



ELECTRICAL INSTALLATION ENGINEER

NEWS LETTER

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE (Regn. No. 211/1992)

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வாழ்த்துகிறோம்

எங்கள் அன்பிற்கும், மதிப்பிற்கும், மரியாதைக்கும் உரிய
மாண்புமிகு தமிழ்நாடு முதல் அமைச்சர் டாக்டர் ஜெ. ஜெயலலிதா அவர்களுக்கு
எங்களின் அன்பார்ந்த வணக்கம்.



தற்போது நடைபெற்ற 2016 சட்டசபை தேர்தலில் அமோக வெற்றி பெற்று வெது முறையாக
தமிழ்நாட்டின் முதல் அமைச்சராக பொறுப்பேற்கும் தங்களுக்கு எங்கள் TNEIEA
சங்கத்தின் அனைத்து உறுப்பினர்களின் சார்பாக மனமார்ந்த வாழ்த்துக்களை தெரிவித்துக்
கொள்கிறோம்.

தங்கள் அன்புள்ள

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G. VENKATESH
Editor – Newsletter

COMMITTEE MEETING PHOTO - 23.04.2016

The Committee meeting was held on 23rd April 2016 at Silver Holiday Cottages, Yercaud.



Salem Vice President Mr. S. Manivannan, welcomed the gathering and handed over the proceeding to the secretary Mr. K. Kannan. The following points were discussed during the meeting.

1. It was decided to pool in more effort to hasten the process for the extension of License period through proper representation to CEIG Office.
2. A Committee shall be formed to proceed further. The same shall be carried out after Assembly elections (May 16th).
3. A Grade Notice board and a Flag for the associations has been proposed and a team for designing the same has been formed.
4. Subscription collection pending was discussed and secretary requested the district VPs to follow up the same. The pending lists have been handed over to the district VPs.
5. Recently our association staff, employee for more than 10 Years, has lost her husband. As a humanitarian gesture it was proposed and accepted by the committee to deposit Rs.2,00,000/- (Rupees Two Lakhs Only) in fixed deposit towards her children's education.
6. Few more points were discussed and the meeting came to an end.
7. The secretary delivered Vote of Thanks.
8. Excellent dinner followed the Meeting. All the members congratulated Mr. S. Manivannan, Salem Vice President and his team for excellent arrangements for the committee meeting.

EDITORIAL

Dear Members, Fellow Professionals, Friends and Well wishers,

Seasons Greetings To One And All!

Best Wishes To One And All For Getting A Clean And Proactive Government!!

What is on top of the mind this month is the State Elections which is being held with lot of Actions, Noise and Excitement. Though there is lot of criticism from all the platforms about the horrible conditions etc, which are not totally untrue, it will certainly be acknowledged by all the intelligential, who have been seeing the Progress in the Country and in the State in the past 3 or 4 decades, that there has been lot of Progress, be it Industries or Businesses or Agriculture or Transportation or Improvements in General Standards of living. But the sad fact that needs to be seen and acknowledged is the spread of wide network of corruption in anything and everything with the organized participation of all concerned including receivers and the givers and the channeling of the proceeds. If only the pilferages in the increased Wealth Generation in all fronts can be totally arrested or at least reduced to a great extent, the Progress would have been and continue to be much more and much faster. ‘**May Day**’ representing the labour movements all over the World, is an important ‘**Land Mark**’ day of the World, but the Focus on Productivity like in Countries like Japan, China, Korea and many others will have to be stressed in our Country, which can only make us competitive both in local and export markets.

17th May each year marks **World Telecommunications Day** celebrating the constant evolution of one of the most important factors of our lives: communication. The main goal of World Telecommunications Day (WTD) is to highlight the importance of communication and how information travels across the world. It also aims to increase awareness of how crucial communication is in our lives, and stimulate the development of technologies in the field.

World Information Society Day is also celebrated each year on 17 May to remind the world of the vision of the World Summit on the Information Society to build “a people-centered, inclusive and development-oriented information society” based on fundamental human rights. World Information Society Day promotes people’s awareness of the power of information and communication to build societies in which they can create, access, use and share information and knowledge to achieve their full potential. Organizations such as UNESCO actively take part in the day by inviting people to engage in various activities to promote campaigns centered on this event.

National Technology Day is an annual observance in India, celebrated on May 11. It commemorates the series of five nuclear bomb test explosions conducted on May 11, 1998 and known as Operation Shakti or Pokhran-II. India was one of the first countries in Asia to begin the development of a nuclear program. The program started in 1944. Its key component was the Pokhran Test Range located in the Thar Desert. India’s first nuclear weapon explosion was performed in 1974. The second test took place 24 years later, in May 1998. Pokhran-II is considered the crucial moment in the growth of India’s technology prowess, therefore Prime Minister of India declared its anniversary as **National Technology Day**. It is observed annually throughout the country by scientific and industrial organizations as well as educational institutions. As rightly claimed by many, India was recognized by the World as the Technologically Competent Country and we became one of the important Technological and Manufacturing Hub of the World.

We thank all those members who have helped us by participating in the advertisements appearing for the issue April 2016 – Universal Earthing Systems Pvt. Ltd., OBO Bettermann India Pvt. Ltd., Power Links, Dehn India Pvt. Ltd., Wilson Power and Distribution Technologies Pvt. Ltd., Elektrotec 2016, Galaxy Earthing Electrodes Pvt. Ltd., Faith Power Solutions, Sun Sine Solution Pvt. Ltd., NSIC Technical Services Centre, Anchor Electricals Pvt. Ltd., Supreme Power Equipment Pvt. Ltd., Ashlok Safe Earthing Electrode Ltd., Abirami Electricals, FLIR Systems India Pvt. Ltd.

EDITOR

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| 75. | R.G. Power Consortium | Chennai | 044-42056730, 77081 07489 | EA 2900 |



POWER LINKS

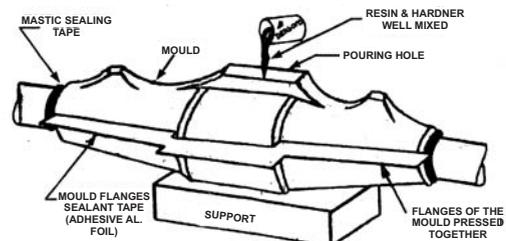
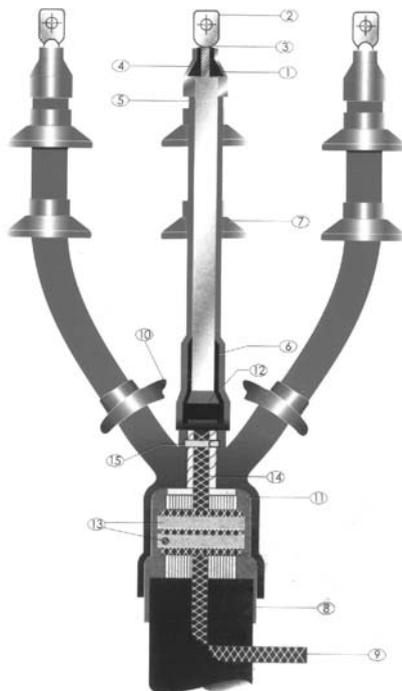
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UNIQUE ELECTRIC TORQUE VECTORING TECH ENTERS REAL WORLD

GKN Automotive has entered its eTwinster technology into the real world, as automakers test the torque vectoring electric drive system. The plug-in hybrid module is being showcased at the company's Wintertest proving ground in Sweden as an all-wheel drive driveline option.

The eTwinster is meant to offer automakers a combined solution for hybrid and plug-in all-wheel drive platforms. It's a combination of the eAxle technologies GKN provides for companies like Volvo, Porsche and BMW, and the twin-clutch torque vectoring features the company created for vehicles from Ford and Range Rover.



GKN built a prototype vehicle for testing based on a premium SUV. The prototype utilizes a 240 Nm (177 lb-ft) electric motor and gasoline engine. With ratios, a total production of 2,400 Nm (1,770 lb-ft) of torque is sent through the dual-clutch eTwinster system. Vehicle dynamics experts from several leading automakers are currently test driving the prototype vehicle. The high amounts of torque mean that the prototype receives more propulsion power from the electric motor than it does the combustion engine.

The company says that the eTwinster will be ready for production vehicles within the next three years and predicts that by 2025, about half of all vehicles produced will have some form of electrification (hybrid, plug-in). To that latter end, GKN is developing a range of electric-drive systems meant to augment or boost the power produced by the electric motors in hybrid and plug-in vehicles.

GKN Driveline is the world's leading supplier of automotive driveline systems and solutions. As a global business serving the leading vehicle manufacturers, GKN Driveline develops, builds and supplies an extensive range of automotive driveline products and systems – for use in the smallest ultra low-cost car to the most sophisticated premium vehicle demanding the most complex driving dynamics. With 25,500 people at 46 locations in 23 countries, GKN design, develop and integrate driveline technologies that transmits power to the wheel in the most effective and efficient way possible.

Source: GKN

A science is any discipline in which the fool of this generation can go beyond the point reached by the genius of the last generation. - MAX GLUCKMAN, Politics, Law and Ritual, 1965

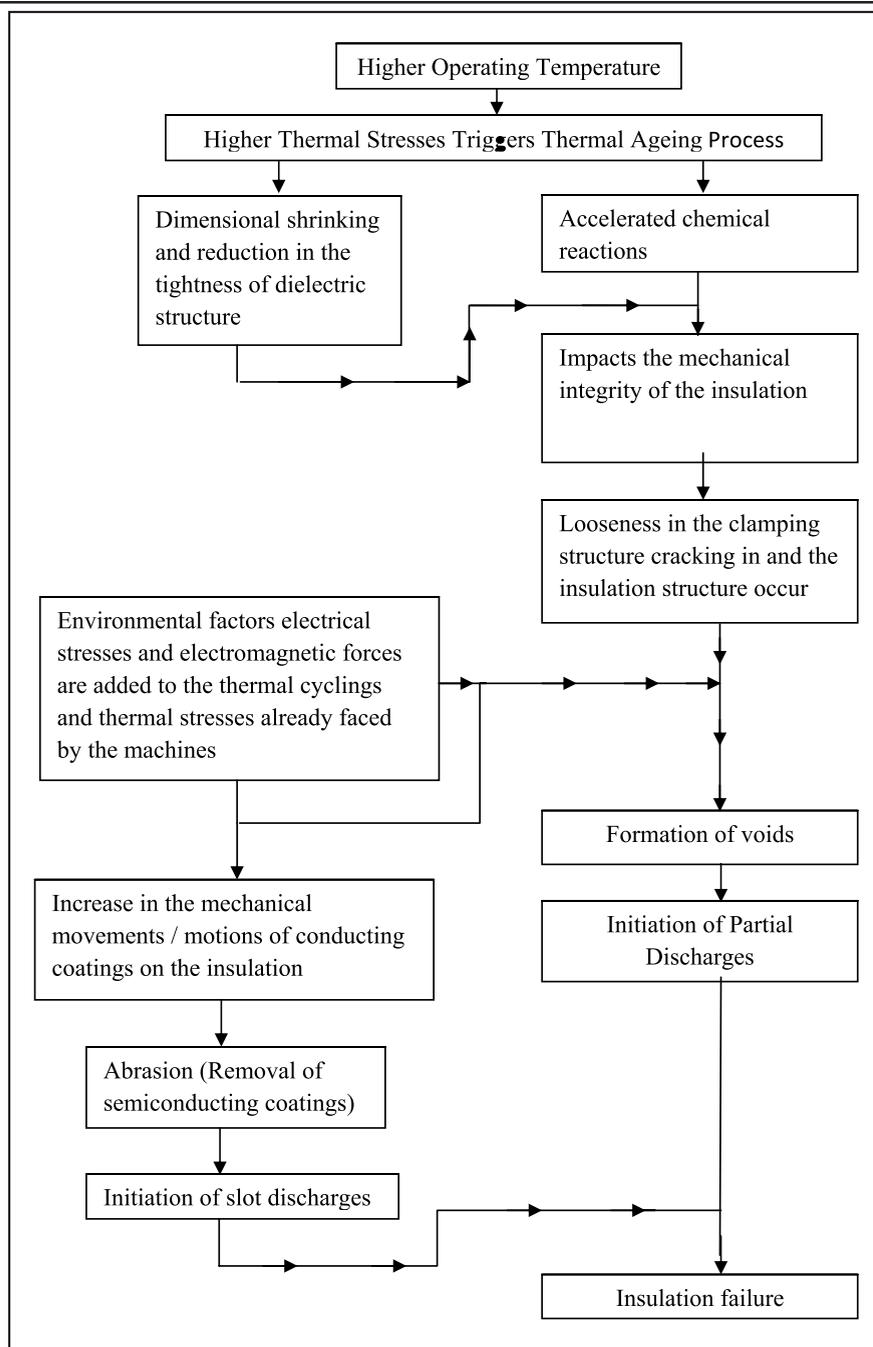
We are on the second leg of Electrical Equipment Ageing Phenomena. “Ageing is nothing but the response of the equipment to various forces faced by it”. How it meets these forces determines its deterioration or loss of working life. Now let us learn how vital and costly by electrical equipment experience various stresses of ageing and what are the possible testing techniques currently available to estimate the deterioration suffered by these equipment. A measure of short and long term ageing effects that include residual life prediction will certainly be of much use to the end users. Such measurements can help to evaluate the performance of the equipment under extreme conditions of Temperature, Humidity, Dust, Dirt, Oil leaks, Chemical, Mechanical and Critical Electrical Conditions. In addition, it also helps to check the quality of design, manufacture, erection, testing operation, maintenance and users; response to its health condition. Prior to the probing of the stresses faced by various equipment, let us see some more related details on this insulation ageing Phenomena. First point to be noted is that the equipment itself has stored / harboured adequate seeds of degradation of its own insulation. The second point to be noted is that without any exception all end users are interested in getting the reliable data / information on the loss of life suffered by the equipment i.e. at any time they desire to know the useful remaining life of the equipment. This gives an idea about the ageing suffered by the equipment. When this being reality of the field position, it is indeed worth to note that none can accurately / precisely predict / determine the rate of ageing suffered by an electrical equipment nor its remaining life. All that one knows is that Ageing is a phenomena that gradually degrades an equipment insulation and finally brings its failure / end. It is chiefly due to the fact that the ageing effects are caused by the combination of all kinds of stresses experienced by the equipment which are not amenable to any prediction measurement. Simply put, it is an internal process of change for the worse aided by aggressive external factors. At best, thermal ageing of organic components like cellulose paper and paper board can be estimated to certain level by adopting the chemical reaction theory governed by the well known Arrhenius equation. Since the reality faced by equipment is far different from the one assessed by Arrhenius equation, we may not be successful in our estimation of ageing suffered by the equipment by using this equation alone. So the adoption of the thermal rule (10° rule) viz. 50 percent loss in insulation life for each 10°C rise in the temperature of the insulation can only be an approximation. Among the operating conditions that warrant our attention in this context are sudden shocks, vibrations, excess generation of heat / temperature rise. Unusual and abnormal movements / oscillations of equipment parts, loose links / connections, metal erosion, corrosion of components, cracks, thinning out of material, higher friction, rubbing noise of surfaces and parts, loss of lubrication, leaks of lubricating oil and misalignments. We have to take a “clear focus” on these factors while considering the factors responsible for the ageing of the equipment.

