): to confirm the insulation strength of the transformer connection terminals and the connected windings to the earthed parts and other windings, both between the phases and through the winding.

Partial discharge measurement: to confirm the "partial discharge below a determined level" property of the transformer insulation structure under operating conditions.

Method No 1 (separate source voltage withstand test)

All the terminals of the winding under test should be connected together and the voltage should be applied. The secondary windings of bushing type current transformers should be connected together and earthed. The current should be stable during test and no surges should occur. A single phase power frequency voltage of shape approximately sinusoidal is applied for 60 seconds to the terminals of the winding under test. The test shall be performed on all the windings one by one. The test is successful if no breakdown in the dielectric of the insulation occurs during test. During the Separate source AC withstand voltage test, the

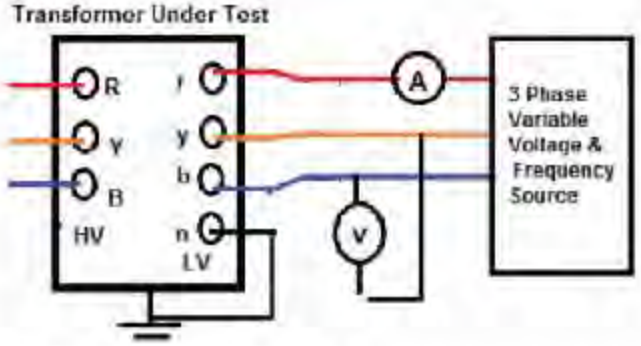


Dielectric Test (Seperate Voltage Source withstand Test)

frequency of the test voltage should be equal to the transformer's rated frequency or should be not less than 80% of this frequency. In this way, 60 Hz transformers can also be tested at 50 Hz. The shape of the voltage should be single phase and sinusoidal as far as possible. This test is applied to the star point (neutral point) of uniform insulated windings and gradual (non-uniform) insulation windings. Every point of the winding which test voltage has been applied is accepted to be tested with this voltage. The test voltage is measured with the help of a voltage divider. The test voltage should be read from voltmeter as peak value divided by 2. Test period is 1 minute.

Method No 2 (Induced source voltage withstand test)

The aim of this test is to check the insulation both between phases and between turns of the windings and also the insulation between the input terminals of the graded insulation windings and earth.



Dielectric Test (Induced Voltage Test)

During test, normally the test voltage is applied to the low voltage winding. Meanwhile HV windings should be keeping open and earthed from a common point. Since the test voltage will be much higher than the transformer's rated voltage, the test frequency should not be less than twice the rated frequency value, in order to avoid oversaturation of the transformer core. The test shall start with a voltage lower than 1/3 the full test voltage and it shall be quickly increased up to desired value. The test voltage can either be measured on a voltage divider connected to the HV terminal or on a voltage transformer and voltmeter which have been set together with this voltage divider at the LV side. Another method is to measure the test voltage with a peak-value measuring instrument at the measuring-tap end of the capacitor type bushing (if any). Test period which should not be less than 15 seconds. It is calculated according, Test period = 120 seconds x (Rated frequency / Test frequency). The duration of the test shall be 60 second. The test is accepted to be successful if no surges, voltage collapses or extreme increases in the current have occurred.

Acceptance Criteria

The test is successful if no break down occurs at full test voltage during test.

Method No 3 Lighting Impulse Test

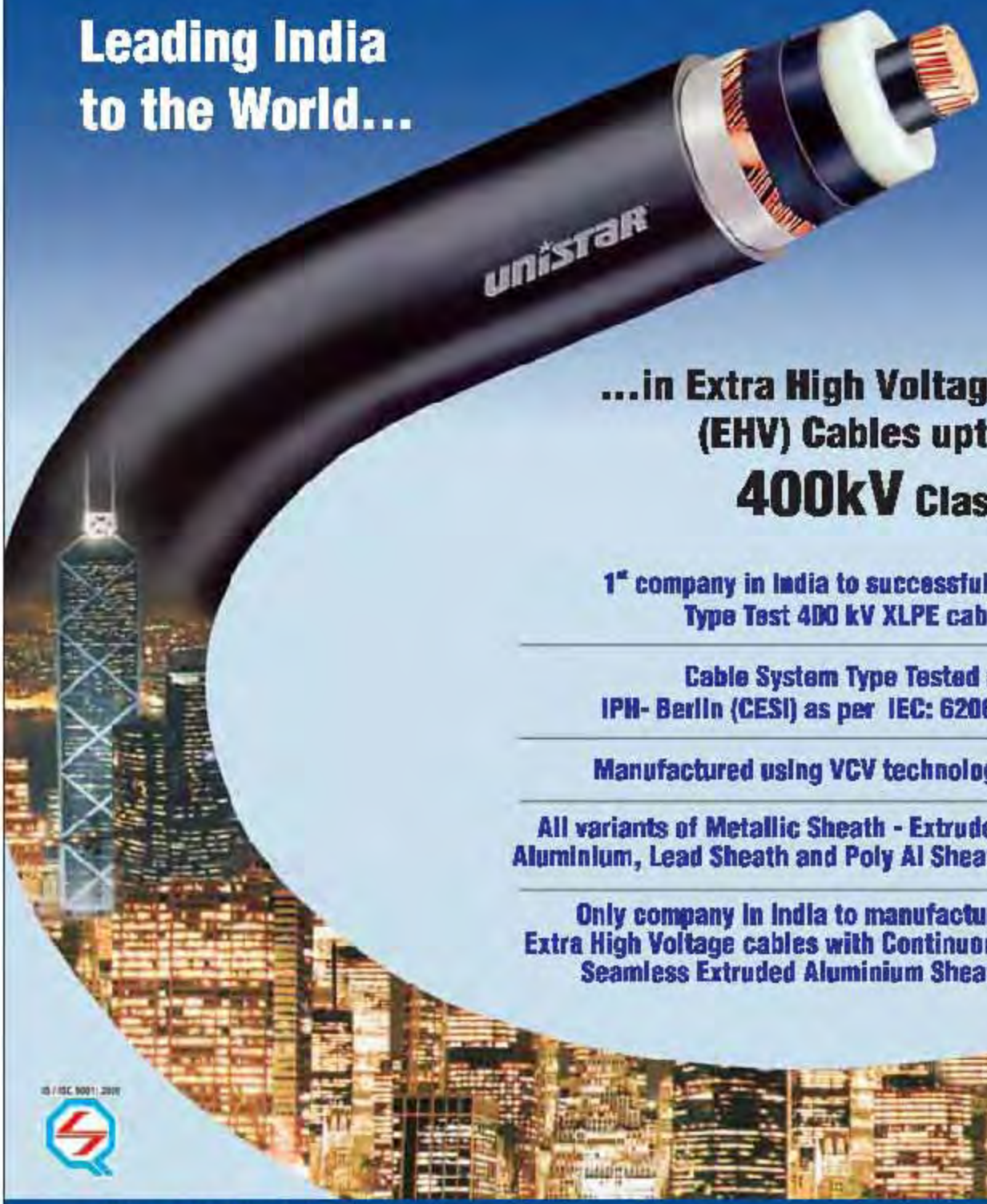
All the dielectric tests check the insulation level of the Transformer. Impulse generator is used to produce the specified voltage impulse wave of 1.2/50 micro seconds wave. One impulse of a reduced voltage between 50 to 75% of the full test voltage and subsequent three impulses at full voltage. For a three phase transformer, impulse is carried out on all three phases in succession. The voltage is applied on each of the line terminal in succession, keeping the other terminals earthed. The current and voltage wave shapes are recorded on the oscilloscope & any distortion in the wave shape is the criteria for failure.

