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S P E NEWS LETTER

USE MORE NON-CONVENTIONAL ENERGY .... SAVE ENERGY

A QUATERLY PUBLICATION OF THE SOCIETY OF POWER ENGINEERS (INDIA)

THE SOCIETY OF POWER ENGINEERS (INDIA)
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SPECIAL INVITEE TO THE EXECUTIVE COMMITTEE

Er. N Dinker

NEW MEMBERS DURING APRIL TO JUNE-2016

Sr. No.	G.R.No.	Name	Member
1.	**2240**	**Chharchhoda Mufaddal H**	Student Member
2.	**2241**	**Shah Aakash M**	Associate Member
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4.	**2243**	**Joshi Varsha R**	Life Member
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10.	**2249**	**Zavre Khushbu R**	Associate Member
11.	**2250**	**Saswadkar Pratik V**	Associate Member
12.	**2251**	**Chauhan Bhadresh B**	Life Member

Future Programmes

- 1-Day Workshop on **Electrical Power System** for Industries and Academia on 23 Sep. 2016 at Bhuj (Kutchh).
- 20th AGM on 18 Sep. 2016
- Celebration of completion of 20 years of existence of Society of Power Engineers (India) , Vadodara Chapter on 30 Sep. 2016 (Tentative), Satyanarayan Pooja on foundation day on 3-10-2016.

From The Chairman's Desk

Dangers of Climate Change – Real or Simply Hype?

5th June 2016 was celebrated as the "World Environment Day". For many, it was just one more of those special days, dedicated to a person or a cause, like Fathers' Day, Mothers' Day, Yoga Day, and so on, which occupies considerable space in the newspapers and sound bytes on the radio and television channels, but about which no one really cares.

For the environmentalists it was an important day, especially this year, as they believe that our planet is at the tipping point – where either we take immediate and concrete actions to reverse Climate Change or continue with our Ostrich-Like-Ways, and push our planet and humanity into the inevitable and unimaginable environmental catastrophe.

The skeptics totally deny climate change. They say that there is no scientific evidence to prove that the so-called global warming is caused by human activity.

Yet another segment of humankind strongly believes that every conceivable problem in the universe has a technological solution. They are advocating weird solutions like dumping chemicals in the atmosphere to reflect-back sunlight into outer space, and keep the planet cool, and so on.

In the meanwhile, political leaders of all hues, and from all continents, for so long were used to meet in high profile forums like "The World Economic Forum, Davos", "G7", "G8", "G20", and gun for economic growth, while paying lip service, to climate change. For them, economic prosperity ensured votes, and their continuation in power.

The real brunt of global warming and climate change is actually borne by the common man. Ordinary people are increasingly facing alternating bouts of droughts and floods. Frequency of severe cyclonic storms, wrecking havoc on coastal cities, both in the developed countries, like the US, as well as developing countries like ours and Bangladesh, is increasing. On one hand, Arctic regions are reporting permanent thawing of snow and growth of grass, and on the other hand, perennially hot cities like Dubai are experiencing snowfall.

International Energy Agency(IEA),in their report in 2015,mentioned that an average of 1600 premature deaths per day were attributed to outdoor air pollution and now it is estimated that around 2500 people may die prematurely by 2040 in India if stringent regulations are not put in by government to check outdoor pollution.

Global warming is no more a debatable issue. We are indeed at the cusp of a precarious situation. Everyone, including the political leadership, has slowly started realizing the reality. At last world leader made meaningful progress at the recently concluded climate talks in Paris. Small and environmentally fragile nations like island nations, realize that their countries could simply vanish into the oceans if sea levels rise a couple of feet, on account of global warming. Similarly, if sea levels rise, Great Coastal Cities like New York, Mumbai, Chennai, Kolkata, and so on, will simply go under, causing unimaginable death and economic loss. Scientists are predicting ghastly scenarios, where significant rise in sea levels will result in mass migration of population of low lying coastal nations like Bangladesh, into India, which in turn may result in the collapse of borders. War like situation may also arise deploying destructive weapons.

So, what is the solution? Are we simply doomed? No, there is a way, and that is

"Sustainable Living". Mahatma Gandhi might have visualized the situation when he said, "India Lives in its Villages". We should learn to live simple, low energy consuming, and sustainable lives. Technology may provide many wonderful solutions for sustainable living, but will fail certainly and miserably, when used mainly for mitigation of consequences, while stubbornly continuing our unsustainable ways.

There cannot be a solution until and unless every single human being is aware of the problem, that the Dangers of Global Warming and Climate Change are not Hype, but are Totally Real, and that the Only Way Forward is that We Change Our Ways and Learn to Lead Simple and Sustainable Lives.

Minister of Power Mr. Piyush Goyal, on the occasion of Environment Day, expressed his thoughts as under.

"As a society, we must show zero tolerance towards this crime against nature and spread awareness of how unsustainable consumption patterns are the main cause of large scale environment deterioration and critical condition of our wildlife and eco-systems.I urge all citizens to commit themselves to clean and green environment and pledge to work together to help save our Planet." Let us join our hands together for this cause.