When we turn our focus on the understanding of the deterioration with time of rotating machineries, the main point to be noted is that the ageing of small machines is chiefly caused by its operating environment, frequency of start-ups and operating temperature whereas the loss of insulation life suffered by large machineries is chiefly due to the combined effect of Thermal, Electrical, Mechanical and Environmental stresses faced by it.

I. Sequence of events noticed during ageing process

- a. Rotating machines (Dynamic Equipment)
 - i) Ageing of large machines \longrightarrow caused by Thermal, Electrical Environment and Mechanical factors
 - ii) Small Machines \longrightarrow operating temperature + operating environment
- b. Transformers (static equipment)

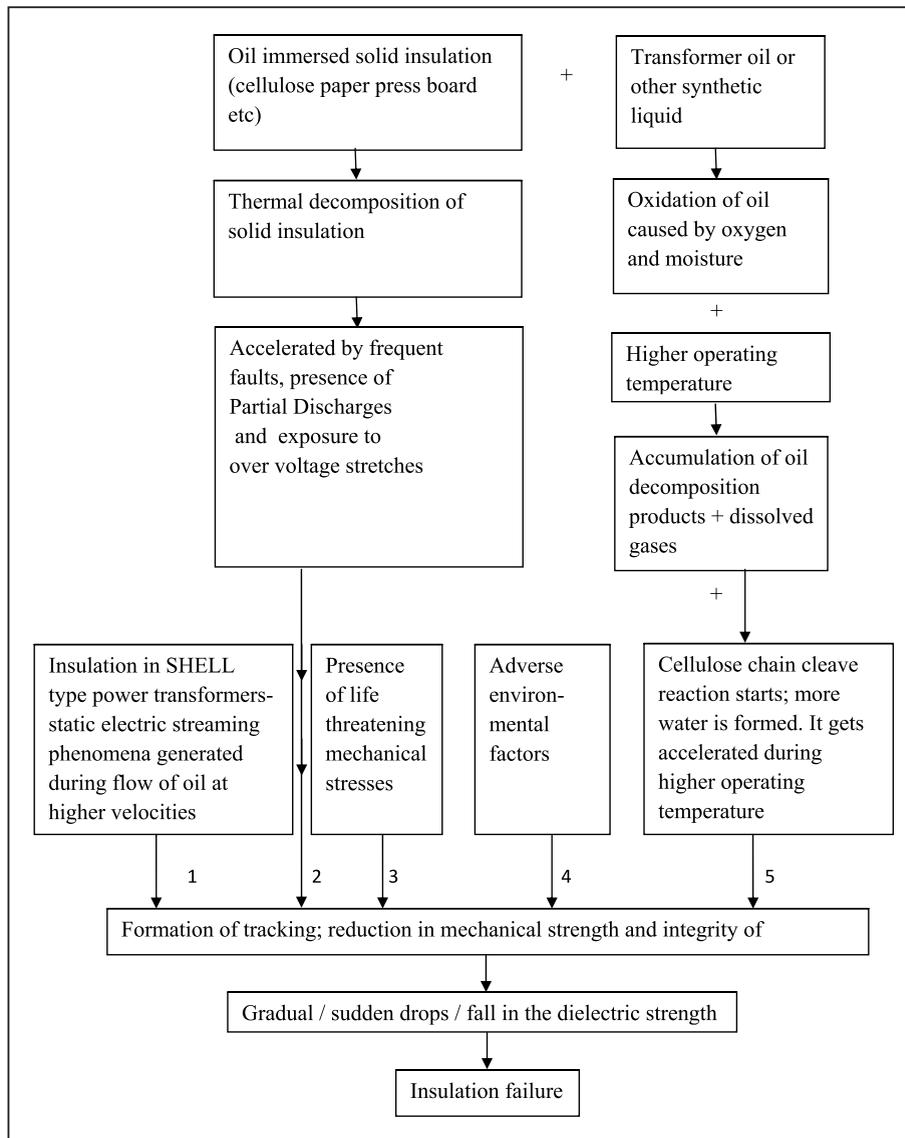
Transformers help to transfer electrical energy from one voltage level to another voltage level. It acts as a static energy transferring equipment only – not an energy converting equipment. Physically in an oil filled transformer, the solid insulation / materials are impregnated with oil. Thus there are two insulating mediums – oil and solid insulation. In dry type transformer, resins are used; oil medium is not employed. Majority of the transformers currently in use are of oil – filled type; hence there is a big need to focus on the ageing of both oil and solid insulation. It makes the study of ageing process in an oil-filled transformer more difficult and complex. i.e. we have to study the ageing faced by oil and solid medium present in the transformer. To meet the rigours of its surrounding oil medium, insulated conductors in a transformer have to be designed with adequate thermal resistance, electrical integrity, resistance to mechanically induced stresses and finally inertness to the chemical reactions produced by the oil. In addition, a higher factor of safety has also to be added to it to cover the factors if any missed.



Thus we can easily visualize that a transformer, while performing its assigned duty is always exposed to electrical, mechanical, thermal and environmental stresses which normally test its endurance or tolerances levels and hence its life span.

- The electrical stresses experienced by the transformer are mainly due to,
 - Normal power frequency electrical stresses and short circuit forces caused by close up faults
 - Abnormal voltage stresses caused by external (lightning) and internal (*VFTOs and Switching surges*)
 - The mechanical stresses faced by the transformer are mainly due to the electrical forces, brought by the faults and other transient conditions due to the looseness, vibrations of its foundations / supporting structures and wind forces.
 - The thermal stresses seen by the transformer are mainly attributed to its higher operating temperature and energy losses (Iron and Copper losses)
- The environmental stresses experienced by the transformer are mainly due to the hostile factors present in its surrounding environment.

c. Schematic diagrams of the ageing processes in
(a) Transformer



II UG cables and OH lines

The UG cables / OH lines which are employed to deliver the required electric power to the equipment also demand our focus while we discuss the “ageing” of the concerned equipment. We can’t avoid them totally. So let us have a brief focus on these elements also.

I. U.G. Cables – Salient points

- Cellulose materials play an important role in the construction of UG cables
- The operating temperature of UG cables is significantly low, when compared with the hot spot temperature of a transformer. Due to this low operating temperature, its degradation is also gradual in steps. Thus we find the deterioration suffered by the UG cables due to ageing / rigours of service conditions is not serious enough to threaten its life.
- Thermally – induced degradation as experienced by the cables normally bring lower stresses. The voltage stresses suffered by the cables are also at the lower level.
- In an oil – filled cable, the gas in oil analysis do not bring significant results. It is because the gases generated are different from that occur in an in-service transformers.
- Reliable information is still not available about the ageing of to composite dielectric materials that are used in the construction of UG cables. This handicaps the ageing study of modern cables.

- XLPE cables generally face degradation due to the entry of water, electro – chemical tree formations and voids.
- HVDC testing which is used to find out the faults / health to status of the cable shortens the life of the cable because of the effects of trapped charges brought by it.
- Ageing of UG cables is influenced by environmental factors, voltage stresses, moisture ingress, higher operating temperature, nature of its heat sinks and surrounding soil, presence of trapped charges that are caused by DC testing, lightning and switching surges, injuries suffered during installation / digging by other agencies, inadequate air circulation and finally rodent and chemical attacks.
- Cable joints and terminations also experience the above mentioned adverse factors. In addition they face surface contaminations and the impact of ultra violet rays.
- The problem areas thus far revealed by various studies are
 - i. Water tree degradation widely prevalent in LT distribution type cables.
 - ii. Electrical trees and
 - iii. Electrical tree degradation widely noticed in HV and EHV class power cables.
 - iv. Problems in prefabricated EHV class joints
 - v. Side effects of HVDC testing specially noticed in the performance of EHV cables.

In this context it is to be stressed that in all modern developments, compactness or occupation of less space is always considered as the prime / chief requirement. But this compactness brings some significant problems in its wings. Among them are enhanced electric stress – an equipment life threatening factor. This kind of higher stress design magnifies certain phenomena which have not shown their ugly heads earlier. Now these factors suddenly enter into the operating environment of the equipment as **dragons**. In this regard the problems now faced by the insulated substation and composite insulators may be treated / counted as good examples. In the case of GIS, Partial Discharge and particle movements occurring at the metal epoxy space interface and in the free SF₆ space are found to be the concern areas. As regards the composite insulators, the macroscopic interfaces that exist between the air and shed insulation and between the shed and core insulation and the microscopic interfaces that exist between air and the shed insulation and between the shed and core insulation are considered as the problem areas during ageing weathering phenomenon and reduce the reliability of composite insulators. Now let us move on further to the topics related to the residual life assessment of the equipment and its connected accessories.

III Residual life assessment of an equipment

It can be simply compared to the internal clocks that work in a human being and help to establish a close estimation of a person's true age which is different from his actual biological or chronological age. In the case of equipment, it simply shows that

- How the working life of an equipment has been used so far.
- How much useful life still remains for further use
- Whether the ageing process suffered by it is at the normal rate or at an accelerated rate. If so, what are the reasons for its rapid / fast ageing process.
- What corrective measures are required to retard / defuse the prevailing situation
- Whether any opportunity exists for the repair / retrofitting / replacement of the equipment in service which may help to avoid the untimely / unscheduled costly outage or failure.

Let me sign off here

In our next article, kindly make a brief visit to the site relating to residual or remaining life assessment of equipment so as to get the answers to the questions outlined above. Then we can move on to the determination of the happiness quotient of in service electrical equipment.

Till then kindly remain connected.

(To be continued...)



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EVENTS

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Big3
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PRESENTS



THE ARCHITECT & INTERIOR EXPO 2016

Events Profile: Big3 Exhibitions is a Trade Shows organizing company providing seamless professional and personalized solutions for our clients. Our persistence for perfection and our determination and dedication towards what we do allow us to deliver the best result and quality client services. Big3 Exhibitions formed in 2015 serving the exhibitors and professionals from various industry and is committed to building an efficient communications platform for the industry around the globe.

Date: 26th – 29th May 2016

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Website: <http://www.big3exhibitions.com/>



7 - 9 SEPTEMBER, 2016
India Expo Centre, Greater Noida, India

A UBM Event

Events Profile: Expo intends to accelerate the growth of India's Renewable Energy sector and contribute to the country's sustainable economic development. The show aims to upscale and mainstream the applications of renewable energy resources, showcase innovations, and enrich deliberations by providing the industry with an international exhibition and conference platform.

Date: 7th – 9th September 2016

Venue: India Expo Centre, Greater Noida, India

Website: <http://www.renewableenergyindiaexpo.com/>



15th to 18th September 2016
CODISSIA Trade Fair Complex, Coimbatore

Events Profile: **Elektrotec 2016** is one of the largest electrical and industrial electronics sector trade events in India.

Date: 15th – 18th September 2016

Timings: - 10.30 AM to 06.00 PM

Venue: CODISSIA TRADE FAIR COMPLEX, Avinashi Road, Coimbatore

Website: <http://elektrotec.codissia.com/>

SHRI PIYUSH GOYAL JOINTLY LAUNCHES PROGRAMMES UNDER ISA ALONG WITH MS. SÉGOLÈNE ROYAL, FRENCH MINISTER OF ENVIRONMENT & PRESIDENT OF COP21

Shri Piyush Goyal, Union Minister of State (IC) for Power, Coal & New and Renewable Energy and Ms. Ségolène Royal, French Minister of Environment, Energy and the Sea, in charge of International Relations on Climate and President of COP21 co-chaired a **Ministerial Side Event on International Solar Alliance (ISA) at Headquarters of the United Nations in New York on Friday.**

Ministers and Representatives from over 25 countries including Bangladesh, Brazil, Ethiopia, Namibia, Uganda, Nigeria, Peru, Djibouti, Surinam, Zambia, Bolivia, Seychelles, Sri Lanka, Mali, India, USA and France participated in the ISA side event.



In order to accelerate massive deployment of solar energy at various scales in their countries, Ministers agreed to take concerted action through targeted Programmes launched on a voluntary basis, to better harmonize and aggregate the demand for:

- **Solar finance**, so as to lower the cost of finance and facilitate the flow of more than US \$ 1000 billion investment in solar assets in member countries;
- **Mature solar technologies** that are currently deployed only at small scale and need to be scaled up;
- **Future solar technologies** and capacity building, through strategic and collaborative solar R&D, to improve the efficiency and integration of solar power as well as increase the number of solar applications available.

A common buyers market for solar finance, technology, innovation, capacity building etc., will lead to higher quality, lower costs, products better tailored to needs, collaborative innovation, technology ownership, and a more balanced dialogue with all stakeholders. This will empower solar-rich countries, lying fully or partially between the tropic of Cancer and the tropic of Capricorn, which share common challenges and opportunities.

As an initial step, Ministers agreed to start analysing and sharing the needs, objectives, and obstacles to deployment at scale along the value chain, for those applications for which they seek the benefits of collective action under the Alliance. On this basis, they will design innovative Programmes leveraging initiatives from the ground.

The Two Programmes of the ISA “Affordable finance at scale”; and Programme “Scaling solar applications for agricultural use”, were launched during the event.

While announcing the programmes, Shri Piyush Goyal expressed his confidence that these programmes will serve the interests of the farming communities in the prospective ISA member countries and ensure that there is sufficient flow of affordable finance for solar projects. He further stated that the ISA will provide a vibrant platform to bring together countries with rich solar potential to aggregate demand for solar energy globally, thereby reducing prices; promoting collaborative solar R&D and capacity; and facilitating the deployment of existing solar technologies at scale.

The International Steering Committee of ISA which had met in New York on 21 April 2016 had approved the Programmes on Agriculture and Finance. Prospective member countries will begin work at the earliest and the process of implementation will be reviewed at the Founding Conference of the ISA scheduled to be held in the near future in New Delhi.

WAVELET SPECTRUM ENERGY FEATURE EXTRACTION BASED FAULT DETECTION SCHEME FOR SYNCHRONOUS GENERATORS - 1

This paper presents a wavelet transform based fault detection scheme for synchronous generators of power system equipment. The proposed method analyzes characterization of faults using a multi resolution analysis and defines a novel feature extraction, which is called wavelet spectrum energy. The multi-resolution signal analysis based on wavelet transform is utilized to decompose a given signal into approximate and detail signals of original signal. The detail signal coefficients are utilized for calculating wavelet spectrum energy. The fault detection technique utilizes the wavelet spectrum energy as feature extraction to extract information of fault signals for transient analysis. The simulation results show accurate discrimination of faults and also in characterization of internal and external faults.