Jignesh Parmar

Is a Electrical Engineer having more than 11 years experience in Power Transmission, Power Distribution (T&D Loss control, Electrical energy theft detection), electrical Maintenance, Electrical Projects. He is also freelancer programmer of advance Excel, Design unique Excel base Electrical programs as per NEC, IEEE code. He is also Technical Blogger and contribute Technical papers to various national & international site.

UNISTAR®

Leading India to the World...



...in Extra High Voltage (EHV) Cables upto 400kV Class

1st company in India to successfully Type Test 400 kV XLPE cable

Cable System Type Tested at IPH- Berlin (CESI) as per IEC: 62067

Manufactured using VCV technology

All variants of Metallic Sheath - Extruded Aluminium, Lead Sheath and Poly Al Sheath

Only company in India to manufacture Extra High Voltage cables with Continuous Seamless Extruded Aluminium Sheath

AMA/UC/059

IS / ISO 9001:2008

Universal Cables Limited
Regd. Office & Works:
P. O. Birla Vikas, Satna – 485 005 (M.P.)
Tel.: (07672) 257121-27, 414000
Fax: (07672) 257129
E-mail: sales@unistar.co.in

DIVISIONAL OFFICES
Mumbai – (022) 44422200 • Fax: 22027854
Allahabad – (0532) 2429646 • Fax: 2423192
Bangalore – (080) 23612484 • Fax: 23619981
Baroda – (0265) 2791784 • Fax: 2793128
Chennai – (044) 28746823-24 • Fax: 28746825
Kolkata – (033) 22805043-44 • Fax: 22805048
New Delhi – (011) 23714851-54, 23710157 • Fax: 23711561
Hyderabad – (040) 23550183 / 23608218 • Fax: 23553272
Goa – (0832) 2782829 / 2782613 • Fax: 2782614

www.unistar.co.in

Let there be light for everyone

Individuals can greatly contribute to make India a power-surplus country

Do only the Governments and the electricity generation agencies have the onus to light up every house in this country? Not necessarily; it's everyone's pursuit indeed. While the power companies, electricity authorities and the governments are making all their efforts for providing uninterrupted power supply, every consumer of power can greatly contribute to make India a power-surplus country.

J Devaprakash

Next to food and shelter, electricity is one of the most sought-after things. It has an intricate blending with the human life, and every one of us requires it. Those who already have access to electricity want it more, and those who don't, long for it. Even the people who oppose electricity generation based on some ideology or belief need electricity anyway to bring their standpoints to light.

But how many of us do really get electricity in this country with a population of more than 1.25 billions? Not all, certainly. According to the Planning Commission, nearly half of the Indians have no access to electricity. And most of those who are connected to the grid don't get electricity uninterruptedly.

The recent update of Energy Statistics of India claims that the country has a total installed capacity of 2,66,644 MW (as of March 2014) of electricity generation, putting together all sources of power generation like thermal, nuclear, hydro and renewable. A huge capacity, surely! As a matter of fact, the BP Statistical Review of World Energy-2014 ranked India as the third-largest power-generation country after China and United States in the year 2013. But still, it wasn't just enough to light up the country entirely. No doubt that the generation of electricity has been on the increase year after year-about 9,63,722 gigawatt-hours (GWh) was generated in the year 2013, which was more than 50% higher than what was generated in 2006. But the demand of electricity has been rising at a jet speed, too, & so is the population. As a consequence, the gap between the demand & supply of electricity continues to remain wide.

How to bridge this gap?

Do only the Governments and the electricity generation agencies have the onus to light up every house in this country? Not necessarily; it's everyone's pursuit indeed. While the power companies, electricity authorities and the governments are making all their efforts for providing uninterrupted power supply, every consumer of power can greatly contribute to make India a power-surplus country. Before we know how can we help, let us first understand the scenario of power generation in our country.

Coal on the lead

India depends on thermal power to a great extent and coal remains the primary source of energy for many decades. About 67% of country's total power generation is through fossil thermal resources, largely from coal. Although coal power plants are base-load stations that can supply electricity 24x7, they have two issues. First, India has already begun importing coal from foreign countries, as the domestic coal reserves are not enough to feed the 400 and above coal power units. Therefore, further expansion of coal-based power plants is formidable. Second, release of greenhouse gases like carbon dioxide, nitrous oxide and sulphur dioxide is the worrisome concern as these gases are harmful to the environment. It is, in fact, a global concern. Hence, countries across the world are in the process of experimenting with advanced coal technologies to cut down the pollutants. The green coal technology, as it is called, that aims to use fairly clean coal, assures significantly less emission of greenhouse gases. This eventually will help to mitigate the environmental impact to some extent. With this, coal can still remain as strategic fuel. India has stepped in this era of green coal technology, too.

Next to thermal, hydro is the second major source of electricity in the country that has an installed capacity of 40,195 MW. In the year 2013-14 about 134 billion units of electricity were generated through hydel energy. According to the National Hydro Power Corporation, only about 20% of the total aggregate potential has been exploited yet. Once all the planned and yet-to-be-planned projects, including small to micro hydro schemes become functional, it says, it can double the present hydel capacity.

Wind and solar significantly add to the nation's total power production. They aren't base-load stations that can produce electricity persistently, yet they come in handy when the wind blows much and the sun shines a lot. The February 2014 report of Central Electricity Authority of India says the all India capacity of renewable energy sources is 29,462 MW. This is only about 12% of the potential of renewable energy sources in the country. The rest of it needs to be explored. Above all, in the wake of global warming, the renewable is said to be the best alternate source of power generation that doesn't affect the environment.

