ELECTRICAL INSTALLATION ENGINEER

NEWS LETTER

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE (Regn. No. 211/1992)
Old No.82 / New No. 123, Lloyds Enclave, Avvai Shanmugam Road, Royapettah, Chennai - 600 014.
Phone : 2811 1300 Fax : 2811 1908 Email : tnagrade@gmail.com Website : www.teiea.com

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EVENTS

ELECRAMA-2014

8-12 JANUARY 2014, BIEC, BANGALORE, INDIA

Event Profile: ELECRAMA-2014 shall be one of the world's largest electrical and industrial electronics exhibition. To experience and preview Electrical Power Transmission and Distribution equipments from 220V to 1200kV, participate in seminars, conferences and discuss future technologies. Delegates comprising of states people, senior utility executives and business people from various nations came together to explore opportunities on many fronts.

Date: 8th – 12th January 2014

Venue: Bangalore International Exhibition Centre (BIEC), Tumkur Road, Bangalore, India

Website: http://www.elecrama.com/

WORLD FUTURE ENERGY SUMMIT

20 - 22 JANUARY 2014
ABU DHABI NATIONAL EXHIBITION CENTRE

Event Profile:
The World Future Energy Summit (WFES) 2014 will bring together global leaders in policy, technology and business to discuss the state of the art, develop new ways of thinking and shape the future of renewable energy.

Date : 20th – 22nd January 2014 **Time :** 10:00 AM - 06:00 PM

Venue: Abu Dhabi National Exhibition Company - Abu Dhabi

Website: http://www.worldfutureenergy.com

MIDDLE EAST ELECTRICITY

Event Profile: Middle East Electricity is the largest meeting place for energy industry professionals from over 100 countries worldwide

- The biggest names in the global energy industry
- Over 1,100 exhibitors from 54 countries
- Access to government-supported country groups & national pavilions
- Over 50,000sqm of floor space
- 99% of visitors would recommend Middle East Electricity to their colleagues

Date & Time: 11th – 13th February 2014

Venue: Dubai International Exhibition Centre

Website: http://www.middleeastelectricity.com/

MATELEC

EIBT China 上海建筑电气展 EIBT China 上海建筑智能化展

Event Profile: MATELEC EIBT China 2013 has gained herself a strong market position for the future. Based on the enormous industry resources and professional international organization experience, MATELEC EIBT China 2014 will build the most efficient trading platform for 400 exhibitors and 12,000 visitors with 12,000 m^2 show space.

Date: 25th – 27th March 2014

Venue: No.77, Xing Yi Road, INTEX, Shanghai

Website: www.matelecchina.com

inter solar CHINA

connecting solar business

Organizer: Solar Promotion International GmbH

Date: 26th – 28th March 2014

Venue: Beijing, China

Website: http://www.intersolarchina.com

EDITORIAL

Dear Members, Fellow Professionals and Friends

Seasons Greetings To One And All! Greetings For Happy Christmas!!

Advance Greetings For A Happy And Prosperous 2014!!!

The month of December is marked by Celebration of Energy Conservation Day on the 14th. And the Farmers Day on the 23rd and both are of very vital importance for the stability and the growth of our Economy. It will be apt to review some of the achievements and remember the challenges ahead.

Energy Conservation basically addresses three areas of relevance, each of which contributes to Conservation of both Energy and Resources of Energy. The first one is – Avoiding and Eliminating Waste, which needs to be practiced very strictly at home or work place or industry. General tendency is to be concerned only when it 'pinches ones shoes', but the discipline has to change to be concerned whenever and wherever we see waste of Energy. Simple examples could be fans and lights and air conditioners being on with no occupancy, car engine running even while waiting for long at the signals and machines running idle at the shop floors. We are seeing lot of positive changes in this regard and they need to be improved with more focus. The Second one is – Energy Efficiency. This is really an area of great concern and tremendous scope though there have been substantial improvements in the past few decades. Whether it is 'Mileage' in case of automobiles or efficiencies of prime movers like Engines or Motors or end use equipments like Lights or Fans or Pumps or Air conditioners, there have been lot of improvements over the years but the potential is still very high. All the activities like Agriculture, Manufacturing and Services put together contributing to GDP, India's consumption of Energy per unit of GDP is still considered very high compared to many countries of the world, the ideal one being Japan, compared to which our Energy consumption is about three times per unit of GDP. Though our country's initiatives through BEE with Standards and Labeling Program, Auditing norms, Energy Efficient Building Codes etc have been contributing, focused efforts are still needed to address both Industries and Agriculture as well as Commercial and Domestic consumptions. The third one is – increased use of Renewable Energy Sources for conserving the conventional Energy Resources like Coal and Oil for future generations. Solar and Wind Energies have received lot of attention in India as well as the World at large and with sizable potential of both Bio Energy and Waste to Energy in our country and with lot of Technological advancements in the recent years, it will be very appropriate for us to focus on Bio Energy in the coming decades.

We can feel proud about the Green and White revolutions of the country, and with all problems and vagaries of monsoon etc, we have been able to sustain the developments seen in the past, as we are, even now, producing Exportable surplus in case of Food Grains, in spite of increased population. Both the Indian Farmer and the Indian Government need to be complimented in this regard.

Combining both Energy and Agriculture, it is apt to review a few dimensions. One important dimension is Lift Irrigation which has very substantially helped achievement of Food Production and we have today almost 2 Crore Electrical Pumping sets in operation all over the country, apart from a good number of Diesel Pumping sets. These Electrical pumping sets employed in Agriculture consume around 120 to 180 Billion Units of Electricity and there is lot of scope to improve on Efficiencies as well as reduction of Distribution losses. It will be very appropriate if the Government can gear up more equitable distribution of River Waters and reconsider taking up projects like 'National Water Grid' to tap and store surplus flood waters from all the rivers of the country. These steps can help reduce use of lift irrigation and it is even claimed by the advocates of National Water Grid that it can help completely eliminate use of lift irrigation and can even help additional Electricity Generation.

We thank all those members who have helped us by participating in the advertisements appearing for the issue November 2013 – Wilson Power and Distribution Technologies Pvt. Ltd., Cape Electric Pvt. Ltd., Prolite Autoglo Ltd., Power Links, Universal Earthing Systems Pvt. Ltd., OBO Bettermann India Pvt. Ltd., Intrans Electro Components Pvt. Ltd., V-Guard Industries Ltd., Power Cable Corporation, Hensel Electric India Pvt. Ltd., Abirami Electricals, Supreme & Co. Pvt. Ltd., Galaxy Earthing Electrodes Pvt. Ltd., Ashlok Safe Earthing Electrode Ltd., ***EDITOR***

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343. Mr. R. Ramalingam (2013-15), ***Non Member***
344. Nanjil Power (2013-14), ***New Member***
345. MRM Power Consultants (2013-14), ***New Member***
346. Sri Balaji Engineering (2013-14), ***New Member***

We request other members also to send their contribution for NEWSLETTER early.

(***Please help us to serve you better***)

ELECTRICAL INSTALLATION ENGINEER

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KNOW THY POWER NETWORK – 75

9.2 Let us restart our learning of "Smart Electricity Grid." As stated in the last article, a dynamic communication is essential for making the Smart Grid as a Comprehensive platform to brighten our future life. Among other things, it is a smart network that manages the flow of electrical energy in an effective way and also provides the needed information to monitor, analyze, control and maintain a flawless delivery of electricity to the End Users.

9.3 Advantages of a Smart Grid

9.3.1 The benefits that would accrue through this latest grid structure are,

- Intelligent Control and monitoring. Optimization of Operations through out the T&D network and extension of the existing centralized grid to the network of distributed generation which has components like wind electricity generators, solar cells, battery operated systems and electrical vehicles. Generally these renewable and micro generation sources face unbalanced electrical loads.
- Helps to build a structure with a mix of centralized generation (carbon sources) and the distributed renewables (non carbon sources) in an integrated fashion so as to get the benefits of both the generating sources.

Benefits

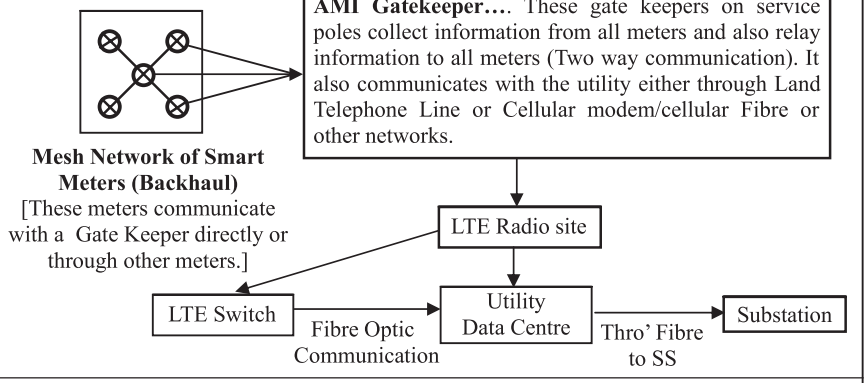
- Improves service continuity while meeting the increased demand and peak loads.
- Helps connecting and managing more green and volatile energy
- Facilitates the delivery of quality power while limiting losses
- Provides greater visibility and decision making tools.
- Helps the End users (consumers) to have a better knowledge about their electricity consumption and usage level.
- Helps to create a new network that delivers wireless Broadband services and at the same time meets the needs of the electricity consumers also.

9.3.2 Advancements in the communications, metering, control and automation render it possible to achieve this sort of pooling of all generation into one place and operating them as "one grid". Essentially to run this Smart grid, a dynamic, flexible, secure, safe, pilfer-free and cost effective two way communications and information management is required.

9.4 Requirements of Smart Electricity Grid

9.4.1 Smart grid structure adopts the communication systems conforming to IEC 62850. It requires

- An effective communication infrastructure
- An advanced Public Broadband access
- An advanced Metering Infrastructure and
- An arrangement for the easy flow of control commands and data among the smart devices that exist through out the system.



A Single Line Diagram describing the essential links of a Smart Grid

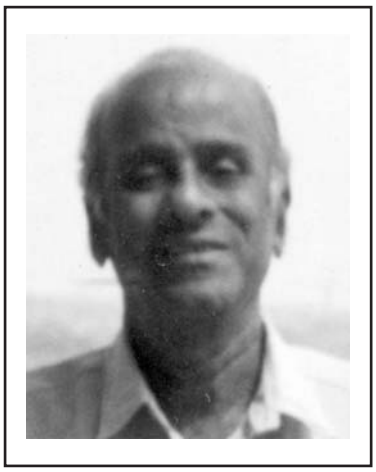
From the experience of the works connected with the formation of Super Grid in U.S.A, it is noted that the minimum installation time of Smart Grid structure is around five years.

9.4.2 The Communication backbone or the network that carries the flow of control commands and data is called *"Backhaul"*. A higher frequency radio mesh network is used. By means of this network, the connected meters exchange/ relay messages to each other and also reach a neighborhood mode called *"Gate keeper"*. These gate keepers aggregate the meter information as received by them and relay the same to the utility data centre. The link from 'Back haul' to "Gate keepers" can be through cellular modems, Ethernet posts and Land telephone lines. However the land telephone lines have only limited capability and stability. At the Customer premise, the weather proof boxes installed on the utility poles act as the *"Network end points"*.

9.4.3 The Smart grid applications depend on the real time communication with the "Gate Keepers". A unique broadband network is primarily needed for this function. Further the Smart grid should operate in the full range of outdoor environment prevailing in the place where it is going to be installed. ***(To be continued…)***

V. Sankaranarayanan B.E., FIE, Former Addl. Chief Engineer/TNEB
e-mail : *vsn_4617@rediffmail.com;* ***Mobile: 98402 07703***

OBITUARY



H. KALYANASUNDARAM

(01.07.1921 - 05.11.2013)

On behalf of ***The Tamilnadu Electrical Installation Engineers Association 'A' Grade*** extends **Heartfelt Condolences** for the demise of **Shri. H. KALYANASUNDARAM**, one of the Senior Electrical Engineer in Best & Crompton Engineering. He helped our Association in many ways.

We pray the almighty to rest His Soul in Peace.

We give below the details of
Shri. H. KALYANASUNDARAM,
furnished by his son ***Shri. K. Muthukrishnan***

We would all know the purpose of this document – a recollection of our association with H.Kalyanasundaram (HK).

Before anything – would say "*Kindness is a two way street*". **A thousand thanks to all of you who have been a part of HK before I was born and after and have made our lives memorable.**

To begin with I would view his journey through my eyes as my father, a teacher, and a social worker.

I was born in Chennai, Tamilnadu, India. Latitude - 13.0839° N, 80.2700° E and lived life in a palatial house.

My mother's name is K. Meenakshi, father is H. Kalyanasundaram and two elder sisters – Ms. Vanaja and Ms. Girija.

My parents heart was as large as the house and there was not a single day when our house was not also a happy conglomeration of relatives and relatively far-away relatives.

My father has been very kind towards me and my sisters, probably had whacked me only twice in my entire life and both times I really deserved them.

As a teacher, he taught English, Science and Mathematics to me during my schooling days, Electrical Engineering and Foundary Technology during my Graduation days, Electrical Safety Engineering and Ergonomics during my Post Graduation days and Job Order Control, Tender Management, 7 M (Men, Machine, Material, Method, Money, Market, Manager) management during my employment period. He was a constant accompaniment.

It was just not myself but several of my friends and others who have benefitted. He was a diploma holder by qualification. And while the requirement is that any course can only be taught by a person who possess the same or higher degree, he was a visiting faculty to several universities for their post graduate courses as well in recognition of his unique expertise in the field. He took the saying "relearn, learn new, unlearn", very seriously.

I was rather struggling with my Graduate ship examination of AMIE, which by itself has a meager success percentage and told him of my helplessness one day. He listened to me patiently and went away. Two days later he asked me "are you having difficulty in passing the AMIE examination?". I expected a succor and told him "yes". He flourished me a form and said "along with AMIE examination, you write this examination as well. It will do you good". He continued "you are now studying for some time and then worrying and brooding how difficult AMIE is for the rest of the time. Forget that worrying and brooding and use that time to study and write this examination". I passed both examinations.

HK – as it was much uncommon in those days, joined and retired from a single company – Best and Crompton Engineering. He joined as a diploma trainee and retired as a Contracts Manager.

He not only was involved at his works but also had a rich professional life.

He was a

Fellow member of Institution of Engineers (India)
Fellow member of Institution of Mechanical Engineers (India)
Fellow member of Institution of Energy Engineers (India)
Fellow member of Institute of Standards Engineers
Fellow member of Indian Institution of Plant Engineers
Fellow member of Indian Society of Lighting Engineers
Member of National Institute of Quality and Reliability
Life Sr. Member of Institute of Electrical and Electronics Engineers (IEEE).

For his contribution to IEEE, he was one of the four recipients of the Region 10 Outstanding Volunteer Award for the year 2001.

He received several other awards from IEEE, including the 1988 RAB Larry K Wilson Transnational Award, the Super Recruiter Award in November 1994, the IEEE India Council Distinguished Volunteer Award in December 2000, and the IEEE Millenium Award in 2000.

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS ASSOCIATION 'A' GRADE

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DISTRIBUTED GENERATION AND ITS IMPACT ON POWER SYSTEM

The penetration of distributed generation (DG) into the main electricity network is changing the paradigm we used to live with. DG is gaining interest worldwide as numerous benefits are associated with this change due to penetration of DG. In this paper the main purpose is to show the basics of distributed generation. The different ways to interface the DG with the utility system are also reported. Penetration of a DG into an existing distribution system has many impacts on the system and equipment operations in terms of steady-state operation, dynamic operation, reliability, power quality, stability and safety for both customers and electricity suppliers. However here in this paper the more focus in on impact of DG on power quality pointing out its positive and negative impacts and its solutions. At last to support this arguments analysis of results are shown which are directly taken from the references, where the results reveals the effect of DG on power quality and based on that some conclusions are documented.

Keywords: *Distributed generation (DG), Power quality and Distributed power generation system (DPGS).*

1.0 INTRODUCTION

In recent years, fossil fuel is the main energy supllier of the worldwide economy, but the recognition of it as being a major cause of environmental problems makes the mankind to look for alternative resources in power generation. The demand of power is escalating in the world of electricity. This growth of demand triggers a need of more power generation. DG uses smaller-sized generators than does the typical central station plant. Hence government tries to replace conventional power generation system with the distributed generation (DG) systems. Distributed generators are small scale generators located close to consumers; normally Distributed Generators are of 1 kW-100 MW.

In Traditional Concept of Power System as shown in Figure 1, in the first stage the electricity is generated in large generation plants, located in non-populated areas away from loads to get round with the economics of size and environmental issues. Second stage is accomplished with the support of various equipments such as transformers, overhead transmission lines and underground cables. The last stage is the distribution, the link between the utility system and the end customers. This stage is the most important part of the power system, as the final power quality depends on its reliability [l].

The electricity demand is increasing continuously. Consequently, electricity generation must increase in order to meet the demand requirements. Traditional power systems face this growth; installing new support systems in level 1. Whilst, addition in the transmission and distribution levels are less frequent.

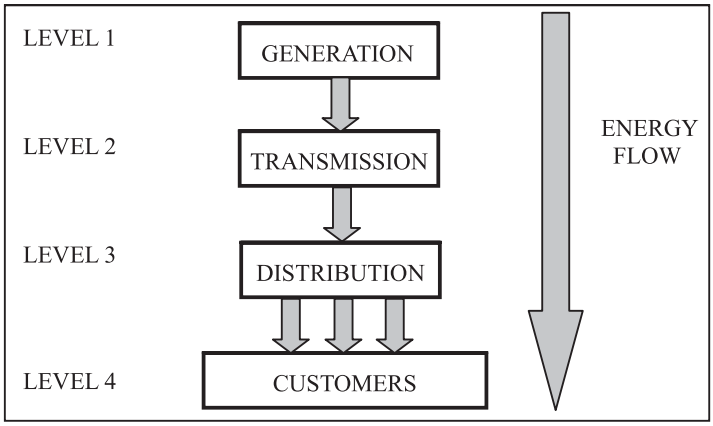


Fig.1: Traditional Industry Conception of the Electrical Energy Supply [1]

Nowadays, the technological evolution, environmental policies, and also the expansion of the finance and electrical markets, are promoting new conditions in the sector of the electricity generation [1].