Keywords: *Synchronous generator, multi resolution analysis, wavelet spectrum energy, fault detection, internal fault, external fault.*

1.0 INTRODUCTION

Synchronous generator is most expensive equipment in the power system network and it is designed to run at high load factor. Its reliable operation and proper functioning is important factor of the electric utilities in order to give continuous supply to the customers. Generally the faults in generator are electrical and mechanical faults. The electrical faults are normally initiated by thermal damage to the insulating material and anti-corona paint on a stator coil. The most common faults in the synchronous generators are in stator winding which are due to short circuit between the winding in the slots and the stator core. These faults are most dangerous and are likely to cause considerable damage to the expensive machinery. Hence, requires a lot of time and high cost of maintenance. Hence it is necessary to safeguard the equipment and prevent from the faults by incorporating the reliable and fast fault detection system.

The synchronous generator is subjected to a wide variety of abnormal electrical conditions and faults. Abnormal electrical conditions can arise as a result of failure within the generating plant itself. It may be subjected to faults in stator and rotor. The most serious faults on synchronous generator which require immediate attention are the stator winding faults. Hence it is necessary to develop a fault detection scheme which detect the faults very fast and prevent the equipment and reduce the damage.

At present, the electric utilities are using electromagnetic relays, solid state relays, and numerical relays for the protection of synchronous generators. The most recent relay technology is directed towards digital relay development. The performance of protective schemes of digital relays has been enhanced but shortcomings of the detection rules have not been eliminated.

In the past decade many techniques have been developed for the fault detection of synchronous generators. A novel protection scheme for detecting faults in synchronous generator is proposed utilizing fault transients. In a fault detection scheme is proposed which was based on measuring third harmonic voltages are at the generator terminals and generator neutral. In the paper Artificial Neural Network (ANN) algorithm is applied to detect the faults in generator stator windings protection. ANN is also used for classification of internal and external faults.

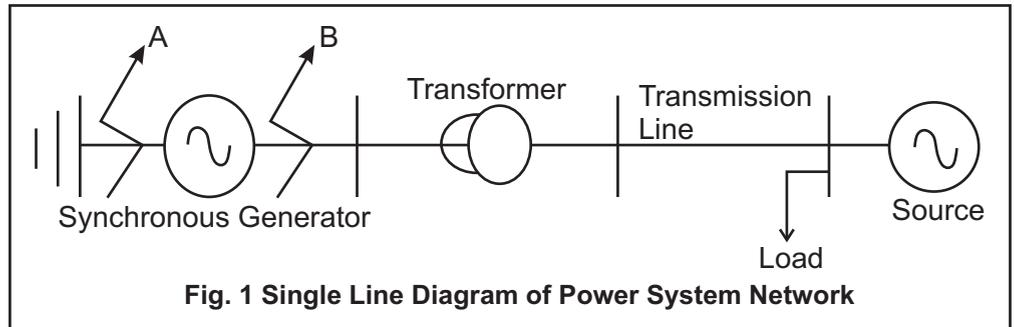
In past three decades several algorithms have been implemented for fault detection in power system equipment using wavelet transforms (WT) and the wavelet transform technique is very useful and efficient in fault detection of power system components. The WT technique has been reported for fault detection in transformers. Wavelet transform has been chosen as an effective signal processing tool for the fault detection in transmission lines. In a High Impedance Fault Detection in distribution systems was implemented using wavelet transforms.

The multi-resolution analysis a signal processing technique based on the wavelet transforms are utilized for calculating wavelet spectrum energy (WSE). The WSE have been used for interpreting the different fault signals. This technique has the capability to extract features of faults signals. The proposed fault detection scheme identifies the internal faults which are close to neutral and external faults on the terminals of synchronous generator.

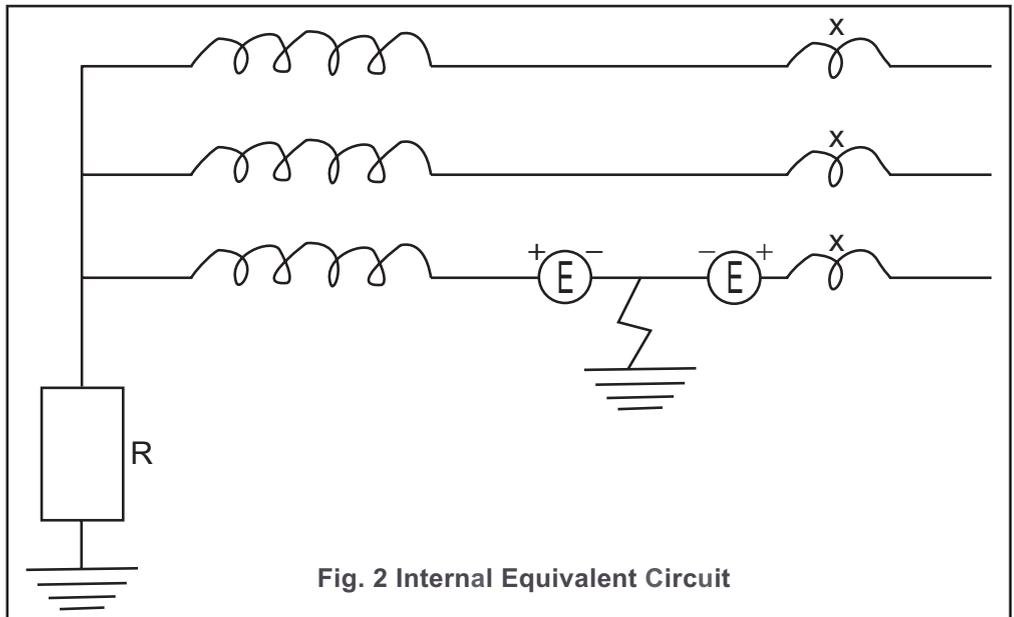
2.0 Problem Formulation

In this paper, the problem for identification of internal faults and external faults of synchronous generator are considered. The differential protection scheme is used to detect the faults in synchronous generator. The single line to ground fault is dangerous and very much difficult to identify. The detection of single line to ground fault is depend on the grounding type of synchronous generator. There are two different types of grounding the synchronous generator which are i) low impedance and ii) high impedance grounding. The common practice is to ground the generator neutral through a resistor and tuned reactors. The differential relay can provide the protection for 95% of the windings. In order to provide protection for 100% of the windings against ground fault a third harmonic voltage method is now in use as generators which produce about 1% or more third harmonic voltage under all service conditions. Lot of attention has been focused on fault detection, which is identification of generator's single phase to ground fault and stator winding faults (internal faults) of Synchronous Generator.

The power system consisting of synchronous generator which is fed to the load through a step down transformer and a transmission line is shown in Figure 1. The internal faults and external faults are created at position A and position B respectively.



In order to simulate stator internal faults near the generator neutral an equivalent circuit described in a model shown in the Figure 2 is considered. In this approach the generator internal fault is simulated by the addition of two series voltage sources of reverse polarities to each other, in series with each of the faulty phases at the external terminals. Each of these voltage sources is equal to the EMF of the sound portion of the windings. The



generator sub transient, transient and synchronous is reduced by a value of x which is equal to the sub transient reactance of the sound portion of the windings.

3.0 Theory of Wavelet Transforms

The wavelet transform technique is a great tool of signal processing. This technique is utilized for many applications related to Engineering, Applied Mathematics, Physics and other Sciences. Recently it is also used for fault detection in power system components for transient analysis because of its ability to extract information of a transient signal in time - scale region. A wavelet is a waveform of effectively limited duration that has an average value of zero and its relation is given in Eq. 1.

$$\int_{-\infty}^{\infty} \psi(t) dt = 0 \quad \dots (1)$$

3.1 Continuous Wavelet Transform

The Continuous wavelet transform (CWT) of for a given signal $x(t)$ with respect to a mother wavelet $\psi(t)$ is defined in Eq. 2.

$$CWT(x,a,b) = \frac{1}{\sqrt{|a|}} \int_{-\infty}^{\infty} x(t) \overline{\psi\left(\frac{t-a}{b}\right)} dt \quad \dots (2)$$

Where 'a' and 'b' represent the scaling (dilation) and translation (time shift) constants respectively and $\psi(t)$ is a complex conjugation. The $x(t)$ and $\psi(t)$ belong to Hilbert Space $L^2(\mathbb{R})$, the set of integral functions.

3.2 Discrete Wavelet Transform

In CWT, the signals are analyzed using a mother wavelet or basis function which relate to each other by simple scaling and translation. In CWT, the information relates to close scales or times is redundant and high computational cost. To avoid these disadvantages, a discrete wavelet transform (DWT) can be used and is defined in Eq. 3

$$DWT(x,m,n) = \frac{1}{\sqrt{a_0^m}} \sum_{t=-\infty}^{\infty} x(t) \overline{\psi\left[\frac{t - na_0^m b_0}{a_0^m}\right]} \quad \dots (3)$$

The parameters 'a' and 'b' used in CWT are replaced by their equivalent as $a=a_0^m$ and $b=nb_0$, a_0^m , where a_0 and b_0 are fixed constants with $a_0 > 1$ and $b_0 > 1$ and m, n are positive integer variables. The choice a_0 and b_0 must be so that mother wavelets form an orthonormal basis. The orthonormal basis satisfies if $a_0 = 2$ and $b_0 = 1$. This leads to Multi-resolution analysis.

3.3 Multi-resolution analysis

MRA is one of the tools of discrete wavelet transform which decomposes the original signal into two other signals which represents a smooth and detailed version of the original signal. This algorithm is developed by Mallet. MRA is effective for analyzing the information of the signals. The DWT is computed by analyzing the signal at different frequency band with different resolutions by decomposing the signal into coarse approximation and detail information.

Let $x[n]$ be a discrete time signal, where n is an integer and this signal will be passed through low and high pass filters to find the coarse and detail approximations respectively. If the low pass filter is denoted by its weighted sequence $g[n]$, the output signal of low pass filter is then down sampled by 2 to produce the coarse approximation signal $a[n]$ for the original signal $x[n]$ and is shown in Eq. 4.

$$a[n] = \sum_n x[n].g[2k-n] \quad \dots (4)$$

The high pass filter is denoted by its weighted sequence $h[n]$, the output signal of high pass filter is then down sampled by 2 to produce the detail signal $d[n]$ for the original signal $x[n]$ and is shown in Eq. 5.

$$d[n] = \sum_n x[n].h[2k-n] \quad \dots (5)$$

The decomposition process can be done with successive approximations so that the original signal is broken down into many lower resolution components. Figure 3 illustrates the procedure of wavelet decomposition for two levels with the bandwidth of the signal at each level. Let $x[n]$ be a discrete time signal with sample rate of f Hz, where n is an integer and

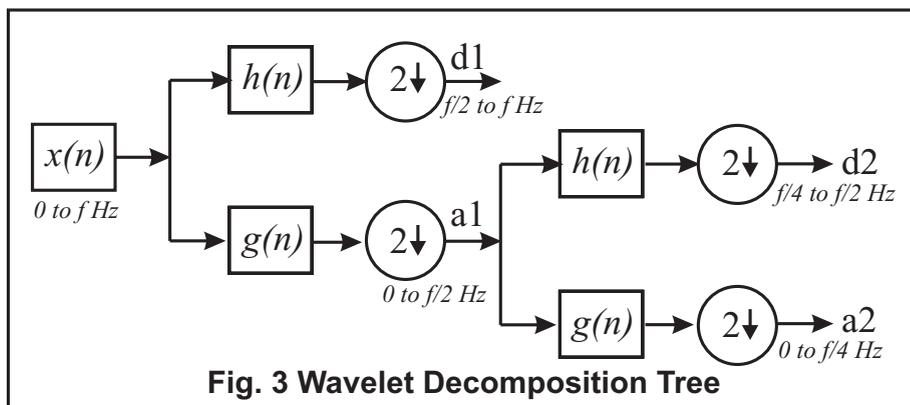


Fig. 3 Wavelet Decomposition Tree

this signal will be passed through low and high pass filters to find the coarse and detail approximations respectively. The highest frequency component detail signal (d 1) will be $f/2$ Hz. The band of frequencies represents the $d1$ signal will be $f/2$ Hz to f Hz. Similarly the band of frequencies in detail signal ($d2$) will be $f/4$ to $f/2$ Hz. The band frequency of low pass filter output, approximate signal ($a1$) will be in the range of 0 to $f/2$ Hz. Similarly, the band of frequencies of an approximate signal ($a2$) will be 0 to $f/4$ Hz.

4.0 Proposed Fault Detection Scheme

The structure of the proposed fault detection scheme of synchronous generator is shown in Figure 4. In this scheme the current signal is acquired from the output of current transformer at terminals of synchronous generator. The Daubechies Db - 5 type wavelet was used as mother wavelet for obtaining MRA. The Daubechies Db - 5 wavelet function is widely used for identification of faults. The detail signal scale 3 is selected as it is superior to the other details signals.

To improve the fault detection scheme, the fault features are extracted from MRA of detail signal scale 3 using WSE. WSE is calculated by squared wavelet coefficients of the detail signal scale 3 of MRA. The coefficients of WSE are utilized for identification of and external faults.

4.1 Feature Extraction Using WSE

The importance of feature extraction is to obtain a unique feature with a good accuracy. The feature extraction involves processing of the original raw signals obtained to extract suitable information. It gives unique feature of each fault transient and able to distinguish internal and external faults accurately.

To improve the performance of detection technique for distinguishing the internal and external faults, a feature extraction technique is utilized wavelet spectrum energy to retain relevant information. WSE is calculated by squared detail wavelet coefficients of the selected scale. The obtained detailed coefficients of current signal are multiplied at a time using the Eq. 6.

$$WSE = \sum_{n=1}^N d_j^2(n) \quad \dots (6)$$

Where N is the length of the discrete vector, d is the detail coefficient signal of MRA at scale j.

4.2 Algorithm for Fault Detection in Synchronous Generators

The algorithm to identify the faults is given below.

Step 1: Acquire the current signals for each phase IR, IY, IB, from the terminals of synchronous generator.

Step 2: The obtained current signals are analyzed using MRA of discrete wavelet transform to get the wavelet coefficients.

Step 3: The appropriate scale will be selected which will give precise information on the local regularity.

Step 4: Calculate the WSE for each phase currents for the detailed coefficients of the appropriate scale obtained in 3.

Step 5: Identify the fault through interpretation of WSE.

Step 6: Distinguish an internal fault current and external fault currents, for tripping the relay for internal faults and restraining the relay for external faults.

(To be continued...)

