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TARANG

TECHNICAL MAGAZINE
2018-19

DEPARTMENT OF ELECTRICAL ENGINEERING

Department Vision and Mission

VISION

To be a center of excellence in Electrical Engineering education to prepare professionally competent engineers with lifelong learning attitude for the accomplishment of ever-growing needs of society.

MISSION

- To prepare technically and professionally competent engineers by imparting quality education through effective teaching learning methodologies and providing stimulating environment for research and innovation.
- To develop professional skills and right attitude in students that will help them to succeed and progress in their personal and professional career.
- To imbibe moral and ethical values in students with concern to society and environment.

Program Educational Objectives (PEOs)

Graduates of the program will

- **PEO I :** Engage in design of system, tools & application in the field of electrical engineering & allied engineering industries.
- **PEO II :** Apply the knowledge of electrical engineering to solve problems of social relevance, pursue higher education & research.
- **PEO III:** Engage in lifelong learning, career enhancement & adapt to changing professional & societal needs.

Hon. Shri. Anil Bagane
Executive Director
SITCOE, Yadrav

Executive Director's Message

Good things remain good only because they are always scant. I am glad to unfold this wonderful magazine as an appreciation of the admirable efforts put forth by the team. The efforts taken to bring about the content is appreciable. This is a productive technical material and subsidiary skill developing tool for the students. The release of this brilliant third issue of the Technical magazine **"TARANG"** has added the value to the department. I also applaud the coordination and efforts behind the team to bring out this issue.

Dr. S. A. Khot
Principal
SITCOE, Yadrav

Principal Message

We have been gifted with this blessed life. The progress of the society is mainly depends on many people who are working behind the scenes, overtime round the clock planning things to the smallest. This Technical magazine will be a medium to provide proper acknowledgement and respect all of these efforts and its results. This is only a small step towards a long journey. This third issue of technical magazine should inspire all of us for a new beginning enlighten with hope, confidence and faith in each other in the road ahead for innovative work. It is expected that wide support for this mission will be provided through the readers valuable suggestions and comments.....Happy Reading!

Dr. Rajesh M. Patil
Head of the Electrical Dept.
SITCOE, Yadrav

HOD's Message

I feel delight to introduced third issue of technical magazine prepared by department of Electrical Engineering. We at SITCOE promise of increasing the knowledge, enhancing the critical thinking, ability to change information in to knowledge & power of analyze the thing technically of each & every individual of ever changing society through students.

As a HOD, I wish to take the opportunity to assure you that our fourth issue of technical magazine **"TARANG"** will try our best.

Mr. C. S. Patil
Electrical Engineering Dept.
SITCOE, Yadrav

Faculty Editor's Message

I am very happy about the successfully completion of second Edition & bringing out third edition of **"TARANG".** It is carnival of student versatile achievements and various measures which entail propertrade fair in form of Technical Magazine to enrich their appetite of composition skills. I appreciate the efforts taken by the committee coordinators for publishing this Technical magazine.

We profusely thank our Hon. Executive Director Mr. Anil Bagane, Principal Dr. S. A. Khot and Head of Electrical Engineering department Dr. Rajesh M. Patil for giving support and encouragement.

Mr. Vishal Dilip Patil
Electrical Engineering Dept.
SITCOE, Yadrav

Student Editor's Message

It is my great honor for being the editor of Third edition of **'TARANG'** Magazine. The purpose of technical magazine to provide a technical platform to the student to improve their technical knowledge. I Hope this magazine encourage many more students to use it to express their creativity.

I am very thankful to faculty editor to fine out me to capable for this work from Electrical department.

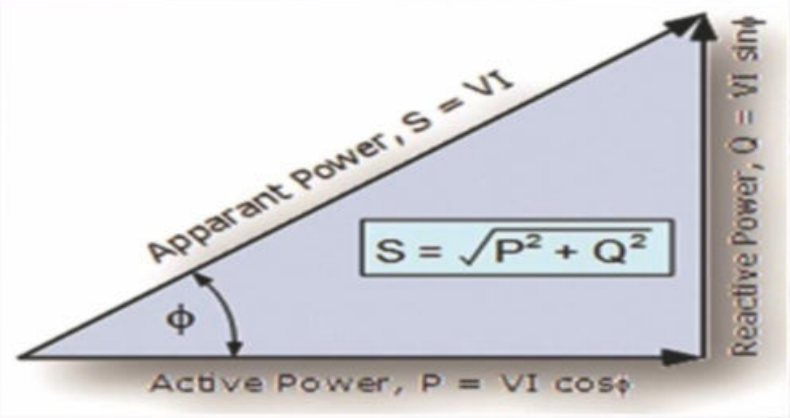
CONTENTS (2018-19)

1. REACTIVE POWER MANAGEMENT & VOLTAGE CONTROL TO AVOID BLACKOUTS

Miss. Patil Bhagyashree (BE), Miss. Ankita Bhandare (BE)

What is Reactive Power?

In an alternating current (AC) power system, Power comprises of two components, activepower and reactive power. Useful work is accomplished by active power while reactive power improves voltage stability and avoids voltage collapse. The reactive power phenomenon can be explained with the help of "Power triangle" given below.



Suppose an apparent power S is carried by a power feeder has phase difference Φ between voltage and current waveforms. If it is resolved into two mutually perpendicular components then its horizontal component along the base of power triangle is called active power, P (=S CosΦ)while its vertical component along the perpendicular is called reactive power, Q (=S SinΦ).

Where, $\Phi = \tan^{-1}(Q/P)$.

The following relationship can be shown by "Power Triangle".

$S = P + jQ = \sqrt{(P2 + Q2)} * e^{j\Phi}$

Usually, a power system network has a wide mix of active and reactive loads. Therefore, its combined power factor varies from lagging to leading through unity. Thus, the generation and consumption of active and reactive components of apparent power depend on nature of the load. The inductive load consumes reactive power while capacitive load generates it with their lagging and leading power factors respectively.

Table1: Active & Reactive Power Scenario for pure loads

Power component		Resistive load	Inductive load	Capacitive load
Power factor		Unity	Lagging	Leading
Active power	Generation	Nil	Nil	Nil
	Consumption	100%	Nil	Nil
Reactive Power	Generation	Nil	Nil	100%
	Consumption	Nil	100%	Nil

The quantity of reactive power depends on thephase shift between the voltage and current wave. The resistive load consumes only active power at unity power factor.The scenario of active and reactive power in pure resistive, inductive and capacitive load is summarized in the Table 1.

A physical analogy for reactive power :

A reasonably accurate analogy for reactive power is the process of filling a water tower tank with water – one bucket at a time.This analogy is based on the facts that," In the power system useful work accomplishes by active power while reactive power supports the voltage."

When you carry a water-filledbucket up the ladder, you have bucket and waterwhile coming down after dumping the water at the top you have an empty bucket. In this case, the empty bucket is a helping agency to do work, while carrying up the water is the desired work. When going up the ladder you need an empty bucket (reactive power) and water (active power), while come down you have the empty bucket (reactive power). Here the role of reactive power is (helping agency) performed by the empty bucket while the role of active power is performed by water.

Another analogy of the reactive power says that "Reactive power is the froth on the Beer" is fairly good here because space in the glass is occupied by the useless froth, leaving less room for real Beer.

Reactive power sources

The reactive power compensation sources are classified as,

- **Static compensation** ideal for a response within seconds and minutes like shunt capacitor, shunt reactor, and tap changer.
- **Dynamic compensation** is ideal for an instantaneous response like Synchronous condenser, Generators, and OLTC .It is further classified as,
- Dynamic shunt compensation
- Dynamic series compensation

Reactive Power Reserve (RPR)

The RPR is spare reactive capability available in the system to assist the voltage control. During the contingency like, an outage of a transmission line or sudden change in demand for reactive power,this capability will balance the supply and demand of reactive power. It helps to maintain steady state voltage, security of the bulk power system, secured system operation against short-term & long-term voltage instability and collapse.

The equipment which can maintain the RPR are synchronous condensers, 'spare shunt capacitors', 'spare shunt reactors' and Static VAR Compensators.