We, at SPE(I), are committed to spread this awareness on the danger of climate change through our lectures, seminars and publications.

G.V. Akre
Chairmen

Editorial

The advent of computer has put the technological development on fast track. The computer has further extended its arms to every walk of life all over the world. This includes finance, utility services, management, business, banking, transport, logistic, tele-communication and much more. In today's world, life is incomplete without computers, laptops and mobile phones. The advantages of these items are innumerable, so much so that many times we are not able to understand or use some of the applications and features inbuilt in them. The phenomenal growth of information technology has brought the world closer. GPS helps in locating your position and also helps in very quick survey and contouring. The aviation is also benefitted in a big way. The Digitalization has helped in remote controls and data acquisition. The service sector is also using computers & IT as a rider.

Like every invention, the computer and IT have also brought in innumerable disadvantages and troubles. The cyber crimes are order of the day. Hackers work day in and out to achieve their malafide goals. The expectations have increased multifold. People want you to respond to their e-mails, SMS, MMS and Whats App. The young generation has started using most of its spare time on surfing web sites and using mobile applications. Social activities, art and culture, spiritual activities, sports etc. are not on the priority list of the young generation.

The softwares which have been developed for various Engineering, Banking, Finance and other usages, have

brought peril. The fundamental theories and principles governing day to day life have become nonexistent. The new pass-outs from the college do not bother to remember the basic equations and postulations learnt by them in the academy. This is simply because google is available at press button on the computers and mobiles. Good vocabulary is not important now for any one as spell check is available on computer. This is really damaging the young ones who want to achieve higher goals.

The software developers have turned the weakness of the society to their advantage. One must remember that every software is developed on the fundamentals given in the books or being practiced for hundreds of years.

The process of developing a software is very lengthy. The software engineers need to transfer theoretical equations and procedures in a coded language. For this they are supported by experts and exponents in the field. Such individuals are involved in every stage of development, till it is tried and marketed.

It is not the intention of the editor to undermine the software developers but the way in which the softwares are marketed, raises hundreds of questions.

The basic strategy of the marketing is penetration. Every software is marketed with an aim to score over the competitors. With basic principles remaining same, each new software tries to improve the comfort level of the user. In the process, the new software needs training for giving proper input and for the correct interpretation of output. The marketing personnel hire the services of expert demonstrator who is able to exhibit the miracles of the software. Discounts are given for a limited period. This results in to good sale of the software. The good offices in the corporate houses and utilities are used as a leverage by the software developer and his marketing team. Such potential buyers then include a clause stating that the submission should be made in a particular software only. The bidder is, therefore, left with no choice but to buy such expensive software and further pay through nose for training and for annual renewal/updating. The editor had fallen prey to such marketing tactic of buying a software for Rs. 2,00,000/- without training. Thereafter Rs.1,30,000/- was spent on the training but the trainer was unaware of the work required to be done by the trainees. The training fee was collected in advance. At the end of the year, the company sent notice for a renewal fee of 50,000/- disregarding the fact that the software was not used due to lack of proper training.

The market of software is flooding with unscrupulous developers. The situation has come to such a pass that no one wants to use calculator or write equation on paper. The engineers do not want to calculate voltage drop or line losses, manually, the software will do it for them.

It is now a time that the aspiring engineering students and practicing engineers take a serious note of the damage being done by the software and make an attempt to go back to their text books and basic theories. Yes, after knowing fully the academic part of the problem, one can take help of the software for faster calculations and optimised solutions. This habit will enable the user to analyse the output of the software in its true perspective.

SM Takalkar,

Editor

Chapter's Activity

- On 30 Apr. 2016, the Chapter organized a National Seminar on "Digital Applications in Electrical System" at Auditorium of FGI, Sevasi, Vadodara. The seminar was a grand success with following special features.

  1. Concise opening session with digitally lamp lighting and invocation.
  2. Only 8 expert speakers hailing from reputed industries. Sufficient time slot for presentation on practical aspects in detail.
  3. The best part is encouraging feedback from delegates and speakers. They appreciated the theme of seminar and the way it was organised. There was no adverse remark on any part of the seminar.
  4. Delegates & speakers indicated their desire to join future programmes by SPE(I)-Vadodara.

  Event was whole heartedly supported by dedicated members Er. AN Makwana, Er. GP Shukla, Er. DC Mehta, Er. NG Yadav, Er. KN Rathod, Er. SM Godkhindi, Er. RS Shah, Er. VB Harani, Er. JK Surti, Er. NC Solanki, Er. BN Raval,Er. NV Rede and Er. MG Mehta (Anchor).

  The report of the Seminar is brought out in this issue.

- On 19 May 2016, a meeting was organized by Vadodara Mahanagar Seva Sadan (VMC) to discuss Challenges & Issues related to the development of **Smart City**

  Members of SPE(I) Vadodara Chapter namely: Er. SM Takalkar-Vice Chairman, Er. SM Godkhindi, Er. RS Shah, Er. PA Shah, Er. KG Gaikwad, Er. Ms. BG Solanki participated in the discussions and presented views on the Power System of Smart City of Vadodara.