Courtesy: Nagireddy Ravi and Narri Yadaiah
CPRI Journal, September 2014

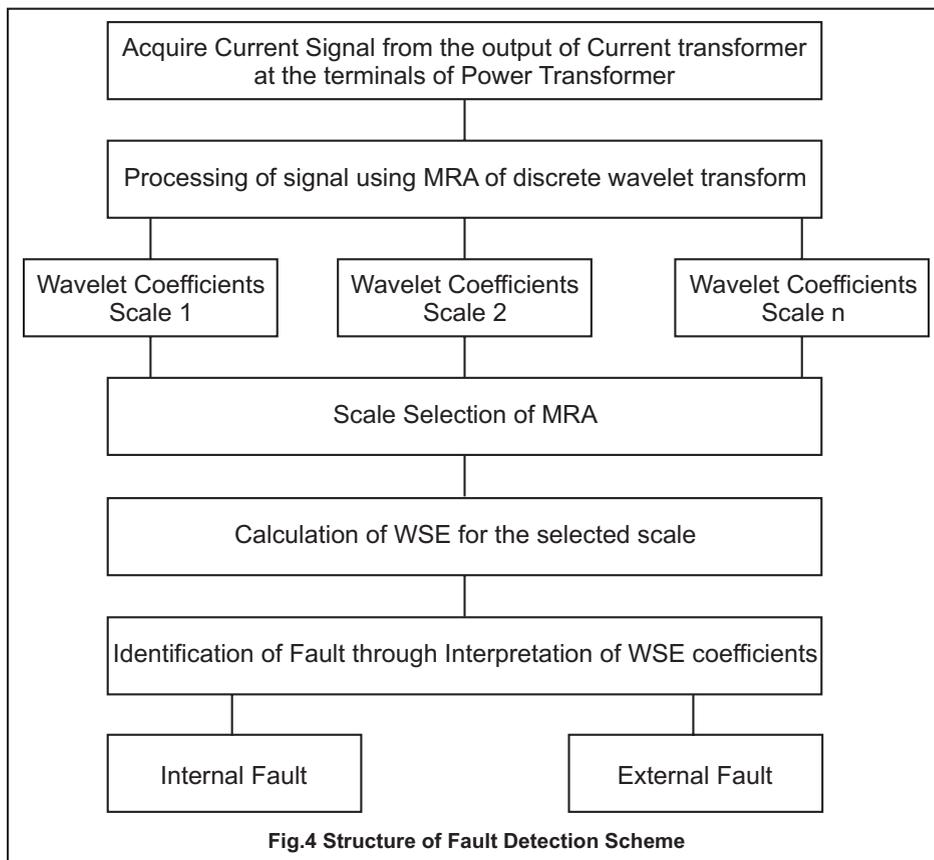


Fig.4 Structure of Fault Detection Scheme

SCIENTISTS TO USE DAMAGED TOMATOES TO GENERATE ELECTRICITY

Damaged tomatoes that are unsuitable for sale in shops could be turned into a source of green energy, according to a team of US-based scientists. Their pilot project involves a biological-based fuel cell that uses tomato waste left over from harvests in Florida. The researchers presented their work March 16 at the 251st National Meeting & Exposition of the American Chemical Society (ACS) in San Diego. It featured more than 12,500 presentations on a wide range of science topics.



“We have found that spoiled and damaged tomatoes left over from harvest can be a particularly powerful source of energy when used in a biological or microbial electrochemical cell,” said Namita Shrestha, a graduate student at the South Dakota School of Mines & Technology, who is working on the project.” The process also helps purify the tomato-contaminated solid waste and associated waste water,” she added.

Tomatoes are a key crop in Florida, said Gadhamshetty. He stresses that the project is important to the state because Florida generates 396,000 tonnes of tomato waste every year, but lacks a good treatment process. “We wanted to find a way to treat this waste that, when dumped in landfills, can produce methane — a powerful greenhouse gas — and when dumped in water bodies, can create major water treatment problems.” The team developed a microbial electrochemical cell that can exploit tomato waste to generate electric current. Shrestha said: “Microbial electrochemical cells use bacteria to break down and oxidize organic material in defective tomatoes.” The oxidation process, triggered by the bacteria interacting with tomato waste, releases electrons that are captured in the fuel cell and become a source of electricity.

The researchers said that the natural lycopene pigment in tomatoes is “an excellent mediator to encourage the generation of electrical charges from the damaged fruits”. The researchers also maintained that some of their results proved to be counterintuitive.” However, we found that electrical performance using defective tomatoes was equal or better than using pure substrates. These wastes can be a rich source of indigenous redox mediators and carbon, as well as electrons,” he added. At the moment, the power output from their device is quite small: 10 milligrams of tomato waste can result in 0.3 watts of electricity. But the researchers note that with an expected scale up and more research, electrical output could be increased by several orders of magnitude. According to calculations by Shrestha, there is theoretically enough tomato waste generated in Florida each year to meet Disney World’s electricity demand for 90 days, using an optimised biological fuel cell.

“Our research question at this time is to investigate the fundamental electron transfer mechanisms and the interaction between the solid tomato waste and microbes,” Gadhamshetty added. The scientists plan to improve the cell by determining which of its parts — electrode, electricity-producing bacteria, biological film, wiring — are resisting the flow of electricity. Then they will tweak or replace that part.

*What counts in life is not the mere fact that we have lived.
It is what difference we have made to the lives of others that will determine
the significance of the life we lead.*

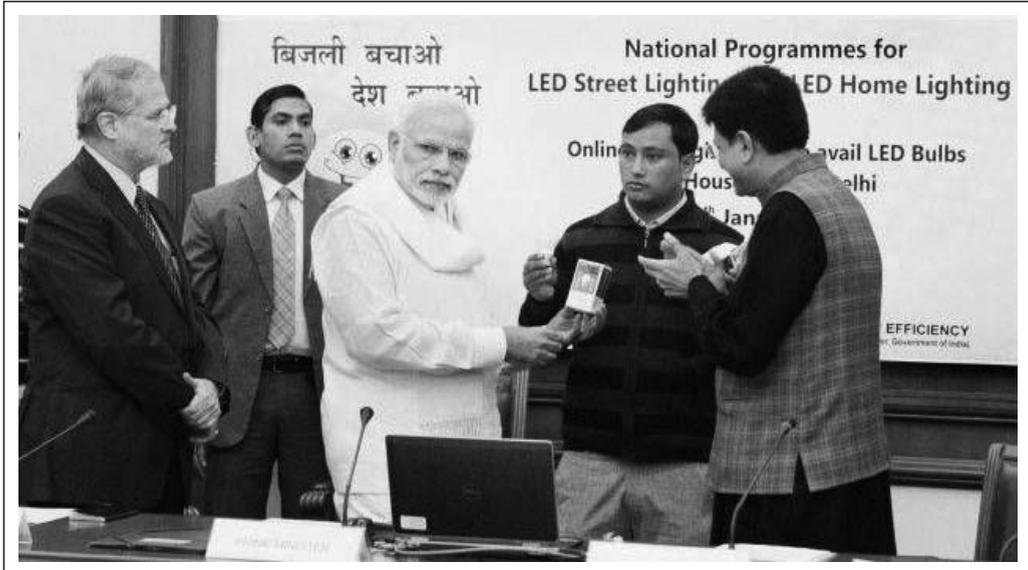
- NELSON MANDELA

PRESS INFORMATION BUREAU GOVERNMENT OF INDIA CABINET

20 January 2016 15:39 IST

Cabinet approves amendments in Power Tariff Policy to ensure 24X7 affordable Power for all

The Union Cabinet, chaired by the Prime Minister Shri Narendra Modi has approved the proposal of the Ministry of Power for amendments in the Tariff Policy. For the first time a holistic view of the power sector has been taken and comprehensive amendments have been made in the Tariff policy 2006. The amendments are also aimed at achieving the objectives of Ujwal DISCOM



Assurance Yojana (UDAY) with the focus on 4 Es: Electricity for all, Efficiency to ensure affordable tariffs, Environment for a sustainable future, Ease of doing business to attract investments and ensure financial viability

Highlights of Amendments are:

Electricity:

- 24X7 supply will be ensured to all consumers and State Governments and regulators will devise a power supply trajectory to achieve this.
- Power to be provided to remote unconnected villages through micro grids with provision for purchase of power into the grid as and when the grid reaches there.
- Affordable power for people near coal mines by enabling procurement of power from coal washery reject based plants.

Efficiency:

- Reduce power cost to consumers through expansion of existing power plants.
- Benefit from sale of un-requisitioned power to be shared allowing for reduction in overall power cost.
- Transmission projects to be developed through competitive bidding process to ensure faster completion at lower cost.
- Faster installation of Smart meters to enable “Time of Day” metering, reduce theft and allow net-metering.
- Lower power cost by creating transmission capacity for accessing power from across India.

Environment:

- Renewable Power Obligation (RPO): In order to promote renewable energy and energy security, 8% of electricity consumption excluding hydro power, shall be from solar energy by March 2022.
- Renewable Generation Obligation (RGO): New coal/lignite based thermal plants after specified date to also establish/procure/purchase renewable capacity
- Affordable renewable power through bundling of renewable power with power from plants whose PPAs have expired or completed their useful life.
- No inter-State transmission charges and losses to be levied for solar and wind power.
- Swachh Bharat Mission to get a big boost with procurement of 100% power produced from Waste-to-Energy plants.

- To release clean drinking water for cities and reduce pollution of rivers like Ganga, thermal plants within 50 km of sewage treatment facilities to use treated sewage water.
- Promotion of Hydro projects through long term PPAs and exemption from competitive bidding till August 2022.
- Ancillary services to support grid operation for expansion of renewable energy.

Ease of Doing Business:

- Generate employment in coal rich Eastern states like Odisha, West Bengal, Jharkhand, Chhattisgarh etc. by encouraging investments. States allowed to setup plants, with up to 35% of power procured by DSICOMs on regulated tariff.
- Remove market uncertainty by allowing pass through for impact of any change in domestic duties, levies, cess and taxes in competitive bid projects.
- Clarity on tariff setting authority for multistate sales. Central Regulator to determine tariff for composite schemes where more than 10% power sold outside State.

These amendments will benefit power consumers in multiple ways. While reducing the cost of power through efficiency, they will spur renewable power for a cleaner environment and protect India's energy security. They would also aid the objectives of Swachh Bharat Mission as well as Namami Gange Mission through conversion of waste to energy, usage of sewage water for generation and in turn ensure that clean water is available for drinking and irrigation.

These amendments will ensure availability of electricity to consumers at reasonable and competitive rates, improve ease of doing business to ensure financial viability of the sector and attract investments, promote transparency, consistency and predictability in regulatory approaches across jurisdictions. It will further facilitate competition, efficiency in operations and improvement in quality of supply of electricity. *These holistic amendments to Power Tariff Policy which complement schemes like UDAY will ensure the realization of Hon'ble Prime Minister Shri Narendra Modi's vision of 24X7 affordable power for all.*

WORLDS FIRST ULTRA LIGHT PERSONAL ELECTRIC PLANE

The two-seater entirely electric plane use ducted fan which makes it much simpler, quieter and safer than conventional helicopters. Daniel Wiegand, CEO of Lilium and one of the four Munich University graduates, the company hosted in a European Space Agency (ESA) business incubator said, *Our goal is to develop an aircraft for use in everyday life. We are going for a plane that does not need the complex and expensive infrastructure of an airport. To reduce noise and pollution, we are using electric engines so it can also be used close to urban areas.*



Highly efficient in its cruising mode, the plane will have a range of 500 kilometres and will be on sale by 2018.

It features a touch screen and fly-by-wire joystick controls, retractable landing gear, wing doors, large storage, panoramic windows and a battery that can be recharged from any wall plug. Thorsten Rudolph, CEO of AZO, which runs the incubator, one of many in ESAs Technology Transfer Programme throughout Europe said.

This German start up has built world's first ultra light personal electric plane that can take off from your garden

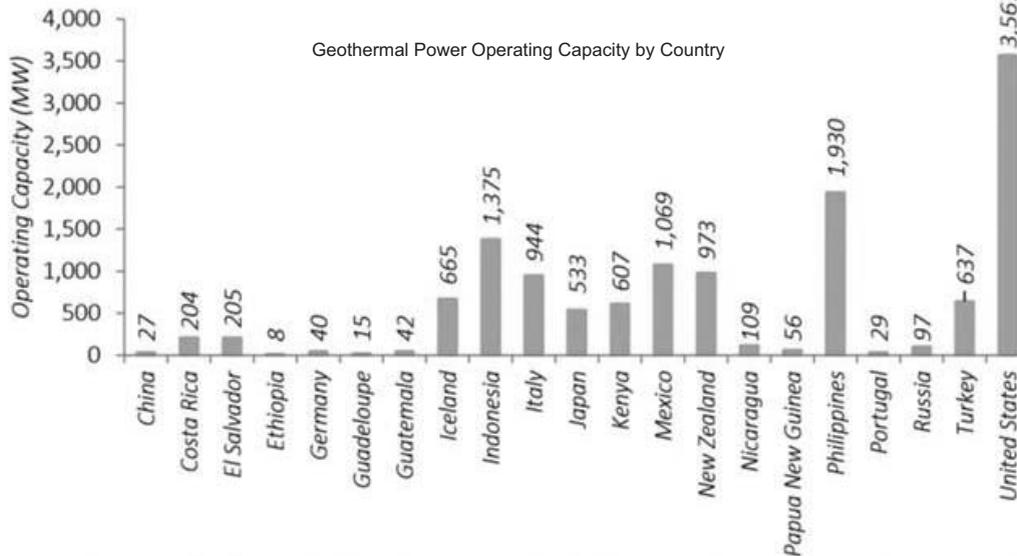
Press Trust of India, 16 May 2016

A German start-up company is developing the worlds first ultra light personal electric plane that can be powered from a wall socket, takeoff and land vertically even from back gardens and is eco-friendly. *source: ndtv*

GLOBAL GEOTHERMAL CAPACITY TO HIT 18.4 GW BY 2021, US TRADE BODY SAYS

Annual U.S. & Global Geothermal Power Production Report

March 2016



Note: 'Nameplate capacity' is often used to derive these estimates but also 'net capacity' is used when nameplate is not available

The world is expected to have about 18.4 GW of geothermal capacity by 2021, after it reached 13.3 GW, spread across 24 countries, in 2015, according to a report by the US Geothermal Energy Association (GEA). There were projects under development in 82 countries that could bring 12.5 GW of additional capacity, doubling the current installed base, GEA said.

The global geothermal power industry added 313 MW of capacity last year, according to the report, released on Wednesday. That was less than in previous years as delays due to natural disasters, permitting problems in some countries and trouble obtaining financing amid low fossil fuel prices slowed growth. A total of 18 projects became operational in 2015 in Turkey, Kenya, Mexico, Japan, Germany and the US. GEA noted that some of the rising stars of the geothermal industry include Kenya and Indonesia.

The US brought online 70 MW and ended 2015 with 3.7 GW of installed nameplate capacity. It had an additional 1.25 GW under development.

The report says that in spite of legislative stops and starts in the US, a few laws passed in 2015 could create opportunities. These include a 100% Renewable Portfolio Standard (RPS) in Hawaii, a 50% RPS in California, a 50% RPS in Oregon, as well as the Environmental Protection Agency's (EPA) Clean Power Plan.

"Globally geothermal power is trending up, but the US market outlook is clouded due largely to federal and state policies that either don't recognize the value of geothermal power or don't treat it with parity," said GEA executive director Karl Gawell.

Courtesy: See News

It must be a strange world not being a scientist, going through life not knowing - or maybe not caring about where the air came from, where the stars at night came from or how far they are from us. I want to know".