Generator supplied reactive power is an effective source of RPRs because of:

1. Its superior performance at low voltage as compared to static reactive devices
2. Fast response of excitation system
3. Large reactive range.

Importance of reactive Power

By regulation of reactive power the following parameters of a power system can be controlled:

- Utilization of active power
- Voltage stability
- Power factor
- System efficiency
- Energy cost
- Power quality

Utilization of Reactive power in Operation

Over a long distance power transmission, additional reactive power losses occur due to the large reactive impedance of high voltage transmission system. To avoid excessive reactive power transmission, generation and consumption of reactive power should be as close as possible to each other; otherwise, it will result in inappropriate voltage profile.

Transmission lines, transformers, induction motors, furnaces, reactors, chokes, wound control gear, consume reactive power, and its transmission is highly localized. Therefore, reactive power is provided to them by some localized sources. For LT Loads, it can be controlled by 'Intelligent Power Factor Control Relay' (IPFC).

By excitation system of the Synchronous generator, supply and demand of reactive power can be adjusted for desired voltage level. Generators also have capability curves which govern the combination of active and reactive power output.

Fig.: Reduction in power losses through regulation of reactive power

Instead of changing voltage level, power and energy losses can be reduced through regulation of a reactive power.

Active power losses ΔP and voltage drop ΔV may be obtained from the following equations:

$$\Delta P = (P2 + Q2) \times R / V2$$

$$\Delta V = \sqrt{[3x (P2 + Q2)]} \times R / V$$

Where: V, is system voltage,

R is circuit's resistance

The above relations indicate active power losses ΔP and voltage drop ΔV depend on transmission of reactive power Q. Consequently to save power losses, distributed/ local sources of reactive power like shunt capacitors for an inductive load or shunt reactors for the capacitive load can be used.

Power transfer Limits

Approximate values of 1.0 SIL	
kV	MW
69	10
138	50
230	150
345	400
500	1000
765	2000

The surge impedance loading or SIL of a transmission line is the MW loading of a transmission line at which a natural reactive power balance occurs.

A line with 1.0SIL loading will have a flat voltage profile (same voltage from sendingto receiving end), with same current in phase with voltage along the line. The reactive power into the line due to shunt capacitance charging will exactly equal to thereactive power consumed by the series inductance losses. Approximate values of 1.0 SIL are given in adjacent Table.

Power transfer limiting factors

There are three important factors which limit transmission of power.

- Thermal limit
- Voltage limit
- Stability limit

Phenomenon of Voltage Instability, Voltage Collapse, and Blackouts:

Voltage Instability

A system enters a state of voltage instability when the demand of reactive power becomes more than supply. It may happen due to –

- Increase in load / demand.
- A progressive and uncontrollable drop in voltage.
- Deficiency of reactive power due to the flow of active and reactive power from inductive reactance of transmission system.

Voltage Collapse Phenomenon

The process by which sequence of events associated with voltage instability leads to loss of voltage in a significant part of the system is called voltage collapse.

The phenomenon of voltage collapse is created when the demand for reactive power increases proportionate to active power. At this moment, a fully loaded transmission line generates extra inductive reactive power. Thus, capacitive reactive power from local sources becomes insufficient.

Therefore, the reactive power will have to be delivered from more distant places, as a consequence transmission of more reactive power through the lines will further increase the voltage drop on the customer side. Local control of voltage by means of auto transformers will supply more reactive power and this, in turn, will increase further voltage drops in lines. In one moment this process can go like an avalanche, thereby reducing the voltage to zero.

Possible Scenario of a Voltage Collapse

Possible scenario for voltage collapse is given below.

- Generating units near load centers are out of service.
- Heavily loaded lines having low Reactive Power Reserves (RPRs).
- Tripping of a heavily loaded line causes load increases over other lines and loss of reactive power and voltage.
- Load consumption would temporarily lower to stabilize. AVRs would act to restore generator voltages, but increased reactive power flow would lower voltages at consumer end or elsewhere.
- Under the capability curve, Generators would hit VAR limits.

Blackouts in a power system

A power system undergoes the voltage collapse if the post-disturbance equilibrium voltages are below acceptable limits. This voltage collapse may be converted into a total or partial blackout. A blackout in an electric system means that the complete system collapses. It originates from several causes.

Overloading of generators and transmission lines creates a deficiency of reactive power which leads voltage collapse and resultant cascade tripping can cause a blackout.

One such example is the loss of generation, e.g. the tripping of a power plant leads to overloading and under frequency over another power plant. It may result in the further loss of other generators.

Another example, is bottlenecking of transmission lines, trips other overloaded power lines, results in cascade trips. Finally, power system undergoes the voltage collapse due to high impedance in the weakened grid.

In general, one initial minor event leads to a second event, a third and so forth. Due to increased stresses on the system, it finally collapses and leads to blackouts.

Reactive power compensation

Flexible AC Transmission System (FACTS) technologies are used for reactive power compensation. It is classified as Dynamic shunt compensation and series compensation.

Dynamic shunt Compensation

Dynamic shunt compensation has the ability to automatically support the voltage level in a specific area of the power system. The voltage level is an immediate image of the reactive power balance – too high a voltage means a surplus of reactive power and vice versa. A dynamic shunt compensator automatically and instantaneously adjusts the reactive power output smoothly compared to the reference voltage level.It improves transient stability by quickly detecting and automatically adjusting its output in response to system events.Currently two types of dynamic shunt compensation technologies are commercially available in the market: the static (non-rotating) Var compensator (SVC) and the static (non-rotating) compensator (STATCOM).

An SVC is built up with reactors and capacitors and it is controlled by Thyristors. To provide voltage and transient stability automatically, it measures the actual voltage and provides reactive power to the system automatically through its capacitor and reactor. This technology has been adopted by more than 800 installations worldwide.

Series Compensation

Series compensation increases the transmission capacity and improves the stability of a power system. Since transmission line itself consumes reactive power as it transmits the active power. It means transmission system is not operated in an optimum way. By adding series compensation technology to the transmission system, the transmission capacity is drastically increased, as the capacitors will produce (capacitive) reactive power. Furthermore, it is a self-regulating phenomenon; as more current is transmitted, the power system will consume more reactive power and the capacitors will also automatically produce more reactive power. As a result, the transmission line is utilized more effectively, and more active power can reach consumers on the existing infrastructure. Series compensation supports the voltage, as long lines otherwise see a decaying voltage profile along the line.

Conclusion:

A lot of research have been done for improving system reliability but still some of the challenges are considered as a subject for research & development to avoid blackouts like, Global strategy for AVR set point, the best locations for Var control devices, determination of 'acceptable' Varmargins, fast contingency analysis for Varcomputation. Although 'under voltage relays', have been developed but there are no relays in the system to directly sense the problem that the voltage is about to collapse.

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2. ENERGY EFFICIENCY IN MOTORS AND INDIA'S STATUS

Mr. Kambale Deepak (BE), Mr. Diwani Tejaskumar (BE)

Globally, 41 countries representing 76 per cent of energy consumed by motor systems have worked to transform their national markets towards high efficiency motors and motor systems through a combination of regulatory measures and supporting policies. The majority of these countries have already adopted IE2 long back and few have progressed to make IE3 as MEPS. In India, upon IS 12615 mandatory certification, the bar has raised for improving efficiency standard for motors. However, there exist roadblocks too. In an interview with Subhajit Roy, Abhishek Dhupar, Manager–Motor & Motor Driven Systems, ICAI explains where does Indian motors industry stand in the road to energy efficiency. Excerpts:

ICAI is committed to encourage adoption of energy efficient motors. Could you discuss on the ways for improving efficiency standard for motors?

International Association of Copper India (ICAI) as an organization through various initiatives work for improving energy efficiency in various domains like motors, transformers, wires and cables, air-conditioners. In industrial motors, specifically the LT motors which form the major chunk in the motor family, it is important to improve its efficiency standard.

The most obvious method is by reducing its losses through upgrading a better and more efficient design. Here comes the improvement on efficiency levels viz. IE1, IE3, IE3 and IE4.

Upgrading the existing Indian standards for motors in line with the global standards and best practices can help in improving energy efficiency. In this regard, ICA is closely working with BIS and IEEMA technical committees.

