DR. SUDHIR CHANDRA SUR DEGREE ENGINEERING COLLEGE

ELECTRICAL ENGINEERING DEPARTMENT

POWER ENERGY SOCITEY

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SURGE

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About SURGE

The Department of Electrical Engineering of Dr. Sudhir Chandra Sur Degree Engineering College released the 1st issue of the departmental wall magazine on September, 2017. The Wall Magazine "SURGE" provides a unique opportunity for the students/faculty to express their thoughts on different emerging areas of Electrical Engineering. The 2nd issue was released one month later which had an e-magazine version for the first time as decided by the editorial board. The SURGE e-magazine had its reach to various departments of several institutes which gained popularity & received appreciation with time. We try to keep an eye on every innovative ideas of igniting minds so that they can be reflected through SURGE. Sincere thanks to the students & faculties who have contributed towards the previous & current issues of the magazine.

This is the 6th issue of SURGE & we sincerely thank all the students & faculties who have contributed towards SURGE till now & helped us to make our journey successful.

The Editorial Board

SURGE

Editorial Board of SURGE

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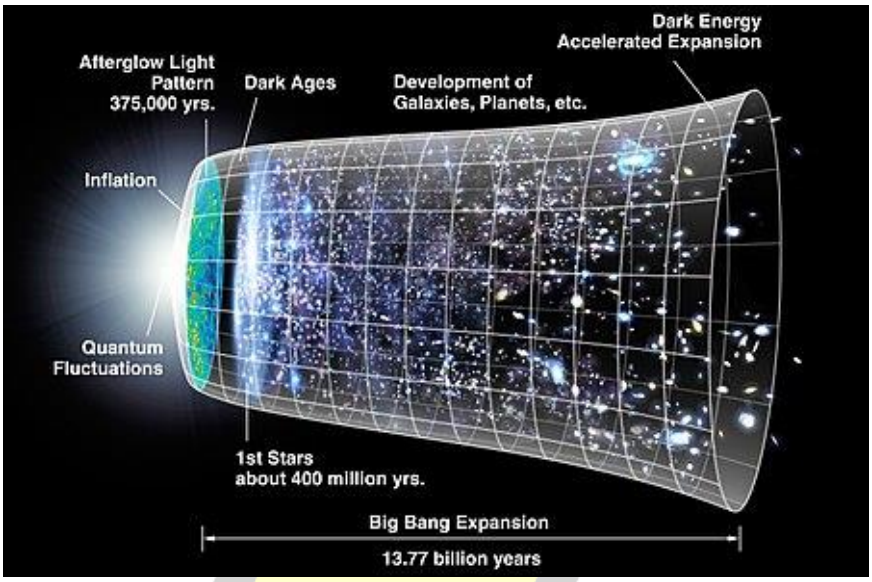
EXPANSION OF UNIVERSE



For the thousands of years, astronomers wrestled with the basic questions about the size and age of the universe. Does the universe go on forever, or does it have an age somewhere? Has it always existed? Caltech made a critical discovery that soon led to scientific answers for the questions. Although the apparent size of the star in the sky becomes smaller as the direction or the distance of the star increases, the brightness of this smaller surface of the sky should be as bright as a star. Obviously, there are dark areas in the sky so the universe must be finite. When The Einstein develop his theory of gravity in his "THEORY OF RELATIVITY", He thought he ran into the same problem as that of the Newton did his equations said that the universe is either expanding or collapsing , yet he assumed that the universe was static. His original solution contained a cosmological constant, which cancelled the effect of the gravity on very large scale and led to a static universe. Meanwhile, other physicist, and mathematicians working on the Einstein's theory of the gravity discovered the equations had solutions that described on the expanding universe. In 1925, Edwin Hubble was working on the expanding of the universe. He measured the red shift of a number of distant galaxies. He also measured relative distances by measuring the apparent brightness of a classes of a variable stars called CEPHEIDS in each galaxy when he plotted red-shift against relative distance, he found that red-shift of a distant galaxies increased as a linear of their distances. The only explanation of this solutions is that universe is expanding. Thus from this Edwin Hubble conclude that the universe is expanding. Latter this solution is modified by the well known physicist from CALCUTTA "Dr. Amal Kumar Roy Choudhury". He formulated an equation which is known as "Roy Choudhury's Equation".

Pratik Chakraborty, EE 2nd YEAR

If we can walk and generate electricity ?