  Municipal Commissioner Shri HS Patel, IAS and Mayor Er. Bharat Dangar appreciated the presentation of SPE(I) members

- On 09 Jun 2016, the Chapter organized a lecture on the topic of **"Modern Electric Traction – Making it Affordable and Sustainable in India"** at Vasvik Auditorium. The lecture was delivered by Shri C Ramanujam, Head Business Improvement, Bombardier Transportation-Vadodara. The speaker gave detailed account of the Electrical System of transportation prime movers. This included Line Converter, Motor Converter, Regenerative Braking, Control Architecture, Sub Station, Vehicle Control Unit, Converter technology moving to IGBT based etc. He also presented the product portfolio of M/s Bombardier. He further stated that continuous change in the technology makes it difficult to maintain the engine and transportation coaches over a long period, unless large inventory of spares is maintained. Local sourcing of components can prove cost effective, he added. He further stated that energy efficient equipment will be a latest technological trend.

  The lecture was well received by the members of SPE(I) as well IE(I), present in large number.

  Speaker was introduced by Er, JD Wadhva.

  Vote of thanks was presented by Er. SM Takalkar

- On 24 Jun 2016, the Chapter organized a lecture on the topic of "Smart Green Field City Dholera"at Vasvik Auditorium. The speakers were Er. Jagdish Salgaonkar, Sr. Vice-President, AECOM, Gandhinagar and Er. SM Takalkar, Managing Director, TPEC, Vadodara. Er. Takalkar is also Vice-Chairman of SPE(I) Vadodara Chapter.

In his presentation,Er. Salgaonkar covered the following:

(1) Background of Dholera Special Investment Rigion(SIR)

(2) The master plan for quality life in Dholera to come up within next 30 years covering 920 Sq. kM.

(3) Topographic and Engineering details of the project including various town planning schemes.

(4) Quality of life in the SIR

(5) Large scale industrial development

Er. Takalkar focused mainly on the power system of the initial town planning scheme of TP2(East) covering 62 Sq. kM. only. He covered the following.

(1) Methods to workout electrical load(power requirement) for different types of usages like industrial, residential, hospitality, roads, services, mixed usages etc.

(2) Lumping of loads and formation of load clusters(28 numbers).

(3) Formation of power zones by lumping clusters(7 numbers)

(4) Sources of power and quantum thereof

(5) Engineering for 24 x 7 power supply with proper voltage and high reliability.

(6) Complete power system being underground with gas insulated switchgear and switching stations.

(7) The entire power system from 400kV to 415V will be in ring main.

Er. ND Makwana, Secretary of the Chapter introduced the speakers.Er. DC Mehta presented vote of thanks.

The programme had a very large attendance of about 175 engineers.

Er.N. D. Makwana
nd_makwana@yahoo.co.in

PARAMETERS FOR SMART CITY

Sr. No.	Parameters	Definition
1	Citizen Participation	A Smart City constantly adapts its strategies incorporating views of its citizens to bring maximum benefit for all
2	Identity & culture	A Smart City has a unique identity, which distinguishes it from all other cities, based on some key aspect: its location or climate; its leading industry; its cultural heritage; its local culture or cuisine, or other factors. This identity allows an easy answer to the question"Why in this city and not somewhere else?" A Smart City celebrates and promotes its unique identity and culture.
3	Economy & Employment	A Smart City has a robust and resilient economic base and growth strategy that creates large-scale employment and increases opportunities for the majority of its citizens
4	Health	A Smart City provides access to healthcare for all its citizens
5	Education	A Smart City offers schooling and educational opportunities for all children in the city

6	Mixed use	A Smart City has different kinds of land users in the same places; such as offices, housing and shops clustered together
7	Compactness	A Smart City encourages development to be compact and dense, where buildings are ideally within 10-minute walk of public transportation and are located close together to form concentrated neighborhoods and centres of activity around commerce and services
8	Open spaces	A Smart City has sufficient and usable public open spaces, many of which are green, that promote exercise and outdoor recreation for all age groups. Public open spaces of a range of sizes are dispersed throughout the City so all citizens can have access.
9	Housing & Inclusiveness	A Smart City has sufficient housing for all income groups and promotes integration among social groups
10	Transportation & Mobility	A Smart City does not require an automobile to get around; distances are short, buildings are accessible from side walk, and transit options are plentiful and attractive to people of all income levels
11	Walkable	A Smart City's roads are designed equally for pedestrians, cyclists and vehicles; and road safety and sidewalks are paramount to street design. Traffic signals are sufficient and traffic rules are enforced. Shops, restaurants, building entrances and trees line the sidewalk to encourage walking and there is ample lighting so the pedestrian feels safe day and night
12	IT connectivity	A Smart City has a robust internet network allowing high-speed connections to all offices and dwellings as desired
13	Intelligent Govt. Services	A Smart City enables easy interaction(including through online and telephone services) with its citizens, eliminating delays and frustrations in interactions with government
14	Energy supply	A Smart City has reliable, 24 x 7 electricity supply with no delays in requested hookups
15	Energy source	A Smart City has at least 10% of its electricity generated by renewables
16	Water supply	A Smart City has a reliable, 24 x 7 supply of water that meets national and global health standards
17	Waste Water Management	A Smart City has advanced water management programmes, including waste water recycling, smart meters, rain water harvesting and green infrastructure to manage storm water runoff