Nuclear to play a greater role

Nuclear power has two great strengths. Like renewable nuclear energy is friendly to environment and like thermal plants, nuclear power plants can generate electricity reliably. With 4780 MW of installed capacity presently nuclear contributes only about 3% of country's total power generation. But it has a tremendous potential that is yet to be tapped. Once the country deploys, on commercial scale, the third stage of the nuclear power programme – which was devised by Dr. Homi J. Bhabha many

decades ago – India need not look around for how to quench its ever-growing energy thirst. Upon implementation, nuclear can generate up to 1,55,000 GWe-year of electricity. Currently, research is in full swing for the implementation of the 3rd stage of the programme, which will utilise the abundant thorium found in our country (about 30% of world thorium reserves are in India). Meanwhile, the country has already mastered the first stage of the programme that uses natural uranium as fuel, while the second stage is close to achievement.

A balanced energy mix

As the country continues to depend highly on thermal sources, other mainstream sources like nuclear and alternate ones like renewable are being stepped up to have a balanced mix of power generation. In fact, all viable sources of electricity generation are being explored. At the same time, environment concern is at the top of all and technologies that are benign to environment are in preference.

While several new strategies are crafted and many initiatives are being implemented by those who are responsible for power production, as end users we can surely take part in the mission to make India 'power-full'.

Energy saved is produced

According to the proceedings of an energy-conference held early this year, wastage of electricity contributes at least 10 % to the power crisis. It says, if two things in this country, distribution loss and wastage, are curtailed, then there will definitely be more electricity for the end users.

Conservation of energy is the need of the hour. There is a simple mantra "energy saved is produced," which all of us know. This shouldn't be just a slogan hanging on the walls of office corridors, but has to be publicized exponentially. Every one of us in this country needs to be aware of the importance of saving energy. It should be taught in schools, told among public and promoted in media.

So how do we save electricity and how difficult it is? We need not turn over the mountain, neither are some special skills required. Saving electricity is as simple as using of it. There are several ways to save energy and you can have your own plan to do that. Nonetheless, some popular ideas that really help to conserve energy are presented here.

Light up consciously

Every time you switch on that power, think whether it is really required. There are countless houses and offices with lights switched on during the bright day. For many to press a switch is much easier than to open a window or to raise a curtain. Some of us may not mind to pay for these extra units of electricity that we waste, but it is not a question of money. It is rather a question of access. By using less, we give a chance to other countrymen to access electricity.

Switch off electronic items when you don't need

TVs should be kept on only when you really watch, computers should be running only when you really work, and music systems should be unplugged when you have stopped listening.

Unplug when not in use

The chargers for your laptops, cell phones and digital cameras draw power the moment you plug in. When the gadgets are not charged or used, unplug the charger from the wall plug to avoid wastage.

Switch to power-saving bulbs

The energy-saving compact fluorescent light, or CFL, uses only one-fourth of electric power that an incandescent bulb uses, while giving the same amount of light. And the light-emitting diodes (LED) are much better: they are at least doubly efficient than the CFLs. About 20% of the total electricity usage across the world goes for lighting, and the optimal use of LED can bring down this to 4%, according to the president of the Institute of Physics, Dr Frances Saunders. Further, the Nobel committee that conferred this year's Nobel Prize for Physics to the scientists who invented blue-light-emitting diodes said that the LED lamp holds great promise for increasing the quality of life for over 1.5 billion people around the world who lack access to electricity grid.

Electricity has silently made entry into the list of the basic needs of human. It has indeed moved to a prominent place in the needs-list and become the propelling force of development. Although it is everyone's right to have electricity, many of us still live with no access to it. The sensible use of electricity by those who already have it can really help to illuminate at least some dark homes in this country. Drop makes ocean; even the smallest effort to conserve energy will make a huge impact. And if the conservation happens sincerely and persistently at every nook and cranny of this country, India can soon be a power-surplus country. Let there be light for everyone.

J Devaprakash is Manager, Corporate Communication at Nuclear Power Corporation of India Limited, Mumbai. He writes about energy and nature.

Profile

Digital Factory: networked manufacturing from product development to production

Digital Factory | HANNOVER MESSE

The overarching integration of industrial processes is entering the next round: Exhibitors at the Digital Factory trade fair - to be staged under the umbrella of HANNOVER MESSE 2015 next April - will demonstrate what industry needs for this next evolutionary phase, how product development and manufacturing processes will be coordinated in the future, and what the integration of information technology and automation can look like in action. The lead theme of the world's most important trade fair for industrial technology is "Integrated Industry – Join the Network!", and it is in this spirit that the hot topic of Industry 4.0 will be addressed. "Since its premiere in 2003, Digital Factory has successfully established itself as the world's leading trade fair for integrated processes and IT manufacturing solutions, covering everything from product development on up to actual manufacturing. It thus provides very fertile soil for the technology needed for Industry 4.0," said Oliver Frese, Deutsche Messe's Senior Vice President in charge of Hannover Messe.

Modular Connector System for process automization in rough handling conditions

A major concern in applications where harsh environmental and rough handling conditions are present is the exposure to external forces, vibrations and shocks that damage contacts used for power, data and signal transmission. In industries such as machinery, oil & gas, and power generation, there is certainly a need for more robust and reliable connectors to ensure servicing and maintenance is reduced to the minimum, saving long term costs and time.

Multi-Contact's modular connector line CombiTac allows individual combination of different contact types in one compact connector, combining power and signal, thermo-couple, coaxial, fiber optics, fluid and compressed air connectors in a single frame or housing according to your needs.

In applications where heavy slide-in motor control center modules are regularly inserted and removed from switchboards, there is a high risk of damaging contacts because of excessive forces and connection misalignment. In addition, low quality individual contacts are not designed to withstand such rough handling. In such cases, and due to the float mounting feature of CombiTac, damage to contacts and connection misalignment is easily avoided.

Because of the robust design and MC MULTILAM Technology used, the CombiTac contacts are characterized by their low contact resistance, ability to achieve high mating cycles, high resistance to vibrations and shocks, which essentially proves CombiTac as the most reliable modular connector of its kind for harsh environment and rough handling conditions.

Features

up to 300 A
up to 5 kV
up to 100'000 mating cycles
up to 15 bar
float mounting
various sizes (upto 6) for panel mounting or DIN housing up to IP68
Complete solution with cable assembly on request.

Possible connections

Electric
Signal
Thermocouple pressure contacts
Coaxial
Optical fibre
Compressed air
Liquid
Electric + PE
Data transfer.

Fully assembled CombiTac connector with connecting cables: On request.

DIN surface and pedestal mount housing: 6 different sizes.

CombiTac finds application in almost all spheres of industrial equipment, Test benches, Electric cars, railways, medical equipment, power supply, robotics, automatic production machines and many more. Some of the examples are:

CombiTac for Electric cars

The future is of electric vehicles and the various options of power supply are rechargeable batteries, super capacitors or renewable sources but the reliability is ensured if this power supply is efficiently transferred to the motor and other electric systems of the vehicle. Again CombiTac meets the stringent conditions of a moving vehicle

CombiTac for Motor Test station

This CombiTac gives accurate test results and works well under the motor testing lab conditions of vibrations, oil, water etc. The key is that the CT housing holds better as compared to other popular brands.