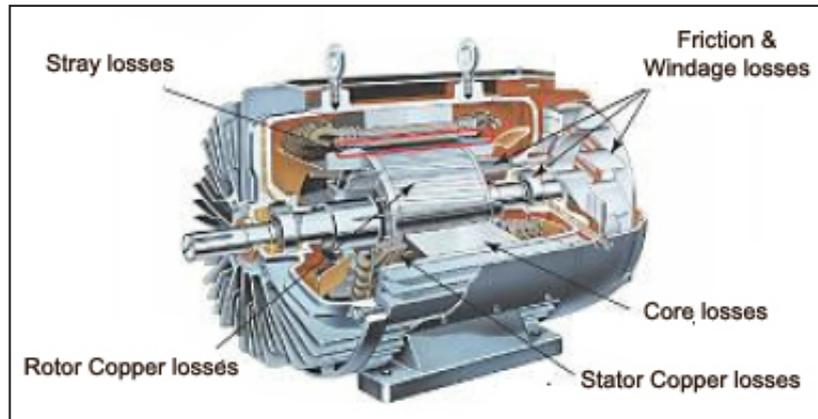
- MICHIO KAKU

ENERGY CONSERVATION THROUGH ENERGY EFFICIENCY – 14

Energy Efficient Motors – Continued

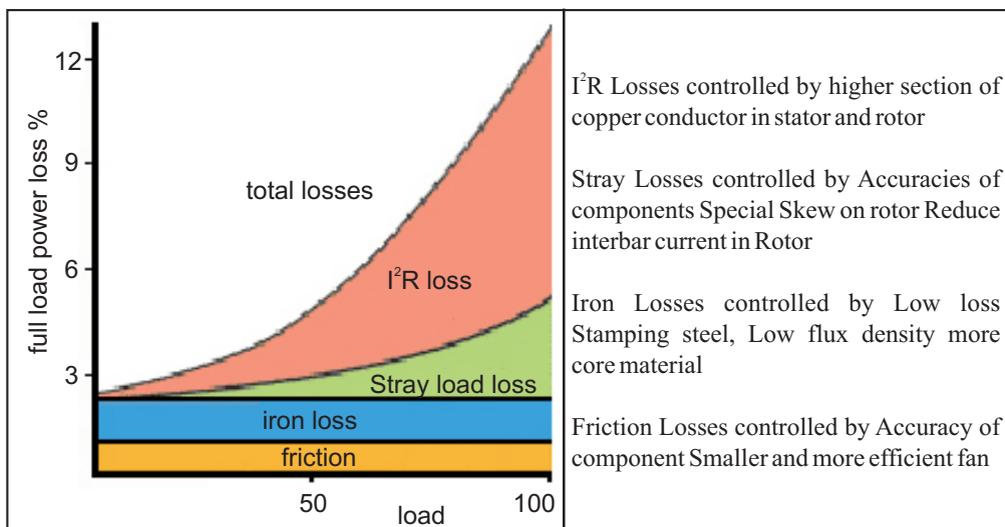
Energy Efficient Motors – Losses and Managing of losses

The various losses are again shown in the ‘Cut View’ of the Induction Motor below:



In the Table below, the various losses and the Factors that affect those loss values are given to bring out the importance of Design and the Materials and the Manufacturing Processes. In the Graph and the Table provided later, deal with various losses and bring out the common practices with which the losses are controlled and managed.

| Losses | 2 – Pole average | 4 – Pole average | Factors affecting losses |
|---------------------------|------------------|------------------|---|
| Core losses | 19% | 21% | Electrical steel, air gap, saturation |
| Friction & Windage losses | 25% | 10% | Fan efficiency, Lubrication, bearing |
| Stator Copper losses | 26% | 34% | Conductor area, mean length of turn, heat dissipation |
| Rotor Copper losses | 19% | 21% | Bar and end ring area and material |
| Stray load losses | 11% | 14% | Manufacturing process, slot design, air gap |



Energy Efficient Motors Standards and its evolution:

Indian Standards for Energy Efficient Motors were brought out by Bureau of Indian Standards, since 1989 and they have been updated from time to time in tune with International Standards, the latest being the New IS:12615 of 2011.

Towards a Worldwide Common Efficiency Standard:

In 2008, IEC came up with a new standard - the IEC 60034-30 with a view to

- Eliminate differences in efficiency standards the world over and
- Enable user to compare motor efficiency with a common reference

The important points of The New IS: 12615-2011

The New IS: 12615-2011 is based on the International Standard IEC 60034-30 (2008) which defines New Efficiency Classification for single speed, three phase, induction motors.

The IS: 12615-2011 covers single speed, three-phase, 50Hz, cage induction motors that:

- have rated voltage $\leq 1000\text{V}$;
- have a rated output $0.37\text{kW} \leq P_N \leq 375\text{kW}$;
- have 2, 4 or 6 poles;
- Meet frame size to output relation as stipulated in IS: 1231 (*for outputs covered by IS: 1231*);
- are rated on the basis of either duty type S1 (continuous duty) or S3 (intermittent periodic duty) with rated cyclic duration factor of 80% or higher;
- are capable of operating direct on-line;
- are designed for operation on virtually sinusoidal and balanced voltage conditions as defined in 7.2.1 of IS/IEC 60034-1;
- designed for an ambient temperature not exceeding 40°C and altitude not exceeding 1000m;
- have degree of protection IP44 or superior;
- have method of cooling IC411 in accordance with IS 6362 / IEC 60034-6;
- have service factor not exceeding 1.0.

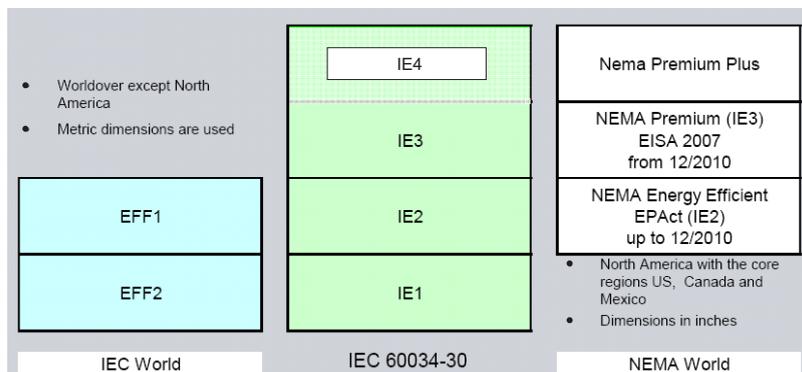
The Efficiency classes defined are:

IE1 - Standard Efficiency IE2 - High Efficiency IE3 - Premium Efficiency

The IS: 12615-2011 also stipulates that for motors to be classified as “Energy Efficient”, these must meet at least IE2 efficiency values.

New IE efficiency classes are as given below

| Efficiency Class | Description | |
|------------------|---------------------|---------------------|
| IE 1 | Standard efficiency | Comparable to eff 2 |
| IE 2 | High efficiency | Comparable to eff 1 |
| IE 3 | Premium | Premium |
| IE 4 | Super premium | Super premium |



| IE 2 | | | | IE 3 | | | |
|--------|--------------|------|------|--------|--------------|------|------|
| Output | No. of poles | | | Output | No. of poles | | |
| KW | 2 | 4 | 6 | KW | 2 | 4 | 6 |
| 0.37 | 72.2 | 70.1 | 69.0 | 0.37 | 75.5 | 73.0 | 71.9 |
| 0.55 | 74.4 | 75.1 | 72.9 | 0.55 | 78.1 | 78.0 | 75.9 |
| 0.75 | 77.4 | 79.6 | 75.9 | 0.75 | 80.7 | 82.5 | 78.9 |
| 1.1 | 79.5 | 81.4 | 78.1 | 1.1 | 82.7 | 84.1 | 81.0 |
| 1.5 | 81.3 | 82.8 | 79.8 | 1.5 | 84.2 | 85.3 | 82.5 |
| 2.2 | 83.2 | 84.3 | 81.8 | 2.2 | 85.9 | 86.7 | 84.3 |
| 3.7 | 85.5 | 86.3 | 84.3 | 3.7 | 87.8 | 88.4 | 86.5 |
| 5.5 | 87.0 | 87.7 | 86.0 | 5.5 | 89.2 | 89.6 | 88.0 |
| 7.5 | 88.1 | 88.7 | 87.2 | 7.5 | 90.1 | 90.4 | 89.1 |
| 11 | 89.4 | 89.8 | 88.7 | 11 | 91.2 | 91.4 | 90.3 |
| 15 | 90.3 | 90.6 | 89.7 | 15 | 91.9 | 92.1 | 91.2 |
| 18.5 | 90.9 | 91.2 | 90.4 | 18.5 | 92.4 | 92.6 | 91.7 |
| 22 | 91.3 | 91.6 | 90.9 | 22 | 92.7 | 93.0 | 92.2 |
| 30 | 92.0 | 92.3 | 91.7 | 30 | 93.3 | 93.6 | 92.9 |
| 37 | 92.5 | 92.7 | 92.2 | 37 | 93.7 | 93.9 | 93.3 |
| 45 | 92.9 | 93.1 | 92.7 | 45 | 94.0 | 94.2 | 93.7 |
| 55 | 93.2 | 93.5 | 93.1 | 55 | 94.3 | 94.6 | 94.1 |
| 75 | 93.8 | 94.0 | 93.7 | 75 | 94.7 | 95.0 | 94.6 |
| 90 | 94.1 | 94.2 | 94.0 | 90 | 95.0 | 95.2 | 94.9 |
| 110 | 94.3 | 94.5 | 94.3 | 110 | 95.2 | 95.4 | 95.1 |
| 125 | 94.5 | 94.7 | 94.5 | 125 | 95.3 | 95.6 | 95.3 |
| 132 | 94.6 | 94.7 | 94.6 | 132 | 95.4 | 95.6 | 95.4 |
| 160 | 94.8 | 94.9 | 94.8 | 160 | 95.6 | 95.8 | 95.6 |
| 200 | 95.0 | 95.1 | 95.0 | 200 | 95.8 | 96.0 | 95.8 |
| 250 | 95.0 | 95.1 | 95.0 | 250 | 95.8 | 96.0 | 95.8 |
| 315 | 95.0 | 95.1 | 95.0 | 315 | 95.8 | 96.0 | 95.8 |
| 355 | 95.0 | 95.1 | 95.0 | 355 | 95.8 | 96.0 | 95.8 |
| 375 | 95.0 | 95.1 | 95.0 | 375 | 95.8 | 96.0 | 95.8 |

Some of the common tips for minimizing motor losses in operation:

Although motors are designed to operate within 10% of nameplate voltage, large variations significantly reduce efficiency, power factor, and service life. When operating at less than 95% of design voltage, motors typically lose 2 to 4 points of efficiency, and service temperatures increase up to 20°F, greatly reducing insulation life.

Running a motor above its design voltage also reduces power factor and efficiency. **Minimize Phase Unbalance** - Phase balance should be within 1% to avoid derating of the motor. Several factors can affect voltage balance: single-phase loads on any one phase, different cable sizing, or faulty circuits.

An unbalanced system increases distribution system losses and reduces motor efficiency.

Voltage unbalance is defined as 100 times the maximum deviation of the line voltage from the average voltage on a three-phase system divided by the average voltage.

If line voltages measured are 431, 438 and 427 the average is 432. The voltage unbalance is given by

$$\frac{432 - 427}{432} \times 100$$

Voltage imbalance results in added Temperature rise of motors.

Percent additional temperature rise = $2 \times (\% \text{ voltage unbalance})^2$. For example, a motor with a 100°C temperature rise would experience a temperature increase of 8°C when operated under conditions of 2% voltage unbalance. Winding insulation life is reduced by one-half for each 10°C increase in operating temperature.

Maintains Good Power Quality - Motors are designed to operate using power with a frequency of 50 hertz and a sinusoidal wave form. Using power with distorted wave forms will degrade motor efficiency.

System Approach: The key to large savings:

We are going to be dealing with the System approach to achieve considerable Energy Savings particularly with regard to Motor Driven Systems, as Motors merely convert the Electrical Energy to Mechanical Energy with the least of losses by and within the Motors. The Mechanical Energy is used by the Machines and Systems with their allied controls and the 'Torques' and the 'Speeds' decided by the loads, and the losses in the Machines and Systems contribute substantially to the overall System losses and reduction of overall Efficiencies.

Some of the 'Basics' for System Approach are as under:

- Switch off equipment when not needed
- Provide better controls (VSD instead of throttling)
- Process re-engineering

EE Motors and Energy saving – Importance of System Approach:

The following points forms the 'Basics' of Energy Efficiency and Energy Savings in Motor Driven Systems:

1. Of the 'End Use Forms' of Energy, namely HEAT, FUEL and ELECTRICITY. Almost 60% of the Energy is Electricity. This Percentage is steadily increasing.
2. Of the Electrical Energy, almost 80% is used through Electric Motors, to 'Convert' Electrical Energy to Mechanical Energy to put the Energy to 'Productive Use'.
3. AC Induction Motors, particularly the 'Squirrel Cage' Type, have played a Key role in the past 100 years, in Industrialization, Lift Irrigation, Comfortable Commercial Operations and enhancing Domestic Comforts.
4. Energy Efficient Electric Motors shoulder the responsibility of Conversion of Electrical Energy to Mechanical Energy with the Best of Efficiencies and Least of Losses.
5. Energy Efficiency is obtained through reduction of Iron (Fixed) Losses and Copper (Variable with Load) Losses and minimization of Friction and Windage Losses.
6. Losses reduction, particularly Copper Loss reduction, results in reduced 'Slip's, and increased speeds at partial and full loads, increased Starting Currents, slight reduction in Power Factors, and so on.
7. As per the EE Motors Standards, these Motors are also designed to ensure almost constant Efficiencies between 50% and 100% Loads, mainly to take care of the 'Natural over Motoring' that results due to Motor Selection.
8. The Mechanical 'Out Put' of Motors is in the Form of 'Torque' and Speed, the Torque point being decided by the Torque requirement of the Driven Equipment and the Speed, by the Torque Point.
9. Torque and Speed together decide the output and Energy Consumption. If the Out Put needs to be controlled to match the requirements, it is traditionally controlled after the Motor by Throttling, Choking, and Braking or in some applications by Fluid Coupling and Eddy Current Drives etc. Modern Electronic Controls attempt to exercise Controls before the Motors by altering the Speeds and thus the Out Put.
10. "Affinity Law" is applicable to Centrifugal Loads, which is the case in most of the Loads (except probably linear Loads like Conveyors etc.) where the 'Output' is Proportional to RPM and Energy Input is Proportional to Cube of RPM.
11. In case of Output Control after the Motor through Throttling etc, there will be nominal reduction only in case of Energy input, whereas, it is seen that the Energy Input is considerably reduced in case of RPM Control, with controls before the Motor, mainly because of "Affinity Law".

In case of Centrifugal Loads, typically like the case of Pumps, the Diameter of the Impeller will also follow the 'Affinity Law', with output being Proportional to the Diameter of the Impeller and the Input of Energy being proportional to the Cube of the Diameter of the Impeller.