In the New Concept of Power System as shown in Figure 2, new technologies allow the electricity to be generated in small sized plants. Moreover, the increasing use of renewable

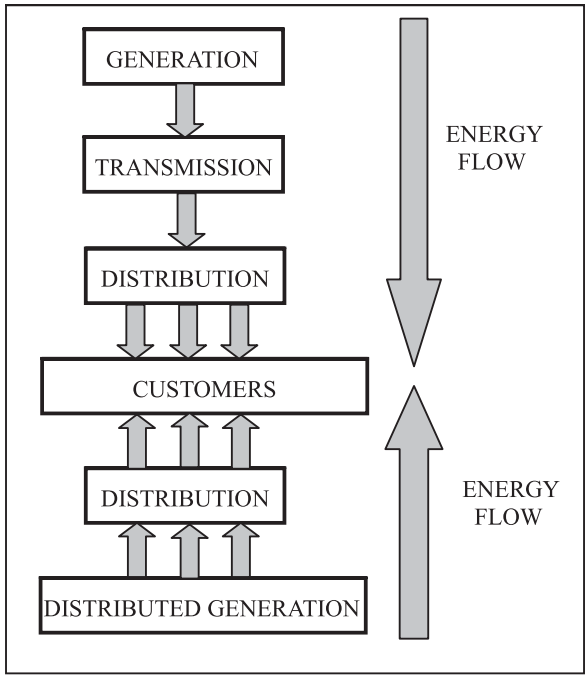


Fig.2: New Industrial Conception of the Electrical Energy Supply [1]

sources in order to reduce the environmental impact of power generation leads to the development and application of new electrical energy supply schemes.

2.0 DPGS (DISTRIBUTED POWER GENERATION SYSTEM) STRUCTURE

A general structure for distributed systems is illustrated in Figure 3. The input power is transformed into electricity by means of a power conversion unit whose configuration is closely related to the input power nature. The electricity produced can be delivered to the local loads or to the utility network, depending where the generation system is connected. One important part of the distributed system is its control. The control tasks can be divided into two major parts. One is Input-side controller which can have the following tasks; Main property to extract the maximum power from the input source; Control input power; To maintain the generator voltage level; Speed control of the generator as if the speed is not maintained the generator will be getting shutdown; Naturally, protection of the input-side converter is also considered in this controller. Another is Grid-side controller which can have the following tasks: Control of active power generated to the grid; Control of reactive power transfer between the DPGS and the grid; Control of dc-link voltage; Ensure high quality of the injected power; Grid synchronization.

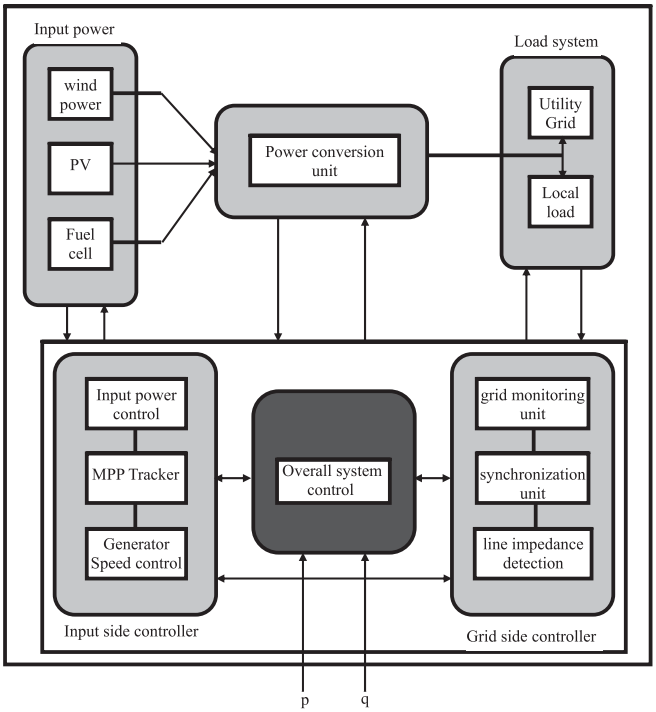


Fig.3: General structure for distributed power system having different input powers [2].

The items listed above for the grid-side converter are the basic features this converter should have. Additionally, ancillary services like local voltage and frequency regulation, voltage harmonic compensation, or active filtering might be requested by the grid operator [2].

3.0 TYPES AND TECHNOLOGIES OF DG

There are different types of DGs from the constructional and technological points of view as shown in Figure 4. These types of DGs must be compared to each other to help in taking the decision with regard to which kind is more suitable to be chosen in different situations.

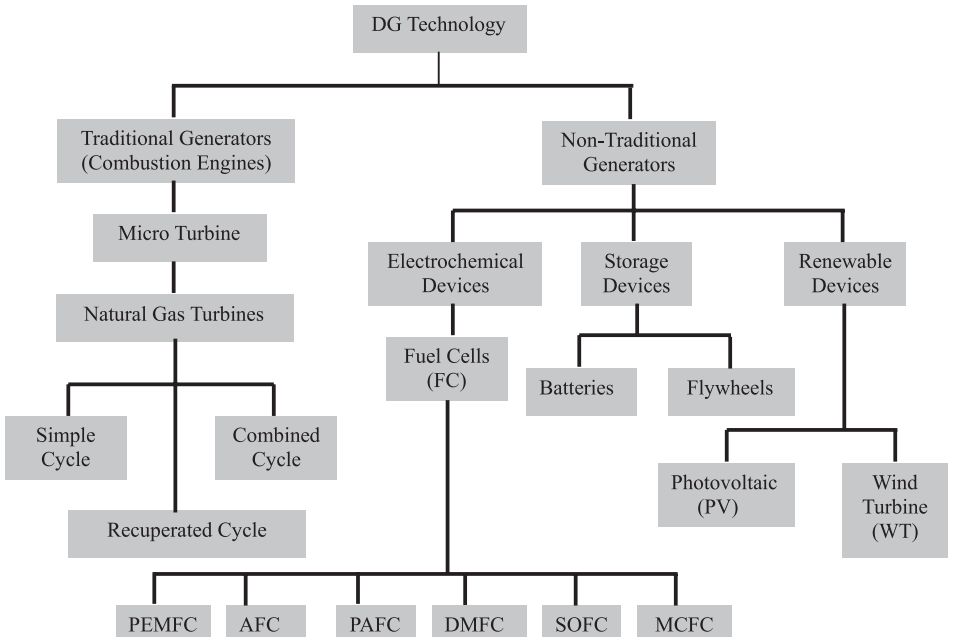


Fig.4: Distributed Generation Types and technologies [3]

There are various types of distributed generation technologies ranging from the well established reciprocating engines and gas turbines to more recent types of renewable sources such as wind farms and photovoltaic. Emerging technologies such as fuel cells and micro turbines are recently commercialized. DG technologies can generally fall under two main categories [3].

DG includes both Traditional generators and Non-Traditional generators. Traditional generators such as gas turbine, micro turbine etc. and Non-traditional generators includes electromechanical devices such as fuel cells (FC); storage devices such as batteries, flywheels etc. and renewable device such as PV and wind turbine.

4.0 CONTROL STRUCTURE FOR GRID-CONNECTED DPGS

Synchronous reference frame control, also called dq control, uses a reference frame transformation module e.g., abc→dq, to transform the grid current and voltage waveforms into a reference that rotates synchronously with the grid voltage. By means of this, the control variables become dc values; thus, filtering and controlling can be easier achieved.

A schematic of the dq control is represented in Figure 5. In this structure, the dc-link voltage is controlled in accordance to the necessary output power. Its output is the reference for the active current controller, whereas the reference for the reactive current is usually set to zero, if the reactive power control is not allowed. In the case that the reactive power has to be controlled, a reactive power reference must be imposed to the system. The dq control structure is normally associated with proportional-integral (PI) controllers since they have a satisfactory behaviour when regulating dc variables.

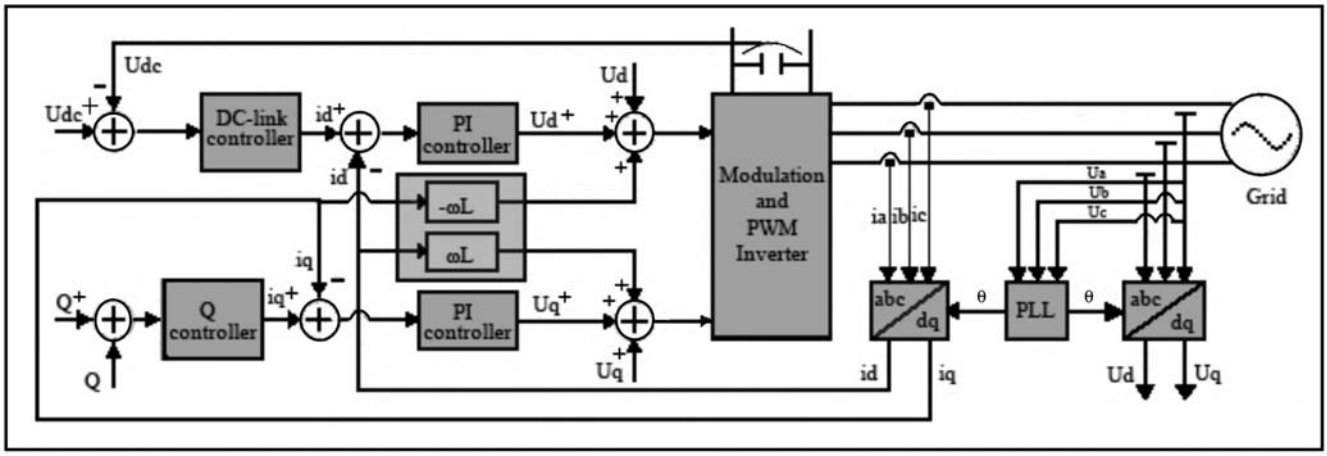


Fig.5: General structure for synchronous rotating frame control structure [2].

The matrix transfer function of the controller in dq coordinates can be written as

$$G_{PI}^{(dq)}(s) = \begin{bmatrix} kp + \frac{ki}{s} & 0 \\ 0 & kp + \frac{ki}{s} \end{bmatrix} \quad \text{..... (1)}$$

Where, Kp is the proportional gain and Ki is the integral gain of the controller. Since the controlled current has to be in phase with the grid voltage, the phase angle used by the abc→dq transformation module has to be extracted from the grid voltages. As a solution, filtering of the grid voltages and using arctangent function to extract the phase angle can be a possibility. In addition, the phase-locked loop (PLL) technique became a state of the art in extracting the phase angle of the grid voltages in the case of distributed generation systems. PLL is used to synchronize the DG system with grid. For improving the performance of PI controller in such a structure as depicted in Figure 5, cross-coupling terms and voltage feed forward are usually used. In any case, with all these improvements, the compensation capability of the low-order harmonics in the case of PI controllers is very poor, standing as a major drawback when using it in grid connected systems. Also the tuning of PI is a big problem [2].

5.0 IMPACT OF DG ON POWER QUALITY

The DG penetration in the grid poses new challenges and problems to the network operators as these can have a significant impact on the system and equipment operations in terms of steady-state operation, dynamic operation, reliability, power quality, stability and safety for both customers and electricity suppliers. However here in this report the more focus is on impact of DG on power quality.

The impact of the DG on power quality depends on many factors including:

- Type of DG.
- Its interface with the utility system.
- The size of the DG unit, its intended mode of operation and expected output fluctuation.
- The total capacity of the DG relative to the system.

- Size of generation relative to the load at the interconnection point.
- Feeder voltage regulation practice.

DG has both positive and negative impact on power Quality. In general, back-up generation and on-site power supply provided by DG improve the system power quality in terms of sustained interruption and voltage sags. However, some issues might arise when distributed generators, with their different types and technologies, are interconnected to the utility distribution system. Among these issues are voltage regulation, harmonics, voltage flicker, islanding etc. [4].

5.1 Sustained interruption

Much of the DG installed as backup generation. The most common technology used for backup generation is diesel-gensets. The bulk of the capacity of this form of DG can be realized simply by transferring the load to the backup system. However, there will be additional power that can be extracted by paralleling with the power system. Many DG installations will operate with better power quality while paralleled with the utility system because of its large capacity.

Not all DG technologies are capable of significant improvements in reliability. To achieve improvement, the DG must be capable of serving the load when the utility system cannot [5]. For example, a home owner may install a rooftop photo-voltaic solar system with the expectation of being able to ride through rotating blackouts. Unfortunately, the less costly systems do not have the proper inverter and storage capacity to operate stand-alone. Therefore, there is no improvement in reliability.

Utilities may achieve improved reliability by employing DG to cover contingencies when part of the delivery system is out of service. In this case, the DG does not serve the entire load, but only enough to cover for the capacity that is out of service. This can allow deferral of major construction expenses for a few years. The downside is that reliance on this scheme for too many years can ultimately lead to worse reliability. The load growth will overtake the base capacity of the system, requiring load shedding during peak load conditions or resulting in the inability to operate the system at acceptable voltage after a fault [5].

5.2 Voltage Regulation

Over-voltages due to reverse power flow: If the downstream DG output exceeds the downstream feeder load, there is an increase in feeder voltage with increasing distance. If the substation end voltage is held to near the maximum allowable value, voltages downstream on the feeder can exceed the acceptable range [5].

Large voltage changes are also possible if there were a significant penetration of dispersed, smaller DG producing a constant power factor. Suddenly connecting or disconnecting such generation can result in a relatively large voltage change that will persist until recognized by the utility voltage regulating system. This could be a few minutes, so the change should be no more than about 5%. One condition that might give rise to this would be fault clearing on the utility system. All the generation would disconnect when the fault occurs, wait 5 min and then reconnect. Customers would first see low voltage for a minute, or so, followed 5 min later by high voltages [5].

Figure 6 illustrates one voltage regulation problem that can arise when the total DG capacity on a feeder becomes significant. This problem is consequence of the requirement to disconnect all DG when a fault occurs. Figure 6(a) shows the voltage profile along the feeder prior to the fault occuring. The intent of the voltage regulation scheme is to keep the voltage magnitude between the two limits shown. In this case, the DG helps to keep the voltage above the minimum limit and, in fact, is large enough to give a slight voltage rise toward the end of the feeder.

When the fault occurs, the DG disconnects and may remain disconnected for up to 5 min. The breaker recloses within a few seconds, resulting in the condition shown in Figure 6(b). The load is now too great for the feeder and the present settings of the voltage regulation devices. Therefore, the voltage at the end of the feeder sags below the minimum limit and will remain low until voltage regulation equipment can react. This can be the better part of a minute or longer, which increases the risk of damage to load equipment due to excessively low voltages.

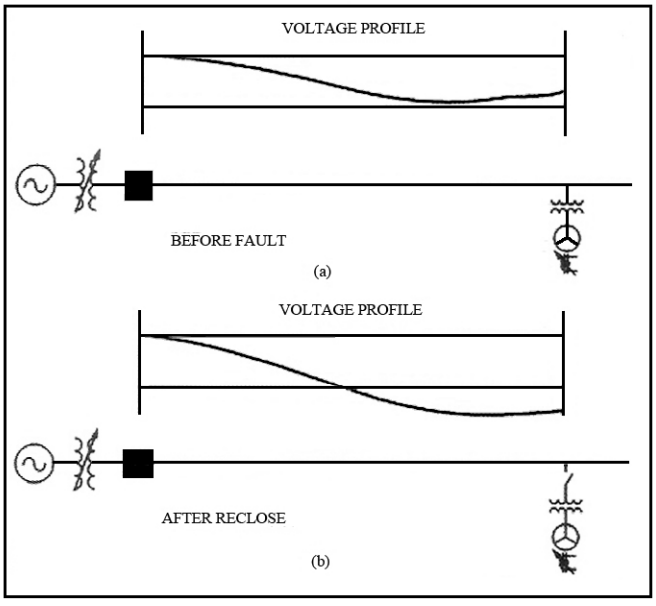


Fig.6: Voltage Profile change when DG is forced off to clear the faults [5]

Solutions include:

- Requiring customer load to disconnect with the DG. This may not be practical for widespread residential and small commercial loads. Also, it is difficult to make this transition seamlessly and the load may suffer downtime anyway, negating positive reliability benefits of DG.
- Installing more voltage regulators, each with the ability to bypass the normal time delay of 30-45 s and begin changing taps immediately. This will minimize the inconvenience to other customers.
- Allow DG to reconnect more quickly than the standard 5 min disconnects time. This would be done more safely by using direct communications between the DG and utility system control.
- Limit the amount of DG on the feeder.

5.3 Harmonic Distortion

Voltage harmonics are virtually always present on the utility grid. Nonlinear loads, power electronic loads, and rectifiers and inverters in motor drives are some sources that produce harmonics. The effects of the harmonics include overheating and equipment failure, faulty operation of protective devices, nuisance tripping of a sensitive load and interference with communication circuits. All power electronic equipments create current distortion that can impact neighbouring equipment. DG like PV, fuel cells are likely to introduce harmonics problem in the system. Harmonics from DG come from inverters and some synchronous machines. The PWM (pulse width modulation) switching inverters produce a much lower harmonic current content than earlier line-commutated, thyristor-based inverters [6].

One new distortion problem that arises with the modern inverters is that the switching frequencies will occasionally excite resonances in the primary distribution system. This creates non-harmonic frequency signals typically at the 35^{th} harmonic and higher riding on the voltage waveform. This has an impact on clocks and other circuitry that depend on a clean voltage zero crossing. A quick fix is to add more capacitance in the form of power factor correction capacitors, being careful not to cause additional harmful resonances [7].

Solutions include:

- Newer PWM inverters have lower current distortion.
- Use non-resonant switching frequencies.
- Use power factor correction capacitors.

5.4 Flicker

Flicker is a low-frequency phenomenon in which the magnitude of the voltage and frequency changes at such a rate as to be perceptible to human eye. Some energy source (e.g., wind turbine or fuel cell) has some mechanical (or chemical) fluctuations in power output and some electrical equipment (e.g., the dc bus and inverter) does not have sufficient energy storage to smooth out these fluctuations. This will result in fluctuations in the power delivered by a DG and can cause flicker in the power system in a fashion very similar to that caused by load fluctuations [8].