Also, use of advanced technologies like die cast copper rotors enables achieving higher efficiencies in the same frame size.

In India, IS 12615 was brought under mandatory certification from 1st October 2017. Will standardization alone help raising the efficiency bar for motors?

You are right when you say that IS 12615 has been made as mandatory MEPS in our country w.e.f. last year. Since then majority of the manufacturers have stopped manufacturing IE1 motors and now the minimum available efficiency class is IE2. But still the switchover has not been completely achieved. For this to happen along with standardization lot of awareness regarding applicable motor standards and adoption of Higher Efficiency Motors (HEMs) by the end-users has to happen. Also, the support to MSME manufacturing sector needs to be extended in order to gear up for supplying HEMs in market. ICA has been working on capacity building by conducting various kinds of awareness workshops for end users, energy auditors and managers, consultants for adoption of HEMs.

How do you see the demand for IE2 and above motors?

The demand for IE2 and above motors has been increasing rapidly due to continuous various reasons. Firstly, by creating awareness regarding benefits of using HEMs in the industries for energy and cost savings. Secondly, efforts made by authorities responsible for driving standards and policy such as Bureau of Indian Standards (BIS) and Bureau of Energy Efficiency (BEE) for climate change mitigation and energy conservation. BEE's highly successful PAT scheme has pushed many energy intensive sectors to accelerate adoption of energy efficient technologies to reduce their energy consumption and carbon emission. Currently penetration of IE2 and above motors last year has been close to 65 per cent which was only 15 per cent in 2016.

What are the major challenges for adoption of HEMs?

Despite of knowledge of development of HEMs, the industry has been slow in replacing the existing motors with Premium Efficiency IE3 motors due to several barriers. These barriers exist at all stages in system, right from the buyer, consultant, operation and maintenance staff and also at supplier's end. Lot of efforts are required to educate buyer on energy and cost savings, payback period of investment and high reliability, low maintenance offered by IE3 motors. The mindset of user has to change, by spreading awareness on positive aspects of implementation of IE3 motors in existing industry. .

What will it take to prohibit import of sub-standard motors?

We must complement the efforts of Dept. of Industrial Policy & Promotion (DIPP) for issuing a Quality Control Order (QCO) in 2017 for motors to ban import of substandard motors in the country. But then total implementation or compliance of the same is still under question as imports haven't reduced significantly. It is quite possible these motors are being imported under some other codes which can easily bypass the customs duty. Hence, there is also a need to strengthen the compliance part and make the concerned authorities aware about how the traders can misuse the options available for other special motors HSN codes.

Is there any progress towards making of IE3 motors as far as Indian industry is concerned?

Still in India the supply of IE3 motors has not been very smooth not only due to lower demand but also investing in the test facilities and design involves significant investment along with skilled manpower which cannot be afforded by the MSME sector at least. Hence there is an urgent need to understand the challenges faced by the motor manufacturers especially the MSMEs and how they can contribute in adoption of IE3 motors quickly so that IE3 can be likely Minimum Energy Performance Standard (MEPS) in 2-3 years down the line.

Conclusion:

Biggest challenge is to spread awareness among users. Other barriers existing at different stages are: Higher initial purchase price of IE3 motors; Development of package solution for existing industrial users to facilitate switching over to IE3 motors; Availability of adequate testing facilities to meet testing requirements as per required testing standards; MSME manufacturers still not geared up to produce IE3 motors due to lack of R&D manpower and high investment in design and testing infrastructure; and users opt for multiple rewinding of old inefficient motors rather than replacing with the energy efficient motors.

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3. SMART MONITORING OF TRANSFORMER

Miss. Patil Ruchita (BE), Miss. Shivani Mane (BE)

An in-depth analysis on how IoT based monitoring system enhances performance of distribution transformers.

Transformers at substation near Denver International Airport, Colorado

The power sector in India is going through a transformation. The electricity generation from conventional sources during 2017-18 was 1206.306 billion unit (BU) as compared to 1160.141 BU generated during 2016-17, representing a growth of about 3.98 per cent. Further, the conventional generation target for the year 2018-19 has been fixed as 1265 BU i.e. growth of around 4.87 per cent over actual conventional generation of 1206.306 BU for the previous year (2017-18). India is likely to attract a massive investment of Rs 11,55,652 crore in power generation sector in the five-year period between 2017 and 2022 in setting up projects across thermal, hydro, nuclear and renewables segment.

IOT enables safe transformer operations

The modern transformers are loaded with SCADA connected instruments which can be easily hooked up to smartphones for activating alarm and trip contacts and also with substation control rooms for emergency stoppage of main line power in the event of any unlikely situation. "Typically, with economic development and continuous city size expansion across length and breadth of the country together with encroachment of existing towns and metros, we find distribution transformers are the closest to human interface. IoT control of these transformers through local substation can aid monitoring and safety of such essential devices. In fact, this is one of the agendas being discussed in smart city projects in India and abroad. It not only helps reducing power interruption and diversion at right moment but also saves the electrical networks from any such damage," said SanjibMitra, Country Head and Sr VP – Transformer Division, Electrotherm (India) Ltd.

IOT helps in remote monitoring of transformers

Distribution transformers are one of the most important equipment in power network. As a large quantity of transformers distributed over a wide area in power electric systems, the data acquisition and condition monitoring become challenging. IoT can play a critical role in monitoring and controlling of distribution transformers. Operation of distribution transformers under rated condition assurances their long life. However, their life is significantly reduced if they are subjected to overloading condition, regular unbalanced loading, non-maintenance of silica gel, oil level, and oil and insulation degradation, resulting in sudden failures and loss of supply to a large number of customers thus affecting system reliability. In transformer monitoring system four sensors for monitoring are used that is voltage sensor, current sensor, temperature sensor and oil level sensor.

Smart grid, the next generation electric power system, is actual way of digital transmission of electricity. It is digital technology that allows resourceful two-way communications between utility and customers. "Using smart grid-based sensors like current, voltage and temperature sensors along with IoT embedded wireless communication protocol enable real time monitoring of power line parameters like voltage, current and temperature. These sensors qualify the remote monitoring of equipment such as transformers and power lines. They improve the performance and extending the life of grid components to ensure a safe and reliable operation of the electricity network. This system also helps to identify problems before any shattering," explains Anil Kadam, GM – Business Development, Solution Architect, Schneider Electric while commenting on how IoT based monitoring system enhances performance of distribution transformers.

Conclusion :

Transformer being the heart of power transfer and the most essential electrical device in a power generation and T&D network, it needs a healthy and safe product life cycle. Monitoring of such essential devices is of course beneficial to avoid any sudden power cut and to avoid accidental blackouts. Any such abnormalities may lead to fatal accidents of major nature depending on the size and vicinity of the running transformers. IoT is the answer to handle all such latent threats, concludes Sanjib Mitra of Electrotherm (India) Ltd.

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4. TECHNOLOGICAL DEVELOPMENT OF SWITCHGEARS

Mr. Rakesh Koli (BE), Mr. Swami Sanjeev (BE)

With the pace of government initiatives for development of smart grid, there is need to develop different kinds of switchgear suitable for smart grid operation and that is more compact, reliable, environment friendly and requires minimum installation and commissioning time.

The reliability of a power system directly depends on the efficient functioning of its equipment especially in the wake of greater integration of variable renewable energy with the grid. Substations transform the voltage from high to low and house the various equipment required for transformation, switching, regulation and protection of transmission and distribution systems.

Switchgear is one of the most important and critical components in an electrical system. It includes all the devices that ensure power system protection and regulate power supply. Switchgear de-energies equipment and clears faults in the system, thereby, ensuring reliable power supply. Electrical switchgear is necessary at every switching point in the electrical power system. Besides the power system, switchgear is also used in the commercial, residential and industrial sectors.

The switchgear comprises devices associated with power system control and protection such as switches, fuses, circuit breakers and relays that are used to control, protect and isolate an electrical equipment to enable continuous and reliable supply of electricity. The use of switchgear helps in protecting against situations of overload, short circuit, insulation failure etc. Power system protection is a bough of electrical power engineering and it is designed to continuously monitor the power system to ensure maximum continuity of electrical supply without damaging equipment. Since power system developments change its structure, the power system protection becomes very vital.