If you can make a tiny bit of electricity by pressing one piezoelectric crystal once, could you make a significant amount by pressing many crystals over and over again? What if we buried crystals under city streets and pavements to capture energy as cars and people passed by? This idea, which is known as energy harvesting, has caught many people's interest. Inventors have proposed all kinds of ideas for storing energy with hidden piezoelectric devices, from shoes that convert your walking movements into heat to keep your feet warm, and cellphones that charge themselves from your body movements, to roads that power streetlights, contact lenses that capture energy when you blink, and even gadgets that make energy from the pressure of falling rain.One of the most visible applications of piezoelectricity is the piezo lighter. Pretty much any lighter with a push button is powered by piezoelectricity. When you push the button, it makes a small, spring-powered hammer rise off the surface of the piezo crystal. When the hammer reaches the top, it releases and strikes the crystal as the gas is turned on. The impact creates a large voltage across the crystal, which flows into two wires. This voltage is high enough to make a spark between the wires, which ignites the gas. Piezo igniters are used on most gas furnaces and stoves now as well.You've probably used piezoelectricity quite a few times today. If you've got a quartz watch, piezoelectricity is what helps it keep regular time. If you've been writing a letter or an essay on your computer or smart phone with the help of voice recognition software, the microphone you spoke into probably used piezoelectricity to turn the sound energy in your voice into electrical signals your computer could interpret. If you're a bit of an audiophile and like listening to music on vinyl, your gramophone would have been using piezoelectricity to "read" the sounds from your LP records. Piezoelectricity (literally, "pressing electricity") is much simpler than it sounds: it just means using crystals to convert mechanical energy into electricity or vice-versa. Let's take a closer look at how it works and why it's so useful! One of the unique characteristics of the piezoelectric effect is that it is reversible, meaning that materials exhibiting the direct piezoelectric effect also exhibit the converse piezoelectric effect. The degree of polarisation is dependent upon the stress and whether tensile or compressive stresses are applied affects the charge produced. The dipoles, which are present due to the non-centro symmetric structure, form domains that are regions where neighbouring dipoles have the same alignment. The piezoelectric effect is very useful within many applications that involve the production and detection of sound, generation of high voltages, electronic frequency generation, microbalances, and ultra fine focusing of optical assemblies. It is also the basis of a number of scientific instrumental techniques with atomic resolution, such as scanning probe microscopes.

The characteristics of piezoelectric materials provided the perfect technology upon which Nanomotion developed our various lines of unique piezoelectric motors. Using patented piezoelectric technology, Nanomotion has designed various series of motors ranging in size from a single element (providing 0.4Kg of force) to an eight element motor (providing 3.2Kg of force). Nanomotion motors are capable of driving both linear and rotary stages, and have a wide dynamic range of speed, from several microns per second to 250mm/sec and can easily mount to traditional low friction stages or other devices. The operating characteristics of Nanomotion’s motors provide inherent braking and the ability to eliminate servo dither when in a static position.

ROSHAN KUNDU, EE 2nd YEAR

Current heat losses produced by electrical operational equipment in LV switchgear

It is widely accepted by all manufacturers that accumulation of heat (leading to overheating of devices) in switchgear is one of the greatest risks that could shorten the life expectancy of a switchgear, thus potentially damaging electrical and electronic devices or even lead to catastrophic failure. Electrical operational equipment in switchgear and distribution systems give off current heat losses to the surroundings. In order to ensure the proper functioning of the built-in equipment, it is necessary to determine the upper temperature limits.

The following points must be considered in order to calculate the over-temperature:

1)Smart I/O card protection type and protection class 2)Type of installation of housing/enclosure 3)Dimensions of housing/enclosure Type of construction (wall-mounted or floor-mounted distribution board) 4)Equipment installed, heat losses, determination of space 5)Location of installation (height, width and depth) 6)Structure of lines 7)Number of inner partitions 8)Type selection 9)Parts list, drawings 10)Reserve space.