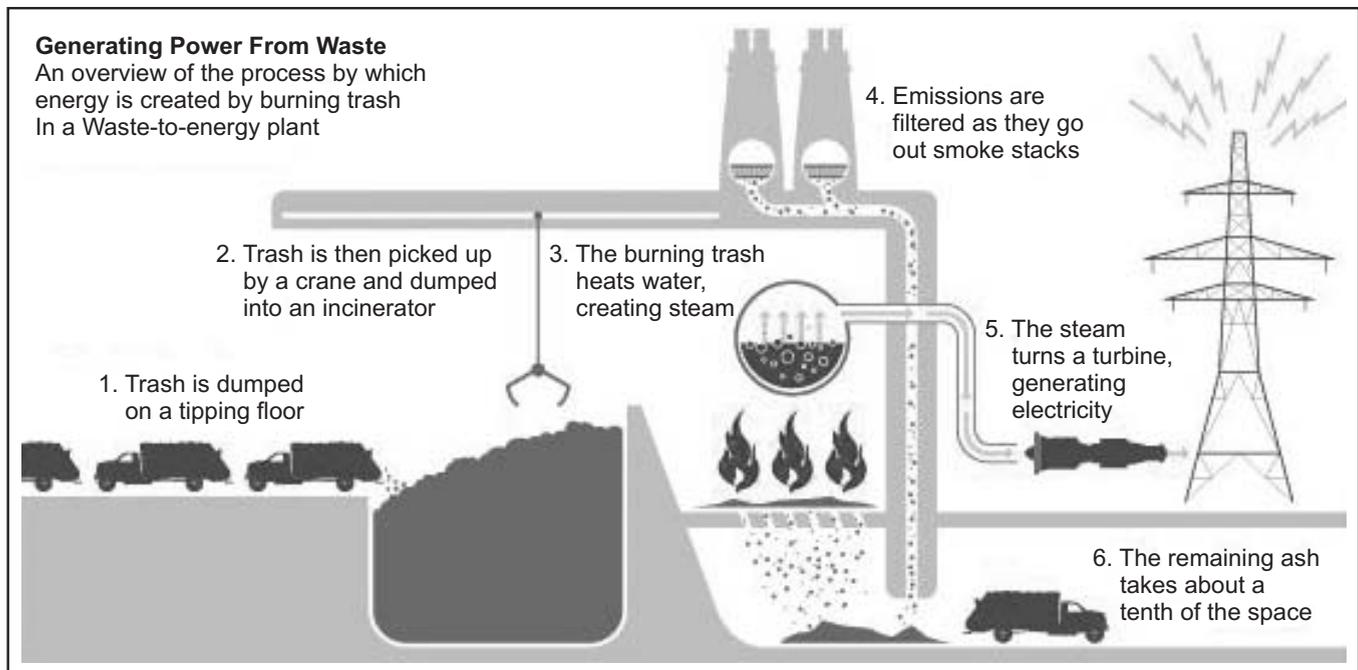
(To be continued)



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CHINA TO BUILD WORLD'S LARGEST WASTE BURNER

China's city of Shenzhen will play host to the world's largest waste-to-energy power plant by 2020, which will be capable of burning 5,000 tonnes of garbage daily. Here's how they're doing it.



A massive waste-to-energy (WTE) power plant, which can burn the equivalent of one-third's waste generated by Shenzhen's 20 million residents every year, is scheduled to begin operations by 2020.

The proposed 267,000-square metre facility will be capable of incinerating 5,000 tonnes of trash every day, said Danish architecture firms Schmidt Hammer Lassen Architects and Gottlieb Paludan Architects, which won an international competition to design the power plant. The Shenzhen East Waste-to-Energy Plant, which will be located on the mountainous outskirts of Shenzhen, aims to showcase Waste-to-Energy production as an important solution in dealing with growing waste by using it to generate electricity, the firms noted.

The facility will also be used to educate the public on the challenges of waste disposal and ways it can be reduced. Architectural concept behind the power plant, such as the proposed circular design of the building instead of a traditional rectangular layout, which minimises carbon footprint by reducing the amount of excavation needed on the site.

Over 65 per cent of the plant's roof (or up to 44,000 square metres) will be fitted with photovoltaic solar panels, which converts solar energy into direct current electricity. A park with panoramic views and walkways will also be constructed around the plant to attract visitors.

Burning waste is not an ideal way to solve mounting waste problems in many countries worldwide because it also emits carbon dioxide into the atmosphere. But as one of China's major industrial cities, Shenzhen's waste continues to pile up after four overloaded landfills. In response, the government has plans to build at least three WTE plants in the next three years. WTE plants will be a solution for waste management and not energy, said Chris Hardie, partner at Schmidt Hammer Lassen Architects to US website Fast Company.

"Cities have to move towards more recycling and reducing their waste for sure—and of course developing more sources of renewable energy. That is sort of the point we are making by proposing this [as] the first waste-to-energy plant that has a renewable component to it," he added.

"We hope that ultimately solar energy can be extensively used in the commercial sector as well as the private sector. Imagine solar cells installed in cars to absorb solar energy to replace the traditional use of diesel and gas. People will vie to park their cars on the top level of parking garages so their cars can be charged under sunlight. Using the same principle, cell phones can also be charged by solar energy. There are such a wide variety of applications." - YANG YANG



ANAND KUMAR
MR. Cent Per Cent



Anand Kumar, founder of Super 30, which helps economically backward students crack the IIT-JEE, was selected by UK based magazine monocle among the list of 20 pioneering teachers of the world.

Anand Kumar was born in Patna, Bihar. His father could not afford private schooling for his children, and Anand attended a Hindi medium Government school, where he developed his deep interest in mathematics. *He secured admission to Cambridge University, but could not attend because of his father's death and his financial condition.* In 1992, Anand began teaching Mathematics. He rented a classroom for Rs. 500 a month, and began his own institute, the

RAMANUJAM SCHOOL OF MATHEMATICS (RSM). After three years there were almost 500 students enrolled. In early 2000, when a poor student came to him seeking coaching for IIT-JEE, and couldn't afford the annual admission fee, Anand was motivated to start the Super 30 program in 2002. During 2003-2012, 263 students out of 300 have made it to the IITs. In 2010, all 30 students of Super 30, cracked the highly competitive IIT-JEE for the third consecutive year. Anand has no financial support from any Government or private agency, and manages on the tuition fee he earns from the Ramanujam Institute. In 2011, 24 out of 30 students made it even when cut-offs were higher due to intense competition from all over India. Once the students reach competitive places like IIT, skills bloom on their own. Very true because by then they have cultivated so much self-respect and self-confidence, life skills become very easy to learn through exposure, observation and experience. Anand is in the **Limca Book of Records (2009)** for his contribution in helping poor students crack IIT-JEE by providing them free coaching. Time Magazine has selected Super 30 in the list of Best of Asia 2010. Barack Obama's special envoy Rashad Hussain termed it the "best" Institute in the country. Anand has been awarded a top award by Bihar Government "**Maulana Abdul Kalam Azad Shiksha Puraskar**" November 2010. He was awarded the **Prof Yashwantrao Kelkar Yuva Puraskar 2010** by Akhil Bharatiya Vidyarthi Parishad (ABVP) in Bangalore. In April 2011, Anand was selected by Europe's magazine Focus as one of the global personalities who have the ability to shape exceptionally talented people.

20 MOST PEACEFUL COUNTRIES IN THE WORLD - 18

PORTUGAL



You might be surprised to know that **Portugal** is one of the most peaceful countries in the world, but it's true. The country has been a member of the EU for roughly 26 years and it forms a part of the European Monetary System and use the single European currency. Portugal is the world's 43rd largest economy according to the World Bank and it has one of the highest GDP growth rates among the OECD countries. The country has the low crime rates, great standards of living and a stable government. Plus, fascinating sandy beaches, golden plains and impressive mountains, a millennial heritage and vibrant cities make Portugal one of the best places to live in.

(To be continued)
Courtesy: Amerikanki

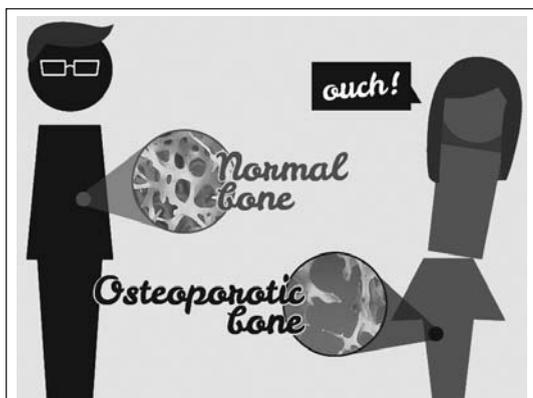
OSTEOPOROSIS

SERVE UP BONE STRENGTH THROUGHOUT LIFE

Osteoporosis

Osteoporosis occurs when bones become thin and fragile. The result is that they break easily, even following a minor bump or fall from standing height. Worldwide, **one in three women and one in five men** over the age of 50 will suffer a fragility fracture (broken bone) due to osteoporosis.

Although fractures can occur in any part of the body, they most commonly affect the wrists, spine and hips. Fractures due to osteoporosis are a major cause of pain, long-term disability and loss of independence among older adults, and can even result in premature death.

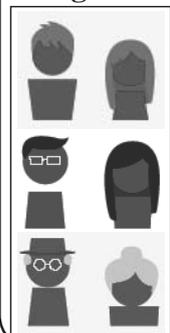


Setting the foundation for bone health throughout life

They say you are what you eat – and that's very true for your bones too. Bones, formed of living tissue, need the right nutrients to stay strong and healthy. A balanced diet, combined with regular exercise, will help to optimize your bone health at all ages and reduce the risk of osteoporosis.

The size and the amount of bone contained in your skeleton changes significantly throughout life. Likewise, as you age, the specific nutritional needs of your skeleton change too.

The goal of a bone-healthy diet is to help



Children & Adolescents

BUILD maximum peak bone mass

Adults

MAINTAIN healthy bones & avoid premature bone loss

Seniors

SUSTAIN mobility and independence

What are the key bone-healthy nutrients?

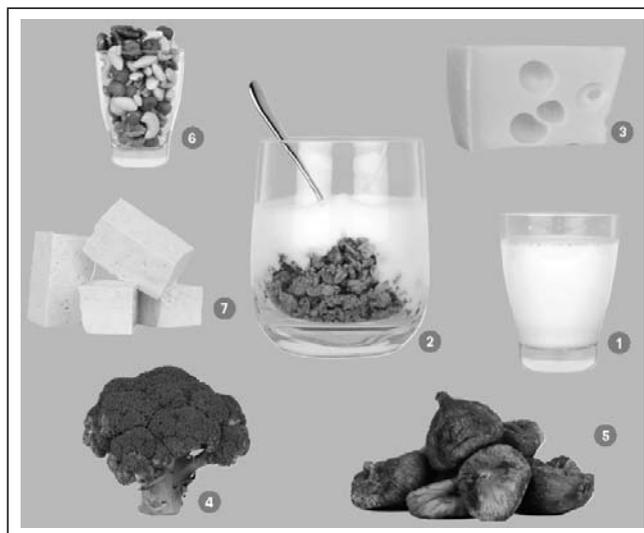
1. CALCIUM

Calcium is a major building block of our skeleton, with 99% of the 1 Kg of calcium found in the average adult body residing in our bones. Bone acts as a reservoir for maintaining calcium levels in the blood, which is essential for healthy nerve and muscle function.

Calcium is a key nutrient for all age groups but the amount needed varies at different stages of life. Demands are particularly high during the rapid period of growth in teenagers.

Dairy foods (milk, yoghurt, cheeses) are the most readily available sources of calcium in the diet, they also contain other important nutrients for growth. Additional food sources include certain green vegetables, whole canned fish with soft, edible bones such as sardines or pilchards, nuts and tofu set with calcium.

Selection of calcium-rich foods



| Food | Serving size | Calcium content |
|----------------------|--------------|-----------------|
| 1. Milk | 200 ml | 240 mg |
| 2. Yoghurt, natural | 150 g | 207 mg |
| 3. Cheese, hard | 30 g | 240 mg |
| 4. Broccoli (raw) | 120 g | 112 mg |
| 5. Figs, dried | 60 g | 96 mg |
| 6. Almonds | 30 g | 75 mg |
| 7. Tofu, calcium-set | 120 g | 126 mg |

2. VITAMIN D

Vitamin D plays two key roles in the development and maintenance of healthy bones. It **assists calcium absorption** from food in the intestine and ensures **correct renewal** and **mineralization of bone**.

Vitamin D is made in the skin when it is exposed to UV-B rays in sunlight. Due to our increasingly indoor lifestyles, low levels of vitamin D have become a worldwide problem as they can jeopardize bone and muscle health. Very few foods are naturally rich in vitamin D. As a result, in some countries certain food and drinks such as margarine, breakfast cereals and orange juice are fortified with vitamin D.

| Food | Vitamin D content* |
|------------------------------|--------------------|
| Wild salmon | 600 - 1000 IU |
| Farmed salmon | 100 – 250 IU |
| Sardines, canned | 300 – 600 IU |
| Tuna, canned | 236 IU |
| Shitake mushrooms, fresh | 100 IU |
| Shitake mushrooms, sun-dried | 1600 IU |
| Egg yolk | 20 IU per yolk |

*per 100g unless otherwise stated

IU: International Unit

How much sun exposure do you need?

Sunlight is not always a reliable source of vitamin D. The season and latitude, use of sunscreen, city smog, skin pigmentation, and a person's age are just some of the factors that will affect how much vitamin D your skin can produce through sunlight. Generally, you should try to get **10-20 minutes of sun exposure** to your bare skin (face, hands and arms) outside peak sunlight hours (before 10 AM and after 2 PM) daily – without sunscreen – and taking care not to burn.

Selection of foods containing vitamin D

3. PROTEIN

Protein provides the body with a source of essential amino acids necessary for health. Low protein intake is detrimental both for the building of peak bone mass during childhood and adolescence (affecting skeletal growth) and for the preservation of bone mass with ageing. Protein under nutrition also leads to reduced muscle mass and strength in seniors, which is a risk factor for falls.

Protein-rich foods include dairy products, meat, fish, poultry, lentils, beans and nuts.

The acid-load claim

Many people have been scared by claims that a high protein intake, including drinking milk, may cause increased calcium loss via the kidneys and therefore be bad for bone health. This claim has been disproved in many studies. Both plant and animal sources of protein promote strong bones and muscles. **Milk and dairy products, as part of a balanced diet, are excellent sources of calcium, protein and other nutrients.**

Micronutrients that support bone health

Micronutrients are required in trace amounts for normal growth and development. Ongoing research suggests that several, listed below, are important to bone health:

Vitamin K

Found in leafy green vegetables, spinach, cabbage and kale, liver some fermented cheeses, and dried fruit

TIP Snack on prunes, a high source of vitamin K

Magnesium

Found in green vegetables, legumes, nuts, seeds, unrefined grains, fish and dried fruit.

TIP 50 g of almonds = up to 40% of your daily need

ZINC

Found in lean red meat, poultry, whole grain cereals, pulses, legumes and dried fruit.

