ELECTRICAL INSTALLATION ENGINEER

NEWS LETTER

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

MEMBERS MEETING ON 30.03.2013

***Left to Right*: Mr. G. VENKATESH,** *Joint Secretary*; **Mr. K. KANNAN,** *Secretary*; **Mr. U. BASKARAN,** *President*; **Mr. P. SUYAMBU,** *Treasurer*

Mr. G. VENKATESH, *Joint Secretary*
Addressing the Members

Mr. A.K. VENKATASAMY, *Immediate Past President*
Addressing the Members

Vote of Thanks by **Mr. K. KANNAN,** *Secretary*

Members Gathering at the Meeting

Members Gathering at the Meeting

Members Gathering at the Meeting

EDITORIAL

Dear Members, Fellow Professionals, Friends and Well wishers,

June has begun auspiciously with the commencement of monsoon in many parts including catchment areas of Kavery River. There are reports that Tamilnadu will also receive Good rains this season and later. India with its sizable population requires Good Monsoon to sustain all round development. Food provides Energy for all living beings and "Energy" is required for all activities including agriculture. Since the beginning of Civilization, since the time man started to use Energy for Cooking, Transportation and all his comforts and with the growth of Science and Technologies and Industries, the demand for Energy went on growing and with it the possible dangers, including Pollution and Environmental damages etc.

During the month of June, National Environmental Week and UN Environment Day are observed to remind us about the need to balance the activities without damaging the environment. At this time it will be apt to review some thoughts on Technology, Economy, Politics and Culture and the philosophy of engineering ethics grounded in the notion of sustainable development.

The four basic aspects of society are technology, economy, politics and culture. There are other aspects of society, but these are the most important. These four aspects are not independent. They are inter-dependent. That is, each of the four aspects influences the other three. The four aspects are not equal in the degree to which they influence the other aspects. Some aspects are "stronger" than others. The four aspects can be arranged in the ascending order of their strength (or importance/influence): Technology, Economy, Politics and Culture. The higher order aspects (culture and politics) influence or determine the lower order aspects (economy and technology) – normally. But sometimes there can be a major change in a lower order aspect. Then the direction of influence is reversed. That is, it becomes possible for the lower order aspects to influence or determine the higher order aspects. Such a major change in the lower order aspects has happened only twice in human history: a) The invention of agriculture (c10,000 BC) and

b) The Industrial Revolution (c1800 AD). On both these occasions, the initial changes were in technology and the economy. But they led to changes in politics and culture as well.

Looking at India, we really started our development activities from the mid fiftees which is really in its gallop now with tremendous needs for Energy improvements. Pollution or Environmental damages can't be allowed at any cost and Engineering and Technology can solve almost all problems with responsible Governance, Officials and the judiciary. We hear news of treated water from sewage being sold to Industries by Chennai and few other Corporations. With this kind of background and with the need for Technology and Economy playing their role with full responsibility, the obstacles to the Nuclear Programs and Copper and Natural Gas are all disturbing as they are essential for Energy Security and growth. The present and future Engineering fraternity must resolve to adopt Engineering Ethics and these Ethicists must work more closely with engineering scientists to ensure that all facets of sustainable technology become a practical reality.

We thank all those members who have helped us by participating in the advertisements appearing for the issue May 2013 – OBO Bettermann India Pvt. Ltd., Wilson Power and Distribution Technologies Pvt. Ltd., Prolite Autoglo Ltd., Power Links, K-Lite Industries, Axess Seven, Universal Power Equipment Pvt. Ltd., Hensel Electric India Pvt. Ltd., Intrans Electro Components Pvt. Ltd., Pentagon Switchgear Pvt. Ltd., Power Cable Corporation., Galaxy Earthing Electrodes Pvt. Ltd., Ashlok Safe Earthing Electrode Ltd. **EDITOR**

LETTER TO EDITOR

Dear Sir,

I am enclosing a cheque for Rs.1000/- as my contribution towards **TNEIEA's NEWSLETTER.**

It is only a *very small contribution*, compared to *NOBLE SERVICE* rendered by your association.

With Best Wishes,

Yours Faithfully,

Er. R. Athinarayanan, B.E., M.I.E.,
Electrical Inspector (Retd.)
Madurai-625003.

CONTRIBUTION TO NEWSLETTER (Rs.1,000/- per year)

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

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

ELECTRICAL INSTALLATION ENGINEER

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Let us resume our discussions.

- **Engineering Inspections**

  Periodic visual inspections of the substations in point will help to get the first hand information on their overall health status or over all condition. They also provide useful information on the site related problems that require solutions.

- **Specific Equipment Problems**

  From the history cards maintained in the substation or from other utility records, it is always easy to gather information on the failures of specific types of equipment. It can also be collected from other utilities which face similar failures.

- **Equipment Security Audit**

  Another useful study in this context is "Equipment Security audit." This Audit will reveal whether the substation equipment will serve as per their design or will meet violent failures when severe close up fault occur. This Audit will help to identify the weak spots or weak links/Missing links in the protection arrangements for the substation. The problem areas include inadequate earthing systems which will lead to high Ground Potential Rise during faults, incompatibility between the fault level and the rupturing capacity of the breaker which makes the protective system as inadequate, CT saturation conditions, inadequate Surge Protection system or shielding given to the system that includes non-provision of line entrance arresters, energisation from the cable end in the case of composite transmission circuits.

6 CONDUCTING LIFE-EXTENSION STUDY

6.1 The life assessment phase of a life extension study can be conducted on the lines described in the earlier part of this article. In addition, the guidelines given by Electrical Power Research Institute, U.S.A can also be used. Once this phase has been completed, the second part viz. life extension has to be started. The life extension study begins with the objectives as outlined by the utilities and then the options that are available and that require attention. There is no need to elaborate the 'objectives' portion of this study since it is known to all.

6.2 Among the options available for life extension process are: i. Renewal to original design; ii. Life extension with upgrading or retirement

The renewal option attempts to bring back the original design condition of the equipment. It is done by replacing the deteriorated/degraded part of the equipment with a part of similar or higher capabilities. To cite an example, the older obsolete insulation of the old hydel generations can be replaced with modern insulation materials. The second option viz. life extension with upgrade option is the one normally preferred or adopted in many over dutied/over taxed substations. In these stations, the original design conditions or operating conditions scarcely prevail. It is mainly due to increase in the connected loads and their operating behaviour, the increase in the short-circuit level of the station caused by the addition of generating capacities in the grid. The next option viz. "life extension by retirement", is always preferable because the older equipment can be replaced with the modern site specific maintenance – free equipment. The utility can also use this opportunity to upgrade the substations voltage level. Viewed from any angle, the life extension with retirement of old equipment or replacement of old equipment with new, modern equipment can be found to be the best solution.

7 CONCLUDING REMARKS

Before ending this chapter let us have a look at the topics so far discussed or let us have a summary of this discussion.

i. Life extension now becomes a standard method or procedure for meeting the problems experienced in older substations.
ii. Instead of adopting piece-meal programmes, it is always preferable to adopt full-fledged life extension programme.
iii. To accurately assess the condition of old substations, meticulous life assessment should be carried out.
iv. A life-assessment programme depends on a good database and accurate methods that predict the remaining life of the equipment.

The following steps are useful while adopting the above process.

- Proper structuring of maintenance recording procedure. This step will help to assess the required data.
- Periodical testing of equipment to obtain the trends for life-assessment analysis.
- Analysis of equipment failures and their trends.
- Application of modern diagnostic monitors wherever possible.
- Maintenance of accurate loading records.
- Collection of useful information from other utilities and creation of a data base in regard to life expectancy of the equipment.

(To be continued…)

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

EVENTS

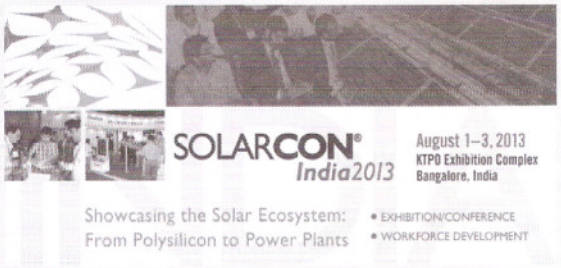
1. CIPV EXPO - 2013

Event Profile: CIPV EXPO, as an integral part of Clean Energy Expo China (CEEC), is the first and only platform for the industry in China which focuses on the Industry's New Technology, Materials, Products and Equipment amongst its comprehensive exhibit scope of all the Solar PV related products spanning the entire range from large-scale PV station construction to BIPV (Building Integrated PV).

Date : 3rd – 5th July 2013

Venue : Beijing, China National Convention Center, China

Website : http://www.cipvexpochina.com



2. SOLARCON INDIA 2013

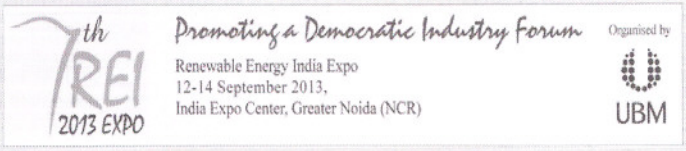
Event Profile: SOLARCON India is organized by SEMI India and is the only event that reinvests its revenues into programs and services that support the growth and expansion of the Solar/PV Industry in India

Date : 1st - 3rd August 2013

Venue : KTPO Exhibition Complex, Bangalore, India

Website : http://solarconindia.org/

3. 7TH RENEWABLE ENERGY INDIA 2013 EXPO



Event Profile: The 7th Renewable Energy India 2013 Expo is recognised as Asia's largest event on renewable. The 3 days international expo comprehensively covers Solar, Wind, Bio-mass/fuel, Small Hydro, Geothermal and Energy Efficiency.

Date : 12th - 14th September 2013

Venue : India Expo Center, Greater Noida (NCR)

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

4. LII 2013 – LIGHT INDIA INTERNATIONAL

Event Profile: The Light India International 2013 will publicise the developments taking place in the lighting industry and provide excellent marketing opportunities for all the products and services covered by the lighting industry.

Organised by

isle
indian society of lighting engineers

Date : 13th – 16th September 2013

Venue : Chennai Trade Centre, Nandambakkam, Chennai

Website : http://lfii.in/index.aspx

5. ELECRAMA-2014

Date : 8th - 12th January 2014

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

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

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

BASICS OF DISSOLVED GAS ANALYSIS AND CASE STUDIES FOR POWER TRANSFORMERS

INTRODUCTION

The trouble free performance of transformer during service is of paramount importance in power stations to ensure uninterrupted and economic power supply. Transformer operates under complex environmental conditions, variable thermal and electrical stresses during service. As a result of normal ageing process, insulating oil in it breaks down and produces gases like hydrocarbons, hydrogen and carbon oxides which dissolve in oil. But the rate of generation and presence of some combustible gases in large quantities definitely indicate some internal fault. Therefore, it is advisable to detect the faults in its early stage, so that the development of the major faults and thus the damage to transformers can be avoided. Analysis of dissolved gases has been a proven technique in use for the last 2-3 decades for monitoring the health of a transformer in service by sensing incipient fault well in advance before, even the buchholz relay operates. As the health of the oil implies the health of the transformer, the oil should be sampled and tested regularly to evaluate the oil condition and to determine the possible fault type. For achieving this transformer oil is evaluated by oil contamination test and four type DGA diagnosis method like IEC ratio method, Rogers ratio method, Key gas method and Dual triangle method [1,3-5].

2.0 OIL CONTAMINATION TEST

The tests described here are classified into the following categories: Physical Tests, Electrical Tests and chemical tests. The various properties covered in IS: 1866-2005 [6].

Below Table I shows limiting value for Transformer oil for different voltage grades < 72.5 kV to >170 kV as per IS: 1866:2005.