CombiTac for slide-in systems

CombiTac modules are perfectly suited for the use on rolling stock. The modular connector system CombiTac allows customized combinations of different contact types for countless applications. The rackable connectors are particularly interesting for slide-in systems: misalignments are compensated, so that the modules can be mounted without looking, e.g. in hidden and confined spaces.

CombiTac for high power laser

When it comes to reliability of the supply and control of special and stringent applications such as high power lasers then the best available option is with the CombiTac modules.

CombiTac for Three Phase Power supply

This CombiTac module ensures efficient power transfer in the panel with minimal power losses and heat generations thanks to the MULTILAM Technology apart from offering high mating cycles.

CombiTac for Fluid, Gas or Pneumatic supply

This CombiTac module was installed in a pharmaceutical industry machine for the simultaneously filling of pipettes with different liquids, nutrients solutions and drug mixtures and coolants. It successfully met the applications needs as it is able to take upto 15 bar of pressure.

CombiTac for Medical Equipment

This CombiTac module is for connections to mobile trolleys in operation rooms. This solution made the use of trolleys highly efficient and modular.

CombiTac for PCB Testing

This CombiTac module in installed in a plug-in system. This is used for testing of printed circuit boards in a climatic cabinet for various parameters.

The user was overwhelmed with the accuracy of the results and time saving in connection/disconnection per test.

These are just a few applications on which CombiTac greatly enhanced the performance of the system. The CombiTac can be customized with various contacts so as to meet the requirements of any application.

There is an online configurator available on the website. Here you can configure your requirements with some simple clicks of the mouse. After you are done with your choice of contacts you can preview how the configuration looks, what are the dimensional details so as to plan and make cut-outs on the panels etc. If required we can also be supplied with the real 3D STEP files from the configured CombiTac, thereby giving you the possibility to experience the fitment in your application under design. As an example:

The possibility of creating a connector solution is manifold meeting all your application needs and the performance you expect. This modular connector solution not only enhances the performance of your system but also simplifies the cablings and connectivity between the required connections.

This modular connector system fits into applications of process automation, test benches, railways, automobiles, pharmaceuticals, aerospace, defense, navy and many others.

For further details:

India@multi-contact.com

Automation in Indian Power Sector

In today's world nothing runs without power and a reliable supply of electrical power on demand is the task of automation. Keeping in mind the requirements of their consumer base the power sector is looking for a system that should be reliable, energy efficient and an integrated solution. The power generation industry in India is currently undergoing critical changes- vast unconventional gas stores, evolving environmental regulations and escalating energy demand have led to increased investment in power plants. The Indian markets are slowly beginning to feel the stimulus for instrumentation, control and automation techniques thus ensuring that the process industry has the right mix of technologies that can beget growth opportunities, which the industry has been eyeing and seeking for a long time now. Choosing the right automation combinations provides us the facility to integrate the Power generation and transmission processes with business systems. Keeping in mind the requirements of the power sector we are of the view that the need of the hour in power generation sector is smart grids. Smart grid vision is responsive to a need of high distribution losses, poor service quality and reliability in urban areas and also serves the need for electrification in rural areas.

Existing distribution systems have certain innate inefficiencies because of their legacy. Since most systems are monitored manually it leads to maintenance taking place only amidst breakdowns. The present system also does not guarantee reliable and complete power system and usage information that can facilitate trend forecasting or help the utility in better analysis and planning. Today over 23 per cent of electricity generated in India is lost in transmission and distribution and it is possible to bring down these losses to 6-8 % level in India with the help of smart grids which will enable better monitoring and control. Solutions such as smart grids guarantee stable energy expenses, while enhancing power reliability and keeping up productivity and also profit. Smart grids incorporate the capability to store surplus energy produced, which helps increase self-consumption of renewable energy sources during the most cost-effective periods. Simple, automated tools help track all energy-relevant inputs apparatuses helps track energy-relevant inputs, forecast energy needs and coordinate control actions. For regions with variable tariffs, it could help adjust consumption in response to changes in energy pricing. Demand management helps avoid peak demand penalties by rescheduling non-critical tasks.

But the challenges are abound in meeting the goal of automation in the power sector, particularly for energy-intensive industries. While the opportunities for effective implementation of automation are varied, it needs an 'integrated systems' approach to realise the full potential of energy savings. Power utilities are continuously facing the challenge of producing more power for less and less fuel consumption. Governments and T&D entities face the challenge of ensuring that losses are minimized when this expensive power reaches final consumers. Entities tasked with ensuring energy efficiency face the challenge of getting real time and authentic data of energy consumption. The Government is pushing hard to help the power sector and the sector does seem to be moving in the right direction after all. The government and the generation companies both need to focus upon alternate solutions such as automation and generation of renewable energy in order to reduce dependence on conventional source of energy because an increase in the gap between demand and supply will lead to a significant rise in imported coal from 150 million tonnes at the present.

As far as Schneider Electric is concerned it provide solutions that help make entire power value chain more efficient, right from generation, transmission, distribution and even consumption by individuals or industries. Their solutions make energy safe, reliable efficient, productive and green. Schneider Electric's PowerStruxure solutions deliver integrated power management systems that improve the reliability of the power distribution system while also increasing the financial and operational efficiency of the enterprise. At Schneider Electric it is their aim to help the customers to make the most of their energy. As a global specialist in energy management, SE has endeavoured to make energy safe, reliable, efficient, productive, and green. The global expertise that they bring to their solutions while keeping the Indian requirements in mind is the USP. All the solutions are designed to meet the specific needs of the customers. With a strong presence of 50 years in India, they are a dependable and reliable partner for all customers.

Courtesy: Sandeep Selot, Director-Marketing & Strategy-Energy Business (India Region), Schneider Electric India

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

Transient and lightning protection systems

Your effective protection against surge voltages and lightning strikes

External lightning protection

Air termination > Down conductor > Earthing

Surge Protection

Power line > Telecommunication > Data line

- 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

OBO BETTERMANN India Pvt. Ltd.
A51, 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@oboindia.com

OBO BETTERMANN

THINK CONNECTED.

We put the now in Knowledge

Today's solutions built on a century of innovation and expertise

Knowledge. It's what helps you make the next right decision about your critical assets. And it's what Doble uses to develop market-leading diagnostic tools and solutions that give you the information you need, when you need it. Better yet, we make sure you have that information quickly and cost effectively to ensure your power system's safety and reliability. Right now.

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

Past. Present. Future. Together.

doble®

Home Automation with a difference- NEPTUNE smarti

Smarti products incorporate the latest in Automation field. Smarti products have been high acclaimed world over with nearly 16+ awards to its credit.

The IP based protocols / technologies which the products uses integrates anything and everything making the solution future ready. Most of the other global players adapt a closed protocol making them stand alone and non-integratable to any other systems.