Solutions include:

- Utility companies try to limit flicker so that it is at a level that cannot be perceived by the human eye. This is accomplished by designing the power system to be sufficiently robust so that smaller load variations do not create noticeable voltage variations.
- It is also controlled by imposing limits on the types of loads that are allowed to connect at various points on the system.
- When a larger DR unit is applied on a feeder, rapid response voltage regulators (static Var compensators) or fast-response reactive compensation using inverter reactive power capabilities can do mitigation of flicker.
- Energy storage technologies can be applied to smooth the output fluctuations of solar and wind energy systems.

5.5 Voltage Sags

Voltage Sag is the event that can last from half of a cycle to several seconds. The ability of a DG to counteract voltage sags depends on its type and location. Generally DG has positive impact on voltage sags. Also utility faults are responsible for voltage sag [9].

Solutions include:

- Large DG with synchronous generators can help to support the voltage and reduce voltage sags on local facility.
- However, impedance of interconnection transformers might prevent any impact on adjacent loads on the feeder.

- Inverter-based distributed generators can be controlled to supply reactive power for voltage support during sag.

5.6 Islanding

One of the technical issues created by DG interconnection is inadvertent islanding. Islanding occurs when a portion of the distributed system becomes electrically isolated from the remainder of the power system, yet continues to be energized by DG connected to the isolated subsystem. It can be desirable to permit such islanded operation to increase customer reliability, and this is often done where the DG provides backup power to the facility where it is installed. However, considerable engineering effort, control functionality, and communications infrastructure are necessary to make intentional islanding viable where the island includes a portion of primary system and other loads. Even greater requirements are necessary to coordinate the operation of more than one DG in an island [10].

When the DG capacity is small compared to the system, the impact will normally be insignificant. With higher values of penetration, compared to local load and system capacity, measures intended to limit unintentional islanding can aggravate local disturbances. If DG penetration becomes widespread, the anti islanding measures may also impact bulk power system voltage and frequency stability.

5.6.1 Formulation of Islands

A typical power distribution system in North America is shown in Figure 7. The substation steps down transmission voltage into distribution voltage and is the sending end of several distribution feeders. One of the feeders is shown in detail. There are many customer connection points in the feeder. Large distributed generators are typically connected to the primary feeders (DG1 and DG2). These are typically synchronous and induction generators at present. Small distributed generators such as inverter based PV systems are connected to the low voltage secondary feeders (DG3).

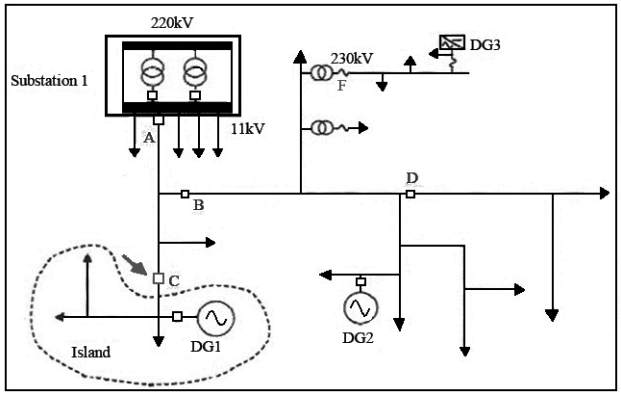


Fig.7: Typical Distributed system with DG's [10]

An island situation occurs, for example, when recloser C opens. DG1 will feed into the resultant island in this case. The most common cause for a recloser to open is a fault in the downstream of the recloser. A recloser is designed to open and re-close two to three times within a few seconds.

The intention is to re-connect the downstream system automatically if the fault clears by itself. In this way, temporary faults will not result in the loss of downstream customers. An island situation could also happen when the fuse at point F melts. In this case, the inverter based DG will feed the local loads, forming a small islanded power system.

5.6.2 Implications of unintentional islanding

The island is an unregulated power system. Its behaviour is unpredictable due to the power mismatch between the load and generation and the lack of voltage and frequency control. The main concerns associated with such islanded systems are:

- The voltage and frequency provided to the customers in the islanded system can vary significantly if the distributed generators do not provide regulation of voltage and frequency and do not have protective relaying to limit voltage and frequency excursions, since the supply utility is no longer controlling the voltage and frequency, creating the possibility of damage to customer equipment in a situation over which the utility has no control. Utility and DG owners could be found liable for the consequences.
- The distributed generators in the island could be damaged when the island is reconnected to the supply system. This is because the generators are likely not in synchronism with the system at the instant of reconnection. Such out-of-phase reclosing can inject a large current to the generators.
- Protection systems on the island are likely to be uncoordinated, due to the drastic change in short circuit current availability.

5.6.3 Out-of-phase Reclosing

Out-of-phase reclosing creates large mechanical torques and currents which can damage the generator or the prime mover if rotating generators are used. Out-of-phase reclosing can also produce transients which are potentially damaging to utility and other customer equipment. Significant shunt capacitance will usually be present in the islanded system in order to provide the reactive power balance required for the island to persist.

Out-of-phase reclosing, if it occurs at a voltage peak, will generate a very severe capacitive switching transient. In a lightly damped system, the crest over-voltage can approach three times rated voltage. With more typical damping, the switching transient can exceed 2 p.u. and utility surge arresters and customer equipment are susceptible to damage. Figure 8 provides analyzed results for an out-of-phase reclosing, showing the high transient voltage which can result [11].

Out-of-phase reclosing can also cause unusually high inrush currents in transformers and motors. The simultaneous inrush to many devices downstream of an over current protective device can cause nuisance operation of fuses and circuit breakers on both the utility system and within customer facilities. Large transient torques can also occur on motor loads, possibly leading to mechanical damage. The following analyzed results shown in Figure 9 show the 3-phase voltage and current signals under Islanding condition retrieved at the target DG location (starts at 0.3 sec) [12].

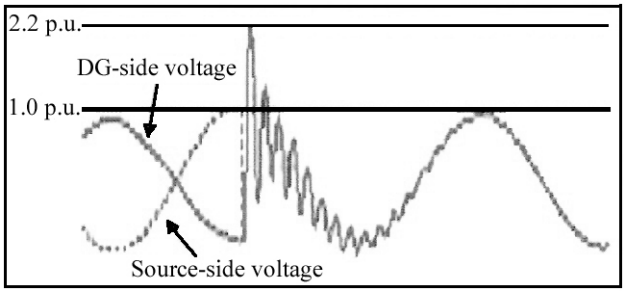


Fig.8: Phase voltages on source and DG side for a simulation of 180° out-of-phase reclosing [11]

6.0 ANALYSIS OF RESULTS

The previous sections discussed the impact of DG on the distribution network to which it is interconnected, pointing out its main supporting benefits as well as the operating conflicts that might arise with more focusing on power quality issues. To support this argument, analysis of results is provided in this chapter, which is taken from reference [4], to reveal the effect of DG on power quality. Figure 10 shows the IEEE 34-bus distribution system, with DG and local load connected at the end of the feeder. This system was simulated on EMTDC/PSCAD software [4]. The purpose of the analysis is to study the effect of a 1 MW synchronous generator based DG and a 100 kW inverter-based DG on voltage regulation, voltage sag and harmonics.

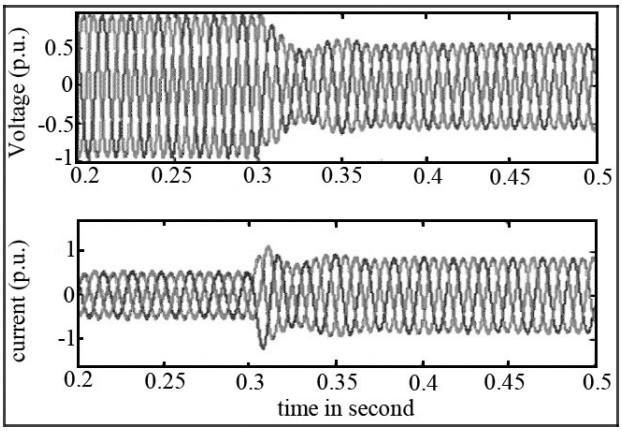


Fig.9: Three-Phase voltage and current signals under islanding condition retrieved at the target DG location (starts at 0.3 sec) [12]

6.1 One MW Synchronous generator based DG.

A 1 MW synchronous generator based DG is interconnected at the end of the 34-bus radial distribution system; i.e. at node 848. The utility supply is at the beginning of the main feeder; at node 800. The effect of DG on voltage regulation is studied by measuring the voltage near the supply (node 802) and that at the end of the main feeder (node 846), with and without the DG. The voltage at node 802 near the utility supply is denoted VG while that at node846 is denoted V_{last}.

The analyzed waveforms are as show in Figures 11(a-j), which are simulation results of 1 MW Synchronous generator based DG [4].

The first analysis is done without the DG or the local load. The waveforms for VG and V_{last} are shown in Figures 11 (a-b). The results are: VG = 21 kV; V_{last} = 17.5 kV; VR = 16.7%. When the DG is connected, the voltage at the end of the feeder is boosted, whereas the voltage near the utility supply remains the same. This is revealed in Figures 11(c-d). The results are: VG = 21 kV; V_{last} = 19.5 kV; VR = 7%. The results significantly show the effect of DG on voltage regulation and the improvements that can be achieved. It is now even possible to add another load at the end of the feeder. This is one of the main supporting benefits of DG that it improves the voltage profile across the distribution feeder and allows for load growth without the need for new transmission lines.

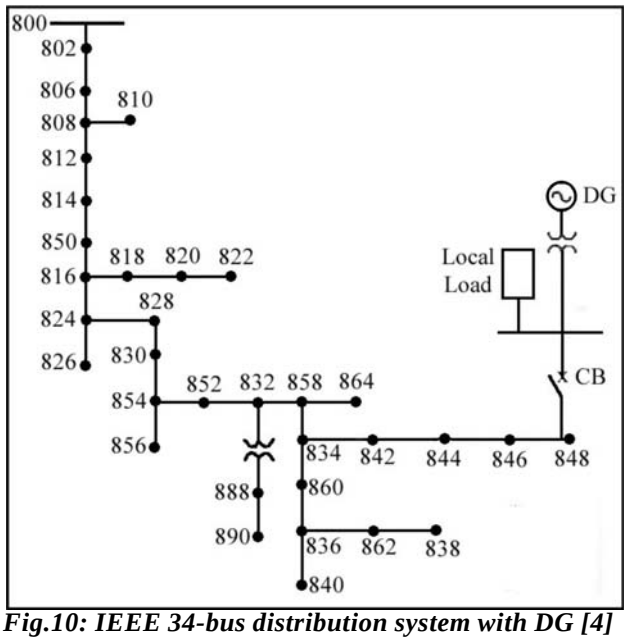
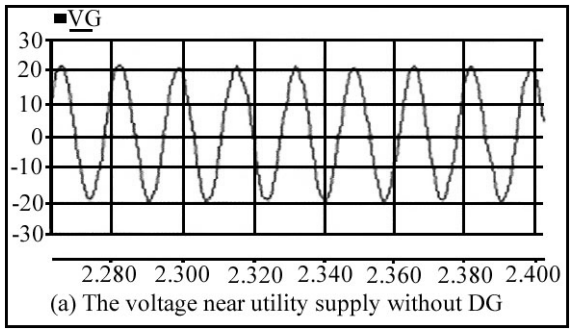
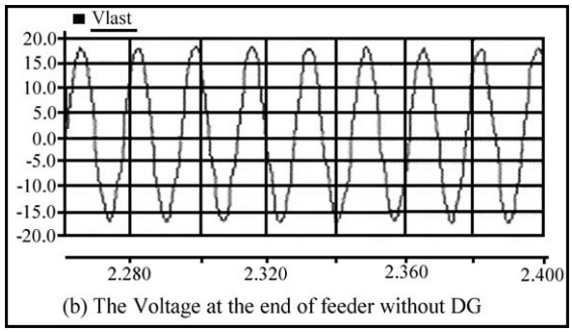


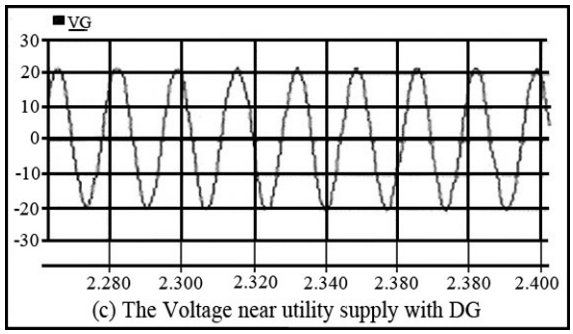
Fig.10: IEEE 34-bus distribution system with DG [4]



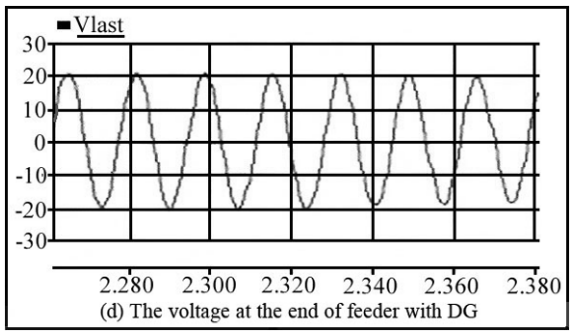
(a) The voltage near utility supply without DG



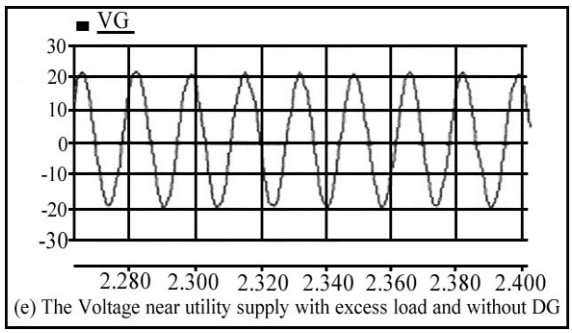
(b) The Voltage at the end of feeder without DG



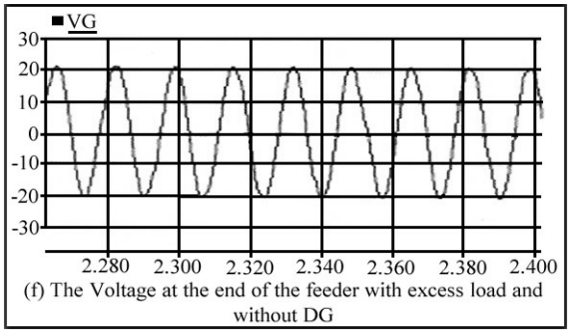
(c) The Voltage near utility supply with DG



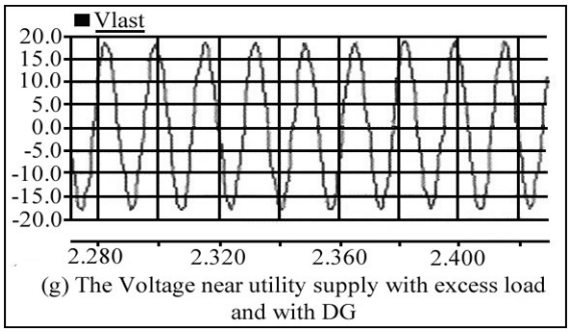
(d) The voltage at the end of feeder with DG



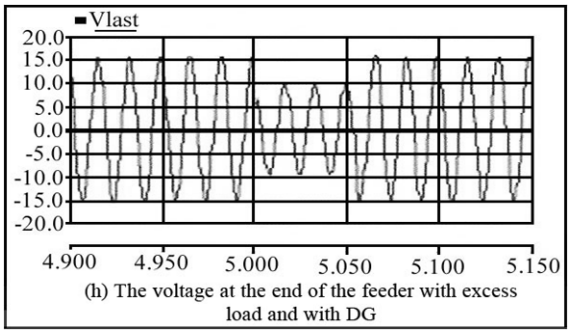
(e) The Voltage near utility supply with excess load and without DG



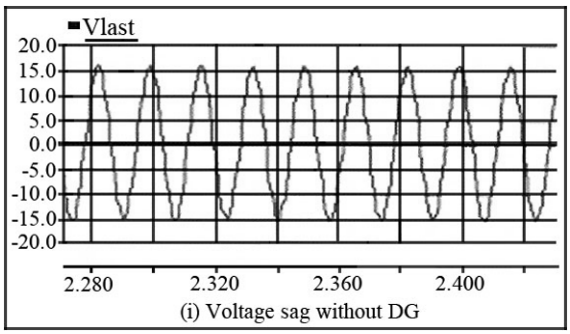
(f) The Voltage at the end of the feeder with excess load and without DG



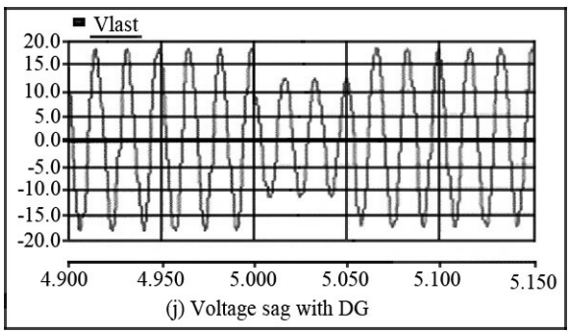
(g) The Voltage near utility supply with excess load and with DG



(h) The voltage at the end of the feeder with excess load and with DG



(i) Voltage sag without DG



(j) Voltage sag with DG

Fig.11: Simulation results of 1 MW synchronous generator based DG.

A local load now is added as shown in Figure 11. The voltages are first measured without DG to see how far the excess load will worsen the voltage regulation. The voltages waveforms are given in Figures 11 (e-f). The results are: VG = 20.5 kV; V_{last} = 15.5 kV; VR = 24.4%. The DG is now connected at the end of the feeder and the new voltages are measured to show the capability of the system to properly supply this excess load after connecting the DG. Figures 11(g-h) reveal the effect of the DG and the improvements that could be achieved concerning the voltage profile across the feeder even after adding this excess local load.

The results are: VG = 21 kV; V_{last} = 18 kV; VR = 14.3%.

The effect of the synchronous based DG on voltage sag is now studied by applying a fault at t = 5 seconds for a duration of 0.05 seconds and investigating the voltage at the end of the feeder (near the DG) in both cases; with and without the DG. The waveforms of the voltages for both cases are shown in Figures 11(i-j). Without the DG, the voltage sag is 62%, whereas when the DG is connected an improvement takes place with voltage sag equals to 67%.