18	Water quality	A Smart City treats all of its sewage to prevent the polluting of water bodies and aquifers
19	Air quality	A Smart City has air quality that always meets international safety standards
20	Energy efficiency	A Smart City promotes state-of-the-art energy efficiency practices in buildings, street lights and transit systems
21	Underground electric	A Smart City has an underground electric wiring system to reduce blackouts due to storms and eliminate unsightliness
22	Sanitation	A Smart City has no open defection and a full supply of toilets based on the population
23	Waste Management	A Smart City has a waste management system that removes household and commercial garbage and disposes of it in an environmentally and economically sound manner
24	Safety	A Smart City has high levels of public safety, especially focused on women, children and the elderly; men and women of all ages feel safe on the streets at all hours

Members in NEWS

Er. JC Marathe, Retd. Chief Engineer, MGVCL and Life Member of SPE(I) Vadodara Chapter is nominated as Member of Managing Committee of Electrical Research and Development Association(ERDA) Vadodara. ERDA will be benefited by his vast experience in Engineering and Management of Power System. Congratulations to **Er. Marathe.**

Er. PN Trivedi, Advisory Committee Member of SPE(I) Vadodara Chapter has established a Vocational Training Centre at village Nana Phofadia near Vadodara. The training centre was inaugurated on 30 Jun 2016 by Shri Vijaybhai Rupala, Minister for Labour, Govt. of Gujarat. Number of engineers members of SPE(I) Vadodara attended the inaugural function.

The centre will provide training to youths who would like to make careers in artisanship. The skills include Piping, Fitting, Welding, Solar Power, Electricians etc.

Er. Trivedi is a selfless social worker and would always like to work for the power engineering fraternity and for those who need help. He is a chairman of Trivedi and Associates and Pratibha Engineers in Vadodara. The firms are engaged in construction of utility and industrial electrical installations including Sub-Stations upto 400 kV. Congratulations :

- Best Wishes to **Er. P N Trivedi**

Minesh Patel
Managing Director

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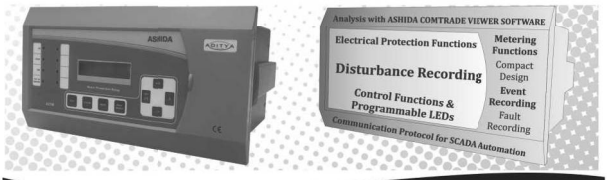

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MOTOR PROTECTION : **A21M**

A21F Feeder Protection Relay is designed with Feeder Protection Functions like Phase and Ground Over-Current Protection, Negative/Zero Phase Sequence Over-Current Protection, Sensitive Ground Over-Current Protection, Thermal Overload Protection, Broken Conductor Protection, Cold Load Pickup Functions, etc.

A21F Transformer Protection Relay is providing Protection for Transformer and equipped with Low Impedance Differential Protection including Amplitude & Phae Compensation automatically according to Transformer name plate details, High & Low Impedance REF Protection, Phase and Ground Over-Current Protection, Negative / Zero Phase Sequence Protection, Thermal Overload Protection, 2nd & 5th Harmonic Blocking Functions etc. It can also provide the Online Monitoring and Recording of Differential and Bias Current to user.

A21M Motor Protection Relay model is highly anticipated Relay which increases Protection for equipment and personnel in Low and Medium Voltage Motor Control Centers (MCCs) by using Motor Thermal Management, Phase and Ground Over-Current Protections, Harmonic Restrain Function, Negative / Zero Phase Sequence / Unbalanced Protection, Locked / Stall Rotor Current Protection, Broken Conductor Protection, Loss of Load and Integrated Programmable Logic. A21M Relay model is also providing report for Motor Start Current to analyze the behavior of induction machine during swtiching ON condition.

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REPORT ON 1-DAY SEMINAR ON "DIGITAL APPLICATIONS IN ELECTRICAL SYSTEM"

The chapter organized a 1-Day Seminar on the topic of **"Digital Applications in Electrical System",** in the Auditorium of Federation of Gujarat Industries (FGI). The seminar was organized on 30th April 2016 with Gujarat Energy Transmission Corporation Ltd.(GETCO) as the knowledge partner. The Prime Minister of India, Hon'ble Shri Narendra Modi has a dream for Digitalizing all the public services including Power system. The seminar was organized to highlight efforts and issues related to digitalization in power sector.