TABLE 1: LIMIT VALUE AS PER IS:1866:2005

Property	Highest voltage of equipment, kv		
	<72.5	72.5 to 170	>170
Breakdown voltage (kv), Min.	More than 40	More than 50	More than 60
Water Content (ppm), Max.	Max.20	Max.15	Max.10
Neutralization value (mg KOH/g), Max.	Max.0.3	Max.0.3	Max.0.3
Resistivity at 90°C x 10^{12} (ohm-cm), Min.	6 x 10^{12}	6 x 10^{12}	6 x 10^{12}
Dielectric dissipation factor at 90°C, Max.	0.015	0.015	0.010
Interfacial tension (mN/m), Min.	35	35	35
Flash Point, (°C), Min.	140	140	140

2.1 Breakdown Voltage

This is a conventional test intended to reveal the extent of the advisability of carrying out drying and filtration treatment before the oil is introduced in to the apparatus. According to IS: 1866-2005 the acceptable minimum breakdown voltage is 40 kV for transformer with rated voltage 72.5 kV and below, 50 kV for transformer rated between 72.5 kV and 170 kV, and 60 kV for transformer rated 170 kV and above.

2.2 Water Content

The presence of water in insulating oils results in poor electrical properties. A low water content in oil is necessary to achieve adequate electric strength and low dielectric loss characteristics. Water in oil (solution) cannot be detected visually and hence indirect methods are used. According to IS: 1866-2005 the acceptable maximum water content is 20PPM for transformer with rated voltage 72.5 kV and below, 15 PPM for transformer rated between 72.5 kV and 170 kV, and 10 PPM for transformer rated 170 kV and above.

2.3 Neutralization Value

The acidity of a mineral oil is an indication of electrical conduction and metal corrosion. A low total acid content of an oil is necessary to minimize electric conduction and metal corrosion. In used insulating oils, an increase in total acid number from the value of the unused product indicates contamination by substances with which the oil has been in contact or a chemical change in the oil from processes such as oxidation. According to IS: 1866-2005 the acceptable maximum neutralization 0.3 mg KOH/g.

2.4 Resistivity

The resistivity of a liquid is a measure of its electrical insulating properties under prescribed conditions. High resistivity reflects low content of free ions and ion-forming particles and normally indicates a low concentration of conductive contaminants. According to as per IS: 1866-2005 the acceptable minimum resistivity value is 6 x 10^{12} ohm-cm.

2.5 Dielectric Dissipation factor

This property is a measure of the dielectric losses in an oil and hence of the amount of energy dissipated as heat. A low value of dissipation factor indicates low losses and a low level of soluble polar ionic or colloidal contaminants. According to IS: 1866-2005 the acceptable minimum dielectric dissipation factor is 0.015 at 90°C for transformer up to 170 kV and 0.010 at 90°C for transformer rated 170 kV and above.

2.6 Interfacial tension

This is defined as the molecular attractive force between unlike molecules at an interface and is expressed as Newton per meter. IFT measurements on insulating oils provide a sensitive means of detecting small amounts of soluble polar contaminants and products of oxidation. A high value indicates the absence of such contaminants and low IFT number means a high amount of tiny particles in the oil. According to as per IS: 1866-2005 minimum acceptable value for IFT is 35 mN/m.

2.7 Flash Point

The flash point is the temperature at which a material gives so many vapours, that this vapours when mixed with air forms an ignitable mixture and gives a momentary flash on application of a small pilot flame. The flash point and fire point tests give an indicating of the flammability of oil. According to as per IS: 1866-2005 minimum acceptable value for Flash point should be 140°C.

3.0 Dissolved gas analysis

Dissolved gas analysis is one of the efficient methods for the detection of incipient fault in oil filled electrical apparatus. We can say that DGA is not a science but an art. IEC standard 60599 introduces the basic gas ratio methods, Key gas method and the Dual Triangle method. The IEC gas ratio method uses only three gas ratios. The Dual triangle is based on the relative proportions of the three gases detecting a fault. One problem of the gas ratio methods is that the diagnosis cannot interpret some DGA results, which do not match the ratio codes. The Dual method does not face this problem because all coordinated points must be in the triangle. Total 108 no's transformer tested for oil contamination test and dissolved gas analysis. Out of them 3 no's case study chosen for analyzing Insulating oil condition, and 2 no's case study also chosen from other industries for analysis purpose.

3.1 Dual Triangle Method

The Dual triangle method concerns only three hydrocarbons gases: CH4, C_2H_4, and C_2H_2. Concentrations in ppm of the gases are expressed as percentages of the total of CH4 +C_2H_4 +C_2H_2 and plotted as a coordinated point of % CH_4, % C_2H_4, and % C_2H_2 in a Dual triangle. Fault zones are divided into seven types, as shown in Figure 1. Six zones individual faults such as partial discharge, thermal faults, and electrical discharges. The seventh zone is a mixture of electrical and thermal faults [1]. Figure 1 Shows coordinates and fault zone for Dual triangle method.

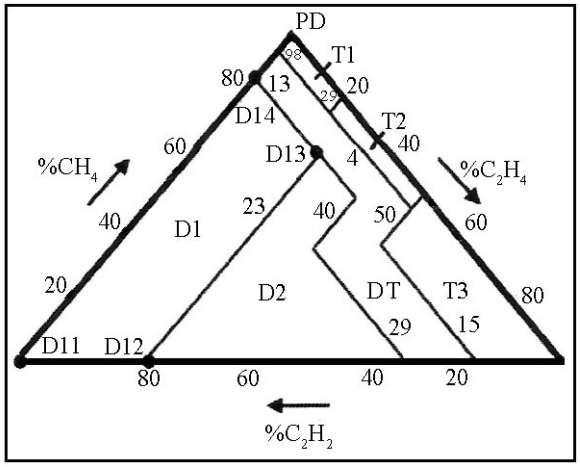


Fig.1: Dual Triangle

In Dual triangle method following 7 Zones are classified.

PD - Partial Discharge

T1 -Thermal Fault less than 300°C

T2 - Themal Fault between 300°C and 700°C

T3 - Thermal Fault greater than 700°C

D1 - Low Energy Discharge (Sparking)

D2 - High Energy Discharge (Arcing)

DT - Mix of Thermal and Electrical faults

3.2 Key Gas Method

The key gases utilized to predict a specific problem are H_2 (Hydrogen) for corona in oil, C_2H_2 (Acetylene) for arcing, C_2H_4 (Ethylene) for severe overheating, CH_4 (Methene) for sparking, CO (Carbon Monoxide) for overheated cellulose and C_2H_6 (Ethene) for local overheating. Permissible concentration of dissolved gases are as per [3].

3.3 IEC Ratio Method

A suitable basis for fault diagnosis is the calculations of ratios of the concentration of the gases listed in Table 2, which shows a code for each range of the ratios of the characteristics gases [4].

TABLE 2: CODE FOR EXAMINING ANALYSIS OF DISSOLVED GASES

Ratios of gases	Code of range of ratios		
	C_2H_2/C_2H_4	CH_4/H_2	C_2H_4/C_2H_6
<0.1	0	1	0
0.1-1	1	0	0
1-3	1	2	1
>3	2	2	2

From Table 2 as per below Table 3 fault code can be found and we can diagnose transformer fault condition.

TABLE 3: FAULT CODE

Characteristic Fault	C_2H_2/C_2H_4	CH_4/H_2	C_2H_4/C_2H_6
No fault	0	0	0
Partial discharges of low energy density	0	1	0
Partial discharges of high energy density	1	1	0
Discharges of low energy	1-2	0	1-2
Discharges of high energy	1	0	2
Thermal fault of low temp.<150°C	0	0	1
Thermal fault of low temp. range 150°C to 300°C	0	2	0
Thermal fault of medium temp.range 300°C to 700°C	0	2	1
Thermal fault of high temp.> 700°C	0	2	2

3. 4 Rogers Ratio Method [2, 5]

Four ratios are considered to detect incipient failure in the transformer. These ratios are encoded depending on their value. The combination of codes provides Rogers fault diagnostic as per below Tables 4-5.

TABLE 4: ROGERS RATIO CODES

GAS RATIO	Ranges	Codes
CH_4/H_2	<0.1	5
	0.1-1	0
	1-3	1
	>3	2
C_2H_6/ CH_4	<1	0
	>1	1
C_2H_4/ C_2H_6	<1	0
	1-3	1
	>3	2
C_2H_2/C_2H_4	<0.5	0
	0.5-3	1
	>3	2

TABLE 5: FAULT TYPES ACCORDING TO ROGERS RATIO METHOD

Sr. No.	CH_4/H_2	C_2H_6/ CH_4	C_2H_4/C_2H_6	C_2H_2/C_2H_4	Fault Type
1	0	0	0	0	No fault
2	1-2	0	0	0	<150°C thermal fault
3	1-2	1	0	0	150-200°C thermal fault
4	0	1	0	0	200-300°C thermal fault
5	0	0	1	0	General conductor overheating
6	1	0	1	0	Winding circulating currents
7	1	0	2	0	Core and tank circulating currents, overheated joints
8	5	0	0	0	Partial discharges
9	5	0	0	1-2	Partial discharges with tracking
10	0	0	0	1	Flashover without power follow through
11	0	0	1-2	1-2	Arc with power follow through
12	0	0	2	2	Continues sparking to Floating potential.

4.0 CASE STUDIES

Total 108 no's transformer tested for oil contamination and dissolved gas analysis. Out of them 3 transformer data chosen for analysis purpose. First oil contamination test is evaluated after that DGA results analyzed with Key gas method, Dual triangle method and ratio method. All the results by different DGA analysis method evaluated.

4.1 Case Study No-1

Transformer Rating : 1.6MVA
Voltage Ratio : 33 kV/0.415kV
Commissioning Year : 2006
Test date : Feb.2011

Oil contamination Test result is shown as per below Table 6

TABLE 6: OIL CONTAMINATION TEST RESULT

BDV (kV)	48.7	**Water content (PPM)**	18
IFT (mN/m)	38	**NN (mg KOH/g)**	0.021
Resistivity (ohm-cm)	13.15	**PF at 90°C**	0.2
Flash point (°C)	156		

From above test result it is found that all other test except dissipation factor test value is found within limit. Maximum dissipation factor value at 90°C is 0.015 Max as per IS: 1866-2005. These test results indicate that the transformer oil is contaminated or deteriorated with water and other particles.

1) DGA Test result IS shown as per below Table 7.

TABLE 7: DGA TEST RESULT FOR CASE STUDY 1

Combustible Gases (ppm)

CO	1032	**C_2H_6**	45
H_2	2332	**C_2H_4**	135
CH_4	30	**C_2H_2**	150

From Table 7 shows DGA test results for case study-1. Above data is analyzed by four different DGA analyses technique Key gas method, Dual triangle method, IEC ratio method and Rogers ratio method.

Key Gas method

Total concentration of CO dissolved in the oil is 27.72 % and H_2 is 62.62%. The high percentage of H2 indicates corona in oil and high percentage of CO indicates overheated cellulose. Figure 2 Shows graphical representation of % dissolved gases concentration on the oil.

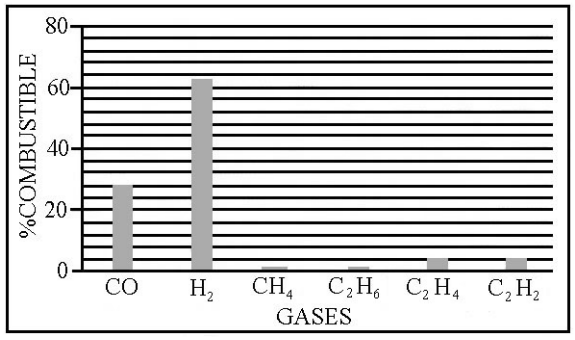


Fig.2: Dissolved Gas Concentration in Oil

Dual Triangle Method

Table 8 shows the percentage of three gases in the Dual Triangle method.