6.2 100kW Inverter-Based DG

The effect of inverter-based DG on the harmonics in the system is studied in this section by introducing some non-linear loads to the distribution system, then calculating the total harmonic distortion (THD) for both the voltage and the current in both cases; with and without the DG. The analyzed waveforms are as show in Figures 12(a-b), which are simulation results of 100 kW Inverter-Based DG [4]

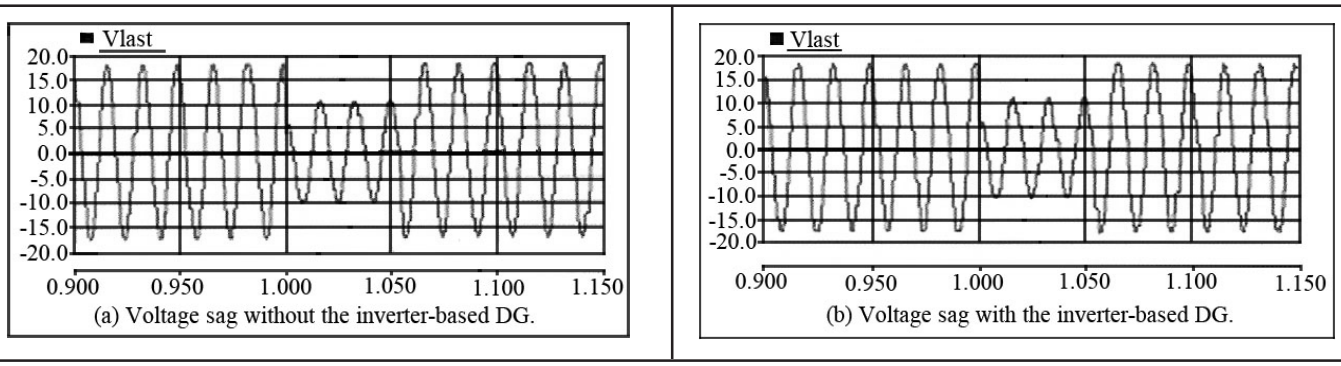


Fig.12: Simulation results of 100 kW inverter-based DG.

Without the DG, the voltage THD is 4.3% while the current THD is found to be 12.8%. When the inverter-based DG is interconnected to the network, the voltage THD remained the same while the current THD increased to 14.5%. This completely supports the fact that inverter-based DG introduces or increases the harmonics in the system to which it is connected. It is worth mentioning here that the severity of the introduced harmonics depends on the technology of the power electronic inverter.

The effect of the inverter-based DG on voltage sag is studied by applying a fault at t = 1 sec for a duration of 0.05sec and examining the voltage at the end of the feeder (near the DG) in both cases; with and without the DG.

The results shown in Figures12 (a-b) clearly support the fact that the inverter-based DG doesn't affect the voltage regulation or sag, unless it is controlled to provide reactive power. The voltage sag is the same in both cases; with and without the inverter-based DG and it is equal to 59%.

7.0 CONCLUSION

Distributed Generation is expected to play a greater role in power generation over the coming decades, especially close to the end-use low voltage consumer side. While DG may greatly improve reliability for some DG owners, it can reduce it for other customers on the feeder as some problems concerning power quality and system reliability may arise under certain circumstances. Also it can be concluded that when interconnecting DG to the power system, the issues must be considered which could affect power quality and safety.

Penetration of DG has both positive and negative impact on power quality. Large synchronous generator based DG can improve the voltage regulation and voltage sags. Whereas the small inverter based DG increase current harmonic distortion into the system. It doesn't affect, the voltage regulation and voltage sags.

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WORLD GREEN BUILDING COUNCIL

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The World GBC's mission is to strengthen green building councils in member countries by championing their leadership and connecting them to a network of knowledge, inspiration and practical support.

Green building councils are member-based organisations that empower industry leaders to effect the transformation of the local building industry toward sustainability. With one hundred thousand buildings and almost one billion square metres of green building space registered, the influence and impact of this global network is a significant force for social and environmental change.

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We foster and support new and emerging Green Building Councils by providing them with the tools and strategies to establish strong organisations and leadership positions in their countries. Since our establishment in 2002, we have been working closely with councils to promote local green building actions and address global issues such as climate change.

By driving collaboration and increasing the profile of the green building market, the World GBC works with its member councils to ensure that green buildings are a part of any comprehensive strategy to deliver carbon emission reductions.

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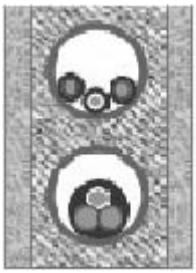
HELP LINE

Query: What are the commonly adopted Cable laying methods ?

Mr. P. Marutha Vinayagam, SSE Enterprises, Chennai

Explanation: CABLE REFERENCE INSTALLATION METHODS

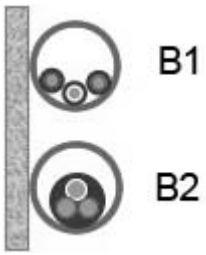
The IEC 60364 standard defines a number of installation methods which represent the various installation conditions. By the following icons, they are divided into groups and defined by the letters A to G which determine how to read the table of the current-carrying capacities in conductors.



METHOD A

- A1 - Insulated single core conductors in conduit in a thermally insulated wall
- A2 - Multicore cable in conduit in a thermally insulated wall

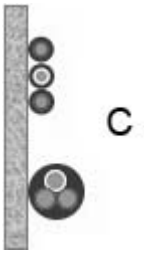
This method also applies to single core or multicore cables installed directly in a thermally insulated wall (use methods A1 and A2 respectively), conductors installed in mouldings, architraves and window frames.



METHOD B

- B1 - Insulated single core conductors in conduit on a wall
- B2 - Multicore cable in conduit on a wall

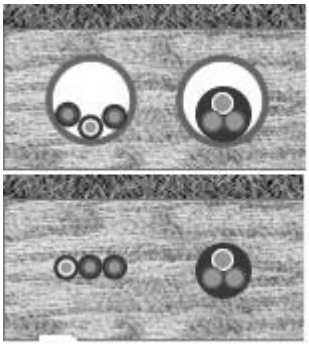
This method applies when a conduit is installed inside a wall, against a wall or spaced less than 0.3 x D (overall diameter of the cable) from the wall. Method B also applies for cables installed in trunking / cable duct against a wall or suspended from a wall and cables installed in building cavities.



METHOD C

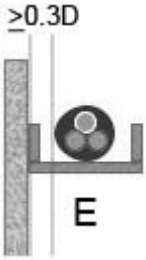
- C - Single core or multi-core cable on a wooden wall

This method also applies to cables fixed directly to walls or ceilings, suspended from ceilings, installed on unperforated cable trays (run horizontally or vertically) and installed directly in a masonry wall (with thermal resistivity less than 2 K.m/W).



METHOD D

- D1 - Multicore or single core cables installed in conduit buried in the ground
- D2 - Multicore or single core cables buried directly in the ground

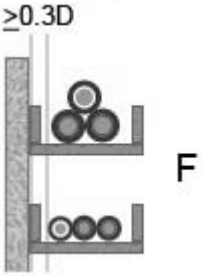


METHOD E

- E - Multicore cable in free-air

This method applies to cables installed on cable ladder, perforated cable tray or cleats provided that the cable is spaced more than 0.3 x D (overall diameter of the cable) from the wall. Note that cables installed on unperforated cable trays are classified under Method C.

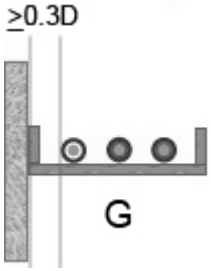
Don't be safety blinded, be safety minded.



METHOD F

- F - Single core cables touching in free-air

This method applies to cables installed on cable ladder, perforated cable tray or cleats provided that the cable is spaced more than 0.3 x D (overall diameter of the cable) from the wall. Note that cables installed on unperforated cable trays are classified under Method C.



METHOD G

- G - Single-core cables laid flat and spaced in free-air

This method applies to cables installed on cable ladder, perforated cable tray or cleats provided that the cable is spaced more than 0.3 x D (overall diameter of the cable) from the wall and with at least 1 x D spacings between cables. Note that cables installed on unperforated cable trays are classified under Method C. This method also applies to cables installed in air supported by insulators.

GARBAGE RECYCLED FROM RAMAIYANPATTI DUMP TO GENERATE POWER

The Corporation has enlisted the services of a Madurai-based firm to generate electricity from recycled waste collected from the Ramaiyanpatti garbage dump.

The company proposes to generate 2 MW of electricity every hour, which will be sold to the Tamil Nadu Generation and Distribution Corporation.

AAPL Infra Private Limited, Madurai, in partnership with Rochem Separations Systems India Private Limited, Mumbai, won the open tender for the project. The Corporation will supply garbage to the company with the revenue generated to be shared on a 50:50 basis.

As per the proposal submitted by the Madurai firm, the project, to be executed under DFBOT (Design, Finance, Build, Operate and Transfer) mode by establishing the plant on 15 acres of land, will have an outlay of Rs.72 crore and generate 2 MW power (for every 60 minutes) from 160 tonnes of garbage using Concord Blue Technology, the only commercially proven non-polluting solution that transforms nearly any form of local waste into a variety of renewable fuels and electricity.

The garbage arriving at the Ramaiyanpatti dumping yard will be stored at a particular spot and covered to eliminate the stench. The inert waste, which will be 15 per cent of the total quantum of garbage used for power generation, will be utilised for land-filling. The waste water from the power generation unit will be recycled through the reverse osmosis process.

Courtesy : The Hindu

HCL TO EXTRACT PRECIOUS METALS FROM ORE WASTE

Hindustan Copper Ltd. has invited expressions of interest from global firms for recovering precious metals from copper ore waste. “It will be a game changer, and will greatly improve our profitability,” company Chairman-cum-Managing Director K. D. Diwan said here after the company’s annual general meeting.

He said nearly 100 million tonnes of ore waste were available at the ‘tailings’, and it was possible to recover gold, silver and other precious metals from them. “We have found technology for this, and received responses to our EOI from overseas and domestic companies.”

Technologies that are available for this extraction are Australian, Indian and Chinese. The payback for this project is one and a half years.

He said work on four of the eight mining projects had started, and the balance was awaiting statutory clearances. Together, they entail a Rs.3,435-crore investment and envisage increasing capacity to 12.4 million tonnes in five years from 3.4 million tonnes now.

Courtesy : The Hindu

NATIONAL BUILDING CODE WITH GREEN NORMS WILL BE READY BY MARCH

The country will have a fine-tuned National Building Code by March next year. This addendum to the original building code will incorporate green building norms among other aspects, according to Prem Chand Jain, Chairman of Indian Green Building Council.

The draft upgraded norms have been circulated and feedback received. Based on the response, the 13-member panel, which Jain works with, has incorporated many of new features.

"We will take the draft code to several cities, discuss with various stakeholders, including municipal bodies, before releasing them. This will serve as a reference point and a guideline for engineers, architects, builders, local bodies and material suppliers etc," Jain told Business Line.

Jain outlined how the country's green building movement has made big strides and has begun to make a difference. Excerpts.

How do you see the progress in the green building movement?

Over the last three years, the acceptance of green building norms has become much wider and intense. The country now has 1.65 billion sq.ft of registered green buildings and of this over half is accounted for by home segment. People have realised the importance of green buildings and its positive impact on quality of life. In the last 100 years or so, we had begun copying what other countries were doing rather than focussing on the traditional Indian architecture which always was environment-friendly.

The concept has spread to tier-II and -III cities and has become popular in places such as Indore, Kanpur, Allahabad and smaller towns. Internally, we have a set a target of achieving 5 billion sq.ft of registration within three years. By then the existing registered buildings would have been completed.

What is the level of acceptance of new norms?

Apart from green building norms for new buildings, the IGBC has come out with norms for existing buildings, which has caught up with people. It has attracted Government buildings and older buildings and people who are keen to be part of going green. We have also come out with norms for landscaping. Apart from Green factory norms announced earlier, various green building norms that IGBC has come out with work well with the Government's and Bureau of Energy Efficiency (BEE) norms which seek to bring overall energy savings. There are more than 100 large companies such as ITC, which have taken to these norms. Each group has several projects under its fold.

Have the costs come down further. How much more does one have to invest for a green home?

The costs have gradually come down from a high of 15 per cent over a conventional building to close to 2-3 per cent when it comes to green buildings. The payback now is less than 2-3 years. In about 2-3 years, there won't be any cost differential for green homes, it will become the norm. When it comes to homes, there is not much difference.

You have broadened the scope of green building movement. How is the progress?

Now, we are working on evolving norms for schools and hospitals, two very important aspects of our life. By ensuring new norms for schools and hospitals, we seek to improve the quality of educational institutions and also that of hospitals. There is also a major drive to bring down green house gases. The green building and company norms are all directed towards bringing this down.

Courtesy: The Hindu

BHEL BAGS Rs 96 Cr WORTH NTPC ORDER

Bangalore, Sept 5: State-owned BHEL today said its electronics division here has bagged an order worth Rs 96 crore from NTPC to set up a 15 MW-solar power plant in Uttar Pradesh.

The engineering, procurement and construction (EPC) order is for design, manufacture, testing, erection and commissioning of the 15 MW grid-Interactive solar power plant at Singrauli in Uttar Pradesh, the company said in a statement.

BHEL will execute the project covering all works from concept to commissioning and will operate and maintain the project for one year, it added.

The solar plant will come up near the 2000 MW thermal power plant of NTPC at Singrauli. On completion, it is expected to supply over 23 million units of solar power every year to the Uttar Pradesh State grid.

The company said BHEL — electronics division is also executing two more solar power plants of 10MW each for NTPC at Unchahar in Uttar Pradesh and Talcher in Orissa.

Courtesy: Business Line

PROTON POWER ANNOUNCES WORLD'S FIRST BATTERY AND FUEL CELL OPERATED ELECTRIC COMMERCIAL VEHICLE IN THE 7.5 TO 12 TONNE WEIGHT CLASS

Source:

The world's first electrically operated commercial vehicle in the 7.5 to 12 tonne class with a battery and HyRange fuel cell system from Proton Power

Proton Power is pleased to announce the introduction, by its subsidiary Motor Fuel Cell GmbH ("Proton Motor") based in Puchheim near Munich, of the world's first battery and fuel cell operated electric commercial vehicle in the 7.5 to 12 tonne weight class. The vehicle is based on the battery-powered Newton vehicle built by Smith Electric Vehicles.

Proton Motor has integrated a HyRange hydrogen fuel cell system with an output of 8kW into the vehicle which supplies the battery with electrical energy. This significantly improves the vehicle's range and enables power to be supplied to the driver cabin air conditioning unit or additional equipment such as electrically powered refrigeration units.

The vehicle is available immediately for field testing by interested customers in the box van and tail lift configuration. The project was supported by funding from the NIP (National Hydrogen and Fuel Cell Technology Innovation programme).

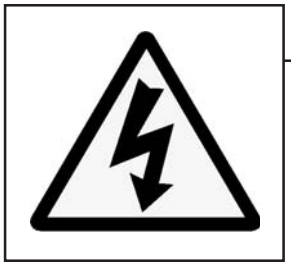
Dr. Francoise Faiz Nahab, Managing Director of Proton Motor Fuel Cell GmbH, said:

"We developed our HyRange system for buses and commercial vehicles for inner-city use. The vehicles are extremely quiet and emissions free. This is an optimal solution for every city that needs to meet the planned environmental targets. We are very proud of the results of our work over the last 3 years and hope that we will see considerable interest. Field testing the vehicles should give users from the logistics and service sectors an impression of the performance and reliability of our technology."

The Proton HyRange system is available for commercial vehicles up to 12 tonnes and for buses for local public transport. The modular design of the fuel cell system enables the electric output to be scaled accordingly.

The vehicle will be presented at the World of Energy Solutions trade fair next week in Stuttgart and will be available for test drives there.

Courtesy: Fuel Cells Works



ELECTRICAL SAFETY TIPS

GENERAL:

OSHA and state safety laws have helped to provide safe working areas for electricians. Individuals can work safely on electrical equipment with today's safeguards and recommended work practices. In addition, an understanding of the principles of electricity is gained. Ask supervisors when in doubt about a procedure. Report any unsafe conditions, equipment, or work practices as soon as possible.

FUSES:

Before removing any fuse from a circuit, be sure the switch for the circuit is open or disconnected. When removing fuses, use an approved fuse puller and break contact on the hot side of the circuit first. When replacing fuses, install the fuse first into the load side of the fuse clip, then into the line side.

GFCIs:

A groundfault circuit interrupter (GFCI) is an electrical device which protects personnel by detecting potentially hazardous ground faults and quickly disconnecting power from the circuit. A potentially dangerous ground fault is any amount of current above the level that may deliver a dangerous shock. Any current over 8 mA is considered potentially dangerous depending on the path the current takes, the amount of time exposed to the shock, and the physical condition of the person receiving the shock.

Therefore, GFCIs are required in such places as dwellings, hotels, motels, construction sites, marinas, receptacles near swimming pools and hot tubs, underwater lighting, fountains, and other areas in which a person may experience a ground fault.

A GFCI compares the amount of current in the ungrounded (hot) conductor with the amount of current in the neutral conductor. If the current in the neutral conductor becomes less than the current in the hot conductor, a ground fault condition exists. The amount of current that is missing is returned to the source by some path other than the intended path (fault current). A fault current as low as 4 mA to 6 mA activates the GFCI and interrupts the circuit. Once activated, the fault condition is cleared and the GFCI manually resets before power may be restored to the circuit. See Figure 1.