Smarti products are of highest standards and imported from their manufacturing units in Europe. They offer through their system real & actual display of all the rooms and a touch display which gives real image touch.

Some features which make smarti system very different from others in the market:

- products work on latest IP based communication systems which make them highly integrated and future ready
- theirs user-interface solution is cutting edge solution providing the interactive real live room picture
- they can integrate all common condominium solution, like CCTV, parking, lighting, street lights, gas, water into one central control station
- the video intercom in the system can also be used for video conferencing with other rooms as well as with all apartments in the condominium
- they have their own CCTV solution which is integrated in the HA system
- company's multi-room audio system is integrated in the HA system and can be controlled from any touch screen in the house or using any smart mobile phone.

For the Indian residential market they have introduced 3 levels of automation: Basic, Standard, Advanced. Since the basic requirement of builders in India has been to get a system which gives them an edge when show casing an apartment of dreams to their customer with something different then what is offered in market. The BASIC Automation ensures that there are video intercoms by 'Vega system' between guard/visitor and house owner or between house owners which also carries controls for basic lighting, intrusion system and upto 6 camera feed.

The biggest advantage for the builders is that they can use the system for advertising as well as RWA can use on this for personalized messaging. The other advantage is that builders can integrate the electrical meter data wherein the usage and the pre-paid amounts are available for the customers to know.

Company's touch screen controller 'Polara' is a wonderful device which has the actual pictures of the rooms and all the products can be seen in motion or working condition whenever the control is required by just a touch of the fingers. The graphic interface provided is path breaking and unique the world over. This out-of-world experience of operating the device will make one think this is out of science fiction movie. The product gives the functions of the Home Automation system of the entire premises at ones command from a single panel.

Some of other functions with company's HOME AUTOMATION system are:

Audio Controller: smarti's multi-room audio system will bring music to life. Weather one have a party or just want to spend a relaxing day in soothing music smarti audio will bring all that. Their multi room system satisfies different tastes. That means each room, where smarti audio is connected one can listen to different music of ones choice.

Lighting Control: smarti lighting systems is designed to give a level of commands and control over it. Turn lights ON/ OFF or dim them & create atmosphere to suit occasion.

Communication System: smarti Intercom system will connect with a trendy & innovative video phone system that will fit in the home & office. It is an all-in-one device that gathers many features converting it into a virtual communication & multimedia tool. Main purpose is to alert you when someone rings door bell and will notify the unanswered door bells with video messages of the visitor, which can be check later. Calls can also be made from room-to-room, door intercom or outside calls.

Security: Easily monitor & control the premises & ensure safety & peace. With smarti alarms, sensors & CCTV one can create a complete security for the place.

Curtains / Shade Control: Curtains/ Shades can be simply controlled from the sofa. When one want sun to shine in open shades & close them when going to bed.

Air Conditioning: smarti system will control the climate and no matter what the outside weather always have a perfect conditions for the comfort. With smarti automation system they create a place which is secure, comfortable and controlled. Whether one want it in home or office or hotel, smarti will adapt to every environment giving a system which fits the requirements.

They can also retrofit the premises.

EMI Transmission Limited

Emi Transmission Limited is engaged in the business of manufacture of Hardware Fittings and Conductor Accessories for High Voltage Transmission Lines upto 1200KV since last 54 years, having its manufacturing facility at Nashik and enjoys substantial market share in domestic market and is also a leading supplier in overseas market of Hardware Fittings and Conductor Accessories. The Company is a largest manufacturer in India with products ranging from 11kV to 1,200kV and has been approved by Power Grid Corporation of India (PGCIL) and other Utilities in India, for supply of Hardware Fittings and Conductor Accessories for Power Transmission Lines. The Company enjoys preferred supplier status in domestic as well as in several overseas markets and has supplied to over 40 countries across the Middle East Asia, South East Asia, Europe and Africa. Since last 15 years, EMI Transmission Ltd. has been certified as an ISO Company and currently it is certified by TUV NORD CERT GmbH for ISO 9001-2008. The present facility at Nashik is having a total constructed area of around 24,345 sqm and is regularly upgraded to meet the demand from Domestic as well as International Market. The machineries like CNC Plasma Profile Cutting Machine, Automatic Drilling Machines, 250MT Hydraulic Press Machine, CNC Pipe Bending Machine, Machine for Rubber Products etc, have aided in increasing the quality and productivity. The factory is equipped with a full-fledged Testing Laboratory, acceptable to various National & International Utilities/Consultants to carry out various tests to determine the quality and performance of equipments and components for Transmission lines upto system voltage of 800kV. The said testing facility is also made available to third party to carry out their testings.

For further details contact:
www.emi.co.in

OBO Bettermann

OBO Bettermann announced the opening of its state-of-the-art manufacturing facility at SIPCOT Industrial Growth Centre, Oragadam, Kanchipuram district, India.

OBO Bettermann is a family company, and has been since 1911. OBO's product range was defined from the outset. With a legacy of 103 years, OBO BETTERMANN is a premium provider of cable management, lightning protection systems and fire sealants for all kinds of electro-mechanical installations with over 30,000 products from 7 unique product lines. The company's headquarters still stands on the same spot where Franz Bettermann founded it a hundred years ago. With its headquarters in Menden, Germany, the company has production facilities in Germany, Hungary, Switzerland, the Netherlands, South Africa and now India. Globally, OBO Bettermann employs about 3,000 people in 40 subsidiaries across 60 countries with presence in every continent, generating an annual turnover of over EUR 500 million. Today, OBO generates more than half of its business abroad.

OBO Bettermann started its India operations in 2008, for its renowned products, which are best known for its quality, OBO Bettermann India has so far invested 10 million Euro (approx. Rs 80 crores) in this modern facility.

For further details contact:
www.oboindia.com

K-Lite introduces LED Bollards

Efficient and cost- effective LED bollards with rotationally symmetrical illumination for ground surfaces. The photometric design of these luminaires is based on LED integrated with K-Lite's precision reflector module. Consistent implementation of a new technological developments combined with the highest technical and structural quality have resulted in these state of art luminaires. These luminaires are characterised by their high luminous efficiency, extremely long service life and the uniformity of the degree of illuminance. These luminaires are available in Ø100 and Ø166 three different heights to suit the installation site. Their sturdy construction makes them especially suitable for areas in which considerable robustness is required to ensure vandal proof service.

Application: for the illumination of footpaths, entrance areas, driveway, private and public areas.