TABLE 8: COMBUSTIBLE GASES (%)

CH_4	**C_2H_2**	**C_2H_4**
9.52	42.85	47.81

After plotting these gases as a coordinate point in the Dual Triangle, the result shows that the coordination is in D_2 zone. D_2 zone indicates High energy electrical discharges (Arcing) in the transformer.

IEC Ratio Method

As per IEC ratio method concentration ratio for C_2H_2/C_2H_4 = 1.11, CH_4/H_2=0.012 and C_2H_4/ C_2H_6=3 is derived. From this results, as per Table 3, any fault Condition is not derived.

Rogers Ratio Method

According to Rogers ratio method concentration ratio for C_2H_2/C_2H_4=1.11, CH_4/H_2=0.012, C_2H_4/C_2H_6=3 and C_2H_6/CH_4=1.5 derived. From this value as per Tables 4-5 no appreciate fault condition is found. As per above four types of Dissolved gas analysis technique Key Gas method and Dual triangle method clearly indicates suspect condition in the transformer.

This transformer opened in our workshop and found mechanical winding deformation which shows clearly high energy discharge in the transformer as per below Figures 3A and 3B.

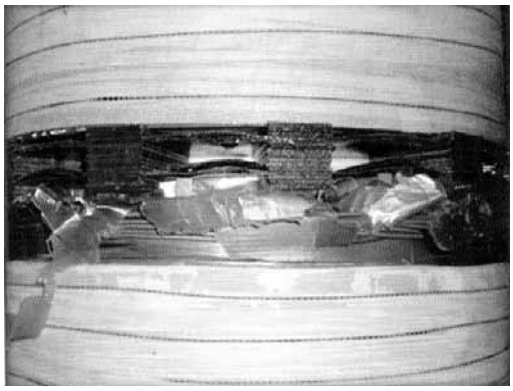


Fig.3A: High Energy Discharge in Transformer Winding

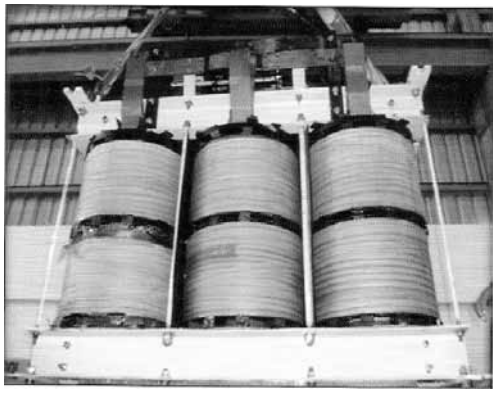


Fig.3B: High Energy Discharge in Transformer Winding

4.2 Case Study No.2

Transformer Rating : 16 MVA
Voltage Ratio : 33 kV/6.6kV
Commissioning Year : 2005
Test date : March 2011

1) Oil contamination Test result is shown as per Table 9

TABLE 9: OIL CONTAMINATION TEST RESULT

BDV(kV)	28	**Water content (PPM)**	120
IFT(mN/m)	40	**NN (mg KOH/g)**	0.066
Resistivity(ohm-cm)	15	**PF at 90°C**	0.010
Flash point (°C)	161		

From above test result it is found that all other test except BDV and water content value is found within limit. Minimum value for BDV should be 40 kV and for water content is 20 PPM as per IS: 1866-2005. The values of both dielectric breakdown and voltage and water content identify the poor condition of the insulating oil. Also the IFT points out that the oil is in suspect condition. This result indicates the contamination in the transformer oil.

2) DGA Test result is shown as per below Table 10.

TABLE 10: DGA TEST RESULT FOR CASE STUDY 2

Combustible Gases (ppm)

Co	40773	C_2H_6	6462
H_2	1049	C_2H_4	39998
CH_4	6986	C_2H_2	1476

From Table 10, shows DGA test results for case study-2. Above data is analyzed by four different DGA analyses technique Key gas method, Dual triangle method, IEC ratio method and Rogers ratio method.

Key Gas method

Total concentration of CO dissolved in the oil is 42.14, H_2 is 1.084%, CH_4 is 7.22%, C_2H_6 is 6.67%, C_2H_4 is 41.34% and C_2H_2 is 1.52%.The high percentage of CO indicates overheated cellulose, High percentage of C_2H_4 (Ethylene) indicates thermal fault in oil. Decomposition products include ethylene and methane, with small quantity of Hydrogen. Traces of acetylene may be formed if the fault is severe in nature. All over transformer condition found highly in suspect condition and its buchholz relay also operated. This transformer is taken out from service for further investigation.

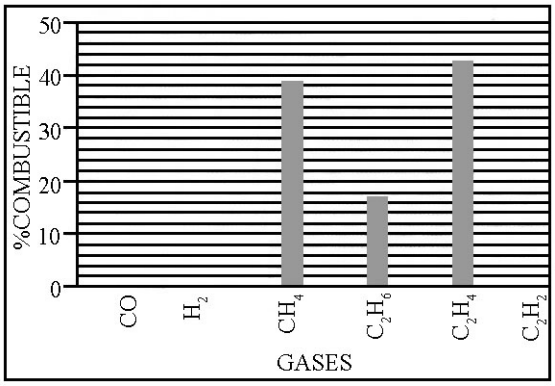


Fig.4: Dissolved Gas Concentration in Oil

Figure 4 Shows graphical representation of % dissolved gases concentration in the oil.

Dual Triangle Method

Table 11 shows the percentage of three gases in the Dual Triangle method.

TABLE 11: COMBUSTIBLE GASES (%)

CH_4	C_2H_2	C_2H_4
14.41	3.04	82.53

After plotting these gases as a coordinate point in the Dual Triangle, the result shows that the coordination is in T3 zone. T3 zone indicates Thermal Fault greater than 700°C.

IEC Ratio Method

According to the IEC ratio method concentration ratio for C_2H_2/C_2H_4=0.036, CH_4/H_2=6.65 and C_2H_4/C_2H_6 =6.l8 is derived. From this results, as per Table 3 IEC ratio method fault code derived is 0, 2, 2 which indicates thermal fault greater than 700°C.

Rogers Ratio Method

According to the Rogers ratio method concentration ratio for C_2H_2/C_2H_4 =0.036, CH_4/H_2 =6.65, C_2H_4/C_2H_6=6.l8 and C_2H_6/CH_4=0.92 derived. From this value as per Tables 4 and 5 as per Rogers ratio method no any appreciate fault code derived. As per above four types of Dissolved gas analysis technique Key Gas method, Dual triangle method and IEC ratio method clearly indicates suspect condition in the transformer. This transformer clearly indicates in suspect condition and opened in our workshop and found that metallic bolt used to hold stamping of the transformer winding got melted.

4.3 Case Study No-3:

Transformer Rating : 6.3 MVA
Voltage Ratio : 33 kV/6.6 kV
Commissioning Year : 28.5.2002
Test date : 30.09.2007

1) Oil contamination Test result is shown as per below Table 12.

TABLE 12: OIL CONTAMINATION TEST RESULT

BDV(kv)	55	**Water content (PPM)**	15
IFT(mN/m)	16	**NN(mg KOH/g)**	0.056
Resistivity (Ohm-cm)	35.9	**PF at 90°C**	0.3
Flash point (°C)	186		

From the test result it is found that all other test except Dielectric dissipation factor is found within limit. Minimum value for dielectric dissipation factor is 0.015 at 90°C as per IS: 1866-2005. The high value of dissipation factor is clearly identifying the poor condition of the insulating oil.

From Table 13 shows DGA test results for case study-3. Above data is analyzed by four different DGA analyses technique Key gas method, Dual triangle method, IEC ratio method and Rogers ratio method.

Key Gas method

Total concentration of CO dissolved in the oil is 33.23%, H_2 is 42.40%, CH_4 is 6.25%, C_2H_6 is 1.77%, C_2H_4 is 8.33% and C_2H_2 is 7.97%. The high percentage of H_2 indicates for corona in oil. Also low energy of discharge produces Hydrogen and methane with small quantity of ethane and ethylene. Comparable amount of carbon monoxide and carbon dioxide may result due to discharge in cellulose. All over transformer condition found highly in suspect condition. From above result is found that all key gases are found high. Figure 5 Shows graphical representation of % dissolved gases concentration in the oil.

2) DGA Test result is shown as per below Table 13.

TABLE 13: DGA TEST RESULT FOR CASE STUDY 3

Combustible Gases (ppm)

CO	1742	C_2H_6	93
H_2	2223	C_2H_4	438
CH_4	328	C_2H_2	418

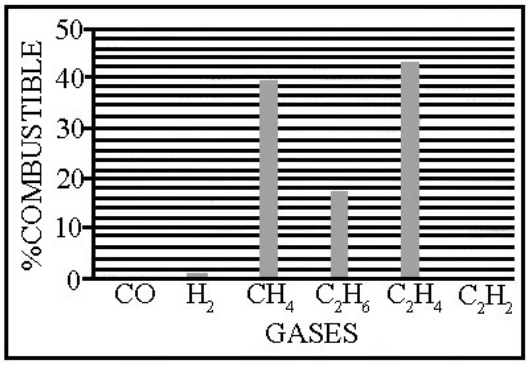


Fig.5: Dissolved Gas Concentration in Oil

Dual Triangle Method

Table 14 shows the percentage of three gases in the Dual Triangle method.

TABLE 14: COMBUSTIBLE GASES (%)

CH_4	C_2H_2	C_2H_4
27.70	36.99	35.30

After plotting these gases as a coordinate point in the Dual Triangle, the result shows that the coordination is in D2 zone. D2 zone indicates High Energy Discharge (Arcing).

IEC Ratio Method

As per IEC ratio method concentration ratio for C_2H_2/C_2H_4=0.95, CH_4/H_2=0.l4 and C_2H_4/C_2H_6=4.70 is derived. From these results, as per Table 3 IEC ratio method fault code derived is 1,0, and 2 which indicates discharge of High energy.

Rogers Ratio Method

As per Rogers ratio method concentration ratio for C_2H_2/C_2H_4=0.95, CH_4/H_2=0.14 and C_2H_4/C_2H_6=4.70 and C_2H_6/CH_6=0.28 derived. From this value as per Tables 4-5 as per Rogers ratio method 0,0,2,1 fault codes derived. And it indicates Arc fault. As per above four types of Dissolved gas analysis technique Key Gas method, Dual triangle method, IEC ratio method and Rogers ratio clearly indicates suspect condition in the transformer. This transformer clearly indicates in suspect condition and opened at their workshop and found, electrical discharges on high voltage leads inside the main tank were observed. The wooden planks used to isolate HV leads clearly show sign of electrical discharges.

4.4 Case study No-4

Transformer Rating : 617.6

Commissioning Year : 27.09.96

Test date : 20.09.97

From Table 15 shows DGA test results for case study-4. Above data is analyzed by four different DGA analyses technique Key gas method, Dual triangle method, IEC ratio method and Rogers ratio method.

TABLE 15: DGA TEST RESULT FOR CASE STUDY 4

Combustible Gases (ppm)

CO	303	**C_2H_6**	23
H_2	249	**C_2H_4**	63
CH_4	52	**C_2H_2**	91

1) Key Gas Method.

Total concentration of CO dissolved in the oil is 38.79%, H_2 is 31.88%. The high percentage of CO indicates overheated cellulose, high percentage of H_2 indicates for corona in oil. All over transformer condition found highly in suspect condition. Figure 6 Shows graphical representation of % dissolved gases concentration in the oil.