Switchgear Classification

The technology and range of switchgear varies across different segments of the grid, depending on the voltage level. Based on the load-bearing capacity, the switchgears are categorized into three segments – low voltage (LV), medium voltage (MV) and high voltage (HV). The LV switchgear segment includes switchgear rated up to 1 kV, the MV segment consists of switchgear rated up to 33 kV, and the HV segment includes devices rated at 66 kV and above.

The key consumer segments of LV switchgear include distribution utilities, industries, residential and commercial buildings, and agricultural consumers. Common LV switchgear devices include air circuit breakers (ACBs), molded case circuit breakers (MCCBs), motor protection circuit breakers (MPCBs), miniature circuit breakers (MCBs), residual current devices (RCDs), switch fuse (S/F) and fuse switch (F/S) units, high rupturing capacity (HRC) fuses, thermal overload and protection relays, connectors, starters, distribution boards and switches.

MV and HV switchgear is often categorized as one owing to its usage and applications, which are mainly in power systems. MV switchgear includes various types of circuit breakers such as air circuit breakers, minimum oil circuit breakers and vacuum circuit breakers. For the MV and HV segment, transmission and generation utilities are the key users. Depending on the insulating medium, HV switchgear is classified into three major types – air insulated switchgear (AIS), gas insulated switchgear (GIS) and hybrid switchgear (HS).

The different kinds of switchgears can also be classified on the basis of their load bearing capacity (or voltage class), the medium used to interrupt the current, the interrupting rating (which is the maximum short circuit current that the device can safely interrupt), construction type, operating method and type of current.

As per the construction type, switchgear is classified as indoor, outdoor, industrial, live front, dead-front, open, metal enclosed, metal-clad, arc resistant etc. With regard to the method of operation, a switchgear is classified either manually operated or motor/stored energy operated, or solenoid operated. Meanwhile, depending on the type of current, it operates either on alternating current or direct current. In addition, based on the medium used to interrupt the current, switchgear is classified as either a simple open-air isolator switch or it may be insulated by some other material like oil and vacuum.

New developments in the switchgear industry are vacuum switchgear, hybrid switchgear and intelligent switchgear. Vacuum switching widely used in the medium voltage range, is also emerging as an alternative in HV applications. This trend is being driven by the fact that the vacuum switchgear is more environment friendly than SF6 switchgear. Hybrid switchgear is a combination of conventional air insulated switchgear and high voltage gas insulated switchgear. With the development of smart grid, the smart switchgear has also become popular. It is also capable to handle increasing integration of variable renewable energy into grid.

Technology Development

Owing to an increasing focus on conserving right of way and ensuring uninterrupted power supply, power utilities are focusing on substation and switchgear technologies that require less space and have a reduced outage. Historically, air-insulated switchgear has been the most commonly used switchgear in India due to the low price. However, gas-insulated switchgear, which use Sulphur hexafluoride (SF6) gas as the insulating medium, are picking up pace and gaining popularity, is the emerging as the preferred technology in India, especially, in the transmission segment.

Its compact and encapsulated structure makes it ideal for areas with space constraints. This kind of switchgear is also suitable for use in locations with severe weather conditions (high temperature and high altitudes) and in industrial environments. GIS substations require approximately 35 per cent less space than AIS substations and have lower maintenance and outage costs. Although the initial cost of GIS substations is about 50 per cent higher than that of their AIS counterparts, the overall capital costs are comparable.

Utilities can also opt for a hybrid switchgear – based substation, which is a mix of AIS and GIS technologies. In a hybrid substation, the bus bars are air insulated and all other equipment such as circuit breakers, bushings, bus ducts, connecting elements, disconnectors, current transformers and sensors are gas insulated. The initial cost of hybrid substations is approximately 20 per cent higher than that of AIS, and these substations require a moderate size of land.

Ultra high voltage (UHV) and smart switchgear are the other key emerging technology trends. The growing demand for greater transmission of power over long distances and with lower losses necessitates the more to UHV or EHV transmission technologies at 800 kV, 1100 kV and 1200 kV. Power grid has commissioned the (+/-) 800 kV North East Agra UHDC link, (+/-) 800 kV ChampaKurukshetraBipole and the 1200 kV UHVAC Bina National Test Station. It is currently executing the (+/-) 800 kV Raigarh-Pugalur UHVDC link. These large UHV systems require switchgear that can meet safety, performance and reliability demands.

Smart Grid Operation

In smart grid operation, automated switchgear operation is preferred over conventional operation. In conventional substations, all signals, controls and interlocks are hardwired and records are manually maintained in a logbook. Therefore, a lot of work and efforts is required to draw comparisons for analysis and trouble shooting. An automated substation, wherein all operations are automated, is more efficient and requires less manpower. It also promotes energy efficiency and ensures better utilization of assets thereby, smartly handled the uninterrupted power flow through smart grid.

Traditionally, remote terminal units were used in substations as a link between the switchgear and the control center. Some of these remote terminal units had intelligence features such as interlocking features, but no substation or region-wide automation was available. However, now more and more remote terminal units are being replaced by or complemented with specialized intelligent electrical devices that are capable of multiple protections and measurements in smart grid operation. In addition, intelligent gateways and concentrators have been introduced in the substation. In smart grid operations, monitoring and signaling are becoming an integral part of the switchgear, in addition to protection and control functions. Manufacturers are including intelligent built-in protection and control electronic devices in the switchgear to enhanced grid efficiency and reliability.

Switchgear Digitalization

Over the past few years, several technological solutions have emerged that have contributed significantly to enhancing the operational efficiency of utilities and to scaling down costs, making projects more viable. Digital switchgear and substations are one such solution which offers a range of benefits to utilities. To begin with, they are equipped with advanced software solutions that protect systems from potential cyber threats, thereby, strengthening system security. Further, all the auxiliaries of the digital switchgear are automated, enabling faster implementation of future technological solutions. Moreover, since utilities can track real-time data from substations and remotely control specific functions of the switchgear, it provides operational and financial benefits. Real time monitoring of data also reduces outage time and increase reliability of the system.

In addition, digital substations and switchgears possess backward compatibility, which enables the smooth integration of new communication technology with the utilities existing systems. Other benefit of digitalization is reduced maintenance costs. This is primarily because utilities can monitor and control parameters in real time, thereby, reducing the need of periodic maintenance. Apart from the operational and financial benefits, digital switchgears have another crucial purpose. Through compact primary equipment and smaller relay rooms, they reduce the substation footprint, thereby, allowing utilities to use the remaining space more efficiently. Digital switchgear also entail a lower installation time, since there are fewer panels to install and fewer cables to be pulled, connected and tested.

Conclusion:

With the pace of government initiatives for development of smart grid, there is need to develop different kinds of switchgear suitable for smart grid operation and that is more compact, reliable, environment friendly and requires minimum installation and commissioning time. Moreover, as the pace of renewable energy integration increases, utilities would be required to increase the deployment of intelligent switchgear or to undertake modifications to transform the existing switchgear modules into smart switchgear.

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5. APPLICATION OF WLAN TO AUTOMATIC VEHICLES

Miss. Swati Jugulkar (BE), Miss. Gouri Kambale (BE)

Automated cars definitely are the future means of transportation. Existing system of transportation is simply not efficient owing to human errors. Thus, creation of a new system which is fully automated and efficient is need of the hour. In our system, we connect a car with those in its vicinity using WLAN or wireless LAN in order to transfer data about the specifications of the car, traffic conditions, lane shifting and its speed. The computer process this information obtained from other cars and uses parameter such as road rules obtained from the sensors placed along the road, the route map derived from the GPS database and radar scanning to maintain optimum distance between other vehicles and obstructions.

EXISTING SYSTEM:

The Ohio State University Center for Intelligent Transportation Research (CITR) has developed three automated vehicles demonstrating advanced cruise control, automated steering control for lane keeping, and autonomous behavior including automated stopping and lane changes in reaction to other vehicles. Various sensors were used, including a radar reflective stripe system and a vision based system for lane position sensing, a radar system and a scanning laser range finding system for the detection of objects ahead of the vehicle, and various supporting sensors including side looking radars and an angular rate gyroscope. Whenever multiple sensors were available, data fusion and fault detection were employed to maximize functionality without driver involvement.