Er. GV Akre welcomed Er. SK Negi, MD, GETCo and Chairmam-All India SPE(I) and all invited guests and delegates. He explained the theme of the seminar which was based on our Hon'ble Prime Minister Shri Narendrabhai Modi's vision of "Digital INDIA". Er. Akre felicitated Er. SK Negi with flowers. Then befitting the theme of seminar on "Digital Applications...", formal inauguration was done by Digitally Lighting of Lamps at the hands of dignitaries.

In his address, Er. SK Negi lauded SPE(I), Vadodara Chapter's initiative in arranging seminars addressing contemporary issues for the benefit of society at large and the engineering fraternity in particular. He complemented SPE(I), Vadodara Chapter's initiative in bridging gap between industry, academia and utilities.

Er. Negi opined that in absence of proper knowledge and skill; even large industries are outsourcing maintenance of their switchyards. He advised industries to adopt "Digital Applications" to run unmanned switchyards. Er. Negi emphasized need for such seminars to disseminate knowledge to concerned stake holders and enhance their operational efficiency. Gone are the days to discuss basic fundamentals of systems and products, both of which are matured, he added.

Er. Negi complimented and advised SPE(I) to continue to look in the future and arrange seminars to address "what is required instead of what has been...". To emphasize the point he gave an example of 'Relays'. Present day relays have recolonized the whole concept of protection and have become like a Black Box of an Aeroplane. These relays, apart from providing protection to the equipment, also carry our analysis. They provide Human-Machine Interface with the help of Information Technology and Communication Consoles. Next development relates to Digital Technology using Fibre Optics which will reduce and some day may even totally eliminate conventional copper wires.

Er. Negi requested engineers to explore digital applications in using real time data in analyzing faults, use real time data with GIS switchyards and unmanned switchyards. He cajoled engineers to spend time in acquiring knowledge of Information Technology, Communication Systems and Analytics based on Digital Techniques, since diagnostics have now become online. Cause and event leading to a fault can be analyzed in real time. This will help in future design improvements.

Er. Negi extolled contribution of Digital Technology in changing the way Management information System has evolved over time. Function of SLDC has improved as assimilation of data can now be in terms of milliseconds or even microseconds, from earlier days of minutes and seconds. This coupled with Substation Automation leads to integration of entire power system into one comprehensive system. This will be needed to fulfill the dream of our Hon'ble Prime Minister of integrating 1 Lac MW of Wind Power and 60,000MW of Solar Power in the system, since operation of these generations will depend largely on use of Digital Applications as power swings will have to be seamlessly integrated with conventional generation.

At the end, Er. Negi threw a gauntlet to engineering fraternity at large and assembled engineers in particular, to seek an answer to "How to convert existing conventional Substation into Digital Substation".

Er. Negi's address was followed by felicitation of Seminar Sponsors, Co-Sponsors and Supporters, followed by Vote of Thanks by SPE(I), Vadodara Chapter Secretary Er. ND Makwana.

Technical Sessions came to an end after a marathon 8 hours of knowledge sharing which were also interspersed with inputs by delegates and lively Q & A Sessions.

Er. SM Takalkar summed up the proceedings with a request to delegates to share their feedback about the seminar, which was overwhelmingly responded by the delegates.

Er. SK Negi asked delegates to share their 'Take Away' from the seminar, and how they would implement the lessons learnt which was also spontaneously shared by the delegates.

Seminar concluded with feelings of a day well spent to acquire/sharpen the skills and a scoop of ice-cream to beat the scorching heat of summer.

The following eminent speakers accepted the invitation of GETCO and made excellent presentations over seven technical sessions.

Sr. No.	Speaker	Company Name	Topic
1	Er. Shashendra Pandey	ABB	Role of communication in Digitalization
2	Er. Kamin Dave	Ashida Electronics Pvt. Ltd.	Digital Applications in substation Engineering
3	Er. (Dr.) Kasi Gadiraju	General Electric	Dynamic line rating system
4	Er. Mukesh Wadhwa	General Electric	GIS Mapping
5	Er. Sameer Gaikwad	Doble Engineering Co.	Transmission Grid Operation
6	Er. (Dr.) Kasi Gadiraju	General Electric	Load dispatch management
7	Er. P. Devanand	Tata Power Delhi Distribution Ltd.	Digitalization in Discoms
8	Er. Ramkrishna Koti	Siemens Ltd.	Digitalization in Industrial Electric

Each presentation was followed by questions and answers as well as discussion. This indicated that the presentations were well received and the seminar was a grand success.

Total number of delegates registered for the seminar was 150.

The seminar received financial support from the followings:

Sponsors:

1. Gujarat Energy Transmission Corporation Ltd.
2. Gujarat State Electricity Corporation Ltd.
3. Madhya Gujarat Vij Company Ltd.