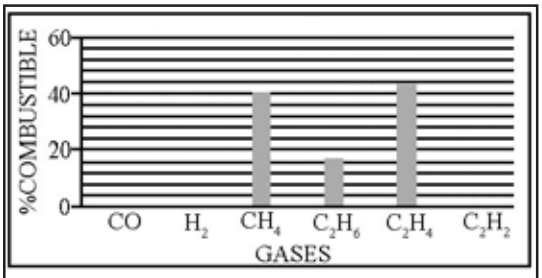


Fig.6: Dissolved gas concentration in oil

2) Dual Triangle Method

Table 16 shows the percentage of three gases in the Dual Triangle method.

TABLE 16: COMBUSTIBLE GASES (%)

CH_4	C_2H_2	C_2H_4
25.24	44.17	30.58

After plotting these gases as a coordinate point in the Dual Triangle, the result shows that the coordination is in D2 zone. D2 zone indicates High Energy Discharge (Arcing).

IEC Ratio Method

According to IEC ratio method concentration ratio for C_2H_2/C_2H_4=1.44, CH_4/H_2=0.2 and C_2H_4/C_2H_6=2.73 is derived. From this result, as per Table 3 IEC ratio method fault code derived is 1, 0, and 2 which indicates discharge of High energy.

Rogers Ratio Method

As per Rogers ratio method concentration ratio for C_2H_2/C_2H_4 =1.44, CH_4/H_2 =0.2, C_2H_4/C_2H_6=2.73 and C_2H_6/CH_4=0.44 derived. From this value as per Tables 4-5 as per Rogers ratio method 0,0,1,1 fault codes derived. And it indicates Arc fault. As per above four types of Dissolved gas analysis technique Key Gas method, Dual triangle method, IEC ratio method AND Rogers Ratio method clearly indicates suspect condition in the transformer. This transformer clearly indicates in suspect condition and opened at workshop and found damage to the insulation and deposition of carbon on one of the leads were found.

Everyone thinks of changing the World, but no one thinks of changing himself. - **LEO TOISTOY**

4.5 Case study No-5

Transformer Rating : 35 MVA

Commissioning Year : 07.09.92

Test date : 01.03.94

From above Table 16 show DGA test results for case study-5. Above data is analyzed by four different DGA analyses technique Key gas method, Dual triangle method, IEC ratio method and Rogers ratio method.

Key Gas Method

Total concentration of C_2H_4 is found 42.93% which is somewhat higher, the high percentage of C_2H_4 (Ethylene) indicates thermal fault in oil. Decomposition products include ethylene and methane, with small quantity of Hydrogen. Traces of acetylene may be formed if the fault is severe in nature. All over transformer condition found highly in suspect condition. Figure 7 represents Graphical concentration of Dissolved gases in oil.

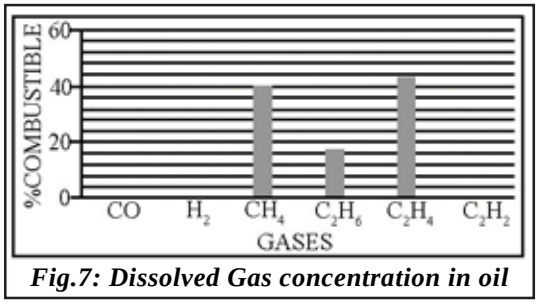


Fig.7: Dissolved Gas concentration in oil

Dual Triangle Method

TABLE 17: DGA TEST RESULT FOR CASE STUDY 5

Combustible Gases(ppm)

CO	0	**C_2H_6**	33
H_2	1	**C_2H_4**	82
CH_4	75	**C_2H_2**	0

TABLE 18: COMBUSTIBLE GASES (%)

CH_4	C_2H_2	C_2H_4
47.77	0	52.29

Table 17 and 18 show the percentage of three gases in the Dual Triangle method. After plotting these gases as a coordinate point in the Dual Triangle, the result shows that the coordination is in T2 zone. T2 zone indicates Thermal Fault between 300°C and 700°C.

IEC Ratio Method

As per IEC ratio method concentration ratio for C_2H_2/C_2H_4 = 0, CH_4/H_2=83.33 and C_2H_4/C_2H_6 = 2.48 is derived. From this results, as per Table 3 IEC ratio method fault code derived is 0,2,1 which indicates thermal fault of medium temp range 300°C to 700°C.

Rogers Ratio Method

As per Rogers ratio method concentration ratio for C_2H_2/C_2H_4 = 0, CH_4/H_2 = 83.33, C_2H_4/C_2H_6=2.48 and C_2H_6/CH_4=0.44 derived. From this value as per Tables 5-6 as per Rogers ratio method no any appreciate fault code has derived. As per above four types of Dissolved gas analysis technique Key Gas method, Dual triangle method and IEC ratio method clearly indicates suspect condition in the transformer. Whereas as per Rogers ratio method no any appreciate conclusion derived.

This transformer clearly indicates in suspect condition and opened at workshop and found thermal fault of medium temperature range at an early stage in a power transformer. Here though key gases are on the border, analyses was confirmed after opening the transformer by observing overheating on one of the insulated joints in HV busbar connection towards R phase bushing of transformer, probably due to loose connection.

5.0 CONCLUSION

DGA is power fool tool for predicting of transformer incipient fault at early stages. Transformer insulating oil is analyzed for prediction of transformer incipient fault at early stages. From that condition of power transformer is accomplished by two main methods. Oil contamination test indicates whether oil is contaminated or deteriorated. In oil contamination test dielectric strength, IFT, acidity, water content, resistivity and dissipation factor test performed. After that DGA results analyzed by four different methods like Key gas method, Dual triangle method, IEC ratio method and Rogers ratio method. All methods result verified with actual transformer condition. For case study no-l and 2 no any conclusion derived from Rogers ratio method but Dual triangle method and Key gas method conclusion is achieved. Also no any conclusion derived from IEC ratio method for case study no 1. Total 108 no's transformer DGA tested for research work out of them 3 case study chosen as these DGA results indicate suspect condition of transformer. After opening in workshop, four type of DGA method is verified by actual transformer fault. The key gas technique is used primarily to predict a specific problem such as overheated oil, overheated cellulose, corona in oil, and arcing in oil. The Dual triangle method, IEC ratio method, and Rogers ratio method is then applied to verify the fault; partial discharge, thermal and electrical faults. In all cases it is found that Dual triangle method give useful information for transformer insulation system. Also two case study taken from another industries for verify older results with Key gas method, Dual triangle method, IEC ratio method and Rogers ratio method, in these two case IEC ratio method and Dual triangle method provides more accurate results.

Courtesy: Dipak Mehta and Hitesh Jariwala, CPRI Journal, December, 2012

INSTITUTE FOR DESIGN OF ELECTRICAL MEASURING INSTRUMENTS

IDEMI is an Organization established by the Government of India in the year 1969 as a service to Instrument Industry Organisation. The main objective of setting up this Institute was to gear up the growth potential of indigenous instrument industry and hence to meet the ever growing instrumentation needs of the country by augmenting productivity quality control in industrial sector – be it in Electrical, Electronics or Process Control Instruments. The Institute is looked upon a nodal centre in view of its multifarious activities offered to suit various needs of instrument industry. The Institute offers following services to the Instrument Industry.

- Technical Consultancy in various aspects of Instrumentation.
- Industry sponsored projects in the Design & Development of Electrical, Electronic & Process Control Instruments & Transducers. Know how available may be transferred to interested party either exclusive or non-exclusive basis.
- Calibration and Testing of Electrical, Electronic and Process Control Instruments, Sensors, Transducers & Electrically Operated Domestic appliances.
- Calibration of Mechanical Measuring Instruments & Inspection of Mechanical Products & Components.
- Technical Training for wide range of professionals in numerous disciplines of Instrumentation.
- Design & Manufacturing of Press Tools for sheet metal components, Plastic Moulding Tools, Forging Tools, Pressure Die Casting Tools, Jigs & Fixtures
- Manufacturing of critical mechanical components and maintenance spare parts required for Instrument Industry. IDEMI is rendering its services through its various Laboratories, Training Department & Mechanical Workshop.

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ELECTRICAL LABORATORY

The Electrical Laboratory consists of Electrical Calibration Laboratory & Electrical Testing Laboratory. The Electrical Laboratory undertakes calibration and testing of Electrical Instruments relating to DC & AC electrical parameters like Voltage, Current, Power, Energy, Resistance, Inductance & Capacitance, Power Factor, Frequency (rpm) etc. The standards maintained in the Laboratory are traceable to National / International Standards. Besides calibration the Instruments are also Type – Tested as per BIS, BS, NEMA & IEC standards. The Lab also undertakes field calibration & testing at sites in plants, ships etc. Electrical Laboratory also undertakes testing of Domestic Appliances, Igniters, Electrical / Electronic Ballast & Electrical Relays as per relevant BIS Standards. The Laboratory has facilities to carryout Energy Audit, Harmonic Measurement, Environmental Testing & Ingress Protection (IP) testing of Instruments, Equipments, Electrical Panels & Products.

PROCESS CONTROL INSTRUMENTS LABORATORY

The Process Control Instruments Laboratory consists of Pressure Laboratory, Temperature Laboratory & Flow Laboratory. The Process Control Instruments Lab undertakes calibration and testing of Instruments relating to Pressure, Vacuum, Temperature, Force & Flow. The standards maintained in the laboratories are traceable to National / International Standards. Besides Calibration Instruments are also Type Tested as per B/S, NBS, DIN & IEC Standards. The lab also undertakes field calibration at sites, in-plants, on shore installations and drilling ships & service vassals at off shore. DIMENSIONAL METROLOGY LABORATORY Dimensional Metrology Laboratory undertakes calibration of Instruments relating to measurement of length, Torque such as Vernier Calipers, Micrometers, slip Gauges, Dial Gauges, Torque Testers etc. It also undertakes Dimensional Verification of Tools, Products, Profile contour using CMM etc. The Calibration & Testing Laboratories are well equipped meeting the National / International Standards. The Electrical & Process Control Instruments Laboratories were accredited earlier under the NCTCF program of accreditation and recently in the area of calibration under the National Accreditation Board for Calibration & Testing Laboratories (NABL) for Electro-technical, Mechanical (Pressure) & Fluid Flow Measurements.

TRAINING Department

The Training Department conducts short term courses ranging from 2 days to 1 week duration on various topics related to instrumentation. National Seminars on front-line topics on instrumentation and electrical engineering are also conducted every year. Tailor made programs are conducted exclusively catering to the requirements of customer either in the Institute or at site. The NABL/DST has also recognized IDEMI as a Regional Training Center for conducting residential courses on "Laboratory Quality System and Management", "Internal Audit for Laboratories" and "Laboratory Assessors Training". These courses are conducted in accordance with the new International Standard ISO/IEC 17025 which is the "General Requirements of Competence of Testing and Calibration Laboratories". Institute has setup CAD / CAM Training Center & conducts Training Programs in this field of duration ranging from 60-100 Hrs to 3 months for Engineering Students & Professionals.

MECHANICAL WORKSHOP

Mechanical Workshop plays a vital role in the development of Instrument Industry whether it falls under small, medium or large scale. Apart from prototype models manufacturing, Mechanical Workshop greatly caters to Industry's needs in Tool Design, Tool fabrication, Critical & Complex components production, batch production or special instrument parts in smaller quantity etc right from the inception. Mechanical Workshop has been undertaking design and fabrication of press tools, Plastic Moulding Tools, Pressure Dies Casting Tools. By accepting and undertaking jobs in Mechanical Workshop IDEMI's endeavor is mainly to help small scale sector for upliftment of their Technology Development and Manufacture of import substitutes against specific demand is also undertaken by Workshop is already equipped with most modern machine tools and some are added every year purely depending on critical needs & long term objectives.