TIP Beans and chickpeas are good plant sources

Carotenoids precursors to vitamin A

Found in many vegetables, including in leafy green vegetables, carrots and red peppers

TIP 50 g of raw carrots meet your daily need



Building bones early in life

Bone health starts early in life – in fact it begins at the foetal stage, when good maternal nutrition helps optimize the development of the baby's skeleton.

Childhood and adolescence is a critical time for bone building. It is during this period that both the size and strength of our bones increases significantly.

Approximately half of our bone mass is accumulated during adolescence, with a quarter being built up during the two-year period of fastest growth. The process continues until our mid 20s.

Although genetics will determine up to 80% of the variability in individual peak bone mass, factors such as nutritional intake and physical activity will help a child achieve optimal bone strength. This is beneficial in late adulthood as there is more bone in reserve from which to draw; unlike in their younger years adults cannot replace bone tissues as quickly as they lose it. It is believed that a **10% increase in peak bone mineral density (BMD)** – one measure of bone strength – **could delay the development of osteoporosis by 13 years.**

Calcium and Protein rich - nutrition boosts bone development

Young people aged between 9-18 years have higher calcium and protein requirements, with the peak age for bone building being 14 years in boys and 12.5 years in girls.

Milk and other dairy products provide up to 80% of dietary calcium intake for children from the second year of life onwards. Although calcium is a vital nutrient for bone development during this stage of life, children are consuming less milk than they did 10 years ago and are instead turning to sweetened beverages. This trend needs to be reversed and children encouraged to drink more milk.

Young people also need enough protein to achieve their genetic potential for peak bone mass. Studies have shown a positive link between children who were given extra servings of milk in their diets – which is high in protein – and increases in a growth factor that enhances bone formation.

Getting enough of the sunshine vitamin

Young people often don't get enough vitamin D. This is partly due to their increasingly indoor lifestyles. By ensuring that children spend more time participating in sports and outdoor physical activity – and less time indoors in front of their computers or televisions – parents can help them maintain a healthy level of this key vitamin.

Recommended daily intake of key nutrients

According to the Institute of Medicine (IOM) USA

| Years | Calcium | Protein |
|---------------|----------------|-------------------------------|
| 1 – 3 (Age) | 700mg | 13g |
| 4 – 8 (Age) | 1000mg Calcium | 19g |
| 9 – 13 (Age) | 1300mg Calcium | 34g |
| 14 – 18 (Age) | 1300mg Calcium | 46g for girls 52g for boys |

Psst.. and we all need 600 IU of vitamin D per day!

Exercise and lifestyle matter

Nutrition and physical activity work hand in hand to enhance bone development in people of all ages, and at no stage in life is this more important than in youth. Young people who exercise regularly show a significant increase in bone mass.

A healthy body weight during childhood and adolescence – being neither too thin nor overweight – contributes to optimal bone health. Anorexia has a serious and negative impact on BMD and skeletal strength in adolescents, while obese children are more likely to sustain fractures at the wrist.

Bone – building tips for kids

Snack: on cheese, Yoghurt, nuts and dried fruit

Drink: milk – based beverages, fruit smoothies and mineral waters

Eat: balanced meals that contain calcium and protein, as well as fruits and vegetables

Move: spend time outdoors on physical activities that involve running and jumping

Maintaining healthy bones as an adult

Bone tissue loss generally begins at around the age of 40 years when we can no longer replace bone tissue as quickly as we lose it. At this stage in life you should take action to stem the tide of bone loss.

- Ensure bone – healthy nutrition, with sufficient calcium, protein, vitamin D and important micronutrients
- Engage in weight – bearing and muscle – strengthening exercise
- Avoid negative lifestyle factors such as smoking and excessive alcohol use

Adopting a bone – healthy lifestyle is of critical importance and adults need to pay particular attention at key points in their lives. In women, this is around the age of menopause when they experience a period of rapid bone loss due to reduction in protective oestrogen levels. In men, bone loss accelerates after the age of 70 years.

Keep up your intake of dietary calcium

Adults ages 19–50 years should have a dietary calcium intake of 1,000 mg/day. For people who cannot get enough calcium through their diet, supplements (preferably combined with vitamin D) may be beneficial. These should however not exceed 500 – 600mg per day.

Easy ways to boost your calcium intake:

- Consume dairy products as they are calcium rich; add low-fat cheeses to your meals
- Try calcium-set soy, which can be used as a substitute for meats

- Drink milk or calcium-enriched substitutes – and add to your coffees and tea
- Eat yoghurt regularly as a nutritious breakfast or snack
- Add whole grains or seeds like quinoa and chia to your meals
- Snack on nuts or dried fruit
- Drink calcium-rich mineral water (check the labels)
- Choose vegetables that are especially calcium rich (such as cress, broccoli, okra)
- Add chickpeas, lentils and white beans to your meals

Are you at risk of vitamin D deficiency?



The IOM recommended **vitamin D allowance for adults aged 19-50 is 600 IU per day**. To maintain your vitamin D levels you need regular safe exposure to sunlight. Although sunlight is the primary source of vitamin D, eating fatty fish regularly (e.g., salmon, sardines and tuna) or consuming vitamin D enriched food and drink, can help boost your levels.

Adults at greater risk of deficiency include anyone who lives at latitudes with minimal exposure to sunlight and people who are obese, have a dark skin tone, cannot expose their skin to the sun for medical or cultural reasons, or have diseases that reduce uptake of vitamin D from the intestine (e.g., Crohn's disease). If you have any of these risk factors, measurement of vitamin D, based on 25-hydroxyvitamin D levels in the blood, may be advisable. Supplementation may then be prescribed if required.

Proteins and healthy body weight

The current recommended daily allowance for healthy adults is 0.8g of protein per kilogram (kg) of body weight, per day.

Adults should eat sufficient protein-rich foods such as dairy products, meats and fish, lentils, beans and nuts. Poor protein intake is often related to under nutrition. A person's body mass index (BMI) should ideally be between 20 – 25 kg/m². A BMI below 19 kg/m² is a risk factor for osteoporosis.

Nutrition in seniors: stay strong and mobile

In seniors, a bone-healthy diet is an essential ingredient in helping to slow the rate of bone thinning and preserve muscle function. This in turns **helps reduce the risk of falls and fractures**.

Malnutrition is common among the elderly for a number of reasons. Seniors may have reduced appetite or be less inclined to cook balanced meals. Vitamin D levels may be lower because of less frequent exposure to sunlight, especially in seniors who are housebound. The skin's capacity to synthesize vitamin D also decreases, as does the kidney's capacity to convert vitamin D to its active form. In addition, with age, the body is less able to absorb and retain calcium.

More calcium, protein and vitamin D needed

In addition to higher calcium intake, **Seniors need more dietary protein and vitamin D than the young**. Both these nutrients help prevent muscle wasting (known as sarcopenia) and thereby help lower the risk of falls and fractures. Higher dietary intake of protein in older people who have been hospitalized with hip fracture has been shown to improve bone density, reduce the risk of complications and reduce rehabilitation time.

| Age | 51 -70 Years | | >70 Years | |
|----------------------|--------------|---------|-----------|---------|
| Gender | Female | Male | Female | Male |
| Calcium RDA | 1200 mg | 1000 mg | 1200 mg | 1200 mg |
| Vitamin D RDA | 600 IU | 600 IU | 800 IU | 800 IU |
| Protein RDA* | 46 g | 56 g | 46 g | 56 g |

Based on IOM recommendations

RDA: Recommended Dietary Allowances

*According to IOF, a moderate increase in protein intake from 0.8 to 1.0–1.2 g/kg per day is considered optimal for skeletal muscle health in older adults

The International Osteoporosis Foundation recommends that seniors aged 60 years and over take a Vitamin D supplement at a dose of 800–1000 IU/day.

Vitamin D supplementation at these levels has been shown to reduce the risk of falls and fractures by about 20%.

Exercise enhances the benefits of bone-healthy nutrition

As at all stages of life, exercise is essential for bone health in seniors too. At this age, muscle strengthening exercises, suitable to individual needs and abilities, will help improve coordination and balance. This in turn helps to maintain mobility and reduce the risk of falls and fractures.

Treatment for those at high risk

Although bone-healthy nutrition is important, drug therapies are critical for fracture prevention in people at high risk, including those who have already experienced a first fracture.

Today, there are many **proven and effective treatments** which have been **shown to reduce the risk of osteoporotic fracture by between 30–50%**. If you're over aged 50 years and have broken a bone, or have other risk factors for osteoporosis ask your doctor for a clinical assessment.

Controlling osteoporosis risk factors and complying with treatment regimens, where prescribed, can ensure people live mobile, independent, fracture-free lives for longer.

Non-age related nutritional factors

Alcohol and caffeine: moderation is key

Excessive alcohol intake – more than two units per day – can increase the risk of suffering a fragility fracture. As a rough guide: 1 unit would be the equivalent of 25 ml of spirits (40% alcohol) or 250 ml of beer (4% alcohol).

If you enjoy drinking coffee or other caffeine-containing drinks you need to ensure that you are getting sufficient calcium. Caffeine intake at 330 mg per day (approximately 4 cups) could be associated with a 20% increase in risk of osteoporotic fractures.

Coeliac disease and other disorders can affect nutritional status

Diseases of the gastrointestinal system that affect nutrient absorption in people of all ages include inflammatory bowel disease (e.g., Crohn's disease and colitis) as well as coeliac disease. People with these diseases may be at increased risk of osteoporosis and fractures and need to ensure an adequate intake of

calcium (1,000 mg/day) and Vitamin D. In such cases it is recommended that individuals have their nutrient status checked as they may need supplements.

Getting enough calcium despite lactose maldigestion or intolerance

People with some degree of lactose maldigestion may avoid dairy products. As a result they often don't get enough calcium, which may increase their risk of osteoporosis.

If you are sensitive to lactose you may not need to eliminate dairy consumption completely: lactose-reduced milks, yoghurts with live cultures, and some hard cheeses are normally tolerated. Another alternative is to take lactase tablets or drops along with dairy foods. People who are lactose intolerant should consult with their doctor to discuss the best way of ensuring adequate calcium intake, either through diet, or if necessary, through the use of supplements.

Are you getting enough calcium?

Calculate your average daily calcium intake in three easy steps. Available online and on mobile devices.

www.iofbonehealth.org/calcium-calculator

Knowing your risk factors

Take the IOF One-Minute Osteoporosis Risk Test to find out whether you may have specific factors which place you at higher risk of osteoporosis and fractures.

www.iofbonehealth.org/iof-one-minute-osteoporosis-risk-test

Courtesy:  International Osteoporosis Foundation

HUMOUR

After being married for thirty years, a wife asked her husband to describe her. He looked at her carefully, then said, "You are **A, B, C, D, E, F, G, H, I, J, K.**" "What does that mean?" she asked suspiciously. He said, "**Adorable, Beautiful, Cute, Delightful, Elegant, Foxy, Gorgeous and Hot!**" She beamed at him happily and said: "*Oh, that's so lovely! But what about I, J and K?*" "**I'm Just Kidding!**" He is now in hospital recovering from swollen face and eyes.

Picky Beggar...

Wife: I hate that beggar.

Husband: Why?

Wife: That rascal, yesterday I gave him food and today he gave me a Cookbook!

Careful What You Wish For...

A State Government Employee sits in his office and out of boredom, decides to see what's in his old filing cabinet. He pokes through the contents and comes across an old brass lamp.

"This will look nice on my mantelpiece," he decides, and takes it home with him. While polishing the lamp, a genie appears and grants him three wishes.

"I wish for an ice cold beer right now!" He gets his beer and drinks it. Now that he can think more clearly, he states his second wish.

"I wish to be on an island where beautiful women reside." Suddenly he is on an island with gorgeous females eyeing him lustfully.

He tells the genie his third and last wish:

"I wish I'd never have to work ever again." POOF! He's back in his government office.

God Is With Us...

Two priests were riding very fast on a motorcycle. They were promptly stopped by a policeman who said, "What do you think you are doing?"

"What if you have an accident? The priests say, "Don't worry, my son. God is with us."

The policeman says, "In that case, I have to book you. Three people are not allowed to ride on a motorcycle."

KARIAMANICKAM SRINIVASA KRISHNAN

Kariamanickam Srinivasa Krishnan (KSK) is mostly known as co-discoverer of the famous Raman effect, a discovery which brought the first and till date the only Nobel Prize in Science to India. The Prize was awarded to Krishnan's mentor and research guide



C.V. Raman in 1930. A lot of unnecessary controversies were raised and still continue to be raised on the point that KSK was not given due credit for his part in the discovery. In fact some have even gone to the extent that it was KSK who had discovered the Raman Effect and Raman took the entire credit for it. But Krishnan himself had no grievance for it. KSK, in one conversation with S. Ramaseshan, had said: "It is a blatant misrepresentation. The best I can say is that I participated actively in the discovery...." On being asked that Raman was being accused of taking away the lion's share of the credit of the discovery KSK replied. "...that is another misrepresentation. Professor never tried to do this. If you read the Nobel lecture, which is a true and honest account of the progress and history of the subject, Professor names all his collaborators in order starting with K. R. Ramanathan giving everyone (and including me) his due credit. Again and again in public lectures he always mentioned that I collaborated with him in the discovery of the effect and that our collaboration was similar to that of Bowen and Millikan which was praise indeed". It was also pointed out by Krishnan that while recommending Krishnan for a professorship at the Andhra University Raman wrote to the Vice Chancellor. "If the Nobel Award for physics made in 1930 had been for the work done in the year 1928 alone instead of the entire work on the scattering of light done at Calcutta from 1921 onwards, Krishnan could justly have come in for the share of the prize." The citation for the Nobel Prize also stated that the Prize was given to Raman for his work on the scattering of light and the discovery of the effect named after him. In reality there is no controversy. It was Raman who deserved the Prize. In this connection it is worthwhile to note from the preface by G. Baskaran of the Institute of Mathematical Science, Chennai. to the Special