Drawbacks:

The system which CITR has developed is applicable only for highways where there is a single road and constant speed. Such a system would fail if it is applied in a region of high traffic density such as a big city because of some many other factors such a taking turns and multiple destinations. For such a situation where you have different vehicles going to different destinations, communication between the vehicles is essential and WLAN plays an important role in overcoming this difficulty.

PROPOSED SYSTEM:

We propose to integrate the following systems in our Automated Vehicular System to overcome the difficulties faced in the drawbacks stated above.

WLAN:

A wireless LAN or WLAN is a wireless local area network, which is the linking of two or more computers or devices without using wires. WLAN uses spread-spectrum or OFDM modulation technology based on radio waves to enable communication between devices in a limited area, also known as the basic service set. This gives users the mobility to move around within a broad coverage area and still be connected to the network.SAN JOSE, Calif. Nov. 2003 Cisco Systems Inc. announced the results of a new study conducted by independent research firm NOP World Technology, which shows significant productivity gains and increasing financial returns to organizations adopting

a policy of wider wireless local area network (LAN) deployment. Results from this current 2003 study demonstrate a rise in employee productivity, increased cost savings and other benefits. While wireless LANs [for healthcare organizations] have been postulated to represent a major area for potential growth, widespread deployment has yet to be realized. There remains a need to quantify the benefits offered by their implementation (including increased flexibility, productivity, and cost savings). This research has been designed to provide the required substantiation.

WLAN Penetration

Education has the highest WLAN penetration (at 29%), followed by manufacturing (23%), healthcare (13%) and government sectors (12%). Beyond these, most other sectors tend to be implementing WLANs at a relatively laggard pace (with an average 6% penetration).

These are the benefits of wireless LANs:

• Convenience: The wireless nature of such networks allows users to access network resources from nearly any convenient location within their primary networking environment (home or office). With the increasing saturation of laptop-style computers, this is particularly relevant.

• Mobility: With the emergence of public wireless networks, users can access the internet even outside their normal work environment. Most chain coffee shops, for example, offer their customers a wireless connection to the internet at little or no cost.

• Productivity: Users connected to a wireless network can maintain a nearly constant affiliation with their desired network as they move from place to place. For a business, this implies that an employee can potentially be more productive as his or her work can be accomplished from any convenient location.

• Deployment: Initial setup of an infrastructure-based wireless network requires little more than a single access point. Wired networks, on the other hand, have the additional cost and complexity of actual physical cables being run to numerous locations (which can even be impossible for hard-to-reach locations within a building).

• Expandability: Wireless networks can serve a suddenly-increased number of clients with the existing equipment. In a wired network, additional clients would require additional wiring.

Conclusion:

The advantages of WLAN are its portability, ease of installation, and practicality. The most appealing aspect of WLAN is its convenience, it allows flexibility and roaming. A user is not tied down to a LAN and can move around with relative ease while staying connected. WLAN are also easy to install, an entire network can be put together in a matter of hours rather than days. Finally, WLAN may be installed where rewiring is impractical. Wireless systems can be installed in different environments and users can communicate with the existing wired network through access points or wireless adapters. The popularity of wireless LANs is a testament primarily to their convenience, cost efficiency, and ease of integration with other networks and network components. The majority of computers sold to consumers today come pre-equipped with all necessary wireless LAN technology.

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6. OPTIMAL VOLTAGE REGULATOR PLACEMENT IN A RADIAL DISTRIBUTION SYSTEM

Miss. Mhetre Vijayalkshmi (BE), Miss. Ragini Patil (BE)

The operation and planning studies of a distribution system require a steady state condition of the system for various load demands. Our aim is to obtain optimal voltage control with voltage regulators and then to decrease the total cost of voltage regulators and losses, to obtain the net saving. An algorithm is proposed which determines the initial selection and tap setting of the voltage regulators to provide a smooth voltage profile along the network.

The same algorithm is used to obtain the minimum number of the initially selected voltage regulators, by moving them in such a way so as to control the network voltage at the minimum cost. The algorithm has been implemented using MATLAB along with Fuzzy Logic and the result of both conventional and Fuzzy Logic are compared.

General description of Distribution System

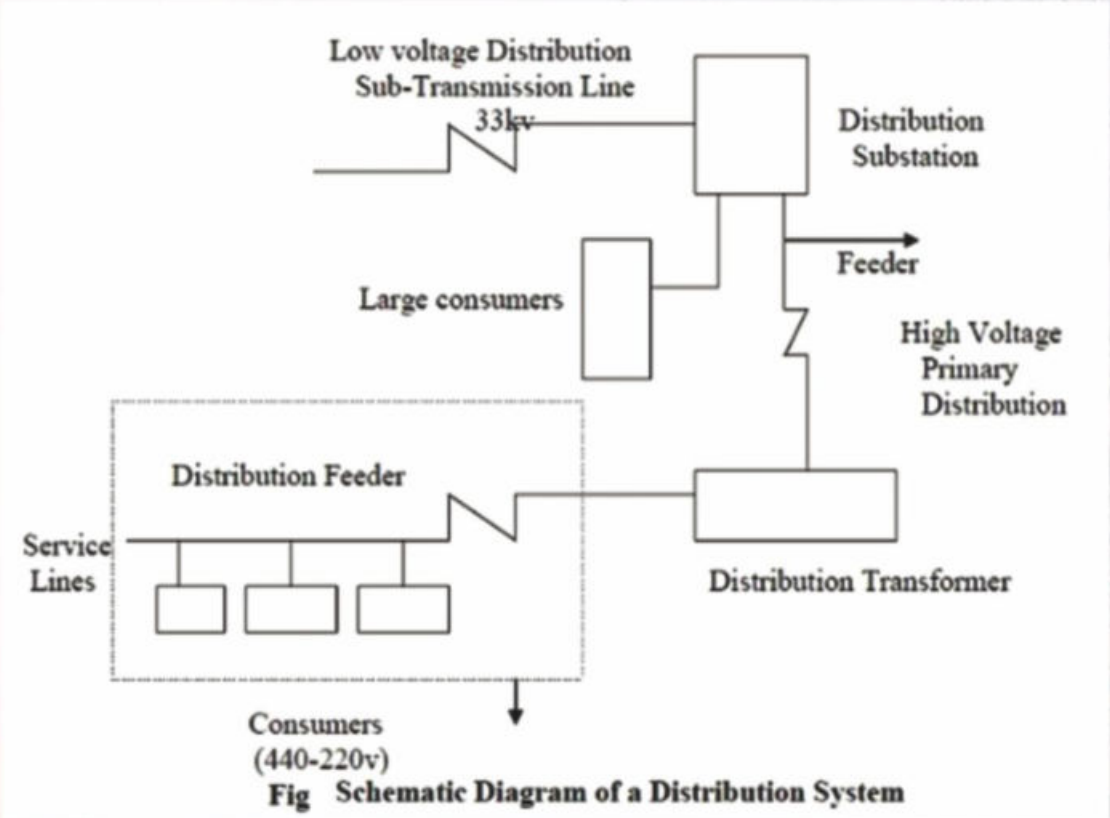


Fig Schematic Diagram of a Distribution System

Distribution system is that part of the electric power system which connects the high voltage transmission network to the low voltage consumer service point. In any distribution system the power is distributed to various uses through feeders, distributors and service mains. Feeders are conductors of large current carrying capacity which carry the current in bulk to the feeding points. Distributors are conductors from which the current is tapped of from the supply to the consumer premises. A typical distribution system with all its elements is shown in figure.