For more details: Institute For Design Of Electrical Measuring Instruments, Mumbai
Telephone: 022-24050301-04; Email: info@idemi.org / idemi@vsnl.net

THE RENEWABLES CLUB

On the invitation of the German Environment Minister Peter Altmaier, high-level representatives from 10 countries have gathered in Berlin to establish the Renewables Club on June 1st, 2013. Their common goal is to scale up the deployment of renewable energy worldwide. Founding members of this pro-renewable alliance are China, Denmark, France, Germany, India, Morocco, South Africa, Tonga (as a representative of small and medium-sized island nations), United Arab Emirates, United Kingdom, and the Director-General of the International Renewable Energy Agency (IRENA).

Renewable energy is not only a good way of combating climate change, it also contributes to prosperity and supply security throughout the world," said Altmaier. "Especially at a time of growing energy demand, this is the attraction of renewable energy for countries all over the world."

The Club members agreed to unite in putting renewable energy on the political agenda in the future. At the next UN climate conference, the Club plans to jointly present the advantages of renewable energy for prosperity, climate, and sustainable development. As a network and driver of ideas, the Club also aims to generate impetus for projects promoting the global transformation of the energy system.

Courtesy: Clean Technica

GUJARAT'S SPRAWLING SOLAR FIELDS OUTPOWER REST OF INDIA, CHINA

Gujarat's Charanka village in Patan, over 2,965 acres, rows of photovoltaic cells or solar panels have been laid out to harness the sun. It generates 214 MW of electricity every day-more than China's 200 MW Golmund Solar Park.

The Gujarat Government claims that nearly 17 private and state companies have pumped Rs 9,000 crore as investments in this park. Apart from Charanka, solar parks are present across 13 districts and spread over 2,375 acres, most of which is vast stretches of non-arable land. Almost 84 developers have joined hands to construct solar power plants of 1 to 40 MW capacities in these places.

The impact of these projects seems to be showing. "The main solar drivers in India have been the Gujarat solar policy and the National Solar Mission (NSM). Projects under these two policies account for 80% of India's installed capacity until October 2011," claims Tobias Engelmeier, MD of Bridge to India (BTI).

Courtesy: Ieema Journal, May 2013

The real problem is not whether machines think but whether men do.–B. F. SKINNER Contingencies of Reinforcement, 1969

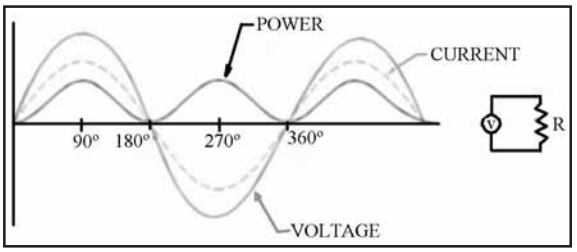
POWER FACTOR CORRECTION IN HARMONIC ENVIRONMENT

The **power factor** of an AC electrical power system is defined as the ratio of the real power flowing to the load to the apparent power in the circuit and is a dimensionless number or a factor between 0 and 1. Or the ratio between the current that delivers power, i.e. in phase with the voltage and the total current flowing in the circuit. Due to the energy stored in the load and returned to the source, or due to a non-linear load that distorts the wave shape of the current drawn from the source, the apparent power is greater than the real power.

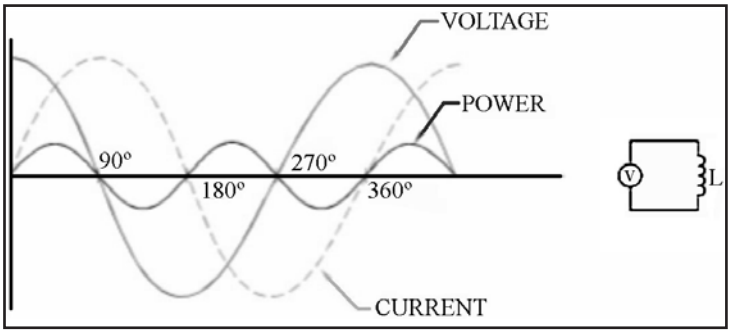
A load with a low power factor draws more current than a load with a higher power factor for the same amount of useful power delivered. The higher current increases the energy lost in the distribution system by way of I^2R loss, and require bigger cables and other equipment like transformers, switch gears and generators. Because of the costs of larger equipment and wasted energy, electrical utilities charges for the apparent power demand, i.e. kVA demand and levies a penalty for a lower power factor for industrial or commercial customers.

Linear loads with low power factor, such as induction motors, can be corrected with a passive network of capacitors or inductors. Non-linear loads, such as rectifiers, distort the current drawn from the system. In such cases, active or passive power factor correction may be used to counteract the distortion and raise the power factor. The devices for correction of the power factor may be at a central substation, spread out over a distribution system, or built into power-consuming equipment.

Power factor correction of linear loads



Power factor correction brings the power factor of an AC power circuit closer to 1 by supplying reactive power of opposite sign, adding capacitors or inductors that act to cancel the inductive or capacitive effects of the load, respectively. For example, the inductive effect of motor loads may be offset by connecting capacitors. If a load had a capacitive value, inductors, also known as *reactors*, are connected to correct the power factor. In the electrical power systems, inductors are said to *consume* reactive power and capacitors are said to *supply* it, even though the energy is just moving back and forth on each AC cycle.



In Diagram above, a purely resistive load, like an incandescent light source or a resistive heater, the current is in phase with the voltage. The power is always positive. Power is always being dissipated by the resistive load.

In Diagram above, a purely inductive load, the current lags the voltage by 90 degrees. Power alternates equally between cycles of positive and negative. This means that the power is being alternately absorbed and returned to the source. If the power source is a mechanical generator, it would take almost no net mechanical energy to turn the shaft because no power would be utilized by the load.

Non linear loads

Impact of Power Factor Correction Capacitors on Power Quality

Despite the significant benefits that can be realized using power factor correction capacitors, there are a number of power quality-related problems that should be addressed before capacitors are installed. Potential problems are: resonance, increased harmonic distortion and transient over voltages.

A more serious condition, with potential for substantial damage, occurs as a result of harmonic resonance. Resonant conditions are created when the inductive and capacitive reactances become equal in an electrical system. Resonance in a power system may be classified as series or parallel resonance, depending on the configuration of the resonance circuit. Series resonance produces voltage amplification and parallel resonance causes current multiplication within an electrical system. In a harmonic rich environment, both types of resonance are present. During resonant conditions, if the amplitude of the offending frequency is large, considerable damage to capacitor banks would result. And, there is a high probability that other electrical equipment on the system would also be damaged.

Harmonic Distortion:

Generally, the harmonic impedances are low enough that excessive distortion levels do not occur. However, power factor correction capacitors can significantly alter this impedance and create what is known as a “resonance” condition. High voltage distortion can occur if the resonant frequency is near one of the harmonic currents produced

by the nonlinear loads. A harmonic resonance exhibits as device overheating, frequent circuit breaker tripping, unexplained fuse operation, capacitor failures, and electronic equipment malfunction. The capacitor size can be changed to avoid a harmful resonance point (e.g., 5th, 7th), altering the size of the nonlinear loads, adding reactors to the power factor correction capacitors to configure them as harmonic filters.

Transient Over voltages:

Transient over voltages can be caused by a number of power system switching events; however, utility capacitor switching often receives special attention due to the impact on customer equipment. Each time a utility switches a capacitor bank a transient overvoltage occurs. Generally, these overvoltages are low enough that they do not affect the system. However, high overvoltages can occur when customers have power factor correction capacitors. This phenomenon is often referred to as "voltage magnification". Magnification occurs when the transient oscillation initiated by the utility capacitor switching excites a resonance formed by a step-down transformer and low voltage power factor correction capacitors. Magnified over voltages can be quite severe and the energy associated with these events can be damaging to power electronic equipment and surge protective devices (e.g., transient voltage surge suppressors). Adjustable-speed drives have been found to be especially susceptible to these transients and nuisance tripping can result even when overvoltage levels are not severe.

A non-linear load of a power system is typically rectifiers, variable frequency drives, switched power supplies, arc discharge devices such as a fluorescent lamp, electric welding machine, or arc furnace. Because current in these systems is interrupted by a switching action, the current is distorted and contains frequency components that are multiples of the power system frequency.

Sinusoidal voltage and non-sinusoidal current give a distortion power factor of 0.75 for a computer power supply load. Distortion power factor is a measure of how much the harmonic distortion of a load current decreases the average power transferred to the load.

Displacement power factor

Non-linear loads change the shape of the current waveform from a sine wave to some other form. These create harmonic currents in addition to the original (fundamental frequency) AC current. In linear circuits having only sinusoidal currents and voltages of one frequency, the power factor arises only from the phase difference between the current and voltage. This is "displacement power factor".

Distortion power factor

The *distortion power factor* describes how the harmonic distortion of a load current decreases the average power transferred to the load.

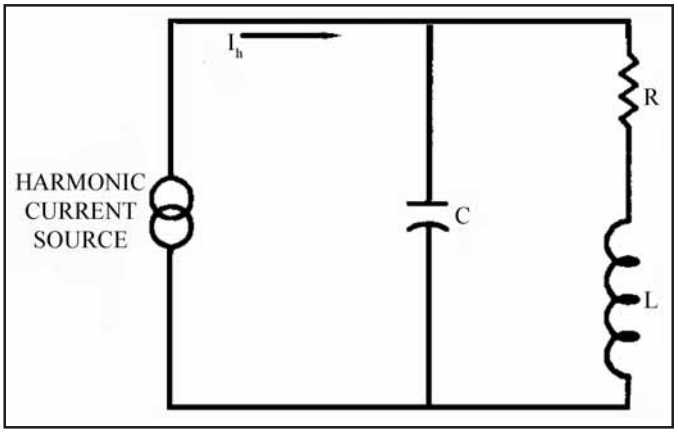
$$\text{distortion power factor} = \frac{1}{\sqrt{1 + THD_i^{\,2}}} = \frac{I_{1,\,\text{rms}}}{I_{rms}}$$

THD_i is the total harmonic distortion of the load current. This definition assumes that the voltage stays undistorted (sinusoidal, without harmonics). This simplification is often a good approximation in practice. $I_{1,\,\text{rms}}$ is the fundamental component of the current and I_{rms} is the total current- both are root mean square-values.

The result when multiplied with the displacement power factor (DPF) is the overall, true power factor or just power factor (PF):

$$\text{PF} = \text{DPF}\,\frac{I_{1,\,rms}}{I_{rms}}$$

Capacitors and resonance:



Since the capacitive (X_C) and inductive (X_L) reactances are frequency dependent, as frequency increases, X_C decreases and X_L increases; there is a frequency at which these two reactances will become equal; this frequency is called the system's natural resonant frequency.

At this frequency, the system's impedance appears to the harmonic source to be very large, therefore, a harmonic current at the resonant frequency flowing through this impedance will result in a very large harmonic voltage as per Ohm's Law ($V_h=I_hZ_h$)

A large harmonic voltage will in turn result in a much larger harmonic current exchange between the capacitor bank and the system impedance This secondary harmonic current may be many orders of magnitude larger than the generated harmonic current, resulting in nuisance operation of circuit breakers or fuses that happen to be in the path of this current. The degree of magnification is determined by the system resistance.