For further details contact:
info@klite.in

Meco Multifunction Power & Energy Monitor

MECO Multifunction Power & Energy Monitor, Model "MFM-96S" Microcontroller based with MODBUS RTU Protocol is manufactured by the R & D Department of MECO. "MFM-96S" eliminate using conventional panel with 10 different meters. It save more then 50% of the cost in panel, as it reduce size of panel, with One MFM-96S having 10 parameters and very little wiring. "MFM-96S" is built with 4 rows, Super Bright Red LED Displays with 4 Digits Resolution and 8 Digit Resolution. It has Inbuilt Memory to store CTR, PTR, Inst. Address, Password & Energy Reset facility. "MFM-96S" has Simultaneous Display of 10 Parameters, 48 Values on 16 Pages 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, 3Phase 3Wire / 3Phase 4 Wire (User Selectable) CTR, PTR, Instruments address, Password Protected, Energy Reset & Auto / Manual Scroll Display (Programmable) are key features of "MFM-96S".

For further details contact:
sales@mecoinst.com

Kusam-Meco offers Cable Fault Pre-Locator: Underground Cable Fault Pre Locating Equipment

Kusam-Meco introduced new product "CABLE FAULT PRE-LOCATOR" which is extensively used for cable fault finding in Railways. "KUSAM-MECO" underground Cable Fault Pre-locator Model KM-CFL-620 is an automatic Cable Fault Locator which adopts ARM, FPGA & Dot Matrix Color LCD display Technology. This tester combines both pulse reflecting technology (TDR) & Intelligent Bridge testing (Bridge) for measuring the exact fault location such as broken line, cross faults, earthing, poor insulation & poor contact of the lead covered cables as well as plastic cables. It is capable of giving IR tests in Bridge mode.

This product is user friendly and tests almost all power cables, telecom & signal cables. With Megameter & Ohmmeter it enables to test insulation resistance & loop resistance. It has USB Port for uploading test data to computer.

Small size, light weight and ABS plastic housing which is ergonomically designed for easy use by user. Menu driven simple operation. Measurement maximum 8 km in selectable ranges. Tests any type of copper

telecom and signal cables. Range, VOP and Gain are selected automatically. It has Color LCD Display (480 x 280 dots) & Automatic testing mode. Both pulse reflection (TDR) and intelligent bridge (Bridge) testing for open, short, or low insulation cable faults. With mega meter it enables to test insulation resistance and loop resistance. Six function keys and simple operation. Manual testing function is also available. With 4 GB USB Pen drive, it is easy to upload memory data to computer. Rechargeable lithium battery with intelligent charger & charging time is 3hours & Charging voltage 230V +/-10%, 50Hz, single phase. Continued 8 hours operating time on internal battery. Rugged construction and easy to carry on site.

In TDR MODE Fault Distance Range is 8 km (240m, 480m, 1000m, 2000m, 4000m, 8000m) & Accuracy is 1 meter. Cable Constant (VOP) range is 100 – 300. Sampling Speed 100 MHZ. Testing accuracy is+/- 1% cable length. Pulse Width 40ns---10us. Pulse Waveform Two polarity pulse. Pulse Amplitude 0 - 30V adjustment adaptive. Impedance matching Automatic. Output Impedance 25 - 120 adaptive. Gain adjustment is Automatic and Manual & Range Control is 0 – 9. Resolution 1 Meter. Memory Location U – disk. Serial port for PC / Printer is USB.

IN BRIDGE MODE the max length of testing cable is 10 Km & Max. poor insulation resistance is 100 M Ohm. Testing accuracy +/- 1% x cable length & maximum resistance of defective insulation is 100 M Ohm.

For further details contact:
sales@kusam-meco.co.in

Combicon - Connection technology for various applications by Phoenix Contact

Connectors are also among the important parts of a system or a device and how well they connect and disconnect along with the ease of assembly & installation is important to users.

Phoenix Contact brings a complete comprehensive range of innovative PCB connectors to cope up with each and every application related to data, signal and power connection solution within and outside the device. One can find various connection solutions such as panel feed-through, PCB Terminals, Pluggable Terminals, ranges from 2.5 mm to 15 mm pitch with ratings up-to 125A, 1000V with a variety of connection technologies like screw, spring-cage, crimp, insulation displacement, piercecon. There is also a choice in mounting technologies like SMD, THR, wave-soldering and Press-in.

Product spectrum based on Data, Signal and Power - Combicon Compact

To inculcate the demand of miniaturization of modules and devices along with the increase in connection density, Phoenix Contact introduces an innovative range of products - COMBICON Compact. The range provides solutions with Spring-cage, Push-in and Screw connection technology for all types of applications in building automation, analytical instruments and telecommunication

where space saving is critical. This product line offers pitches ranges from 2.5 mm to 7.5 mm, with ratings up to 32A/600V and cross-section ranges from 0.5 mm^2 to 4 mm^2. Fiber optic PCB terminal block is also an innovative product lies in this category.

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

Thermal Imagers testo 885 and testo 876 by Testo India

Four renowned expert committees - the business consultants Frost & Sullivan, the Fraunhofer Institute and the photovoltaics trade magazines Photon and Photon-International, have now confirmed, The thermal imagers testo 885 and testo 876, and the testo SuperResolution technology, are among the best in the world.

The trade magazines Photon and Photon-International comprehensively tested 14 thermal imagers including the model testo 885. The current market overview records almost 100 individual pieces of information per imager, and is of special significance because Photon's laboratory has for the first time has given ratings. 13 categories were scored with varying weighting. The testo 885 (with the testo SuperResolution option) was at the very top in almost all individual disciplines. "Everything fits" was Photon's judgement of the test winner. Studies also proved testo SuperResolution improves thermal images by one class.

Increasing demands placed on energy and resource efficiency make the use of thermal imagers worthwhile in more and more areas of contracting and industry. In all applications the detailed presentation of the thermographically recorded object and the accuracy of the temperature measurement play a crucial role.

The testo SuperResolution technology improves the usable geometric resolution of the thermal image by a factor of 1.6 – with four times as many measuring values. Independent experts are convinced by the technology. The renowned Fraunhofer Institute confirms the advantages of testo SuperResolution for typical applications in industry.

Testo Thermal Imagers - Best-in-class

Testo 876: for solar engineers. Among other things "Photon" praises the solar mode, the easy handling and intuitive operation of the thermal imager testo 876.

For further details contact:
info@testoindia.com

Megger brings Portable Appliance Testing PAT 420 - Business in a box

The New PAT420 'Business in a Box' from Megger includes everything an electrical contractor needs to diversify into PAT Testing. It includes comprehensive guides on performing PAT testing, PAT420 Portable Appliance Tester, Powersuite software, protective pouch, Adaptor for testing laptop power supplies, Combined earth bond, continuity, and insulation test lead with probe and crocodile clip, 13 A extension lead adaptor, PASS labels for tested assets, roll of 1000 Lead storage pouch. Laminated quick-start guide for the PAT 420 and Full user guide for the PAT420 on CD.