Co-Sponsors

1. LNG Petronet, Dahej
2. L&T Special Steels & Heavy Forgings, Hajira, Surat
3. Parth Electricals, Vadodara

Supporters

1. NTPC, Kawas
2. Eco Technology & Projects Udhna-Surat
3. Takalkar Power Engineers & Consultants (P) Ltd., Vadodara
4. Gururaj Engineers, GIDC, Makarpura
5. Vasudev Power, Surat
6. Shreeji Electricals, Surat
7. RR Kabel, Vadodara
8. DankeTechnoelectro (P) Ltd. Waghodia
9. Multidry Systems

The organizations who deputed delegates, in addition to above financial supporters include,

1. GETCo-Vadodara
2. Parth Electricals-Vadodara
3. NTPC-Kawas
4. Vasudev Power-Surat
5. Shreeji Electricals-Surat
6. RR Kabel-Vadodara

The GETCO had a Lion's share in making this programme a grand success.

Er. SK Negi, MD, GETCO had personally monitored the programme. Er. RP Satani, Dy. Engr., Engineering Department, GETCO, Head Office, was the key personnel in co-ordinating the seminar's activities.

The office bearers, the executive committee members, advisory committee members and other active members of the chapter strived hard to pull the resources and make arrangements for the seminar.

INDUCTION MOTORS,AC VARIABLE FREQUENCY DRIVES AND DC MOTORS

Three phase squirrel cage Induction motors are the most widely used motors in all industries, thanks to the reliable, robust design and high efficiency combined with low cost.

Most of the applications are designed with fixed speed of motors and induction motor is the ideal choice. But, equipment designers had only one problem in their usage in some of the industrial applications where variable speed of the motor was required. Induction motors were not suitable for variable speed applications.

Some of the applications of variable speed drives are:

Steel rolling mills, Paper mills, Winders, Cut to length applications, traction, extruders, positioning systems, weighing etc.

PRINCIPLE OF OPERATION OF INDUCTION MOTORS:

The 3-phase, 50Hz supply connected to the 3-phase distributed winding on the stator produces a rotating field in space moving at synchronous RPM and the rotor follows this rotating field and starts rotating.

The speed of the 3-phase induction motor depends purely on 2 parameters, frequency of supply and number of poles of motor. The number of poles being fixed for a given motor, the speed depends purely on the frequency of input supply. The electric supply all over the world has only 2 frequencies, namely 50 or 60Hz.

For example, the 4 pole, 50Hz induction motor synchronous speed is 1500 RPM. The same motor will have synchronous speed of 1800 RPM with 60Hz input supply. Equation is $N=120 \times F/P$, P= no of poles.

To vary the speed of induction motors, therefore, we have no alternative but to change the frequency of supply to the motor by adding one equipment in between the fix frequency supply and motor.

The induction motor develops mechanical torque because of the slip between the actual rotational RPM of the shaft and synchronous speed, as defined earlier.

The slip produces emf in the rotor and therefore rotor currents. The electromagnetic field developed because of the supply voltage to the stator and the rotor currents because of slip emf, produces the mechanical torque.

Obviously, when induction motor is on no load, the motor speed is very close to the synchronous speed as the torque requirement is very low. Slip is low. As the load on the motor increases, the slip starts increasing to develop more torque required. The nominal slip on full load is 4% for most of the conventional induction motors. This means that a 4 pole 50Hz motor, whose synchronous speed is 1500 RPM, will run at 1440 RPM on full load.

The standard induction motor is designed for a standard supply voltage and frequency; say 3-phase, 415V, 50 Hz.

30-40 years ago, there were no easy solutions to get variable frequency supply to induction motor.

DC motors were widely used wherever variable speed was required. The control circuits were comparatively easy but DC motor was complicated in construction, bigger in size. The biggest problem was of maintenance of DC motor because of commutator and brushes.

1980.... ONWARDS TILL TODAY

Once the power components like Thyristors, IGBTs, MOSFETs and micro controllers were invented and as the reliability increased, researchers could think of using these components and develop equipment which could accept DC as input and produce 3-phase variable voltage output at variable frequency, to be fed to the induction motor.

This equipment is called as the inverter, which converts DC to AC, as opposed to the rectifier which converts AC to DC.

The inverter consists of a 3-phase rectifier with capacitor which converts 3-phase AC to DC having low ripple. This DC voltage is applied to a 3-phase inverted bridge having 6 IGBTs. They are energized sequentially to produce 3-phase output.

The output is varied by PWM, Pulse Width Modulation, of the switching of IGBTs.

These inverters have now become very reliable and are easily available off the shelf. They are available from 0.5 HP to 100s of HP. Large companies like Siemens, GE, Schneider, Omron, ABB, and so many others are manufacturing these drives in large quantities.

As the frequency is reduced the voltage applied to the motor also has to reduce in the same proportion, to keep the magnitude of flux the same as design value. If we reduce the frequency to 25Hz but apply 415V to the motor, the flux requirement will double as Flux=K x V/F. To produce this double flux, the current drawn by motor could be much more than double as the magnetic design is already done on the knee part of BH curve. The motor will burn even on no load.

Since the flux is the same as design value and motor current cannot exceed rated current, the motor torque remains the same as the rated torque at lower speeds. This is called as constant torque operation. So, as speed reduces the HP output of the motor reduces, as HP= K x Torque x Speed.