Since the generated harmonic current is considered to be constant for a given frequency, then the harmonic voltage will be proportional to the impedance. Consequently, the frequency response of the impedance is a good indication of the system's susceptibility to harmonic resonance.

$$h=\sqrt{\frac{KVA_{sc}}{KVAR}}$$

Where, h = harmonic order

$$KVA_{SC} = \frac{KVA}{Z_{pu}}$$

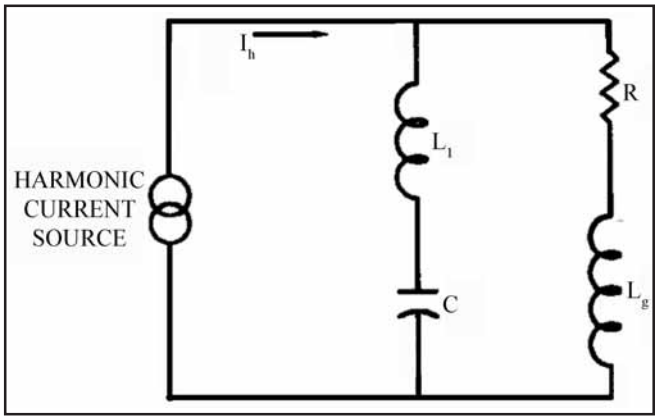
KVA_{sc} : available short circuit at point of capacitor bank installation

KVAR =capacitor bank size

This calculation, even though it does not take into account upstream system impedance, is reasonably accurate for most applications since the bulk of the impedance is contributed by the transformer itself.

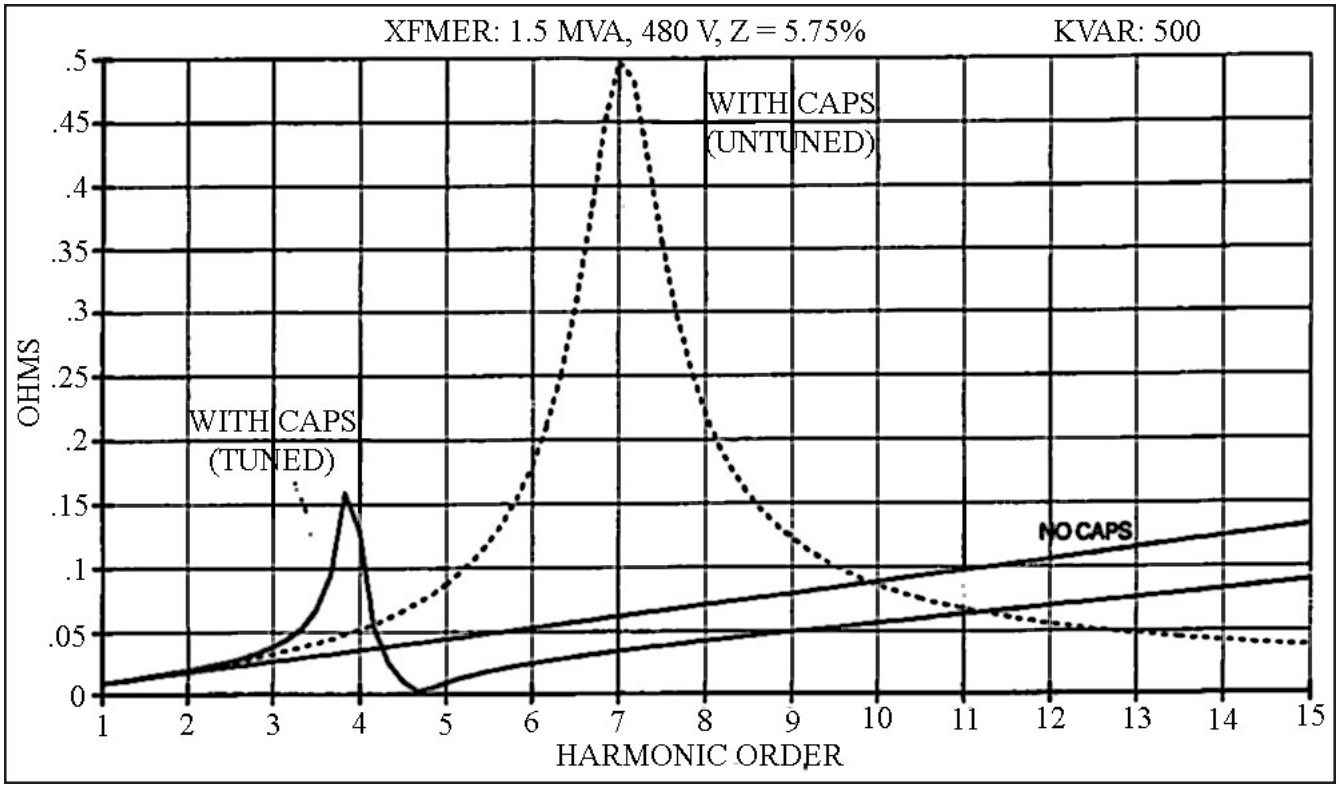
Detuning the Circuit

The most effective solution to this problem consists of series tuning the capacitor bank to the lowest offending harmonic, usually the 5th. This is done by introducing an inductor in series with the capacitor as shown in figure 5.



The impedance versus frequency plot, as seen by the harmonic source, is shown in figure below; the original impedance response (unturned) is shown for comparison.

The minimum impedance occurs at the series resonant point, the 4.7th harmonic, while the peak represents a parallel resonance due to the capacitor and the two inductors. Harmonic currents generated at or near the series resonant frequency (such as the 5th) will flow to the trap harmlessly, provided the capacitor and reactor are sized properly to withstand the additional stresses. These currents are simply following the path of least impedance. The system will not resonate above this frequency since it is inductive.



This approach will accomplish two objectives: system power factor is corrected and harmonic voltage distortion is reduced, Harmonic voltage (V_h) is the result of a harmonic current (I_h) flowing through the system impedance (Z_h), i.e. Ohm's Law ($V_h = I_h Z_h$)- By reducing the system impedance (Z_h) we can reduce the harmonic voltage (V_h) even though the harmonic current (I_h) remains the same.

For example, if the plant has a 1,500 kVA transformer with 5.5 % impedance and the short circuit rating of the utility is 48,000 kVA then kVA (sys) would be equal to 17,391 kVA.

If 350 kVAr of capacitors were used to improve power factor, the resonant harmonic order would be:

$$h = \sqrt{\frac{17,391}{350}} = \sqrt{49.7} = 7.0$$

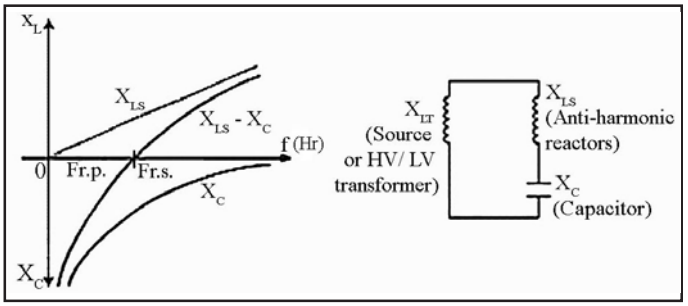
Because h falls right on the 7th harmonic, these capacitors could create a harmful resonance condition if non-linear devices were present in the factory. In this case the capacitors should be applied only as *harmonic filtering assemblies*.

When the main objective is to reduce harmonic distortion, consider the use of more filter stages, each tuned to the next higher harmonic (7th, 11th, etc). In some cases, where harmonic currents are excessive, the use of capacitors rated at the next higher voltage may be required.

In power systems with a high level of harmonic interference, installing an anti-harmonic reactors connected in series with the capacitor proves to be the only effective solution.

The anti-harmonic reactors have two purposes:

- To increase the impedance of the capacitor against harmonic currents
- To shift the parallel resonance frequency (Fr.p.) of the source and the capacitor to below the main frequencies of the interfering harmonic currents.
    * For frequencies below Fr.s., the reactors/capacitor system behaves like a capacitance and compensates for the reactive energy.
    * For frequencies above Fr.s., the reactors/capacitor system behaves like an inductance which, in parallel with the inductance LT, cancels any risk of parallel resonance at frequencies above Fr.s., particularly at the main harmonic frequencies.



Generally a 7% reactor is connected in series to the medium voltage power factor capacitor banks in the industries; this serves the following two purposes:

1. Shifts resonance frequency away for this combination
2. Limits the switching inrush current of the capacitor bank

Caution: the voltage drop across the capacitor will increase by this percentage and hence a capacitor rated for a higher voltage has to be employed.

For the idle service power factor correction of distribution transformers, the capacitance to be connected across the secondary terminals is to be 50% of the percentage impedance multiplied by the kVA rating of the transformer

The effects of harmonic resonance in extensive cable networks:

The effects of harmonic resonance between the supply impedance and power factor correction capacitors on systems with large harmonic sources are well known. The similar effects of resonance with cable capacitance are not commonly encountered and, hence, are not always considered in the design of medium voltage networks.

The harmonics generated by large semi-conductor drives may excite the resonance between the power factor correction capacitors and inductance of the supply. This will have the effect of amplifying the generated harmonics, resulting in lower efficiencies of operating equipment and the possible damage to equipment, especially to the capacitors themselves. These problems are well documented and designers of electrical power systems are cognizant of these difficulties and will usually install power factor correction in the form of harmonic filters in presence of large converter drives.

The effects of resonance with cable capacitance is not as well documented since it is encountered less frequently and because the effects are either not always noted or not traced to the converter drive as the source of the problem. In installations such as mine winders with huge dc motors with rectifier supplies where harmonics are quite appreciable and also involving long distance cables, this aspect has to be thoroughly examined in the installation stage itself.

Conclusion:

The increasing use of non-linear loads in industry means that the effects of the harmonics generated, particularly in the presence of system capacitance, need to be considered. This aspect should be investigated by means of harmonic simulation at the design stage of new projects. Where the non-linear loads on an existing facility are increased, the measurement of the harmonic conditions, followed by harmonic simulation is recommended. Clearly, the possibility of resonance affecting a system that includes non-linear loads increases with the presence of any significant capacitance, whether as part of power factor correction equipment or an extensive cable network.

Courtesy: K.R. Govindan, Kavoori Consultants

All of the biggest technological inventions created by man - the airplane, the automobile, the computer - says little about his intelligence, but speaks volumes about his laziness. - **MARK KENNEDY**

PRODUCT OF THE MONTH

SOLAR SYSTEM ANALYZER FROM MECO

Models: 9018

Features: I-V Curve Test for Solar System Max. Solar System Power (Pmax) search by Auto Scan Capability: 1000V and 12A Max. Voltage (Vmaxp) and (Vopen), Current at Short Circuit (Ishort) Temperature Measurement of Solar Panels, Irradiance measurement of Sunlight and series resistance (Rs) calculation of Solar Panels Real time data logging with Built-in Calendar Clock Efficiency (%) Calculation of Solar Panel with Parameters Entry Conversion of I-V Curve under OPC to Data under Standard Test Condition (STC) Test Reports with Optional Power Clamp (Solar 15 and solar 21) Measure / Record DC Power Output of Solar System and AC Power Output of Inverter (1 Phase or Balanced # Phase); Calculate efficiency of DC to Ac Power conversion and Max. Power Rechargeable Lithium Battery, Low Battery Warning USB Cable for PC

For More Details: http://www.mecoinst.com/meco-product-details/Solar-System-Analyzer.aspx

NEW METTUR THERMAL UNIT MAY MITIGATE POWER CRISIS

The 600-MW single unit of Stage-III reaches full load

The power-deficit State may soon get some relief. The new 600-MW single unit of Stage-III of the Mettur Thermal Power Station (MTPS) reached its full load here after a successful trial run.

Officials said the plant was able to generate power to its full capacity continuously for three days from Thursday to Saturday. Maintenance works would be carried out for the next 45 days and would be handed over to Tangedco for commissioning. It will then attain the state of COD (Commercial Operation Declaration) and 600 MW power would be available for commercial purpose, said a senior engineer.

The trial run went on for the past three months and all complications were sorted out. "The commissioning date has to be decided by Chief Minister," he said.

The plant was built by BGR Energy Systems Limited, Chennai, at a cost of Rs. 3,550 crore with equipment from China.

It ran into rough weather due to technical snags and initial hiccups in the use of furnace oil. This delayed the trial run for the past one year. After rectifying the problems, the trial run began and the plant was able to constantly improve power production and finally reached its full capacity.