The PAT testing and marketing guides included are a unique feature of the package. They are designed to assist in setting up, running and growing a PAT testing business. The Guide to PAT testing explains how to perform PAT testing. While remaining simple, it is intended to aid in the detail of how to test and includes identification of the different types of assets that exist and which tests to perform on each type. It also includes the recommended pass/fail criteria from the Code of Practice for In-service Inspection and Testing of Electrical Equipment (published by the IEE) enabling easy identification of a good or faulty asset.

A key feature of this guide is that it has been written in a brief, easy-to-understand style, enabling an easy grasp of PAT testing. It includes some of the legal background and explains that as an experienced electrician, no additional qualification is required.

PAT420 has memory storage for 10,000 assets and can download direct to a USB memory stick for reading by PC. It has fully configurable tests with direct access via soft-keys and a full QWERTY keypad for fast and precise data entry. Push-button operation makes the PAT420 fast and intuitive to use. All test requirements are supported, including Class I and Class II, IEC power leads, extension leads and full trip time tests for portable RCDs. Automatic testing proceeds sequentially through bond, insulation and operational tests, indicating a pass or fail at each test, with user-selectable PASS/FAIL limits. Should a fail occur, testing is stopped.

A quick-test key provides direct access to individual tests for diagnostic purposes. If a repair has been carried out or a suspect result obtained, just the relevant test can be performed so increasing efficiency. Each test is preceded by a selection screen where the test parameters can be chosen. A selection of test leads are supplied, including a combined earth bond, continuity, and insulation test lead, an extension lead adaptor, and a special adaptor that makes it possible to test most laptop power supplies and leads.

Other options for the PAT420 include barcode asset identification with the optional scanner and label printer. Thermal-transfer labels provide permanent, resilient and robust labels for locally identifying asset numbers and re-test dates.

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

FLIR Systems announces New T-Series Cameras with UltraMax Resolution

New FLIR T660 Thermal Imaging Camera

FLIR System Inc, announced the addition of exciting new features and capabilities for its popular T-Series family of premium thermal cameras today, as well as two new members of that family, the T460 and the T660. FLIR T-Series cameras now feature UltraMax™, a unique image processing feature that significantly improves the IR resolution and sensitivity of the cameras. UltraMax images have four times the thermal pixels, twice the resolution, and 50% greater sensitivity than standard unprocessed images. Images are viewed and processed in FLIR Tools software for PC's. UltraMax images allow users to zoom in on smaller heat anomalies, get more accurate measurements and see more detail than with previous un-processed images. Select T-Series cameras also now come with improved thermal sensitivity – as low as 20mK – and improved temperature measurement accuracy. The new T460 and the T660 include all of these features plus temperature ranges expanded to 2,000°C, continuous auto-focus, and onboard recording of real-time radiometric video files. Data can be played back and analyzed in FLIR Tools and FLIR Tools+ software so thermal changes over time can be studied in detail. "As the world leader in Thermography cameras, FLIR is committed to continually pushing the boundaries of the state of the art, and these new cameras do just that," said Andy Teich, President and CEO of FLIR. "T-Series cameras have been the most popular line of premium cameras in the world for many years, and these new features will enable Thermographers to see more, get better results & work faster than ever before."

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

Intelligent Eco Led Ceiling Light by Venture Lighting India

Flexible brightness adjustment through remote dimming; integrated Night Light option; lower energy consumption, 50% energy saving, uniform light; instant start without ripple wave, screen flash; excellent uniform diffuse & glare control; comfortable Lighting Atmosphere; without mercury, UV, IR radiation; electric wave and radio interference resistant; efficient thermal management technology; high intensity of illumination.

Technical Details

Input Power: 48W.
Input Voltage: 100 - 265 (VAC).
CCT(K): 3000/4000/5700/6500.
Lumen Output: 3700lm (warm white) /4200lm (cool white)
Beam Angle: 120.
Average Life: 35000 hrs.

Applications

It is applicable for hotel, office, hospitality, auditorium, dome lighting, reception areas, residential

For further details contact:
marketing@vlindia.com

Single & Dual Source Energy Meters from Rishabh Instruments

Rishabh Instruments Pvt. Ltd. introduced new generation Single Source and Dual Source Energy Meters - RISH EM 13xx Series and RISH EM 2340DS. These meters are designed with many advanced features in order to cater to the increasing market expectations.

These energy meters are On-site Programmable and can measure more than 65 parameters including Total Harmonic Distortion (THD) measurement. They are also available with optional RS485 (MODBUS) and Pulse Output options. They come with Click Fit arrangement which makes it very easy to install and less time consuming. Their low back depth of 35 mm requires lesser space. So these compact meters can fit into any panel in single or three phase network. Considering the future requirements that may come after the meter is installed, we have provided On-site Pluggable Output Options which provides more flexibility to customers for fulfilling these future needs.

These feature packed energy meters are mainly designed for applications in Gen-sets, Building Management system, Energy Billing, Panel Instrumentation, SCADA & PLC Systems and many others.

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

TÜV InterCert - System pass photovoltaic

The System-Pass Photovoltaic is not the only pass at the market in the field of Photovoltaic-(PV)-plants testing but it excels in a comprehensive view when analyzing PV-plants. The System-Pass Photovoltaic examines planning as well as operating and execution phases of the plant. System-Pass Photovoltaic is based on testing methods which were composed and developed from our well experienced engineers who have substantial experience with PV modules and plants. They derive from several existing rule types and international norms, which are amongst others:

DIN EN 62446 Minimum standards to the system documentation, start-up tests and testing requirements;
VDE 0100 Buildup of low voltage;
VDE 0100 Part 712 Solar-Photovoltaic-(PV)-power supply system.

Advantage

The plant will be examined independent and objective.
The full functionality of the plant will be tested and documented.
The risk assessment of a TÜV tested plant turns out superiorly.

For further details contact:
www.tuv-intercert.org

LED Polar Lighting Series

* Integral lamp source of 24W / 45W

K-LITE INDUSTRIES
India's Lighting Company

D-10, Ambattur Industrial Estate, Chennai - 600 058.
Tel : 26257710, 42281950, Fax : 26257866 Cell : 95000 79797, 95000 85511
Email : info@klite.in, Website : www.klite.in

Chennai Showrooms

- G8, Ambattur Industrial Estate, Chennai - 600 058. Tel : 4228 999
- 28, Khader Nawaz Khan Road, Nungambakkam, Chennai - 600 034. Tel : 42144650

Delhi Showroom

- H.No 928, GF, Shop No 2, Khasra No - 402, Main MG Road, Ghitorni, New Delhi - 110030. Cell : 09136533044 / 09136533044

Han® HMC: Robust solution for frequent mating and demating

In industrial production, highly automated large scale production is frequently being replaced by more flexible manufacturing technology. This is due to strongly individualized products. Automotive industry is an excellent example of this. Ten years ago, automakers were still able to cover the market with four to six models, but today they offer ten or more models in order to satisfy their customers' wishes for products tailored especially to their needs.