At super synchronous speeds, beyond 50Hz, we cannot apply more voltage than 415V AC. The flux reduces as speed increases as V/F reduces. So, torque output falls with increase in speed resulting in constant HP output beyond synchronous speed.

Different types of 3-phase induction motors are available to meet different load requirements of the load. Some of them are High starting torque motors, Torque motors etc.

The inverter units are designed from 1Hz to 400Hz and have so many good features like

Very compact. They are programmable to suit different applications.

Adjustable time for soft start and soft stop.

Electronic forward/reverse without use of contactors is possible.

Remote start/Stop.

Automatic V/F curve, slightly adjustable and programmable.

Start, stop or variable speed, direction commands from communication through PLC etc.

It has overload protection, over voltage protection etc.

It has an LCD display indicating status of input, outputs, power input, power output, speed, frequency etc.

We can use equipment using 3-phase motors up to 2 HP in normal domestic single phase supply, as such inverters are available.

DISADVANTAGES:

Although these drives are reliable, they cannot be repaired easily because of their complex and compact design. Critical parts are not available easily and even if the parts are available they do not fit in the same size.

These drives introduce large amount of harmonics in the supply system.

Induction motors have to be de rated by 5-10 % because of overheating due to these harmonics.

Comparison between AC VFD and DC Variable speed drives:

Speed Torque characteristics: Same in both, constant torque in sub synchronous speed range and constant HP in super synchronous range.

Speed range: 1:10, same in both.

Control circuit: Both can be controlled by electronic circuits but AC VFD controls are more complex.

Maintenance: No maintenance in AC VFD and induction motor other than routine mechanical maintenance. Control unit cannot be repaired.

In DC drive system, DC motor needs a fair amount of maintenance because of commutator and brushes. Control unit can be repaired easily.

Efficiency: With control unit, efficiencies of both are comparable, AC VFD efficiency may be marginally better.

WOUND ROTOR INDUCTION MOTORS:

For very high initial torque requirement, we still use wound rotor induction motors and not squirrel cage induction motors. The resistor bank is connected across wound rotor and progressively the resistor value is reduced and finally the rotor terminals are shorted, once full speed is achieved.

Author : **Er. Mohan R Tilwalli,** M.Tech., IIT-Mumbai.
LM, SPE(I) Vadodara & Proprietor : Gururaj Engineers, an ISO 9001:2008 company providing complete automation solutions for industrial SPMs, process plants and equipment. System integrators for GE, OMRON and CROUZET for their automation products like PPLCs, Servo Motors, SCADA.
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Random Thoughts

HURRYING AND JUMPING INTO CONCLUSIONS - A HAVOK, THINK TWICE BEFORE YOU JUDGE.

Science has brought to our doorsteps a number of gadgets & facilities which have no doubt improved the quality of life but, only only of those who know where to draw a line. In the highly competitive modern world, time has become an important commodity and to remain physically happy, he has usurped all the tools available to him. Fast travel, fast food- everything associated with (FAST). But in the mental and spiritual frame, it appears, he has lost much than the gains of the modern world. Good values – Love, Compassion, Empathy, Discrimination, Patience to name a few, have almost disappeared from his life. An anecdote below proves it.

A doctor entered the hospital in a hurry after being called in for urgent surgery. He changed his clothes and went directly to the surgery block. He found the patient's father pacing in the hall waiting for the doctor.

On seeing him, the father yelled. "Why, did you take all this time to come? Don't you know that my son's life is in danger? Don't you have sense of responsibility, the doctor smiled and said "I am sorry, I wasn't in the hospital and I came as fast as I could after receiving the call and now, I wish you would calm down so that I can do my work."

"Calm down" what if your son was in this room right now, would you calm down? If your own son dies while waiting for doctor then what will you do, said the father angrily. The doctor smiled again, and replied, "We will do our best by God's Grace and you should also pray for your son's healthy life".

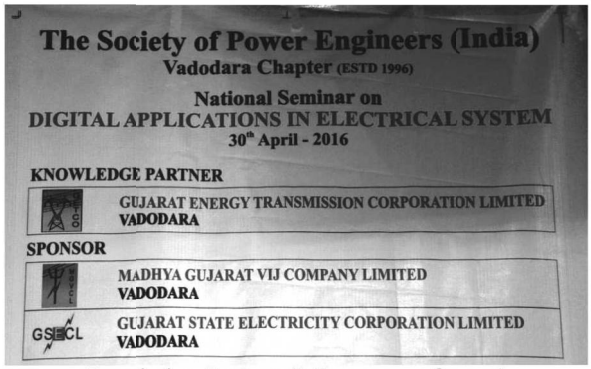
Giving advice when we're not concerned is so easy" murmured the father. The surgery took some hours after which the doctor went out happy. "Thank goodness your son is saved." And without waiting for the father's reply, he hurriedly left saying, if you have any questions, ask the nurse.