*Differentiation of Power Losses

The power losses of the different operational equipment are taken from the manufacturers' information and added. If the equipment is operated with a load current, which deviates from the rated current, the power losses can then be described as in the following four groups:

Power losses proportional to the square of the current, e.g. main circuits of equipment, bus bars and lines:

$$P_v = P_{Vr}\left(\frac{I_B}{I_r}\right)^2.$$

Power losses, which are nearly proportional to the current, e.g. rectifiers and thyristors:

$$P_v \sim P_{Vr}\frac{I_B}{I_r}.$$

Power losses, which show a non-uniform behaviour:

$$P_v = P_{Fe} + P_{Cu}\left(\frac{I_B}{I_r}\right)^2$$

Power losses, which remain constant, e.g. magnetic coils for contactors and light bulbs:

$$P_v = P_{Vr}.$$

Here, the meanings of the symbols are: P_v=Power loss, P_{vr} = Power loss of equipment I_B = Load current, I_r = Rated current, P_{Fe} = Iron losses, P_{Cu} = Copper losses

KINKAR MONDAL, EE 3rd YEAR

Future Power Plants

The placing of distribution transformers in ecologically sensitive areas is a big concern for present days. Special and expensive, measures have to be taken to address this concern, like eliminating the risk of transformer fluids being accidentally released into the environment.

BIOTEMP® is a totally biodegradable vegetable oil that solves the problem. Prototype transformers are in operation in the USA, where they are being reviewed favourably by the utilities. The new fluid also has the potential for application in larger power transformers, capacitors, switchgear and cables.
To solve the ecological problems posed by conventional transformer insulating fluids, ABB launched a program to find a more environmentally favourable fluid that would allow distribution transformers to be placed in ecologically sensitive areas. The payback for such a fluid was seen to be a significant saving in remediation and compliance costs for the electric utilities. The new fluid that came out of this program – called BIOTEMP® – is the result of extensive screening of potential biodegradable fluids. Promising candidates were examined with regard to their suitability based on industry accepted criteria. The final choices were subjected to processing refinements to attain the best possible electrical and physical properties. Final verification of the chosen fluid's favourable environmental and functional characteristics was achieved by accelerating the aging of distribution-size transformer at temperatures of up to 225°C.
BIOTEMP® surpasses conventional insulating fluids, i.e. mineral oil, in several respects:

- It is a totally biodegradable vegetable oil.
- It is classified as a high-temperature fluid in the USA, based on a fire point above 300 °C.
- Its heat capacity and heat transfer properties are superior to those of conventional mineral oils.
  Because of its exceptional thermal properties, the fluid allows electrical equipment to be operated at higher temperatures than is possible with mineral oils.

Prototype distribution BIOTEMP® transformers are being operated with major utility and industrial systems throughout the USA. Solicitation of European test sites is under way.

BIOTEMP® has also been successfully used as a retro fill fluid in a test application in which it replaced petroleum based dielectric fluid. Its use as an insulating and cooling fluid for high-temperature bushings with new solid insulating systems is also being investigated. Potential also exists for the application of BIOTEMP® in other types of electrical equipment, such as larger power transformers, capacitors, switchgear and cables.

KINKAR MONDAL, EE 3rd YEAR

The Climate-Independent Need for Renewable Energy in the 21st Century

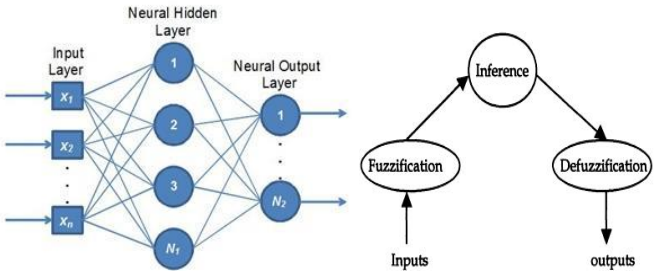
In December 2015 the nations of the world agreed, in principle, to limit global warming to no more than 2 °C above pre-industrial levels. In order to achieve this goal, recent publications have shown that (1) more than 50% of known fossil fuel reserves need to remain unused, and (2) the timing of the transition away from fossil fuels needs to achieve 50% renewable energy by 2028, an expansion of renewable sources of 37-fold in the next 12 years. This rate of expansion is unprecedented and unlikely to be achieved. Even utilizing the 50% of fossil fuels untapped in a <2 °C scenario results in significant expansion of renewable energy sources by 2100. Here we examine three fossil fuel reserve estimates and two per capita energy consumption tracks to understand how dominant renewable energy sources need to be during the second half of the 21st century. We find that per capita energy consumption rates are a more significant factor in the demand for renewable energy infrastructure, as wide ranging estimates of fossil fuel reserves still result in peak production by mid-century. At either of the consumption rates, attempting to uphold the 2 °C global warming goal would demand more energy from renewable sources than was produced from all sources in 2014. In total, the world will likely require between 600 and 2000 joules of renewable energy by the year 2100, a significant expansion from the 13 produced in 2014. Despite meaningful gains in renewable energy sources, the transition away from fossil fuels is not keeping pace with rising global population, and expansion of global per capita consumption. Even in the absence of global warming concerns, renewable energy infrastructure needs to immediately begin significant expansion.