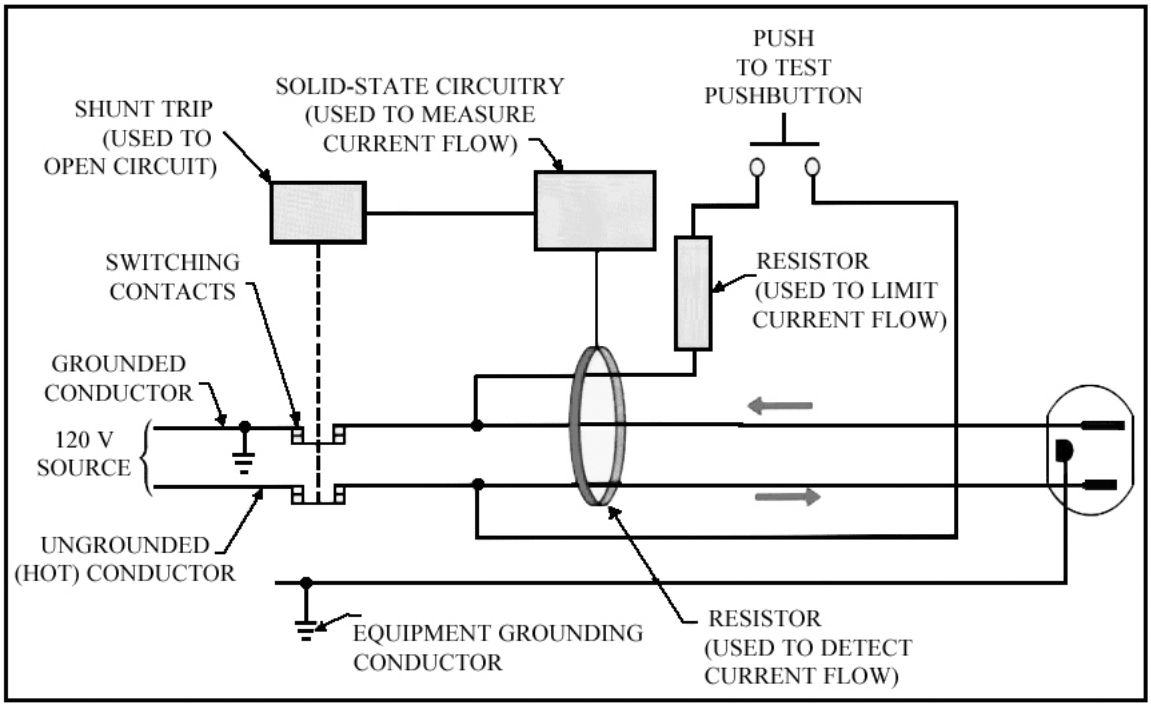


Figure 1: A GFCI compares the amount of current in the ungrounded (hot) conductor with the amount of current in the neutral conductor.

GFCI protection may be installed at different locations within a circuit. Direct-wired GFCI receptacles provide a ground fault protection at the point of installation. GFCI receptacles may also be connected to provide GFCI protection at all other receptacles installed downstream on the same circuit. GFCI CBs, when installed in a load center or panelboard, provide GFCI protection and conventional circuit overcurrent protection for all branch-circuit components connected to the CB.

Plug-in GFCIs provide ground fault protection for devices plugged into them. These plug-in devices are often used by personnel working with power tools in an area that does not include GFCI receptacles.

Electrical Shock:

Strange as it may seem, most fatal electrical shocks happen to people who should know better. Here are some electromedical facts that should make you think twice before taking chances.

It's not the voltage but the current that kills. People have been killed by 100 volts AC in the home and with as little as 42 volts DC. The real measure of a shock's intensity lies in the amount of current (in milliamperes) forced through the body. Any electrical device used on a house wiring circuit can, under certain conditions, transmit a fatal amount of current.

Currents between 100 and 200 milliamperes (0.1 ampere and 0.2 ampere) are fatal. Anything in the neighborhood of 10 milliamperes (0.01) is capable of producing painful to severe shock. Take a look at Table AI-1.

Readings		Effects
Safe Current Values	1 mA or less	Causes no sensation - not felt.
	1 mA to 8 mA	Sensation of shock, not painful; Individual can let go at will since muscular control is not lost.
Unsafe current values	8 mA to 15 mA	Painful shock; individual can let go at will since muscular control is not lost.
	15 mA to 20 mA	Painful shock; control of adjacent muscles lost; victim can not let go.
	50 mA to 100 mA	Ventricular fibrillation - a heart condition that can result in death - is possible.
	100 mA to 200 mA	Ventricular fibrillation occurs.
	200 mA and over	Severe burns, severe muscular contractions - so severe that chest muscles clamp the heart and stop it for the duration of the shock. (This prevents ventricular fibrillation).

As the current rises, the shock becomes more severe. Below 20 milliamperes, breathing becomes laboured; it ceases completely even at values below 75 milliamperes. As the current approaches 100 milliamperes ventricular fibrillation occurs. This is an uncoordinated twitching of the walls of the heart's ventricles. Since you don't know how much current went through the body, it is necessary to perform artificial respiration to try to get the person breathing again; or if the heart is not beating, cardio pulmonary resuscitation (CPR) is necessary.

Electrical shock occurs when a person comes in contact with two conductors of a circuit or when the body becomes part of the electrical circuit. In either case, a severe shock can cause the heart and lungs to stop functioning. Also, severe burns may occur where current enters and exits the body.

Prevention is the best medicine for electrical shock. Respect all voltages, have a knowledge of the principles of electricity, and follow safe work procedures. Do not take chances. All electricians should be encouraged to take a basic course in CPR (cardiopulmonary resuscitation) so they can aid a coworker in emergency situations.

Always make sure portable electric tools are in safe operating condition. Make sure there is a third wire on the plug for grounding in case of shorts. The fault current should flow through the third wire to ground instead of through the operator's body to ground if electric power tools are grounded and if an insulation breakdown occurs.

FIRST AID FOR ELECTRIC SHOCK:

Shock is a common occupational hazard associated with working with electricity. A person who has stopped breathing is not necessarily dead but is in immediate danger. Life is dependent on oxygen, which is breathed into the lungs and then carried by the blood to every body cell. Since body cells cannot store oxygen and since the blood can hold only a limited amount (and only for a short time), death will surely result from continued lack of breathing.

However, the heart may continue to beat for some time after breathing has stopped, and the blood may still be circulated to the body cells. Since the blood will, for a short time, contain a small supply of oxygen, the body cells will not die immediately. For a very few minutes, there is some chance that the person's life may be saved.

The process by which a person who has stopped breathing can be saved is called artificial ventilation (respiration). The purpose of artificial respiration is to force air out of the lungs and into the lungs, in rhythmic alternation, until natural breathing is reestablished. Records show that seven out of ten victims of electric shock were revived when artificial respiration was started in less than three minutes. After three minutes, the chances of revival decrease rapidly.

Artificial ventilation should be given only when the breathing has stopped. Do not give artificial ventilation to any person who is breathing naturally. You should not assume that an individual who is unconscious due to electrical shock has stopped breathing. To tell if someone suffering from an electrical shock is breathing, place your hands on the person's sides at the level of the lowest ribs. If the victim is breathing, you will usually be able to feel movement.

Once it has been determined that breathing has stopped, the person nearest the victim should start the artificial ventilation without delay and send others for assistance and medical aid. The only logical, permissible delay is that required to free the victim from contact with the electricity in the quickest, safest way. This step, while it must be taken quickly, must be done with great care; otherwise, there may be two victims instead of one.

In the case of portable electric tools, lights, appliances, equipment, or portable outlet extensions, the victim should be freed from contact with the electricity by turning off the supply switch or by removing the plug from its receptacle. If the switch or receptacle cannot be quickly located, the suspected electrical device may be pulled free of the victim. Other persons arriving on the scene must be clearly warned not to touch the suspected equipment until it is deenergized.

The injured person should be pulled free of contact with stationary equipment (such as a bus bar) if the equipment cannot be quickly deenergized or if the survival of others relies on the electricity and prevents immediate shutdown of the circuits. This can be done quickly and easily by carefully applying the following procedures:

1. Protect yourself with dry insulating material.
2. Use a dry board, belt, clothing, or other available nonconductive material to free the victim from electrical contact. **DO NOT** touch the victim until the source of electricity has been removed.

Once the victim has been removed from the electrical source, it should be determined whether the person is breathing. If the person is not breathing, a method of artificial respiration is used.

CARDIOPULMONARY RESUSCITATION (CPR):

Sometimes victims of electrical shock suffer cardiac arrest or heart stoppage as well as loss of breathing. Artificial ventilation alone is not enough in cases where the heart has stopped. A technique known as CPR has been developed to provide aid to a person who has stopped breathing and suffered a cardiac arrest. Because you are working with electricity, the risk of electrical shock is higher than in other occupations. You should, at the earliest opportunity, take a course to learn the latest techniques used in CPR. The techniques are relatively easy to learn and are taught in courses available through the American Red Cross.

Note: *A heart that is in fibrillation cannot be restricted by closedchest cardiac massage. A special device called a defibrillator is available in some medical facilities and ambulance services.*

Muscular contractions are so severe with 200 milliamperes and over that the heart is forcibly clamped during the shock. This clamping prevents the heart from going into ventricular fibrillation, making the victim's chances for survival better.

Lockout/Tagout

Electrical power must be removed when electrical equipment is inspected, serviced, or repaired. To ensure the safety of personnel working with the equipment, power is removed and the equipment must be locked out and tagged out.

Per OSHA standards, equipment is locked out and tagged out before any preventive maintenance or servicing is performed. Lockout is the process of removing the source of electrical power and installing a lock which prevents the power from being turned ON. Tagout is the process of placing a danger tag on the source of electrical power which indicates that the equipment may not be operated until the danger tag is removed. See Figure 2.

A danger tag has the same importance and purpose as a lock and is used alone only when a lock does not fit the disconnect device. The danger tag shall be attached at the disconnect device with a tag tie or equivalent and shall have space for the worker's name, craft, and other required information. A danger tag must withstand the elements and expected atmosphere for as long as the tag remains in place. A lockout/tagout is used when:

Figure 2: Equipment must be locked out and tagged out before preventive maintenance or servicing is performed.

- Servicing electrical equipment that does not require power to be ON to perform the service

- Removing or bypassing a machine guard or other safety device
- The possibility exists of being injured or caught in moving machinery
- Clearing jammed equipment
- The danger exists of being injured if equipment power is turned ON

Lockouts and tagouts do not by themselves remove power from a circuit. An approved procedure is followed when applying a lockout/tagout. Lockouts and tagouts are attached only after the equipment is turned OFF and tested to ensure that power is OFF. The lockout/tagout procedure is required for the safety of workers due to modern equipment hazards. OSHA provides a standard procedure for equipment lockout/tagout. OSHA's procedure is:

1. Prepare for machinery shutdown.
2. Machinery or equipment shutdown.
3. Machinery or equipment isolation.
4. Lockout or tagout application.
5. Release of stored energy.
6. Verification of isolation.

Warning: Personnel should consult OSHA Standard 29CFRI910.147 for industry standards on lockout/tagout.

A lockout/tagout shall not be removed by any person other than the person that installed it, except in an emergency. In an emergency, the lockout/tagout may be removed only by authorized personnel. The authorized personnel shall follow approved procedures. A list of company rules and procedures are given to any person that may use a lockout/tagout. Always remember:

- Use a lockout and tagout when possible
- Use a tagout when a lockout is impractical. A tagout is used alone only when a lock does not fit the disconnect device
- Use a multiple lockout when individual employee lockout of equipment is impractical
- Notify all employees affected before using a lockout/tagout
- Remove all power sources including primary and secondary
- Measure for voltage using a voltmeter to ensure that power is OFF

Lockout Devices - Lockout devices are lightweight enclosures that allow the lockout of standard control devices. Lockout devices are available in various shapes and sizes that allow for the lockout of ball valves, gate valves, and electrical equipment such as plugs, disconnects, etc.

Lockout devices resist chemicals, cracking, abrasion, and temperature changes. They are available in colours to match ANSI pipe colors. Lockout devices are sized to fit standard industry control device sizes. See Figure 3.

Locks used to lock out a device may be color coded and individually keyed. The locks are rust-resistant and are available with various size shackles.

Danger tags provide additional lockout and warning information. Various danger tags are available. Danger tags may include warnings such as "Do Not Start," "Do Not Operate," or may provide space to enter worker, date, and lockout reason information. Tag ties must be strong enough to prevent accidental removal and must be self-locking and nonreusable.

Figure 3: Lockout devices are available in various shapes and sizes that allow for the lockout of standard control devices.

Lockout/tagout kits are also available. A lockout/tagout kit contains items required to comply with the OSHA lockout/tagout standards. Lockout/tagout kits contain reusable danger tags, tag ties, multiple lockouts, locks, magnetic signs, and information on lockout/tagout procedures. See Figure 4. Be sure the source of electricity remains open or disconnected when returning to work whenever leaving a job for any reason or whenever the job cannot be completed the same day.

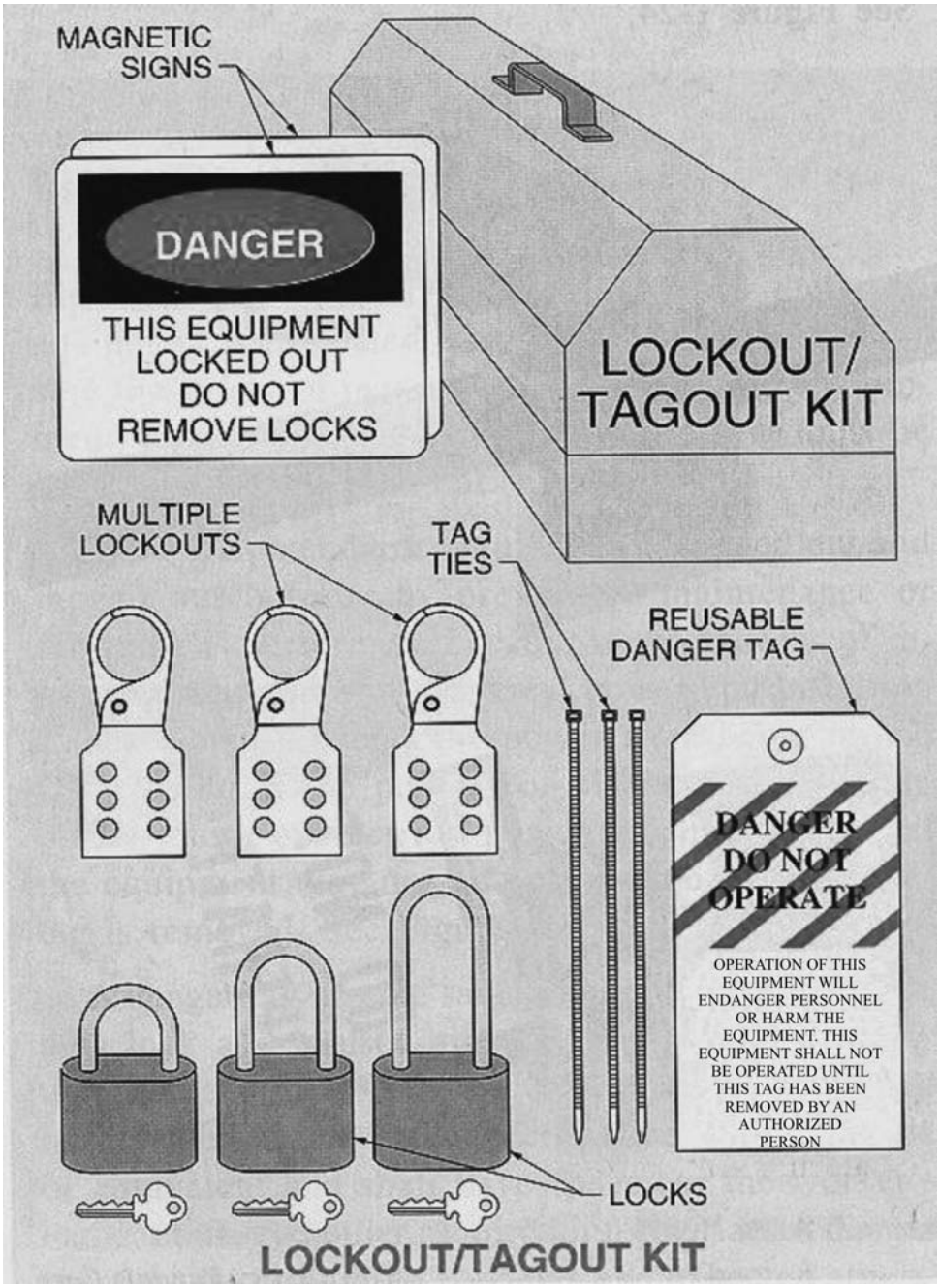


Figure 4: Lockout/tagout kits comply with OSHA lockout/tagout standards.

Clothing and Personal Protective Equipment:

Clothing should fit snugly to avoid danger of becoming entangled in moving machinery or creating a tripping or stumbling hazard. See Figure 5.

Recommended safe work clothes include:

- Thick-soled work shoes for protection against sharp objects such as nails. Wear work shoes with safety toes if the job requires. Make sure the soles are oil resistant if the shoes are subject to oils and grease
- Rubber boots for damp locations
- A hat or cap. Wear an approved safety helmet (hard hat) if the job requires

Confine long hair or keep hair trimmed and avoid placing the head in close proximity to rotating machinery. Do not wear jewelry. Gold and silver are excellent conductors of electricity.

FIRE SAFETY:

The chance of fire is greatly decreased by good housekeeping. Keep rags containing oil, gasoline, alcohol, shellac, paint, varnish, or lacquer in a covered metal container. Keep debris in a designated area away from the building.

Sound an alarm if a fire occurs. Alert all workers on the job and then call the fire department. After calling the fire department, make a reasonable effort to contain the fire.

Fire Extinguishers:

Always read instructions before using a fire extinguisher. Always use the correct fire extinguisher for the class of fire. See Figure 1-27. Fire extinguishers are normally red. Fire extinguishers may be located on a red background so they can be easily located.

Be ready to direct firefighters to the fire. Inform them of any special problems or conditions that exist, such as downed electrical wires or leaks in gas lines.

Report any accumulations of rubbish or unsafe conditions that could be fire hazards. Also, if a portable tool bin is used on the job, a good practice is to store a CO_2 extinguisher in it.

In-Plant Training:

A select group of personnel (if not all personnel) should be acquainted with all extinguisher types and sizes available in a plant or work area. Training should include a tour of the facility indicating special fire hazard operations.

In addition, it is helpful to periodically practice a dry run, discharging each type of extinguisher. Such practice is essential in learning how to activate each type, knowing the discharge ranges, realizing which types are affected by winds and drafts, familiarizing oneself with discharge duration, and learning of any precautions to take as noted on the nameplate.

Extinguisher Maintenance Tips:

Inspect extinguishers at least once a month. It is common to find units that are missing, damaged, or used. Consider contracting for such a service. Contract for annual maintenance with a qualified service agency. Never attempt to make repairs to extinguishers. This is the chief cause of dangerous shell ruptures.