The unit was synchronized on May 2012 and it touched its full load on October 2012. As the plant requires 10,500 tonnes of coal per day officials are gearing up to stock adequate coal for operating the plant after commissioning.

Currently, 840 MW power was generated from the four units in Stage-I and II that were commissioned between 1987 and 1990.

Courtesy: The Hindu, dt: 27/5/2013

STRONG CONTRIBUTIONS FROM UTILITY- BASED PROJECTS AND RENEWABLE PORTFOLIO STANDARDS TO DRIVE 2014 US SOLAR PV ABOVE 5 GW

Santa Clara, Calif. (June 3, 2013) — Demand for solar photovoltaic (PV) panels in the US is forecast to grow significantly during 2013 and post another record high of 4.3 gigawatts (GW), an increase of almost 20% compared to 2012, according to the latest NPD Solarbuzz ***North America PV Markets Quarterly*****.** Solar PV demand from the US market now contributes over 12% of annual global demand, compared to just 5% three years ago.

Demand in Q2'13 is forecast to reach 1 GW, with over 70% coming from California, Arizona, New Jersey, and North Carolina. Residential and small commercial rooftop PV installations will account for 18% of this demand, with another 14% from large commercial rooftops. The utility-dominated ground-mount segment will account for the remaining 68% of new PV demand this quarter.

Large utility-based solar PV projects in Arizona, California, New Mexico, and Texas will drive US demand above 2.5 GW during the second half of 2013. Strong year-end contributions will also come from Hawaii, Massachusetts, Nevada, New York, North Carolina, and Ohio. PV demand from the US is forecast to exceed 5 GW in 2014, representing a 70% compound annual growth rate since 2009.

"The strong commercial and utility-based solar PV being deployed in the US is stimulated by state specific mandates that require solar to meet target levels, or carve-outs, of total energy production," explained Chris Sunsong, analyst at NPD Solarbuzz. "Meanwhile, residential demand is being driven by new third-party ownership models that allow homeowners and businesses to install PV systems with minimal upfront commitments."

Courtesy : Solarbuzz

OTIS INDIA LAUNCHES NEW COMPACT ELEVATOR

Otis India, a subsidiary of Otis Elevator Company, a unit of United Technologies Corp., today announced a new, environmentally friendly, space-saving elevator system for low- and mid-rise buildings in India. The Gen2® Nova elevator from Otis India is the first in the country to address this rapidly growing sector and enables building developers and owners to manage their properties more economically.

Otis' Gen2 Nova elevator system incorporates ReGen™ drives to reduce energy consumption by up to 75 percent compared to conventional systems with non-regenerative drives. ReGen drives from Otis capture energy generated by the elevator during braking and deliver it back to the building for use by other systems. In addition, the Gen2 Nova elevator utilizes Otis' patented, polyurethane-coated steel belts. Flexible belts make the Nova machine 70 percent smaller than conventional geared machines and require no additional lubrication. A more compact, energy-efficient machine also frees up valuable building space and reduces operating costs.

Best-suited for buildings that are up to 60 metres (approximately 18 storeys) in height, the Gen2 Nova elevator from Otis will accommodate passenger capacities from five to up to 13 passengers. Designed with passengers in mind, the Gen2 Nova was engineered to be exceptionally quiet and dramatically minimize noise and vibration. In addition, a Pulse™ monitoring system from Otis automatically checks the elevator belts for any problems 24/7. This reduces downtime required for inspection and ensures the integrity of the flat, Gen2 Nova belts.

"Introducing the energy-efficient Gen2 Nova elevator system is an important step in Otis' ongoing efforts to preserve resources for future generations," Sebi continued. "Every installation will help advance India, and our company, on The Way To Green." A major global environmental program, The Way to Green™, spans every aspect of Otis operations globally, from design and manufacturing to products and end-of-life recycling.

Otis products can be found in landmark structures in India, such as Kohinoor Square, one of India's tallest office buildings in Mumbai, and Kohinoor Hospital, the first hospital in Asia, and only the second hospital in the world, to be awarded LEED Platinum certification.

INDIAN POWER SECTOR GAINING GROUND IN SOUTH AFRICA, SAYS Mr. SANJEEV SARDANA, CHAIRMAN, ELECRAMA – 2014

The Indian power sector is gaining ground in South Africa, where it hoping to secure at least five per cent of global exports currently dominated by European exporters by 2020, said Mr Sanjeev Sardana, Chairman, ELECRAMA- 2014 organized by Indian Electrical and Electronics Manufacturers' Association, led a delegation to the two-day 15th Power and Electricity World Africa 2013 expo. Indian companies were out in force at as they try to boost the annual $2.5 billion exports to the African continent. Expo consult India and Confederation of Indian Industry (CII) with the support of the Ministry of Commerce and Industry arranged the Indian Pavilion at the expo.

As many as 39 Indian companies participated in the areas of electrical equipment, power generation, transmission lines and parts and renewable energy. Sardana said of the $4.5 billion exported from the power sector by India each year, $2.5 billion was to Africa. "There is great interest from our members to come to Africa not only to sell their products but also to find technology partners where they can talk about doing technology transfer," Sardana added.

"Africa spends about $93 billion a year on power sector reform, about 50 percent of this in transmission and distribution, which is what we are all primarily here for." The market in South Africa has been dominated by European players, but now Indian companies are also getting a foothold because a lot of our members have gained approval from the South African Bureau of Standards with certification to international standards." Sardana said his organisation was confident of success in South Africa, setting a target of achieving at least five per cent of the global share by 2020.

Courtesy: IEEMA Journal, May 2013

***Let us be good stewards of the Earth we inherited. All of us have to share the Earth's fragile ecosystems and precious resources, and each of us has a role to play in preserving them. If we are to go on living together on this earth, we must all be responsible for it.* – KOFI ANNAN**

HELP LINE

Query: ***What are numerical relays, how they differ from normal relays?***

Explanation: These are microprocessor-based relays in contrast to other relays that are electromechanically controlled. These relays provide great precision and convenience in application in the sophisticated electronic products. By combining several functions in one case, numerical relays also save capital cost and maintenance cost over electromechanical relays.

The first protection devices based on microprocessors were employed in 1985. The widespread acceptance of numerical technology by the customer and the experiences of the user helped in developing the second generation numerical relays in 1990.

Conventional electromechanical and static relays are hard wired relays. Their wiring is fixed, only their setting can be manually changed.

Numeric relays are programmable relays characteristics and behavior of the relay can be programmed. First generation numerical relays were mainly designed to meet the static relay protection characteristic, whereas modern numeric protection devices are capable of providing ***complete protection with added functions like control and monitoring***.

Working Principles: The input analogue signals are converted into a digital representation and processed according to the appropriate mathematical algorithm. Processing is carried out using a specialized microprocessor that is optimized for signal processing applications, known as a digital signal processor or DSP for short. Digital processing of signals in real time requires very high processing speeds for the microprocessor.

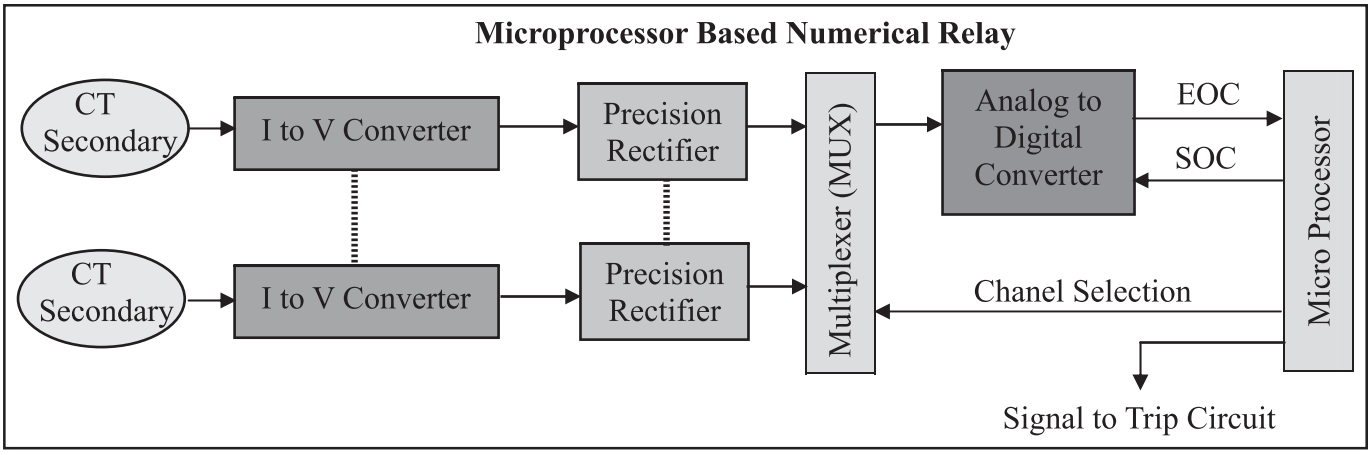
Function of Relay: First generation numerical relays were mainly designed to meet the static relay protection characteristic, whereas Modern power system protection devices are built with integrated functions. Multifunction like protection, control, monitoring and measuring are available today in numeric power system protection devices. Also, the communication capability of these devices facilitates remote control, monitoring and data transfer.

Numerical Relay

Numerical relays are micro processor based relays and having the features of recording of parameter used as disturbance recorder flexibility of setting & alarms & can be used one relay for all type of protections of one equipment hence less area is required. Wide Range of setting, more accurate, Low burden hence low VA of CT is required which minimize the cost. Numeric relays take the input analog quantities and convert them to numeric values. All of the relaying functions are performed on these numeric values.

Operation of Relay: A current signal from CT is converted into proportional voltage signal using I to V converter. The AC voltage proportional to load current is converted into DC using precision rectifier and is given to multiplexer (MUX) which accepts more than one input and gives one output.

Microprocessor sends command signal to the multiplexer to switch on desired channel to accept rectified voltage proportional to current in a desired circuit.



Output of Multiplexer is fed to analog to digital converter (ADC) to obtain signal in digital form. Microprocessor then sends a signal ADC for start of conversion (SOC), examines whether the conversion is completed and on receipt of end of conversion (EOC) from ADC, receives the data in digital form. The microprocessor then compares the data with pick-up value. If the input is greater than pick-up value the microprocessor send a trip signal to circuit breaker of the desired circuit.

Incase of instantaneous over current relay there is no intentional time delay and circuit breaker trips instantly. In case of normal inverse, very inverse, extremely inverse and long inverse over current relay the inverse current-time characteristics are stored in the memory of microprocessor in tabular form called as look-up table.

Advantages of Numerical relays:

Compact Size: Electromechanical Relay makes use of mechanical comparison devices, which cause the main reason for the bulky size of relays. It uses a flag system for the indication purpose whether the relay has been activated or not. While Numerical Relay is in Compact Size and use Indication on LCD for Relay activation.

Digital protection can be physically smaller, and almost always requires less panel wiring than equivalent functions implemented using analog technology.

Flexibility: A variety of protection functions can be accomplished with suitable modifications in the software only either with the same hardware or with slight modifications in the hardware.

Reliability: A significant improvement in the relay reliability is obtained because the use of fewer components results in less interconnections and reduced component failures.

Multi Function Capability: Traditional electromechanical and static protection relays offers single-function and single characteristics. Range of operation of electromechanical relays is narrow as compared to numerical relay.

Different types of relay characteristics: It is possible to provide better matching of protection characteristics since these characteristics are stored in the memory of the microprocessor.

Digital communication capabilities: The microprocessor based relay furnishes easy interface with digital communication equipments. Fibre optical communication with substation LAN

Modular frame: The relay hardware consists of standard modules resulting in ease of service.