Due to this product differentiation the requirements for flexibility in manufacturing have increased. The consequences can again be seen especially clearly in the automotive industry. In the past a new model meant that the complete production line had to be replaced with a new one, but now the existing lines are modified to suit the new model. The trend towards increased flexibility is seen in industrial production in general, however, and not only in automobile manufacturing. The challenges almost everywhere are:

- Larger product ranges
- Smaller production lots
- Shorter throughput times.

High number of mating cycles in Industry 4.0

The answer to these challenges is a highly flexible(high volume) production that for quite some time, has been established under the name Industry 4.0. It draws on the means of automation, the possibilities of self-configuration, self-optimization and self-diagnoses all the way through to more complex, intelligent automation systems. In order to satisfy the growing demands for flexibility, the manufacturing plants and machines are becoming more & more modular.

For machines and systems this flexibility means an increase in the number of modification procedures and tooling changes, some of which take place automatically. As a result, the electrical interfaces in these systems must also be more frequently mated and demated without showing signs of wear. Automatic docking systems that establish the electrical and mechanical connections are increasingly being used in the changeover systems.

The same requirements for the connectors can be found in measurement and testing technology. Here each test procedure involves a mating and demating, and this frequently takes place several times a day. This is why this segment particularly demands reliable connector solutions. Mobile machines and devices are further typical applications in which the electrical connections may have to be mated and then demated again each day. In addition to industrial production, medical technology is also a typical application field for such mobile devices.

In order to enable the mating and demating of such devices, machines and systems reliably over a long period of time, they must feature durable, flexible and robust interfaces. The power, data and signal transfers must remain safe and reliable in spite of frequent mating and demating. HARTING has developed the new Han® HMC connector series to satisfy these requirements. Just like the other Han® industrial connectors, it impresses with: Robustness, Reliability, Longevity, Simple handling & Flexibility.

The series is certified for applications with more than 10,000 mating cycles. This means: Han HMC connectors continue to fulfil the strict requirements of DIN EN 61984 even after 10,000 mating cycles. HARTING has achieved this longevity by consistently enhancing its proven standard industrial connectors. For example, by using a high performance contact spring it was possible to make four different Han® series suitable for applications with a large number of mating cycles. Contacts were also developed that are extremely resistant to abrasion thanks to a special gold surface. These contacts are also at work in eight modules in the Han-Modular® series, rounding out the HARTING program for a large number of mating cycles.

Locking optimized

In harsh industrial environments, but not only there, robust housings are called for to protect the connections. The locking system in the Han HMC was optimized to allow it to stand up to 10,000 closing cycles. And the housings are also qualified for more than 10,000 mating cycles and always close reliably in compliance with the high IP65 protection class. The proven Han docking frames even make it possible to implement automatic docking systems for a large number of mating cycles. Thus, HARTING is presenting a comprehensive program offering many options for applications with a large number of mating cycles. However, besides replacing and other advantages, all existing crimp, assembly and removal tools can still be utilized.

Courtesy:
Heinz-Günther Spreen, Product Manager,
HARTING Electric GmbH & Co. KG

Surge Protection, Lightning Protection & Earthing Solutions

DEHN INDIA Pvt Ltd: Plot No. 213, Sector - 7, IMT Manesar, Gurgaon-122 050 (Haryana), INDIA
Tel : +91 124 4007680 | Fax : +91 124 4007684 | Email: info@dehn in
For more information about our products and services in India, p ease visit: www.dehn.in
100% subsidiary of DEHN + SOHNE, Germany

Index to Advertisers

All You Need Is Just One Brainy Transducer

Rish Ducer Mxx Series

Multi-Function Transducer, the efficient multi-tasker, levers and handles numerous complex systems. This versatile instrument can simultaneously measure many electrical parameters including Voltage, Current, Power, Energy etc. and process them as signals. Its distinct and astounding features makes it at par with a **Brain** for electrical applications.

RISHABH INSTRUMENTS

Measure, Control & Record with a Difference

FORECAST

Tel: 91 253 2202202 / 028 | E-mail: marketing @rishabh.co.in | Web: www.rishabh.co.in

Five taps in one trip.

MRCT
Relay and Current Transformer Tester

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

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

WWW.MEGGER.COM

Megger
211 Crystal Paradise Mall
Off Veera Desai Road
Andheri (w) Mumbai 400053
T +91 22 26740468
F +91 22 26740465
E insales@megger.com

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

An ISO 9001 : 2008 Company

CRISIL SME 2

SIVANANDA
ELECTRONICS

Transformer Test Equipments
Exported to 70 Countries


Tan Delta System


Transformer Winding Resistance Meter


Auto Winding Test System


Microprocessor Based L.R. Tester


Auto Transformer Ratio Meter


Contact Resistance Meter (Micro Ohm Meter)


Oil Insulation Test Kit


C & Tan δ Bridge

Complete Range of Transformer Test Equipments

Over 200 types of test equipments for ***Power Sector, Wire & Cable, Capacitor, Oil & Petroleum Industries.***
Developed by in-house ***R&D lab recognised by Dept. of Science & Technology.***

SIVANANDA ELECTRONICS

Deepak Mahal, Lam Road, Devlali-422 401, Nashik. Maharashtra, India.
Phone : 0253-2491129, 2491423, 2491504, 2491816, 2497625. E-mail : mkb@sivanandaelectronics.com Fax: 0253-2492291

MUMBAI : 208, MIDAS SAHAR PLAZA COMPLEX, ANDHERI KURLA ROAD, ANDHERI (E) MUMBAI 400 059 • PHONE : 022-66430590 / 91, FAX : 28389232.
NEW DELHI : S -145, KALKAJI, NEW DELHI -110 019 • PHONE : 011- 26221502, 26434442
BANGALORE : 442, DICKENSON ROAD, BANGALORE- 560 042 • PHONE : 080-25585678, 25597416
HYDERABAD : 102, ART PLAZA, YWCA LANE, NEAR HIRA HALL, BOGGUL KUNTA, ABIDS, HYDERABAD-500 001 • PHONE : 040-30329539.

MANUFACTURERS OF : ELECTRONIC INSTRUMENTS, METAL DETECTORS, TURNSTILES, COMPUTERISED TIME ATTENDANCE RECORDING & ACCESS CONTROL
Visit us at: www.sivanandaelectro.com

Ad-Ref-1-13

RNI Reg. No.: 6226/1961 • Postal Reg. No.: MH/MR/NORTH EAST/95/2012-2014 Licence to Post Without Prepayment
WPP Licence No. MR/TECH/WPP-228/NE/2014 • Posted at Mumbai Patrika Channel STG. Office, Mumbai - 400001
on 5th of Every Month, Date of Publication 5th of Every Month