Hazardous Locations:

The use of electrical equipment in areas where explosion hazards are present can lead to an explosion and fire. This danger exists in the form of escaped flammable gases such as naphtha, benzene, propane, and others. Coal, grain, and other dust suspended in air can also cause an explosion. Article 500 of The Electrical Code National covers hazardous locations. Any hazardous location requires the maximum in safety and adherence to local, state, and federal guidelines and laws, as well as in-plant safety rules. Hazardous locations are indicated by Class, Division, and Group.

To sum it all up...

Working with electricity can be dangerous. However, electricity can be safe if properly respected.

So be careful out there!

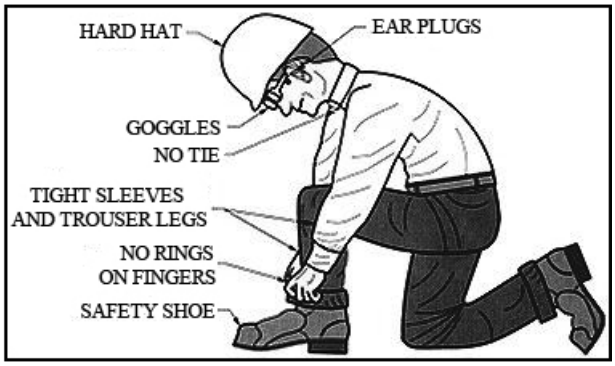


Figure 5: Clothing should fit snugly to avoid danger of becoming entangled in moving machinery or creating a tripping or stumbling hazard.

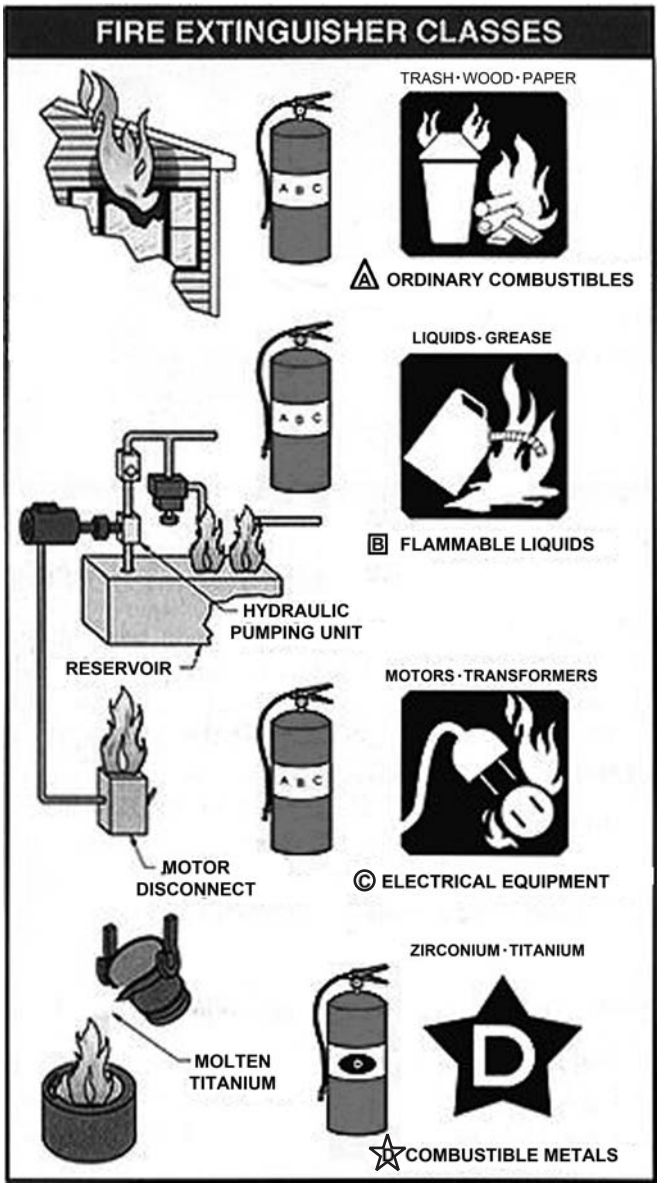


Figure 6: Always use the correct fire extinguisher for the class of fire.

Courtesy: http://www.elec-toolbox.com/Safety/safety.htm

US WIND ENERGY PRODUCTION REACHES RECORD HIGHS

US - The Energy Department and Lawrence Berkeley National Laboratory have released the 2012 Wind Technologies Market Report – detailing the latest trends in the US wind power market.

Last year, over 13 gigawatts (GW) of new wind power capacity were added to the US grid – nearly double the wind capacity deployed in 2011.

This tremendous growth helped America's total wind power capacity surpass 60 GW at the end of 2012 – representing enough capacity to power more than 15 million homes each year, or as many homes as in California and Washington state combined. The country's cumulative installed wind energy capacity has increased more than 22-fold since 2000.

At the same time, the proportion of wind turbine components such as towers, blades, and gears made in America has increased dramatically. The report estimates seventy-two percent of the wind turbine equipment installed in the US last year was made by domestic manufacturers, nearly tripling from 25 per cent in 2006-2007.

The report also finds that nine states now rely on wind power for more than 12 per cent of their total annual electricity consumption – with wind power in Iowa, South Dakota and Kansas contributing more than 20 per cent.

Additionally, Texas added over 1,800 megawatts of wind power last year, more than any other state. On a cumulative basis, Texas remains a clear leader with over 12 GW installed at the end of 2012 - more than twice as much as California, the next-highest state.

Also according to the Energy Department's 2012 Wind Technologies Market Report, technical and design innovation allowing for larger wind turbines with longer, lighter blades has steadily improved wind turbine performance and has expanded wind energy production to less windy areas. Since 1998, the average capacity of wind turbines in the US has increased by 170 per cent.

At the same time, wind project capital and maintenance costs continue to decline, lowering the cost of wind energy to near-record lows.

The price of wind under long-term power purchase contracts signed in 2011 and 2012 averaged 4 cents per kilowatt hour – making wind competitive with a range of wholesale electricity prices seen in 2012.

Courtesy: Thebioenergysite.com

FIRST HOME TO GET IGBC NOD

Energy and water efficiency specialist U.V. Krishna Rao's home at Madipakkam does not even have a municipal water connection, yet has acquired the distinction of being India's first platinum rated green home certified by the Indian Green Building Council (IGBC).

Of the three houses across the country, the Chennai building, Viswa Syamalam, is the first house to have earned an IGBC certification under the single-entity owned independent home category, which was released in March 2013.

The 3000-square feet two-storeyed building had incorporated all aspects of a green home as early as 2009, much before the council's norms were out. "I did not construct my house with a certification in mind," said 59-year-old Rao. "Being an energy consultant, I incorporated all green features that I was advising my clients while building my home," he added.

Among the salient features of Viswa Syamalam are non-consumption of electricity from sunrise to sunset, due to natural lighting and cross-ventilation besides generating 2KW power through a rooftop solar system, no municipal water connection as it has a 50,000 litre rainwater storage tank and uses recycled water using the root zone filtration method, sewage treatment as per the Aur-oville design, use of the Laurie Baker method for construction that ensures better insulation, heat reflective tiles, heat resistant paint, etc. "At that point of time, it took me Rs 43 lakh to build this house. It certainly was hefty but worth every bit of it," Krishna Rao said.

"When the IGBC came to know about my house, they sent an expert team for inspection and found that it had exceeded the standards they had drawn up," said the energy consultant.

The cost of constructing green buildings has drastically come down over the last decade with the availability of raw material locally. "Premiums have fallen from 3-4 per cent to less than one per cent for residential buildings," pointed out S. Raghupathy, executive director of CII.

Courtesy: Deccan Chronicle

IONIC LIQUIDS COULD REDUCE ENERGY CONSUMPTION

EU – Ionic liquids are at the centre of sustainability drive to make lighting more efficient, potentially dropping global energy consumption two per cent.

The EU-funded project EMIL (Exceptional Materials via Ionic Liquids) targeted the improvement of environmentally friendly technologies, in particular for applications in the field of efficient solar cells and innovative light sources.

With a European Research Council (ERC) Starting grant, Professor Anja-Verena Mudring of the chemistry and biochemistry faculty at Ruhr-Universität Bochum in Germany and her research team coated nano energy-conversion phosphors onto devices like light-emitting diodes (LEDs), solar cells and compact fluorescent lamps to test the concept.

The technique, which she says has market potential, will result in higher energy efficiency, and safer and greener production of such lighting.

For that reason, Prof. Mudring received a 'Proof-of-Concept' grant called BrightEMIL (EMIL goes green - exceptional materials from ionic liquids for energy saving applications in photonics') to test in particular the potential of ionic liquids as new solvents for generating nanoscale phosphors.

The project team worked to make the results generated from EMIL marketable.

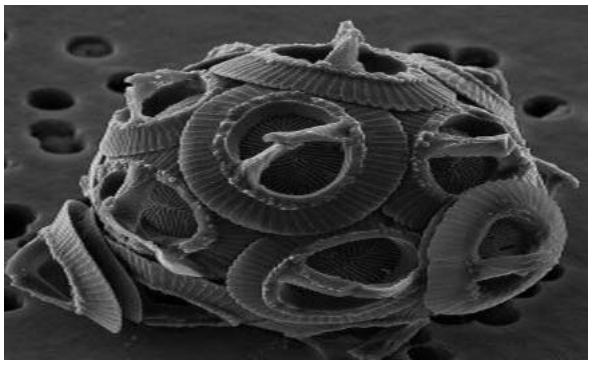
Ionic liquids are salts that are still liquid even at room temperature and are suitable for the synthesis of inorganic materials.

They are unique in that they consist of large ions that encapsulate small particles and cannot grow further. They are recyclable, easy to handle, non-flammable and non-volatile.

Courtesy: The Bioenergy Site News Desk

TURNING ALGAE INTO FUEL, KEEPING COSTS LOW

EU - A team of European scientists is on a mission to prove that microalgae can be used to produce bioethanol as a biofuel for less than EUR 0.40 a litre.



Blue-green in colour, slimy and present in seas and fresh water worldwide - the presence of microalgae is not generally met with great excitement. But this may be about to change.

The EU-funded project DEMA ('Direct Ethanol from MicroAlgae') is focusing on cyanobacteria - a microalgae found in almost every terrestrial and aquatic habitat, including in oceans, lakes and damp soil, and on rocks. They obtain their energy via photosynthesis.

The research team is seeking to improve biofuel production at two levels. First, the team will introduce the capacity to produce ethanol through metabolic engineering - by altering the chemical reactions that occur within its cells so that they can produce bioethanol effectively.

The bioethanol will then be secreted by the algae and filtered from the medium through a membrane.

The DEMA team will develop and demonstrate the technology, and is confident that the process, once fine-tuned, will be superior to any other put forward so far in scientific literature.

Biofuels have the potential to significantly reduce transport's output of carbon and reduce its impact on climate change.

Using microalgae to produce biofuels has many advantages over other forms of biomass: it occurs naturally and grows quickly, and as it does not grow on land, it does not compete with food crops.

The project brings together nine partners from both academia and industry from six EU countries. It is coordinated by the University of Limerick in Ireland and has received almost EUR 5 million from the EU under the energy strand of the Seventh Framework Programme (FP7). The project started work in December 2012 and completes its work in May 2017.

Courtesy: The Bioenergysite.com

GM TOBACCO PLANTS CAN PRODUCE BIOFUELS

WASHINGTON: Genetically modified tobacco plants are viable as raw material for producing biofuels, a new study has found. Scientists have demonstrated, for the first time, the viability of using specific tobacco proteins (known as thioredoxins) as biotechnological tools in plants.

Researchers have managed to increase the amount of starch produced in the tobacco leaves by 700 per cent and fermentable sugars by 500 per cent. Thioredoxins (Trx) are small proteins present in most living organisms.

Ruth Sanz-Barrio, an agricultural engineer of the NUP/UPNA-Public University of Navarre, demonstrated the capacity of the thioredoxins f and m in tobacco as biotechnological tools to increase the starch content in the plant.

Thioredoxin f was shown for the first time in vivo to be more efficient than Trx m in regulating the metabolism of carbohydrates, as it causes "a significant increase in the amount of starch in the leaves, which can reach 700 per cent with respect to the amount obtained from non-modified control plants."

Ruth Sanz explained that this was also new, since "up until now both Trxs were thought to act in the same way, but we have shown that this is not so."

Once the regulating function of Trx f in starch synthesis had been proven, the researchers focussed on its possible application in energy crops used to produce bioethanol.

"We saw that the leaves of the genetically modified tobacco plants were releasing 500 per cent more fermentable sugars.

"With these sugars, which could later be turned into bioethanol, one could obtain up to 40 litres of bioethanol per tonne of fresh leaves — according to the theoretical calculation provided by the National Centre for Renewable Energies where the enzymatic test was conducted," said Ruth Sanz.

This would mean an almost tenfold increase in bioethanol yield with respect to the control tobacco plant that had not been modified, researchers said.

Courtesy: Times of India

ALSET GLOBAL AND ASTON MARTIN WIN PRESTIGIOUS MOTORSPORT AWARD FOR INNOVATIVE HYBRID HYDROGEN RACE CAR

Alset Global and Aston Martin have won the Powertrain of the Year award at the Professional Motorsport World (PMW) Expo 2013 Awards in Cologne last night (November 12, 2013). The Aston Martin Hybrid Hydrogen Rapide S was the most powerful hydrogen-powered car ever and became the first to complete zero CO_2 emissions laps at an international motor race when it completed the ADAC Zurich Nürburgring 24-Hour race in May 2013.

Alset Global and Aston Martin made history with the prototype, twin-turbo Aston Martin Rapide S race car, featuring a Hybrid Hydrogen system developed by Alset Global. The system, which allowed the car to run on pure gasoline or hydrogen or a blend of both according to the driving situation, comprises a hydrogen fuel supply system, tank and proprietary engine management system.

The award was collected at the presentation ceremony by Alset Global vice president of operations, Markus Schneider and Aston Martin director of special projects and motorsport, David King. "We are proud to receive an award from the motorsport community that recognises the huge achievement of the Aston Martin and Alset Global team in developing a track-ready Hybrid Hydrogen car. For Alset Global, the Nürburgring 24 Hours race was always about showcasing a practical, affordable and clean, renewable energy and a powerful, dynamic reliable and durable propulsion system that provides sports car performance, with the carbon footprint of a supermini," commented Schneider.

With a driver line-up that included Aston Martin CEO, Dr Ulrich Bez, Aston Martin partnered with Alset Global to showcase its commitment to engineering innovation in its centenary year.

Mark Raffauf, managing director of race operations at IMSA, said, "The Alset/Aston Martin Hybrid Hydrogen racing car represents a technology application that is difficult and different."

"With all of the interest in hybrids, and various other alternative racing power systems, hydrogen was an unexplored alternative for competition. No more…this bold step has clearly shown that it can be made to work and now we are seeing the necessary interest and development to facilitate hydrogen's use in that most difficult of arenas: competition."

JAPAN STARTS UP OFFSHORE WIND FARM NEAR FUKUSHIMA

ONAHAMA PORT, Japan (AP) - Japan switched on the first turbine at a wind farm 20 kilometers (12 miles) off the coast of Fukushima on Monday, feeding electricity to the grid tethered to the tsunami-crippled nuclear plant onshore.

The wind farm near the Fukushima Dai-Ichi nuclear power plant is to eventually have a generation capacity of 1 gigawatt from 143 turbines, though its significance is not limited to the energy it will produce. Symbolically, the turbines will help restore the role of energy supplier to a region decimated by a population exodus following the multiple meltdowns triggered by the March 2011 earthquake and tsunami.

“Many people were victimized and hurt by the accident at the Fukushima Dai-Ichi nuclear power plant, so it is very meaningful to have a new source of energy - renewable energy - based here,” said Kazuyoshi Akaba, a vice minister of economy, trade and industry, after the turbine was turned on.

“It is the government’s mission to ensure this project is a success,” he said.

The project also highlights Japan’s aspirations to sell its advanced energy technology around the globe.

Trading houses such as Marubeni Corp., which is leading the consortium building the offshore wind farm, are investing aggressively in renewable energy as well as conventional sources, helped by government policies aimed at nurturing favoured industries.

All of Japan’s 50 viable nuclear reactors are offline for safety checks under new regulatory guidelines drawn up after the Fukushima disaster. Utility companies have applied to restart at least 14 reactors under those new guidelines, which include more stringent requirements for earthquake and tsunami protections, among other precautions.

In Japan, the push to tap more renewable sources to help offset lost power capacity, and reduce costs for imported natural gas and oil, also got a boost last year with the implementation of a higher wholesale tariff for energy generated from non-conventional sources.

Japan, whose coast is mostly ringed by deep waters, is pioneering floating wind turbine construction, required for seabed depths greater than 50 meters (165 feet). The 2 megawatt downwind floating turbine that began operation Monday was built at a dry dock near Tokyo and towed to its location off the northeastern coast. Six huge chains anchor it to the seabed 120 meters (almost 400 feet) below.

The turbine is linked to a 66 kilovolt floating power substation, the world’s first according to the project operators, via an extra-high voltage undersea cable.

He cites figures showing wind power’s average generating capacity at 2 watts per square meter versus 20 watts per square meter for solar power - and 1,000 watts per square meter for nuclear.

In theory, Japan has the potential for 1,600 gigawatts of wind power, most of it offshore. About a dozen projects are already in the works, from Kyushu in the south to Hokkaido in the north.

By ELAINE KURTENBACH
AP Business Writer

INDIAN AUCTION FOR 4,000 MW OF SOLAR PROJECTS TO START SOON

In a few months, an auction is to be held for the construction of a colossally huge solar project amounting to 4,000 MW in India. This was announced by the Ministry of New and Renewable Energy (MNRE), Shri Tarun Kapoor, at Intersolar India 2013. 4,000 MW of electricity could power approximately 1.3 million average households.

Kapoor added that the first 1,000 MW phase of the project is scheduled for completion within three years, and that tenders will be invited over the next three to four months.

The aim of the project is to bring the cost of power down to INR5 (7.8 US cents) per kWh from the INR6 (9.4 cents) per kWh it is now at for large-scale projects. The first phase could power up to 333,000 houses.

Viability gap funding up to INR 1,000 crore ($157 million USD) would be obtained for the project under the second round of the government’s national solar programme (3.9 cents per watt of its capacity). This project will be under the “sole authority” of the Solar Energy Corporation.