Section on K.S. Krishnan Birth Centenary in Current Science. Baskaran wrote: "It is my personal opinion, that Raman – Krishnan controversy is no controversy ... Raman, a great scientist, was in a tireless pursuit of an important phenomenon and was fortunate to get a young and great student like KSK. A careful look at KSK's diary as reported in G. Venkataraman's book and a host of other factors clearly illustrate this – Raman deserved the Nobel Prize for the Raman effect. And the then young Krishnan grew into a great scientist on his own right." This fact that Krishnan himself was a very distinguished scientist in his own right and not to be remembered only because he was co-discoverer of Raman effect needs to be highlighted. KSK was an outstanding physicist of international repute. He made pioneering contributions in a number of fields of physics. He had the ability to recognize and exploit connection between phenomena in different fields of physics. KSK played an important role in the development of science and technology in India. He was deeply associated with the premier scientific/ educational organizations in the country like the Atomic Energy Commission, the Council of Scientific and Industrial Research and the University Grants Commission. He was a great teacher, a real guru in the tradition of great ancient sages. Besides being a 'complete physicist' he was 'a whole man with an integrated personality'. He was a staunch nationalist. He forcefully championed the cause of science writing in mother tongue. He himself ably performed the task in Tamil. He was a distinguished writer in Tamil. Thus G. Baskaran wrote: "Conveying the essence of science and its excitement in an understandable way to a layman or a non-expert is an art that few scientists have mastered. This has its very important role and value in society. It is also an important duty of the science community that is being neglected in modern times. KSK had this skill as it is clear from his many articles on science and related issues in Tamil and English as well as the talks that he has given in All India Radio. He was an ardent spokesman for science. KSK strongly believed that one can convey even very complicated scientific facts in his mother tongue. His scholarship and appreciation of Tamil literature must have given the gift to perform this task with ease. In one of his articles he speaks of his school science teacher Thirumalai Kozhunthu Pillai, who enthused the students by teaching science in a understandable way in chaste Tamil. Listening to him he got the conviction that difficult scientific concepts could be conveyed in Tamil. He was an sports enthusiast and played tennis,

bridge and football. He had mastery over Sanskrit and Tamil literature. Inspired by his father, KSK since his childhood developed an abiding love of religion and Indian philosophies. Many people have noted that it was a pleasure to listen him. He could always find an appropriate anecdote to drive home a moral or disarm a critic or just to entertain. KSK was born on 4 December 1898, in the village of Wartrap, in the Ramnad (then Tirunelveli) District of Tamilnadu (then a part of the Madras Presidency). His father was a school teacher. After schooling in his village school and at the Hindu High School at the neighbouring town Srivilliputtur he studied in the American College, Madurai and Christian College Chennai (then Madras). KSK's interest for science grew in his school days. To quote Krishnan : "My first love for science came in my fourth form (class 9) in my high school in 1911. Even though my teacher was not a professional scientist, he was good at explaining science in a clear and captivating fashion. His lessons not only sunk deep into our mind but also made us crave for more science. Whether it is physics, geography or chemistry, his teaching style was unique. He did not simply reproduce the lessons from the book. He demonstrated many simple experiments for us and also encouraged us to do experiments ourselves. Very few teachers I know are of this type, and I feel fortunate to have had him as my first science teacher... My real involvement in science came after a year, when my physics teacher asked us to write an "essay" about an instrument that I constructed on my own, for measuring the density of solids. A few days later I learned that my instrument is nothing new and it was invented by Nicholas many years ago. "The Nicholas hydrometer" was by then text book material." After taking a master degree in physics KSK became a demonstrator in chemistry. Here, at the request of some of his students, KSK organized an informal lunch-hour discussion where the students were free to discuss any question in physics, mathematics or chemistry. It became so popular that students from nearby colleges started attending it. Often the big gallery of the lecture room used to be full to overflowing. G. Venkataraman in his book, Journey Into Light : Life and Science of Raman, a marvellous biography of Raman has written : "Krishnan took a master's degree in physics but the only opening then available to him was a Demonstrator in chemistry in Madras Christian College. During this period, Krishnan ran an informal but highly successful lunch-hour discussion on diverse topics in physics and chemistry which soon began to attract participants from other colleges as well. One beneficiary later remarked that he had learned more physics from the lunch-break seminars than from regular class-room lectures." In

1920, Krishnan went to work with C.V. Raman at the Indian Association for the Cultivation of Science, Kolkata (then Calcutta). About his joining Raman's research group, Krishnan later wrote: "I relinquished the small job I had and decided to do research in physics and went to Prof. C.V. Raman at Calcutta. But, he did not agree for my starting research immediately. Only after learning various aspects of physics properly at Calcutta University for two years was I able to join his research group. I had the good fortune of having a five year "Gurukula Vasam" there. These five years turned out to be a festive season in my science life". KSK worked very hard. It is said that his work in the laboratory began at 6 a.m., often after an early walk and an cold bath. But his interests were not confined to research alone. He also studied a lot of literature, religion and philosophy. One will get a glimpse of the breadth of Krishnan's reading habit and his source of his inspiration from the following remarks made by Krishnan in a radio broadcast : Thackeray, Stevenson, Cervantes, Dumas and Victor Hugo and Conan Doyle linger in my memory as my favourite authors at this time, Plato and Aristotle in translations, Shakespeare, Some of them naturally stand out much more prominently than others in my memories. I should specially mention Don Quixote, Pickwick Papers, Vanity Fair and Book(s) of Snobs, Essays of Elia, Essay and Discourses of Stuart Mill, some of the prose writings of Swift and Alice in Wonderland and Through the Looking Glass, most of which I have re-read later. Among the popular scientific books that made a great impression on me I should specially mention Tyndall's Fragments, Microbe Hunters by Paul de Kruif, Men of Mathematics by Eric Bell, A Mathematician's Apology by Hardy and the biographies of Kelvin, Helmholtz, Lord Rayleigh, Maxwell and Tait. Among the serious scientific writings, the collected papers of Lord Rayleigh have been my constant companion for nearly 38 years and I cannot think of a better model for a research worker. One of the research papers of Einstein I have read off and on during the same period, and every time by read it I get something new out of it. Some of the papers of Niels Bohr had over me even more profound influence." Besides his research work and general reading he also took active interest in sports. He was a good football player. And he was a frequent visitor to the Eden Gardens for watching a football match. He used to play bridge and also tennis. He used to take a very lively interest in political movement. But all this did not affect the quality or quantity of his scientific work. At the instance of Raman he engaged himself in experimental study of the scattering of light

in a large number of liquids, and its theoretical interpretations. He played a significant role in the discovery of Raman Effect. It is important to note that though Krishnan played an important role in the discovery the Raman Effect he did not pursue this subject in later part of his career. He worked in fields like magnetism, thermal conductivity and thermionics. Arnold Sommerfeld visited Calcutta in October 1928 to give lectures on 'Modern Developments in Wave Mechanics'. KSK assisted Sommerfeld to prepare a book based on the lectures for publication by the Calcutta University. It was not just simply reproduction of the lectures. He developed the lectures in an independent and original way, supplying new and elegant mathematical proofs. Sommerfeld commended for KSK's originality and scholarship. In fact it is said that Sommerfeld offered to publish the book under joint authorship. However, the offer was politely declined by KSK. In December 1928 KSK moved to the Dacca University (now in Bangladesh) as the Reader of in the physics Department. At the time Satyendra Nath Bose was the Head of the Physics Department. In Dacca University he studied magnetic properties of crystals in relation to their structure. In the process KSK developed elegant and precise experimental technique to measure the magnetic anisotropy of dia - and paramagnetic crystals. The research papers published by KSK and his colleagues from Dacca University are considered to be foundation stones of the modern fields of crystal magnetism and magneto chemistry. In 1933 KSK came back to Kolkata to take up the post of Mahendralal Sircar Professor of Physics in the Indian Association for the Cultivation of Science. He continued to study of magnetic properties of crystals in relation to their structure. In 1937, KSK was invited by Lord Rutherford to the Cavendish Laboratory, Cambridge, and by Sir William Lawrence Bragg to the Royal Institution, London, to give lectures. In 1942, KSK moved to Allahabad University as Professor and Head of the Department of Physics. Here he took up the physics of solids, in particular metals. In 1948, KSK took over the directorship of the National Physical Laboratory (NPL) set up by free India as one of the national laboratories under the aegis of the Council of Scientific and Industrial Research (CSIR). In NPL, besides carrying out his administrative responsibilities, he continued his activities in his chosen fields of research. He also turned his attention to problem in the thermionics, a branch of electronics dealing with the emission of electrons from matter under the influence of heat. KSK received a number of honours both in India and abroad. **In 1948 he became the General President of Indian Science Congress.**

The title of **Padma Bhusan** was awarded to him by the Govt. of India in 1954. In 1955, the US National Academy of Science invited KSK to be the guest speaker at their Annual Dinner. He was specially flown over to America for the purpose. It was a rare privilege. Earlier this privilege was enjoyed by only the Presidents of the Royal Society of London, of the Royal Netherlands Academy and of the Swedish Academy. Here he delivered a lecture on cultural values in technical education. Hasbrouck van Vleck (1899-1980) pioneer in the development of modern quantum mechanical theory of magnetism and who got Nobel Prize in 1977 commented on this lecture. "He (Krishnan) quoted extensively from Whitehead and it was his speech that prompted me to read some of Whitehead's writings." Alfred North Whitehead (1861-1947), the British mathematician, physicist and philosopher, pioneered (along with Bertrand Russel) in mathematical logic and foundations of mathematics. He was elected a Fellow of the Royal Society of London in 1940. He was Knighted in 1946. In 1956, he was elected a Foreign Associate of the US National Academy of Sciences. KSK was the first recipient of the Bhatnagar Memorial Award in 1961. The Govt. of India made him a National Professor. **KSK was a founder member of the International Union of Crystallography.** Among the other members were Max Theodor Felix Von Laue (1879-1960) and William Lawrence Bragg (1890-1971). **He was President of the National Academy of Sciences and also of its predecessor National Institute of Sciences of India. He was the Vice President of the International Union of Pure and Applied Physics and International Council of Scientific Unions.** KSK died on June 13, 1961. We would like to end this write-up by quoting from an article on Krishnan by Shiv Visvanathan, a sociologist of science and who has worked on Krishnan and his NPL days: "When NPL was being built there were two trees in front which were creating problems. The builders decided to cut them down. When the axe was about to fall, Krishnan was just driving in. He stopped, astonished and horrified and then came running up to the tree cutters jabbering in his not too articulate Hindi. Seeing Krishnan's distress, Kanvinde, the architect, also rushed to the scene. Krishnan asked them 'Why are you cutting down these trees?' The architect answered 'Sir, we thought they looked asymmetrical in the landscape'. Krishnan fell silent and then replied, 'You can still create symmetry. Not by cutting down a tree but by adding one more'. The aesthetics of the man who loved Whitehead and admired Pavlova is captured in this vignette."

TIRUKKURAL AND MANAGEMENT IN A 'NUTSHELL' – 37

Emotional Intelligence or Emotional Quotient, EQ is all about dealing with people, both internal and external. One of the important points discussed in EQ is the 'Law of Deficiency', which gives a view point that every individual will have deficiency both in their Knowledge and Behaviour, in varying degrees, partly due to certain situations or compulsions and partly due to ignorance. It is important for the Manager to have proper outlook, analysis and Consideration, so that the work and the things will move forward. Tiruvalluvar devotes 10 Kurals to deal with this delicate subject under the Title "Kannottam" meaning 'seeing in complete perspective' or 'seeing through completely'. Many leading authors translate this word as 'Considerateness'



The Kurals below will provide the Message of Tiruvalluvar in this regard.

"Karumam Sithaiyamal Kannoda Vallarkku Urimai Udaithuivv Ulagu" Kural 578

கருமம் சிதையாமல் கண்ணோட வல்லார்க்கு உரிமை உடைத்துஇவ் வுலகு குறள் 578

"Behold the man who can be considerate towards others without derogating from any of his duties; he will inherit the earth"

'Kannottaththu Ullathu Ulagiya; Akhthilar Unmai Nilaiykkup Porai' Kural 572

கண்ணோட்டத்து உள்ளது உலகியல்; அ.திலார் உண்மை நிலக்குப் பொறை குறள் 572

"In considerateness have the amenities of life their existence; those who possess it not, are a burden unto the earth"

"Oruthuatrum Panbinar Kannumkan Nodip Poruthuatrum Panbe Thalai" Kural 579

ஒறுத்துஆற்றும் பண்பினார் கண்ணும்கண் ணோடிப் பொறுத்துஆற்றும் பண்பே தலை. குறள் 579

It is nobility to forbear and show indulgence, even unto those that have offended thee"

HOME FESTIVALS – 6

ஆனி - Ani (June/July)

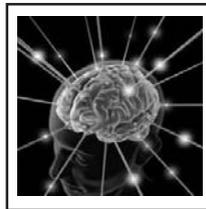


This is the one month of the year when there are no home festivals - coinciding not uncoincidentally with an intense month of agricultural effort. However, during Ani, major temple festivals are held for Lord Siva as Nataraja, King of Dance (above left), and for Siva and Parvati.

(To be continued)

POWER YOUR MIND - WHAT IS FAITH?

Faith is not belief;
It is conviction.
Faith is not blind;
It is an inspiration.
Faith is not the goal;
It is the means.



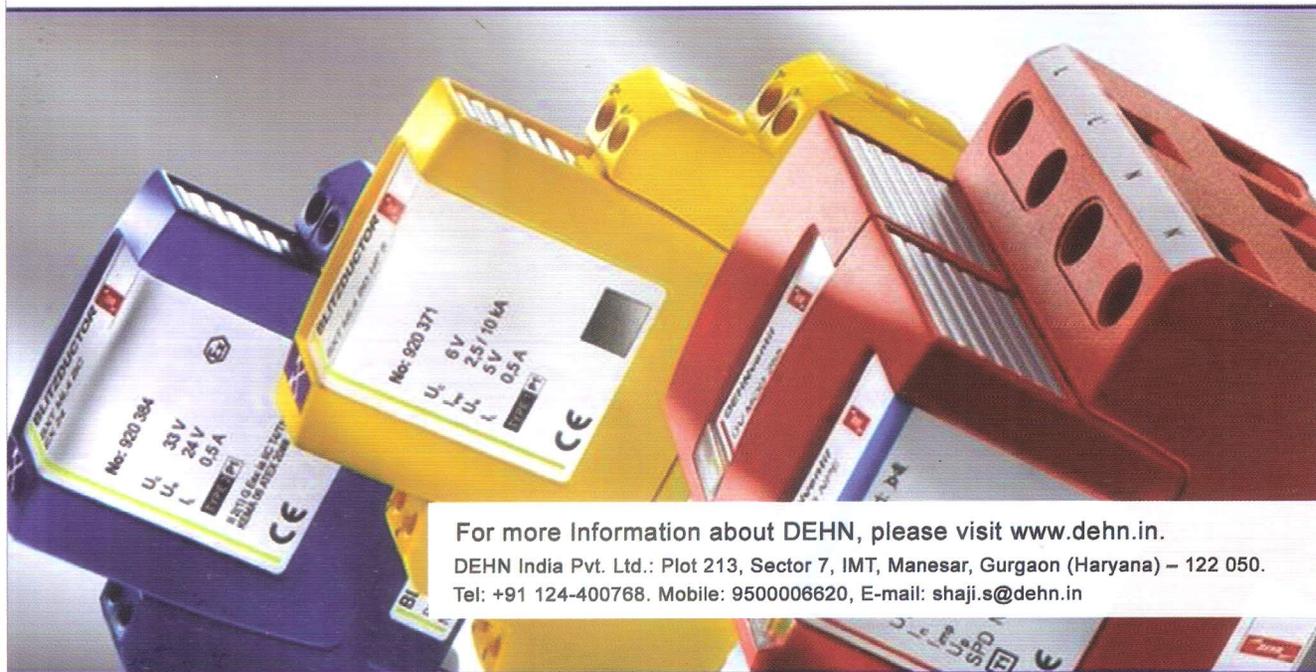
Courtesy: Swami Srikantananda

Faith is not superstition;
It is experience.
Faith is not religion;
It is realization.
The man of faith attains
Knowledge.

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