"Why is he so arrogant? He couldn't wait some minutes so that I ask about my son's state, commented the father when seeing the nurse minutes after the doctor left. The nurse answered, tearing coming down her face. His son died yesterday in a road accident. He was at the burial when we called him for your son's surgery. And now that he saved your son's, life, he left running to finish his son's burial."

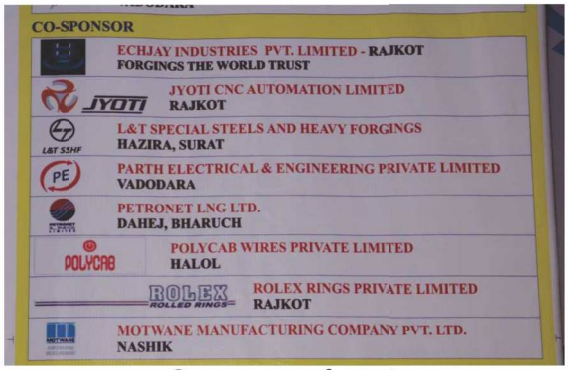
Never Judge anyone because you never know how their life is and what they're going through.

- N. DINKER

Knowledge Partner, Sponsors, Co-Sponsors & Supporters and Felicitation of their Representatives



Knowledge Partner & Sponsors of event



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Felicitation of Speakers

Er. MG Mehta, AC Member & Anchor of the event felicitating speaker Er. Samir Gaikwad of M/s Doble Engineering

Er. KN Velani, Engr.-TPEC felicitating the Speaker Er. Ramakrishna Koti of M/s Siemens Ltd., Mumbai

Er. GM Bahudhanye, Office Adm. C Member, felicitating the speaker Er. Shashendra Pandey of ABB

Er. NG Yadav, EC Member felicitating the Speaker Er. P Devanand-Tata Power, DDL, New Delhi

Er. Vrajesh Desai, AC Member felicitating the Speaker Er. Mukesh Wadhwa of M/s GE

Er. JK Surti, EB Member felicitating the speaker Er. Kamin Dave of M/s Ashida, Thane

Felicitation of speakers, Question to speaker & Feedback session

Er. NV Rede, EB Member felicitating
the Speaker Er. Kasi Gadiraju of M/s GE

Er. SK Negi, President asks question
to speaker after his presentation

Er. Thakkar, Delegate-GETCo(Knowledge partner)
asks question to speaker after his presentation

Er. Mohan R Tilwalli-Gururaj Engineers(event Supporter)
asks question to speaker after his presentation

Er. RS Shah, AC Member asks question to speaker
after his presentation

Er. SK Negi-President getting feed-back
from Speakers & Delegates

Delegate asks question to speaker after his presentation

Feedback & Valedictory session

Er. SM Takalkar, Vice-Chairman 3rd from left handling Feed-back Session. from L to R Er. GV Akre- Chairman, Er. SK Nagi-President& Er. N D Makwana - Secretary

Er. GV Akre, Chairman extreme left replies to the question from delegates from L to R Er. SK Negi-President, Er. SM Takalkar-Vice Chairman & Er. ND Makwana-Secretary during valedictory function

Sitting from L to R Er. GV Akre, Er. SK Negi, Er. SM Takalkar & Er. ND Makwana Standing from L to R Er. KD Kavaiya, Er. Kamin Dave, Er. DC Mehta, Er. VB Harani, Er. MG Mehta, Er. RS Shah, Er. Mukesh Wadhwa, Er. GM Bahudhanye, Er. MM Patel, Er. JK Surti & Er. P Devanand

Photographs of a Lecture Programme on Smart Green Field City Dholera on 24 June 2016

Er. ND Makwana, Secretary giving introduction of Speakers during a lecture on Smart Green Field City Dholera

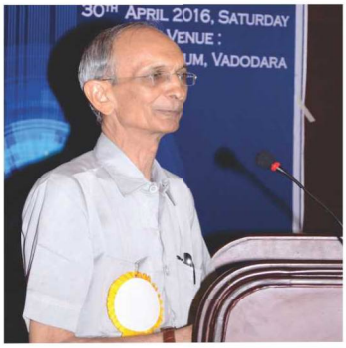
Er. Jagdish Salgaonkar delivering his lecture during a lecture on Smart Green Field City Dholera

Er. SM Takalkar, Vice-Chairman delivering his lecture during a lecture on Smart Green Fielc City Dholera

Photographs of Seminar on Digital applications held on 30 Apr 2016 at FGI-Vadodara, Inaugrual Session

Er. GV Akre, Chairman SPE(I)-Vadodara Chapter delivering inaugural address

Er. SK Negi, National President of SPE(I) delivering his speech



Er. ND Makwana, Secretary, SPE(I) Vadodara Chapter delivering his speech

Dignitaries on dais
L to R Er. GV Akre-Chairman, Er. SK Negi-President,
Er. SM Takalkar-Vice Chairman & Er. ND Makwana-Secretary

Registration of Delegates, Speakers and Invitees

August gathering during seminar

Printed Matter

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