Read more at http://cleantechnica.com/2013/11/15/indian-auction-4-gw-solar-projects-start-soon/#FoXmU6L5lPwWOZ8C.99

NEC SHOWS OFF NEW PaPeRo petit ROBOT

NEC's cute communication robot, Papero, is getting a new lease on life. Japanese electronics giant NEC has announced an initiative called the Papero Partner Program, calling for research and business partners to help develop apps and distribute the robot to end users. Along with this announcement, NEC debuted the Papero Petit, the newest model of the robot.

What exactly *is* a communication robot? In recent years, NEC has positioned PaPeRo as a robotic assistant for the elderly. In experiments conducted at nursing homes, the robot would pipe up from time to time to remind people of their daily routines, like when to take their medication. It also connected with a pedometer to encourage a more active lifestyle by announcing how far a person walked in a day, and could take measurements like blood pressure.

The new robot, Papero Petit, stands 24 centimeters (9.4 inches) tall and weighs 1.3 kg (2.8 lbs)—about half the size of earlier models. It combines multiple sensors (cameras, ultrasonic range finders, temperature sensor, and microphones) to detect people and look in their direction even in complete darkness. The robot can recognize faces and has between 80 to 90 percent success rate at speech recognition.

But the biggest change is that, unlike earlier versions, Papero Petit is stationary, so it can no longer follow you from room to room like a cute little R2-D2. NEC hopes the robot can be improved with new features by connecting to the cloud to access software and computing resources. Family members could, for example, send text messages to the robot, which would read them aloud to their grandparents. NEC has already developed the app with NTT Docomo, one of Japan's largest telecommunications companies.

NEC is looking for more partners to help develop apps targeting a wide assortment of uses, from home security to health care. The company also wants to find partners to provide Papero to end users, renting the robot on a monthly basis. NEC says the monthly fee will likely be less than 10,000 yen (approximately US $100), and could include NTT Docomo wireless Internet, since many nursing home residents aren't online. NEC hopes to grow the business to 10 billion yen over the next three years.

Papero, whose name stands for Partner-type Personal Robot, was originally developed in 2000, following a prototype a few years earlier. Since then, NEC has improved the robot's software capabilities, revised its hardware, and used it in numerous experiments at care facilities and in smart homes. Despite these ongoing developments, the robot has never been made available to the public. The new business model seeks to change that, and if things work out, it could lead to Papero Petit arriving in homes and stores across Japan.

You need to be Brave. You cannot live with one foot in the past;
you need to step fully into the present to LIVE PROPERLY.

ENERGY STORY

ENERGY EFFICIENCY – THE FIFTH FUEL - PART 9

EFFICIENT ELECTRICAL ENERGY UTILIZATION

Electrical Energy Utilization and Motor Driven Systems:

Modern controls of Motors through AC Drives help not only to help start the Motors smoothly without any Current and Power spikes, not only Protect the Motors against over current, overvoltage, phase failure, Short-circuit, line-to-earth fault, overload and over temperature etc, but primarily help regulate the speed of Motors and help regulate the output to tune with actual requirements. The most important outcome of the Application of the Drives – VFDs – Variable Frequency Drives is substantial Power Savings.

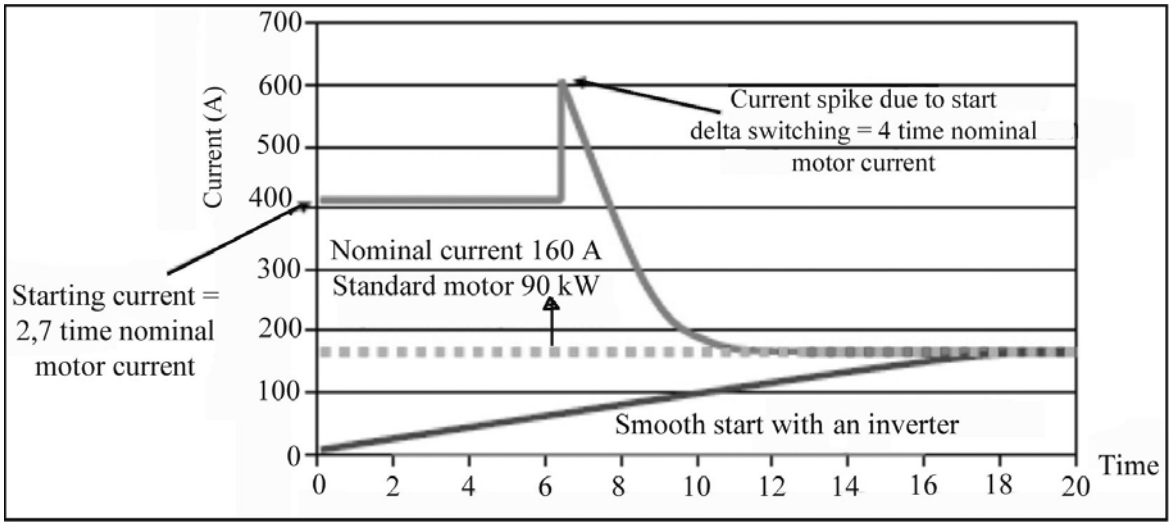


Figure 1 – The smooth starting provided by the Drives / Soft Starters

There are innumerable applications of Motors wherever Electrical Energy needs to be converted to Mechanical Energy. As seen in the earlier parts, the speeds of the Motors are decided by the design and the loads, which may not match with the exact speed at which the driven equipments are needed to run to deliver the exact output. This necessitates either speed control of Motor or regulation of output through choking or dampening or braking etc. The simple fact is that unless outputs are matched to exact requirements, excess energy is consumed by the Motor Driven System resulting in wastages.

The outputs are generally proportional to speeds whereas the input Energy to the Motor may vary proportional Speed or Speed Square or Speed Cube depending on the type of Application. In case of Conveyors, for example, the Energy input is proportional to speed, whereas in all Centrifugal Loads like Pumps and Fans and Compressors etc, the input Power is proportional to Speed Cube.

In the figure below KW, the relationships with speeds are given for different applications and as seen in one of the earlier parts, Centrifugal Loads form a sizable percentage in application of Motors.

The broad study details of applications of Electricity and of Motors within that, are summed up below, which will indicate predominant use of Electricity in areas like Pumps, Fans and Compressors, where the scope to save Electricity by Speed Controls of Motors are enormous

Use of Electricity	Applications	%	Total %
Non – Motors			24%
Motors Total			76%
	Pumps	30%	
	Fans and Blowers	12%	
	Compressors	14%	
	M/C Tools and Hand Tools	10%	
	Other AC and DC Motors	10%	

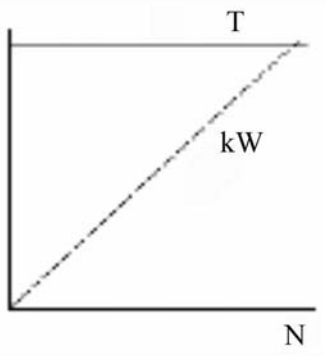
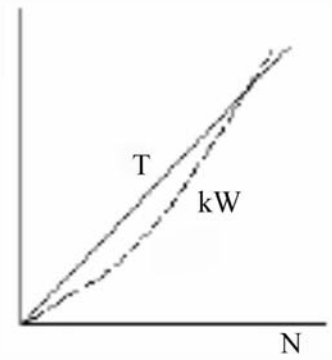
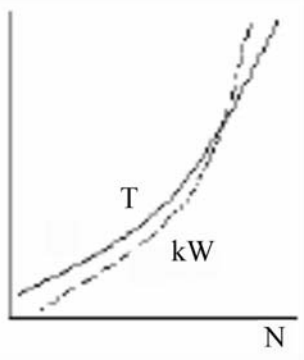
T ∝ Constant	T ∝ N	T ∝ N^2
kW ∝ N	kW ∝ N^2	kW ∝ N^3
		
Hoisting gear Belt conveyors process machines involving forming Rolling mills planers	Calendars with viscous friction Eddy-current brakes	Pumps Fans Centrifuges

Figure 2 – Various Applications of Motors and KW Relationship to Speed

The figure below will show the substantial potential to save Energy through use of Speed Control of Motors in case of Centrifugal Loads.

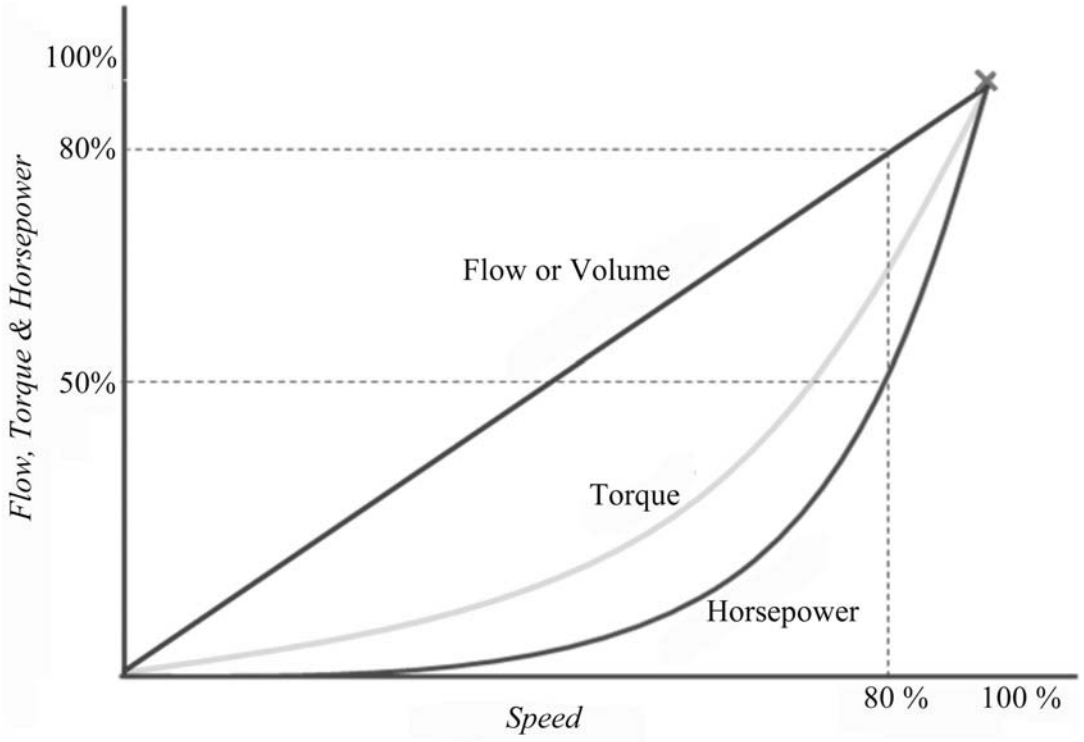


Figure 3 – Relationship between SPEED and FLOW/ HP or KW

A situation of requirement of output being 80% of the output at Full speed is shown in the figure and as can be seen, with speed reduced to 80%, the output reduces to 80%, but the HP or KW Requirement reduces to 50%.

In case of Pumps and Blowers, as shown in the Figures below, with the use of Throttle Valves and Dampers to reduce or match the output to the requirements, Power Requirements reduce to some extent, but the Power Requirements drop considerably with the use of Drives.

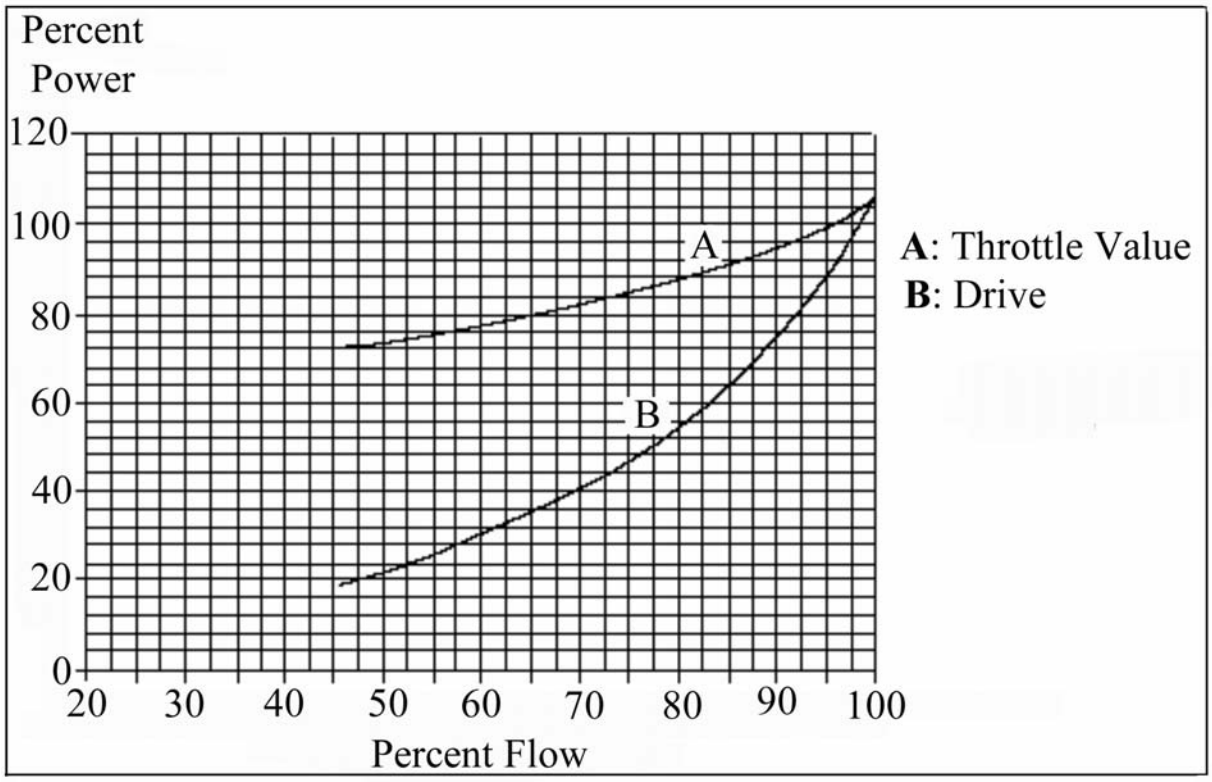


Figure 4 – PUMPS - Power requirements with varying outputs by use of Valve and Drive

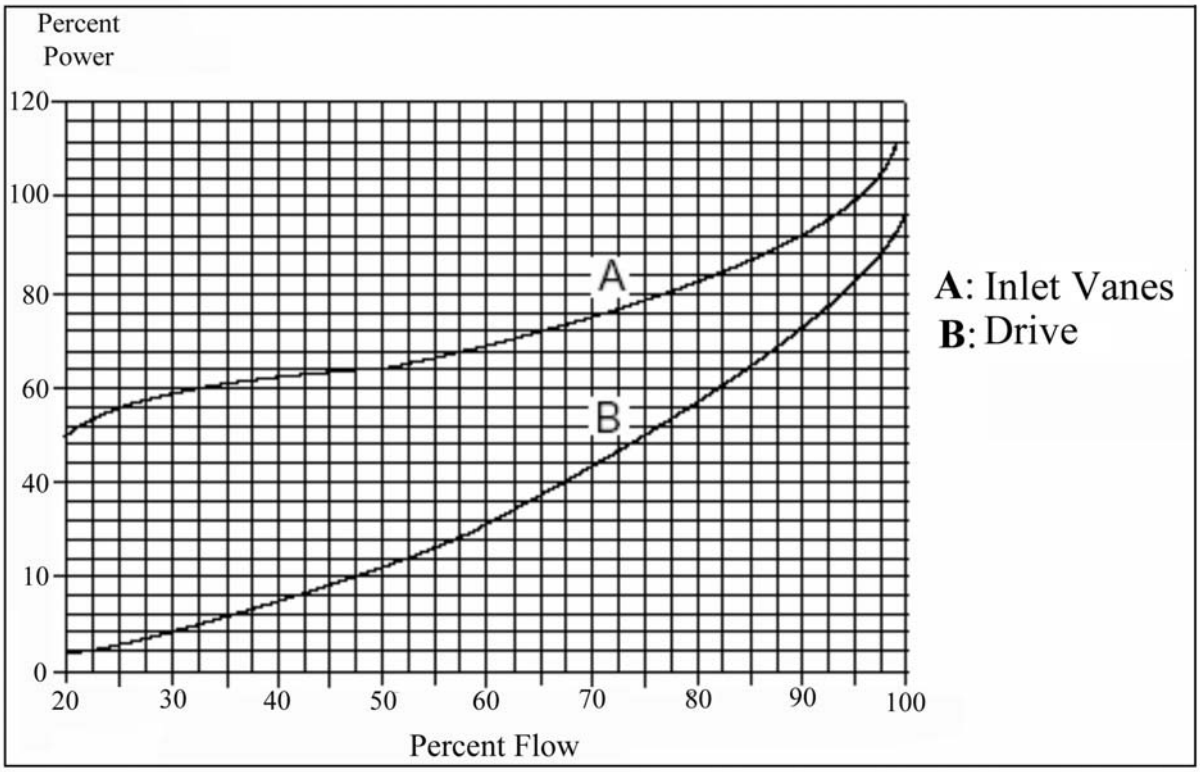


Figure 5 – BLOWERS - Power Requirements with varying outputs by vane control.

The above figures illustrate the enormous potentials available through use of Drives in case of Centrifugal Loads, which form the bulk of Motors Applications and Electricity use. ***(To be continued)***

S. Mahadevan, B.E., F.I.E., M.B.A., Consultant,
Energy and Energy Efficiency, Mobile: 98401 55209

VALLIAPPAN OLAGANATHAN CHIDAMBARAM PILLAI

Valliappan Olaganathan Chidambaram Pillai, (1872-1936) popularly known by his initials, V.O.C. (spelt Vaa. Oo.Ce in Tamil), also known as **Kappalottiya Tamilan** "The Tamil Helmsman", was a Tamil political leader.

He launched the first indigenous Indian shipping service between Tuticorin and Colombo with the Swadeshi Steam Navigation Company, competing against British ships. At one time a member of the Indian National Congress, he was later charged with sedition by the British government and sentenced to life imprisonment; his barrister license was stripped.