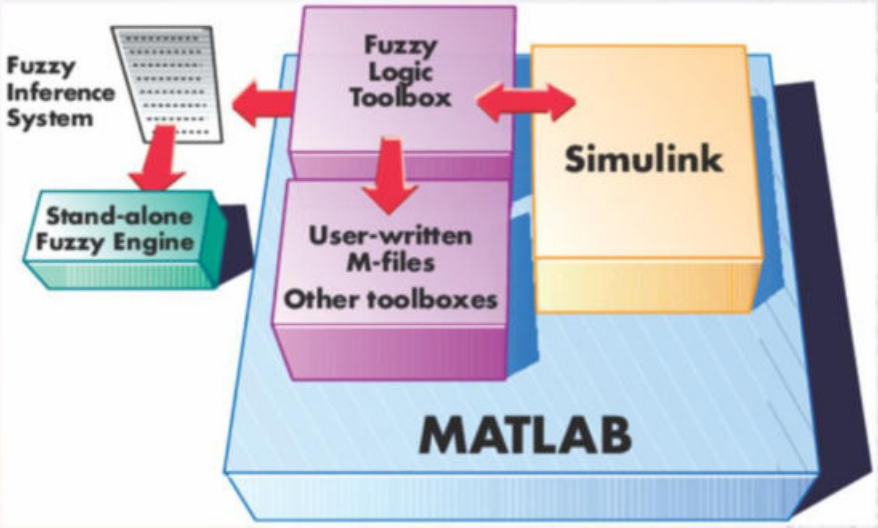
FUZZY LOGIC

Fuzzy logic, invented by Professor LotfiZadeh of UC-Berkeley in the mid-1960s, provides a representation scheme and a calculus for dealing with vague or uncertain concepts. It provides a mathematical way to represent vagueness in humanistic systems. The crisp set is defined in such a way as to dichotomize the individuals in some given universe of discourse into two groups as below:

a) Members (those who certainly belong to the set.)

b) Non-members (those who certainly do not belong to the set.)

Fuzzy Logic in Power Systems



Analytical approaches have been used over the years for many power system operation, planning and control problems. However, the mathematical formulations of real world problems are derived under certain restrictive assumptions and even with these assumptions, the solutions of large – scale power systems problems are not trivial. On the other hand, there are many uncertainties in various power system problems because power systems are large, complex, geographically widely distributed systems and influenced by unexpected events.

Conclusion:

More recently, the deregulation of power utilities has introduced new issues into the existing problems. These facts make it difficult to effectively deal with many power systems problems through strict mathematical formulations alone. Although a large number of AI techniques have been employed in power systems, fuzzy logic is a powerful tool in meeting challenging problems in power systems. This is so because fuzzy logic is the only technique, which can handle in precise, vague or 'fuzzy' information.

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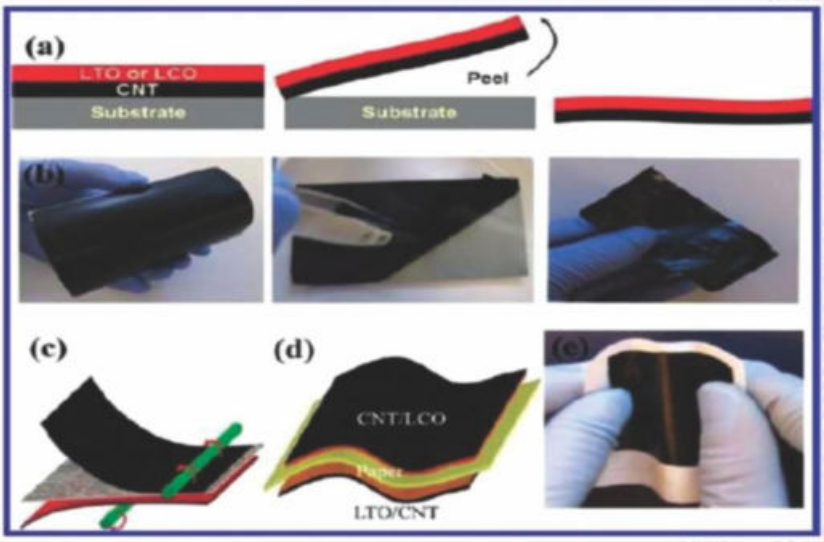
7. PAPER BATTERY

Mr. Ritesh Patil (BE), Mr. Sachin Khot (BE)

In this paper the use of self-rechargeable paper thin film batteries, their performance and applications has been presented. The Glucose activated paper battery based on glucose oxidized enzyme using a simple and cheap plastic laminating technology has been demonstrated. The enzyme and glucose concentration can be optimized to gear up the power requirement. Ultra-fast all polymer paper based batteries are an option with some short comings yet such as low cycling stabilities and functional discharge rate. Also integration secondary battery with the paper battery is also shown to improve the power.

A paper battery is a flexible, ultra-thin energy storage and production device formed by combining carbon nanotube with a conventional sheet of cellulose-based paper. A paper battery acts as both a high-energy battery and super capacitor, combining two components that are separate in traditional electronics. This combination allows the battery to provide both long-term, steady power production and bursts of energy. Non-toxic, flexible paper batteries have the potential to power the next generation of electronics, medical devices and hybrid vehicles, allowing for radical new designs and medical technologies.



Paper batteries may be folded, cut or otherwise shaped for different applications without any loss of integrity or efficiency. Cutting one in half halves its energy production. Stacking them multiplies power output. Early prototypes of the device are able to produce 2.5 volt s of electricity from a sample the size of a postage stamp.The devices are formed by combining cellulose with an infusion of aligned carbon nanotubes that are each approximately one millionth of a centimeter thick. The carbon is what gives the batteries their black colour.

Cellulose based paper is a natural abundant material, biodegradable, light, and recyclable with a well-known consolidated manufacturing process. Here, we expect to contribute to the first step of an incoming disruptive concept related to the production of self-sustained paper electronic systems where the power supply is integrated in the electronic circuits to fabricate fully self-sustained disposable, flexible, low cost and low electrical consumption systems such as tags, games or displays.

Polymer based paper battery

Now we try to replace the metal/metal oxide with polymer. In this process, the preparation of novel redox polymer and electronically conducting polymer-based electrode materials is essential. While it has recently been shown that it is possible to manufacture redox polymer based electrodes and batteries with high-capacities and very good cycling performances, the corresponding development within the field of electronically conducting polymers is ongoing.

Conclusion:

Conducting polymers are particularly interesting materials as devices based on these materials could be used as adaptable energy storage devices due to their inherent fast redox switching, high conductivity, mechanical flexibility, low weight and possibility to beintegrated into existing production processes. While conductive polymers are more environmentally friendly and cost-efficient than most metal containing electrode materials, the insufficient cycle stabilities and the high self-discharge rates have so far been limiting their applicability in commercial battery systems.

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8. INTELLIGENT MANAGEMENT OF ELECTRICAL SYSTEMS IN INDUSTRIES

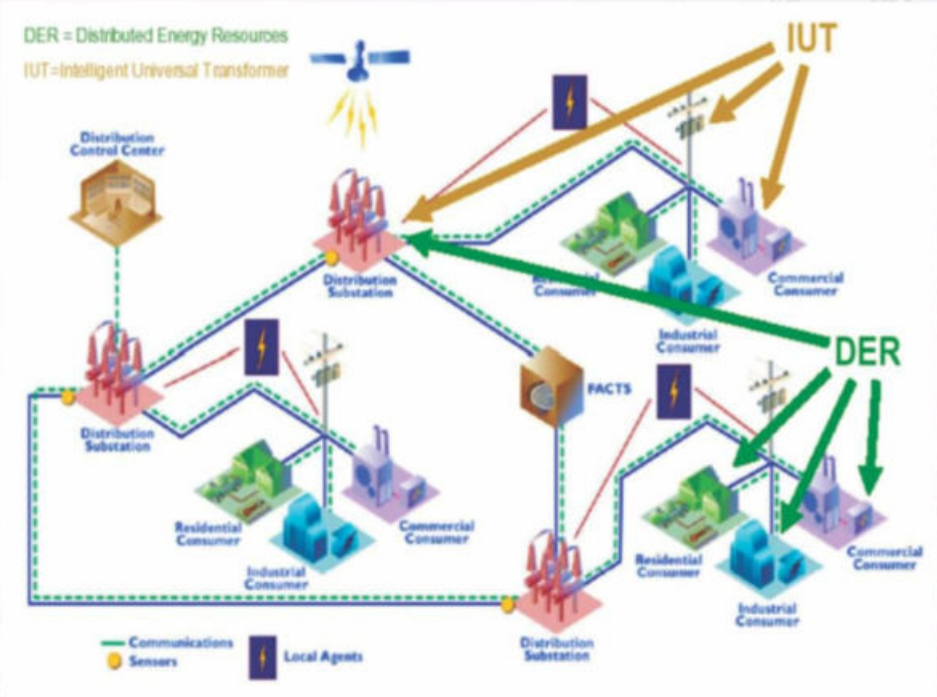
Miss. Puja Nikam (BE), Miss. Ketaki Chougule (TE)

The automation of public electricity distribution has developed very rapidly in the past few years. The same basis can be used to develop new intelligent applications for electricity distribution networks in industrial plants. Many new applications have to be introduced because of the different environment and needs in industrial sector. The paper includes a system description of industrial electric system management. The paper discusses on the requirements of new applications and methods that can be used to solve problems in the areas of distribution management and condition monitoring of industrial networks.