Use of Artificial Intelligence in Power Stations

Artificial intelligence is the science of exhibiting intelligence by machine currently achievable by humans. Power system has grown tremendously over a few decades. As the size and complexity of the power system consisting of generators, transmission lines, power transformers, distribution transformers etc. Increases, the possibility of inviting faults also increases. The acquisition of data, the processing of those data for use by the operator, and control of remote devices are the fundamental building blocks of all modern utility control systems. As the power system grows it becomes more complex due to the technical advancements and dynamic requirements. One may expect that the mobile sensing will play an increasingly important role in the monitoring of power system. Artificial intelligence is known to be the intelligence exhibited by machines and software; for example, robots and computer programs. Artificial neural networks are biologically inspired systems which convert a set of inputs into a set of outputs by a network of neurons, where each neuron produces one output as a function of inputs. A fundamental neuron can be considered as a processor which makes a simple non linear operation of it's inputs producing a single output. They are classified by their architecture: number of layers and topology: connectivity pattern, feed forward or recurrent.

There are mainly three techniques: i) Expert system techniques, ii) Artificial neural networks, iii) Fuzzy logic systems.

- Since expert systems are basically computer programs, the process of writing codes for these programs is simpler than actually calculating and estimating the value of parameters used in generation, transmission and distribution.
- Any modifications even after design can be easily done because they are computer programs.
- As artificial neural networks operate on biological institutes and perform biological evaluation of real world problems, the problems in generation, transmission and distribution of electricity can be fed to the artificial neural networks so that a suitable solution can be obtained.
- Given the constraints of a practical transmission and distribution system, the exact values of parameters can be determined.
- For example, the value of inductance, capacitance and resistance in a transmission line can be numerically calculated by artificial neural networks taking in various factors like environmental factors, unbalancing conditions, and other possible problems.
- Fuzzy logic can be used for designing the physical components of power systems.



Impact of Distributed Generation on Power Systems

The requisite for smart electrical systems having bare minimum technical loss and green impact is providing thrust to go for Distributed Generations (DGs) which may offer several other advantages such as reduced transmission and distribution system resources, increased reliability, better power quality, etc. However, depending on the system constitution and administration, these advantages may not be true. Moreover, due to structural and managerial changes in the electricity supply industry encouraged with introduction of completion, the role of small generations distributed in the low/medium voltage network has gained importance.

With current situation on smart grid and sustainable energy, distributed generations (DGs) are going to play vital role in the emerging electric power systems. DG is often used as back-up power to enhance reliability or as a means of deferring investment in transmission and distribution networks, avoiding network charges, reducing line losses, deferring construction of large generation facilities, displacing expensive grid-supplied power, providing alternative sources of supply in markets and providing environmental benefits. In recent years, DG has become an efficient and clean alternative to the traditional electric energy sources, and recent technologies are making DGs economically feasible. Another environmental driver is to reduce the transmission and distribution expansion along with the avoidance of large power plants. In the commercial driver, the uncertainty in electricity markets favours small generation schemes and DGs are now cost effective to improve the power quality and reliability There has been tremendous research work in the areas of DG technologies, sitting and sizing of DG, impact studies of the increased penetration of DG, economic and financial analysis coupled with DG integration, etc. Owing to the vast scopes, it is difficult for researchers, policy makers, and academicians to read all the related materials. It is important for the researcher to understand the key issue of the large penetration of distributed generation in the power system.

Distributed Generation Technologies:

Due to maturing technologies and increasing size of DGs, which play a significant and topical phenomenon in power system, there is as yet no universal agreement on the definition of DGs. These are also known as embedded generations or dispersed generations. The some of the popular DG technologies are listed below:

- Reciprocating Diesel or Natural Gas
- Fuel Cells
- Photovoltaic (PV) system
- Wind Turbines
- Micro-Turbines

Different types of Distributed Generations (DG) are available and it is expected to grow in the future years. DG includes the application of small generators, scattered throughout a power system, to provide the electric power needed by electrical customers. Such locally distributed generation integrated to power system has several merits from the view point of environmental restriction and location limitations, as well as transient and voltage stability in the power system.

RUMRUM BANERJEE, Faculty, EE Dept.

Moments of inauguration of SURGE