V.O.Chidambaram Pillai was born on 5 September 1872 in Ottapidaram (only in Ottapidaram and not in Vandanam), Tuticorin district of Tamil Nadu State of India, the eldest son of lawyer Olaganathan Pillai and Paramayee Ammal.[1] When Chidambaram was six years old he learnt Tamil from the teacher Veeraperumal Annavi. He heard stories about Lord Shiva from his grandmother and stories from Ramayana from his grandfather. He heard stories from Mahabharatha told by Allikulam Subramanya Pillai. As a child, he played goli (marbles), kabaddi, horse riding, swimming, stilt walking, archery, wrestling, silambattam and chess. He learnt English from a Taluk Officer named Krishnan in the evenings. When Krishnan was transferred, Chidambaram's father built a school with the help of the villagers and appointed Aramvalarthanatha Pillai from Ettayapuram as the English teacher. The school was run by Fr. Adamson, a priest at Pudhiamuthur. At fourteen, Chidambaram went to Thoothukudi to continue his studies. He studied at St. Xaviers High School and Caldwell High School, Thoothukudi and Hindu College High School, Thirunelveli.

Chidambaram worked as Taluk office clerk for some time before his father sent him to Thiruchirapalli to study Law. He passed his Pleadership exam in 1894, returning to Ottapidaram to become a pleader in 1895.

In Chennai, Chidambaram met Ramakrishnananthar, a saint who belonged to Swami Vivekananda Ashram (monastery), who advised him to "do something for the nation". Here he met the Tamil poet Bharathiyar who shared his political ideology. The two men became close friends.

Political life Background

Main article: Indian Independence Movement

In the 1890s and 1900s India's independence movement and the Swadeshi movement, initiated by Bal Gangadhar Tilak and Lala Lajpat Rai of Indian National Congress (INC), were at their peak. From 1892 Chidambaram was influenced by Tilak Maharaj, and became his disciple. Along with Subramanya Siva and Subramanya Bharathi, he became a prominent spokesperson for the cause in Madras Presidency. Following the partition of Bengal in 1905 Chidambaram entered politics, joining the Indian National Congress and taking a hardliner stance. He also presided at the Salem District Congress session.

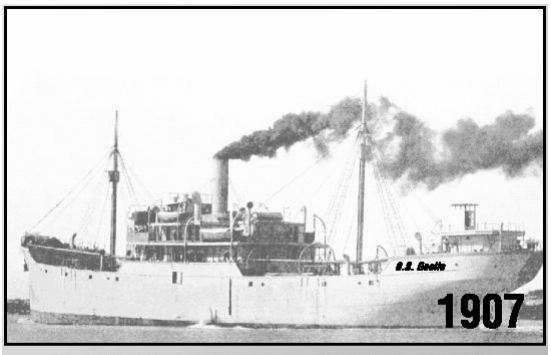
Companies and institutions

Chidambaram established many institutions like Swadeshi Prachar Sabha, Dharmasanga Nesavu Salai, National Godown, Madras Agro-Industrial Society Ltd and Desabimana Sangam. In response to the British India Steam Navigation Company's trade monopoly, Chidambaram started an Indian-owned shipping company. He registered the Swadeshi Shipping Company in October 1906. The capital of the company was ten lakh rupees. The number of shares was 40,000 and the face value of each share was Rs.25/-.Any Asian could become a share holder. The Director of the Company was Mr.Pandi Thurai Thevar, a Zamindar and the President of "Madurai Tamil Sangam". Janab Haji Mohammed Bakir Seit paid Rs.2 lakh for 8000 shares, which was the first capital for the Company.

In the beginning, the Company didn't own any ships, instead leasing them from Shawline Steamers Company. The B.I.S.N.C. pressured Shawline Steamers to cancel the lease; in response, Chidambaram leased a single large freighter from Sri Lanka. Realizing the need for the Swadeshi Shipping Company to own its own vessels, Chidambaram travelled around India selling shares in the company to raise capital. He vowed, "I will come back with Ships. Otherwise I will perish in the sea". He managed to secure sufficient funds to purchase the company's first ship, the *S.S. Galia*; shortly afterwards they were able to acquire the *S.S. Lavo* from France.

In response to the new competition, the B.I.S.N.C reduced the fare per trip to Re.1 (16 annas) per head.

Swadeshi company responded by offering a fare of Re.0.5 (8 Annas). The British company went further by offering a free trip to the passengers plus a free umbrella; however, nationalist sentiment meant that the free service was underused. The B.I.S.N.C. attempted to buy out Chidambaram, but he refused the deal. The ships commenced regular service between Tuticorin and Colombo (Srilanka), against opposition from British traders and the Imperial Government.



Coral Mill strike

Main article: Tinnevely Riot of 1908

On February 23, 1908 Chidambaram gave a speech at Thoothukudi, encouraging the workers at Coral Mill (now part of Madura Coats) to protest against their low wages and harsh working conditions. Four days later, the workers of the Coral Mill went on strike. Chidambaram and Subramanya Siva led the strike. Their demands were included incremental earnings, weekly holidays and other leave facilities.

Chidambaram ensured the strike was widely publicized, and it quickly gained popular support. On March 6 the head clerk Subramanya Pillai met Chidambaram and said that the management was ready to concede their demands. Chidambaram went with 50 workers and met the managers, who agreed to increase the wages, to reduce the working hours and to give leave on Sundays. The workers went back after a nine-day strike. The outcome of the strike encouraged the workers of other European companies, who also gained increased wages and better treatment.

Arrest and imprisonment

By 1908, Chidambaram's political involvement drew the attention of the British. Hearing of his intention to speak at a rally celebrating the release of Bengali leader Bipin Chandra Pal, Mr Winch, a British official invited Chidambaram to meet him in Thirunelveli with his political comrade Subramanya Siva. At the meeting, Winch expressed concern at Chidambaram's activities and asked him to give assurances that he would not participate in any political revolt. Chidambaram refused to accept his conditions, and so he and Siva were arrested on March 12, 1908.

The arrest met with widespread protest. In Thirunelveli shops, schools and colleges were closed in protest, and rioting broke out. Thirunelveli municipal office, post offices, police stations and municipal courts were attacked. A general strike was declared in Thoothukudi, which was the first political strike in India. Public meetings and processions were held, and four people were killed by the police. Although his supporters were able to raise sufficient funds for bail, Chidambaram refused to leave the jail without the release of Siva and his other comrades. Subramanya Bharathi and Subramanya Siva also appeared in the court for questioning for the case instituted against Chidambaram. He was charged under sections 123-A and 153-A of the Indian Penal Code for speaking against the British and giving shelter to Siva. Chidambaram refused to take part in the proceedings.

He was charged with sedition and a sentence of two life imprisonments (in effect 40 years) was imposed. He was confined in the Central Prison, Coimbatore (from 9 July 1908 to 1 December 1910). The judgement was widely condemned in the popular press, with even the British *Statesmen* magazine claiming that it was unjust. Chidambaram appealed the sentence in High Court, gaining a reduced punishment of 4 years imprisonment and 6 years in exile. An appeal to the Privy Council led to a further reduction in sentence.

Chidambaram was interred in Coimbatore and Kannanoor jail. He was not treated as a 'political prisoner', nor was the sentence 'simple imprisonment', he was rather treated as a convict sentenced to life imprisonment and required to do hard labour, which caused his health to suffer. The historian and Tamil scholar, R. A. Padmanabhan, would later note in his works that Chidambaram was "yoked (in place of bulls) to the oil press like an animal and made to work it in the cruel hot sun...." From prison Chidambaram continued correspondence, maintaining a steady stream of legal petitions. He was finally released on December

12, 1912. To his dismay, the Swadeshi Steam Navigation Company had already been liquidated in 1911, and the ships auctioned to their competitors. The company's first ship, the *S.S. Gallio* was sold to the British Shipping Company.

Later life

Upon Chidambaram's release he was not permitted to return to his Tirunelveli district. With his law license stripped from him he moved to Chennai with his wife and two young sons. There he ran a provisions store and a kerosene store. In 1920, Chidambaram withdrew from the Indian National Congress, citing ideological differences with Mahatma Gandhi. He focussed his efforts on establishing Labour Unions in Madras and writing. After moving to Coimbatore Chidambaram worked as a bank manager. Dissatisfied with the income, he petitioned the court seeking permission to practise law again. Judge E.H. Wallace gave permission to restore Chidambaram's pleadership license; to show his gratitude Chidambaram named his last son Valacewaran. Chidambaram moved to Kovilpatti and practised as a lawyer. He rejoined the Congress party in 1927 and presided over the third political conference held at Salem. He said that he wanted to join Congress again because he noticed a remarkable change in the policies of Congress and he was happy to note that the policies which he did not approve of were withdrawn one by one. However, after the Salem conference Chidambaram again severed his contact with Congress. In 1932 he moved to Thoothukudi, where he spent his time writing and publishing Tamil books.

Selected works

Meyyaram 1914., *Meyyarivu* 1915, *Anthology* 1915, *Thirukural* with literary notes of Manakudavar 1917, *Tolkappiam* with literary notes of Ilampooranar 1928, *Autobiography* 1946

Post-independence honours

Posthumously, Chidambaram is known by the titles **"Kappalottiya Thamilan"** ("the Tamizlan who drove the ship") and **"Chekkiluththa Chemmal"** ("a great man who pulled the oil press in jail for the sake of his people"). The Indian Posts & Telegraphs department of India issued a special postage stamp on 5 September 1972, on the occasion of his birth centenary.

Statues of Chidambaram

Many statues of Chidambaram have been commissioned, some of the more notable are located:

- ***At the entrance of the Congress committee office, Royapettah, Chennai (1939).***
- ***At the arch of Palayankottai, Thirunelveli.***
- ***At Marina beach, Chennai. (unveiled at the time of the World Tamil Conference).***
- ***At the port, Thoothukudi. (unveiled by Mrs. Indira Gandhi, the former Prime Minister).***
- ***At Simmakkal, Madurai (unveiled by Mr. M.G. Ramachandran, the former Chief Minister).***
- ***At the commemorative building of V.O.C., Thirunelveli. (unveiled by Ms. J. Jayalalithaa, the Chief Minister).***

A relationship is not based on the length of time you spent together, its based on the foundation you built together.

HOME FESTIVALS - 1

Thai (mid-January/Mid-February)

At left the Sun god, Surya, is being worshiped with the outdoor cooking of a large pot of rice from the recent harvest. The overflowing of the dish is called "**pongalo-pongal**", and thus this festival is known as **Thai Pongal**. Other crops, like sugarcane, bananas and turmeric, are also offered. *Kolams* (hand-made rice flour patterns) are drawn in the form of the chariot, with the Sun and Moon in the centre. On this day cows and other animals are decorated and fed special foods, and their owners prostrate to them. Crows and other birds are offered food on leaves of turmeric. Sisters pray for the welfare of brothers, and elders bless the children. Thai Pongal is celebrated by the poorest farmers and the wealthiest householders.

(To be continued...)

GAYATRI MANTRA

"GAYATRI MANTRA" the most powerful hymn in the world

Dr. Howard Steingeril, an American Scientist, collected Mantras, Hymns and invocations from all over the world and tested their strength in his Physiology Laboratory…

Hindus' Gayatri Mantra produced 110,000 sound waves /second...

This was the highest and was found to be the most powerful hymn in the world.

Through the combination of sound or sound waves of a particular frequency, this Mantra is claimed to be capable of developing specific spiritual potentialities.

The Hamburg university initiated research into the efficacy of the Gayatri Mantra both on the mental and physical plane of CREATION...

The GAYATRI MANTRA is broadcasted daily for 15 minutes from 7 P.M. onwards over Radio Paramaribo, Surinam, South America for the past two years, and in Amsterdam, Holland for the last six months.

"Om Bhoor Bhuwah Swah, Tat Savitur Varenyam, Bhargo Devasya Dheemahi, Dhiyo Yo Nah Pra-chodayaat !"

"It's meaning: God is dear to me like my own breath, He is the dispeller of my pains, and giver of happiness.

I meditate on the supremely adorable Light of the Divine Creator, that it may inspire my thought and understanding."

HUMOUR

Hiccups...

A man rushes into drugstore and asks the pharmacist for something guaranteed to stop hiccups. The pharmacist slowly poured a glass of water and when it was full he picked it up, suddenly screamed at the top of his lungs, and threw the water into the man's face. "Why did you do that?" the man yelled angrily. "Well you don't have hiccups now do you?" replied the pharmacist. "NO!" shouted the man. "But my wife in the car still does!"

Just Joke, No insults meant!

Two men, a lawyer and an MBA, are making breakfast.

As the MBA is buttering the toast, he says, "Did you ever notice that if you drop a piece of toast, it always lands butter side down?"

The lawyer says, "No, I bet it just seems that way because it's so unpleasant to clean up the mess when it lands butter side down. I bet it lands butter side up just as often."

The MBA says, "Oh, yeah? Watch this." He drops the toast to the floor, where it lands butter side up.

The lawyer says, "See, I told you."

The MBA says, "Oh, I see what happened. I buttered the wrong side!"

Messages:

1. A lawyer is bound to be skeptical.
2. An MBA is almost always wrong.
3. An MBA is trained never to accept he is wrong.

Just one

Sign in a Police Station:

It takes about 3500 bolts to put a car together; but only one nut to scatter it all over the road.

TIRUKKURAL AND MANAGEMENT IN A 'NUTSHELL' - 8

"Success Leads to Arrogance and Arrogance Leads to Failure" is a generally seen phenomenon in Management and Business dominated by individuals rather than Systems, Controls, Reviews, Feedbacks and Corrections etc. The Modern Management approaches advocate "Wisdom of Interactivity and Connectivity" as essential Paradigms of Management as these, in essence, help obtain formal and informal feedbacks continuously. There are individuals at the top and all over the organizations, big and small, who, many times start having a dose of arrogance due to their own successes now and then. They always see things in their own narrow way, unmindful of changes and realities and advancements etc. In Management this is also termed by some authors as "Myopia". Tiruvalluvar deals with such individuals and situations in his own way in the following Kural.

The essence of the Kural is that one should identify and be careful while advising such persons, as they will not only 'not change' but can also spoil your balance.

Kaanathan Kaattuvan Thaankaanan; Kaanathan Kandanam ThaanKanda varu Kural 849

காணாதான் காட்டுவான் தான்காணான் காணாதான் கண்டான்ஆம் தான்கண்ட வாறு. குறள் 849

"He that trieth to open the eyes of a fool is a fool himself; for the fool seeth but one way and that way is never wrong in his eyes"

WHAT IS THE DIFFERENCE?

Between ATTITUDE and BEHAVIOUR

Attitude is how you think and feel about things

Behaviour is the way you act.

Attitude can reflect in behaviour, but there are some people who can act very differently than what they feel.

Between WAIT and AWAIT

Wait

To stay in one place because you expect or hope that something will happen.

e.g. Shery said: she'd be waiting in the lobby.

Await

1. To wait for something that you expect to happen

e.g. They were awaiting the birth of their first child.

2. To wait for something that is the next stage in a process

The draft law is still awaiting parliamentary approval.

Between WIND and AIR

Air is the part of the Earth's atmosphere that humans breathe. It is made up of 78% nitrogen, 21% oxygen and 1% other substances.

When Air is moving then the Moving-Air is termed as Wind.

It means, that moving air is called "wind" and the mixture of gases present in atmosphere is called "air"

POWER YOUR MIND

WHAT IS RELIGION?

Religion when practiced
To achieve material goals
Such as wealth, power, etc.,
Is business
And those who propogate such
Religion are merchants.
But when it is practiced
To attain spirituality, immortality,
And freedom through service,
Devotion, meditation and
Discrimination it is yoga,
And those who propogate
Such religion are true Gurus
Or Prophets,
Real benefactors of mankind.

Courtesy: Swami Srikantananda

YOUR REAL NATURE

Let the bubbles of thoughts
Rise and fall
It matters not mind live or die.
You are the witness
Like the eternal sky
Clouds of thoughts will
Come and fly.

When you say, 'Iam God'
You are telling the truth
When you say 'Iam a child of God'
You are telling half the truth
But when you say
'Iam a child of man'
Then you have forgotten the truth.

In all your hurry to be successful, pause a moment to contemplate on TRUTH and DHARMA.

THE PETRONAS TOWERS

Height: *1,483 ft (452 meters)*

Owners: *Kuala Lumpur City Centre Holdings Sendirian Berhad*

Architects: *Cesar Pelli & Associates*

Engineers: *Thornton-Tomasetti Engineers*

Contractors: *Mayjus and SKJ Joint Ventures*

Topping Out: *1998*

Official Opening: *August 28, 1999*

On April 15, 1996, the Council on Tall Buildings named the Petronas Towers the tallest in the world, passing the torch to a new continent. Although the project's developers, a consortium of private investors in association with the Malaysian government and Petronas, the national oil company, had not originally set out to surpass Chicago's Sears Tower, they did aspire to construct a monument announcing Kuala Lumpur's prominence as a commercial and cultural capital. In the design of American architect Cesar Pelli they found a winning scheme—twin towers of elegant proportions with a slenderness ratio (height to width) of 9.4—that would capture not only the title but the public imagination.

Pelli's design answered the developer's call to express the 'culture and heritage of Malaysia' by evoking Islamic arabesques and employing repetitive geometries characteristic of Muslim architecture. In plan, an 8-point star formed by intersecting squares is an obvious reference to Islamic design; curved and pointed bays create a scalloped facade that suggests temple towers. The identical towers are linked by a bridge at the 41st floor, creating a dramatic gateway to the city.

The structure is high-strength concrete, a material familiar to Asian contractors and twice as effective as steel in sway reduction. Supported by 75-by-75-foot concrete cores and an outer ring of widely-spaced super columns, the towers showcase a sophisticated structural system that accommodates its slender profile and provides from 14,000 to 22,000 square feet of column-free office space per floor.

Other features include a curtain wall of glass and stainless steel sun shades to diffuse the intense equatorial light; a double-decker elevator system with a sky lobby transfer point on the 41st floor to accommodate the thousands of people who use the complex daily; and a mixed-use base featuring a concert hall and shopping center enveloped by nearly seventy acres of public parks and plazas.

In both engineering and design, the Petronas Towers succeed at acknowledging Malaysia's past and future, embracing the country's heritage while proclaiming its modernization. The end result, says Pelli, is a monument that is not specifically Malaysian, but will forever be identified with Kuala Lumpur.

THE PETRONAS TOWERS

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