Industrial plants have put continuous pressure on the advanced process automation. However, there has not been so much focus on the automation of the electricity distribution networks. Although, the uninterrupted electricity distribution is one of basic requirement for the process. A disturbance in electricity supply causing the "down run" of the process may cost huge amount of money. Thus the intelligent management of electricity distribution including, for example, preventive condition monitoring and on-line reliability analysis has a great importance. Nowadays the above needs have aroused the increased interest in the electricity distribution automation of industrial plants.

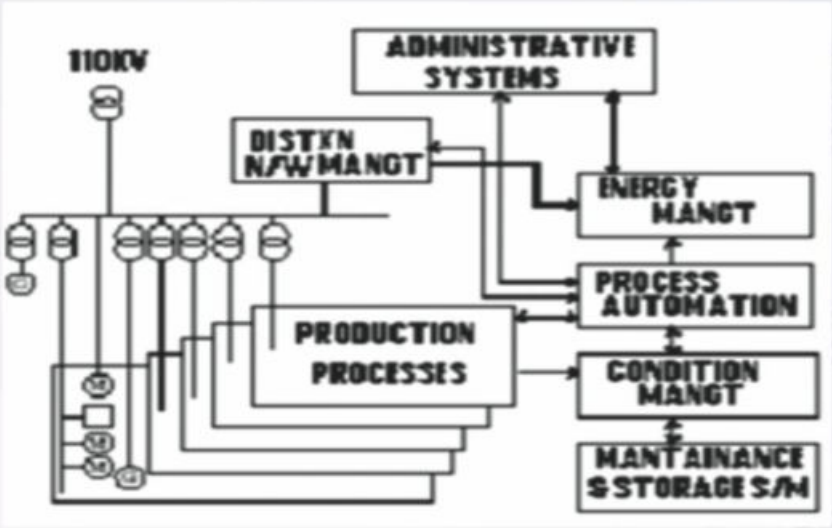
The automation of public electricity distribution has developed very rapidly in the past few years. Very promising results has been gained, for example, in decreasing outage times of customers. However, the same concept as such cannot be applied in the field of industrial electricity distribution, although the bases of automation systems are common. The infrastructures of different industry plants vary more from each other as compared to the public electricity distribution, which is more homogeneous domain. The automation devices, computer systems, and databases are not in the same level and the integration of them is more complicated.

Industrial plants have put continuous pressure on the advanced process automation. However, there has not been so much focus on the automation of the electricity distribution networks. Although, the uninterrupted electricity distribution is one basic requirement for the process. A disturbance in electricity supply causing the"down run" of the process may cost huge amount of money. Thus the intelligent management of electricity distribution including, for example, preventive condition monitoring and on-line reliability analysis has a great importance.



Big industrial plant differs from public distribution company by an organizatory structure and by system environment. A production is divided into many departments or many- companies. While these units have the responsibility of production and maintenance. Very often the maintenance is maintained by a service company. An energy department or company is in charge of local energy production of a distribution network.

Above organizations may have some control systems that serve their needs only, but usually, information systems are closely connected together. However, the process automation system is the most important system in an industrial plant, sometimes including other systems, as illustrated in the below figure. For example, all energy production and distribution network control tasks can be done in a process automation system. This is because of the reliability reasons; vital parts of distribution network control are independent of the process of automation. However, the independency of automation process system vendor has been one of the reasons for separate systems, too.



The systems in the above figure utilize many databases, which contain data that can be used in new applications. However, the process automation systems collect data for process monitoring and optimization tools. These databases contain information of material flow, energy flow, and control data of production machines. Though maintenance of such databases includes technical specifications and condition data of production machine components. Comparable information of electricity network components is supported by network database. Production programs are stored in the databases of administrative systems.

Intelligent applications are needed to:

Handle large amount of information available; this includes filtering of data and producing new information by collecting data. Give instructions for operators in fault situations. "Risk of misoperation in abnormal fault situation is obvious and prevents or holdup operators 'decision making.Atomize analysis tasks. Continuous information analysis is not possible manually.

In order to introduce new intelligent applications for the management of electric systems in industrial plants, a basis for implementation is needed. The following requirements should be satisfied:

- Documentation of electricity distribution network is available for the systems.
- Network databases can supply this information

Conclusion:

Nowadays the above needs have aroused the increased interest in the electricity distribution automation of industrial plants. The automation of public electricity distribution has developed very rapidly in the past few years. Very promising results has been gained, for example, in decreasing outage times of customers. However, the same concept as such cannot be applied in the field of industrial electricity distribution, although the bases of automation systems are common. The infrastructures of different industry plants vary more from each other as compared to the public electricity distribution, which is more homogeneous domain. The automation devices, computer systems, and databases are not in the same level and the integration of them is more complicated.

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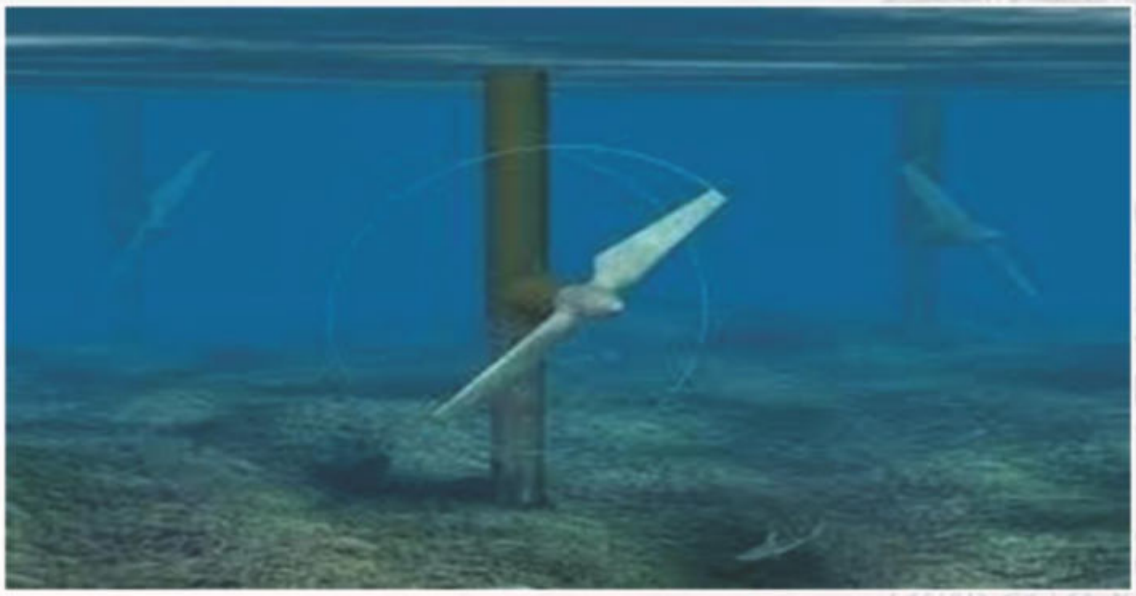
9. UNDERWATER WINDMILL

Miss. Mulla Saba (TE), Miss. Shraddha Sungare (TE)

This Idea should be somewhat obvious in hindsight. We build ordinary windmills to extract useful power from wind energy. We put turbines in rivers (usually accompanied by dams) to extract useful power from downhill water flow. The second is more "energy intensive" than the first, which is why we all know that dams are great sources of electrical power, while electric-generator windmills spent decades in the economic doldrums (return on investment --ROI-- is relatively tiny, and only recently proved viable on a large scale).



Anyway, putting the equivalent of a windmill in a steady ocean current, says the Gulf Stream, should have an automatically-viable ROI that is intermediate between windmills and ordinary hydropower. This is because water is something like a thousand times denser than air, so a volume of flowing water contains a thousand times the energy of an equal volume of equally-flowing air.

Do note that the ocean has different currents at different depths. I once read somewhere that near the seafloor underneath the Gulf Stream is another current going the opposite direction. If true, then we can build towers on the seafloor, just like ordinary windmills, to extract power.

Being so deep will protect them from ships, and most sea life is found at other depths, so they won't be bothered. Also, another thing that protects sea life is the fact that underwater windmills will have a SLOW rotation rate, due to that same greater density of water over air. This means we can also put windmills in the rich-life upper ocean currents; animals will have time to dodge the blades. (Some life forms, like barnacles, need to be discouraged; probably everything needs to be coated with Teflon or something even more slippery.)

Another advantage of underwater energy capture comes from water's high density. Water is denser than air, which means that the same amount of energy can be produced by an underwater turbine as a windmill, but at slower speeds and over less area. What's more, while the amount of wind that passes over any given area of land can be unpredictable, the kinetic energy of tidal areas is dependable. The ebb and flow is so predictable, a given tidal region can be expressed in the amount of kilowatt hours of electricity it can produce per turbine.

Scientists have been examining the amount of energy found in a tidal pool in monthlong periods. There are two main measurements. Mean spring peak velocity is the highest velocity of tidal movement that can be found in an area during a single month. Mean neap peak cycle is the lowest point in velocity that a tidal area experiences in a month [source: Carbon Trust]. These two measurements can help approximate the greatest and least amounts of velocity found in any given tidal pool over the course of a month.

Besides the tides, there are other characteristics that affect the velocity of water. The surrounding terrain -- for example, whether the area is rocky or sandy -- determines how water moves. Whether a tidal area is narrow or wide can also impact velocity. A narrow channel can concentrate water's movement, causing it to speed up.

Tidal movement and water bodies' characteristics can be taken into account on paper, but it's not until real-world tests are undertaken that actual understanding of the impact of tidal turbines can begin. On the next page, find out about some projects around the world that are helping researchers to better understand underwater turbine power production.

Conclusion:

Underwater (or tidal) turbines are a fairly straightforward concept, as far as cutting-edge energy technology goes. They are essentially windmills installed onto an ocean floor or river bed. The underwater current produced by the tides spins blades arranged like an airplane propeller. These turbines are attached to a gear box, which is connected to an electrical generator. This produces the electricity that is carried by cable to shore. Once it's plugged into an electrical grid, the electricity can be distributed [source: New Scientist].

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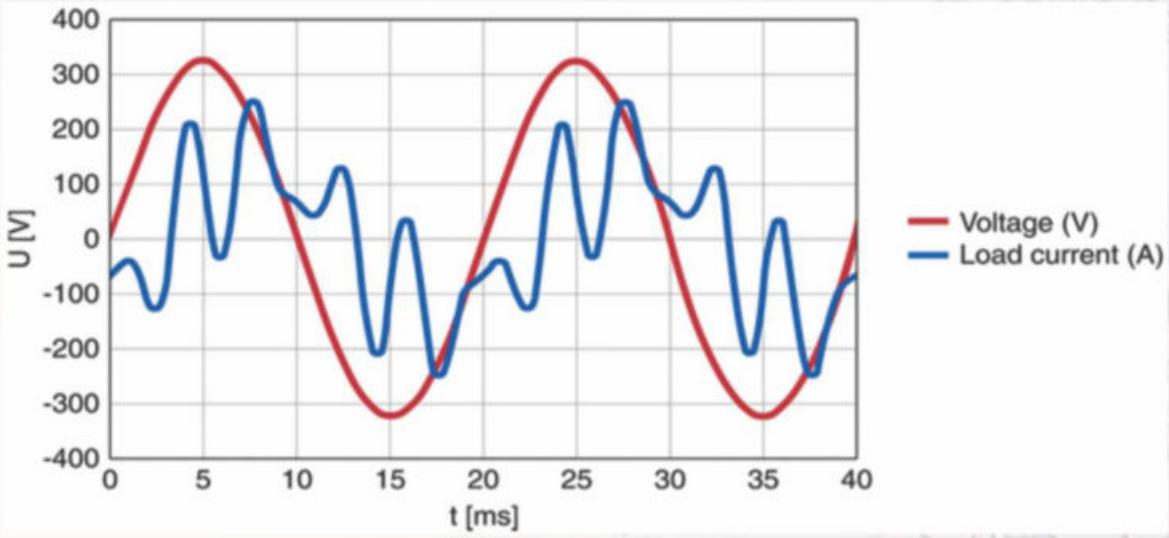
10. HARMONIC REDUCTION IN POWER SYSTEM

Miss. Varsha Desai (TE),Miss. Kajal Kumbhar (TE)

The term harmonics referred to Power quality in ideal world would mean how pure the voltage is, how pure the current waveform is in its sinusoidal form. Power quality is very important to commercial and industrial power system designs. Ideally, the electrical supply should be a perfect sinusoidal waveform without any kind of distortion. If the current or voltage waveforms are distorted from its ideal form it will be termed as harmonic distortion. But, nowadays with the use of complex designs in the industry harmonic distortion has increased as well.



This project explains the effects of Harmonics in the Power System and steps to reduce the effects of Harmonics. This project will also explain how Harmonic distortion is one of the most important problems associated with power quality and creates several disturbances to the Power System. It includes the Harmonic reduction techniques to improve the power quality and it will also include the simulation for the same.

This project also explains different types of inverters that are used in the Power System. During the transformation from DC to AC, harmonics affect the power quality a lot. How harmonic reduction will improve the power quality will be explained in detail.

As always, the main objective of the power system would be generation of electrical energy to the end user. Also, associated with power system generation is the term power quality. So much emphasis has been given to power quality that it is considered as a separate area of power engineering. There are many reasons for the importance given to the power quality. One of the main reasons is, the consumers are well informed about the power quality issues like interruptions, sagging and switching transients. Also, many power systems are internally connected into a network.

Due to this integration if a failure exists in any one of the internal network it would result into unfavorable consequences to the whole power system. In addition to all this, with the microprocessor based controls, protective devices become more sensitive towards power quality variation than were the past generation protective devices.

The percent of non-linear loads in office buildings and industrial facilities has increased over the last decade as incandescent lighting is replaced by fluorescent lighting, as more computers and programmable controllers are connected to the electrical system, and as more electric motors use variable frequency drives (VFDs). Harmonic disturbances can also be transmitted from the network if you have an unfiltered power factor correction capacitor on your incoming power.

Third harmonics are caused by power supplies in computers and electronic ballasts, and can result in a neutral current greater than the phase currents.

The fifth and seventh harmonics produced by the three phase bridge rectifiers in the power supplies of six-pulse VFDs create pulsating torques that can cause shaft vibrations, and damage motor bearings and couplings.

Higher harmonic distortions can also lead to the nuisance tripping of circuit breakers, the overheating of cables and equipment, and the premature failure of electrical equipment. Transformers can quickly overheat and fail after load changes due to replacing or adding electrical equipment, installing VFDs, and upgrading electronic ballasts. Plant manufacturing safety may be at risk.

How bad are your harmonics?

IEEE standard 519 provides guidelines for acceptable values of total harmonic distortion (THD). Its focus is on the point of common coupling. The standard also seeks to limit damage to power factor correction (PFC) capacitors and harmonic filter systems from excessive harmonics, and to prevent series or parallel resonance in the electrical system.

The goal is to limit the THD to less than 5% where an industrial power system is connected to the utility network. If your THD values exceed the IEEE 519 values, it's important to determine whether harmonics are causing problems.

There is often little that can be done with existing load equipment to significantly reduce the amount of harmonic current it is producing unless it is being misoperated. While an overexcited transformer can be brought back into normal operation by lowering the applied voltage to the correct range, arcing devices and most electronic power converters are locked into their designed characteristics.

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