Low burden: The microprocessor based relays have minimum burden on the instrument transformers.

Sensitivity: Greater sensitivity and high pickup ratio.

Speed: With static relays, tripping time of ½ cycle or even less can be obtained.

Fast Resetting: Resetting is less.

Data History: Availability of fault data and disturbance record. Helps analysis of faults by recording details of (1) Nature of fault, (2) Magnitude of fault level, (3) Breaker problem, (4) C.T. saturation , (5) Duration of fault.

Auto Resetting & Self Diagnosis: Electromechanical relay do not have the ability to detect whether the normal condition has been attained once it is activated thus auto resetting is not possible and it has to be done by the operating personnel while in Numerical Relay auto Resetting is Possible

By combining several functions in one case, numerical relays also save capital cost and maintenance cost over electromechanical relays

Separate connection is not required, zero sequence voltages and currents can be derived inside the processor

Basic hardware is shared between multiple functions, the cost of individual protection functions can be reduced significantly.

Limitations of Numerical Relay:

Numerical Relay offers more functionality, and greater precision. Unfortunately, that does not necessarily translate into better protection.

Numerical Relay can make faster decisions. However, in the real world, faster protection itself is of no value because circuit breakers are still required to interrupt at the direction of the protective equipment, and the ability to make circuit breakers interrupt faster is very limited.

Numerical Relay protection often relies on non-proprietary software, exposing the system to potential risk of hacking.

Numerical Relay protection sometimes has exposure to externally-sourced transient interference that would not affect conventional technology.

Numerical Relay protection shares common functions. This means that there are common failure modes that can affect multiple elements of protection. For example, failure of a power supply or an input signal processor may disable an entire protective device that provides many different protection functions

Courtesy: *http://electrical-engineering-portal.com/flexibility-and-reliability-of-numerical-protection-relay*

Image Courtesy : ABB

CHENNAI TO HOST INDIA'S LARGEST AND BRIGHTEST LIGHTING FAIR DURING SEPTEMBER 13-16, 2013

India's largest and brightest lighting fair titled Lii 2013, Light India International 2013, has been organized by Indian Society of Lighting Engineers in Chennai Trade Centre during 13-16 September 2013. Chennai has been chosen for the second time as the venue for this prestigious event keeping in view vibrant economic pace of activity in the city as well as the growth potential.

Lii2013 is expected to be participated by more than 250 manufacturers including 100 from overseas mainly from China, Taiwan, Korea, Italy, Germany, USA. Concurrent show on Solar Lighting Systems and a technical seminar with international experts on the emerging trends in green concepts are expected to draw a larger participation and visitors

Light India International 2013 will publicize the developments taking place in the lighting industry and provide excellent marketing opportunities for all the products and services under the lighting industry. The exhibition will showcase a wide range of products over 16500 sqm exhibition area in Chennai Trade Centre, covering Residential, commercial and retail lighting; Industrial lighting; Street lighting; Security lighting; Environmental / Landscape lighting; City beautification lighting; Architectural lighting; Railway / Metro lighting; Airport & Runway lighting; Refineries / Mines lighting; LED lighting; Intelligent lighting; Lighting with non-conventional energy; Speciality lighting; Lighting accessories and controls; Power saving solutions; and Testing and measuring instruments. IT, Publications and Consultancy services relating to lighting industry will also take part in the event.

Mainly a B2B event, open to business visitors from 10 am to 3 pm, the fair will provide the exhibitors with opportunity to explore investment opportunities and locate partners for joint ventures and tie-ups. The fair will be open to public in evenings from 3.00 PM to 7.00 PM.

The fair **website: www.lii.co.in** gives more information on the event…….for registration of exhibitors and visitors. Limited sponsorship opportunities are also available.

The previous edition of this event titled Lii2011 held in March 2011 had 220 participants including 80 from overseas. More than 15,000 business visitors visited the event and on the spot business worth Rs.200 million were reported to have been transacted.

About ISLE

ISLE is a professional registered body in the field of illumination engineering with a broad-based membership of scientists, engineers, architects, academicians, researchers and designers. ISLE is affiliated to the CIE, the International Commission on Illumination. It is closely associated with the Bureau of Indian Standards, the Department of Science and Technology, the Ministry of Power and the Ministry of Non-Conventional Energy Sources.

Lii2013 Secretariat can be contacted on **Email : info@Lii.co.in** and **Cell phones 98402 73833 & 98402 74355** for details.

FOR FURTHER DETAILS CONTACT:

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Mr. R. Balasubramanian, Secretary - Lii2013 (Mobile : +91-9840055645) E-mail : balu@Lii.co.in

GAMESA

Gamesa, a global technology leader in wind energy, has reinforced its presence in India, having signed two agreements for the supply of a total of 230 MW: 130 MW to China Light & Power India (CLP India) and 100 MW to Greenko Wind Project. The agreement with Greenko, one of India's leading wind power project developers and operators, encompasses the supply and installation of 100 MW. This agreement might be extended to additional 200 MW, with negotiations and site analysis already underway.

Gamesa will install 50 G97-2.0 MW WTGs (100 MW in total) at two 50 MW wind farms located in the states of Karnataka and Andhra Pradesh. Installation of these turbines is slated for completion at the end of the fourth quarter of 2013. In addition, Gamesa will handle the related O&M services for a five-year term. Elsewhere, under the contract with CLP India, a subsidiary of CLP Holdings, one of the largest energy investors in Asia Pacific, Gamesa will take on the supply, installation and commissioning of 65 G97-2.0 MW WTGs (total capacity: 130 MW) at the Jath wind farm being developed by Gamesa in the Sangli district of the state of Maharashtra. The scope of this contract extends to the related O&M services for a period of 10 years.

Installation of the first 50 turbines (100 MW) is expected to begin in the third quarter of 2013, with installation of the remaining 30 MW scheduled for the end of the year. The project is expected to be commissioned in the third quarter of 2014. Once operational, this facility will generate enough energy to supply 90,000 households, thereby preventing the emission of 259,000 tonnes of greenhouse gases every year.

***Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.* – MARGARET MEAD**

C-2 LIMITATION

C-2.1 The technique of limitation allows the circuit-breaker to considerably reduce short-circuit currents. It ensures attenuation of the harmful electromagnetic, thermal and mechanical effects of short-circuits and is the basis of the cascading technique.The assumed fault current I_{sc} is the short-circuit current that would flow at the point of the installation where the circuit-breaker is placed, if there were no limitation. Since the fault current is eliminated in less than one half-period, only the first peak current (asymmetrical peak I) is considered. This is a function of the installation fault cos θ. Reduction of this peak I to limited I_L characterizes circuit-breaker limitation. Limitation consists of creating a back-electromotive force opposing the growth of the short-circuit current. Effectiveness of limitation depends on intervention time, that is the time t_s when the back-electromotive force (b_{emf}) appears, the rate at which b_{emf} increases and the value of b_{emf}. The back-electromotive force is the arc voltage U_a due to the resistance of the arc developing between the contacts on separation. Its speed of development depends on the contact separation speed. As shown in Fig.13, as from the time t_s when the contacts separate, the back less than the assumed fault current flow through when a short-circuit occurs.

C-2.2 Circuit-Breaker Limitation Capacity

The circuit-breaker limitation capacity defines the way how it reduces the let through current in short-circuit conditions (*see* Fig. 14 and 15). The thermal stress of the limited current is the area (shaded) defined by the curve of the square of the limited current $I^2_{SC}(t)$. If there is no limitation, this stress would be the area, far larger, that would be defined by the curve of the square of the assumed current. For an assumed short-circuit current I_{SC}, limitation of this current to 10 percent results in less than 1 percent of assumed thermal stress. The cable temperature rise is directly proportional to the thermal stress.

NOTE: *On a short-circuit, adiabatic temperature-rise of conductors occurs (without heat exchange with the outside due to the speed of the energy supply). The increased temperature for a conductor with a cross-section S is:*

$$B_e = \frac{K}{S^2} V^1 I^2 dt$$ where $I^2 dt$ is the thermal stress (A^2s)

Limitation considerably attenuates the harmful effects of short-circuits on the installation. Consequently, limitation contributes to the durability of electrical installations. Due to limitation, the harmful effects of short-circuits on a motor feeder are greatly attenuated.

Proper limitation ensures easy access to a Type 2 coordination as per IS/IEC 60947-4-1, without oversizing of components. This type of coordination ensures optimum use of their motor feeders.

C-2.3 Limitation Curves

A circuit-breaker's limiting capacity is expressed by limitation curves that give,

a) the limited peak current as a function of the rms current of the assumed short-circuit current. For example on a 160 A feeder where the assumed Isc is 90 kA rms, the non-limited peak Isc is 200 kA (asymmetry factor of 2.2) and the limited I_{sc} is 26 kA peak.

b) the limited thermal stress (in A2s) as a function of the rms current of the assumed short-circuit current. For example, on the previous feeder, the thermal stress moves from more than 100 x 106 A2s to 6 x 106 A2s.

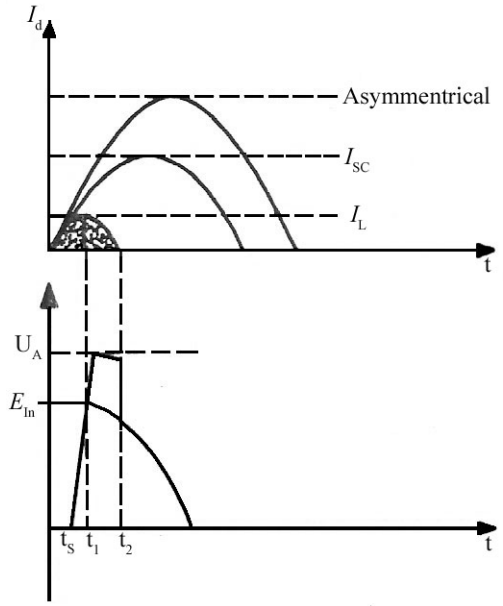


Fig. 13: Effect of limitation on fault current

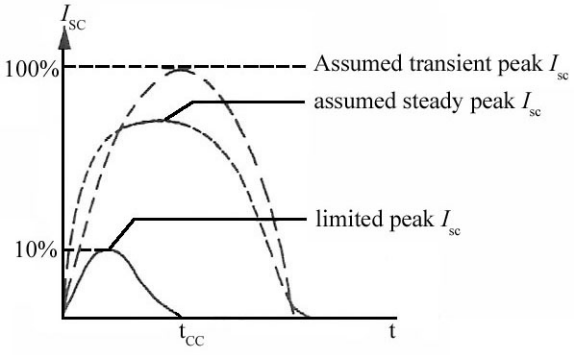


Fig. 14: Current Limitation

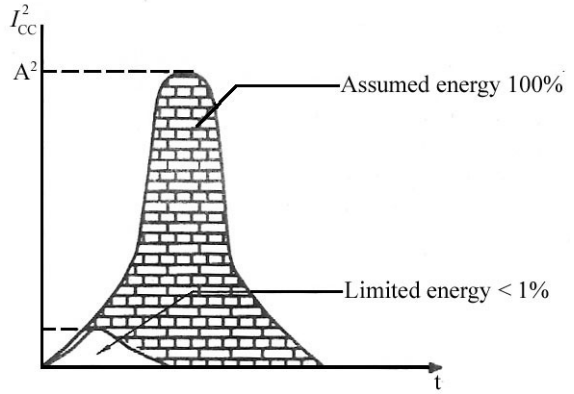


Fig. 15: Thermal Stress Limitation

C-3 DISCRIMINATION

C-3.1 Discrimination is the co-ordination of the operating characteristics of two or more over-current protective devices such that, on the incidence of over- currents within stated limits, the device intended to operate within these limits does so, while the other(s) does (do) not (*see* Fig. 16).

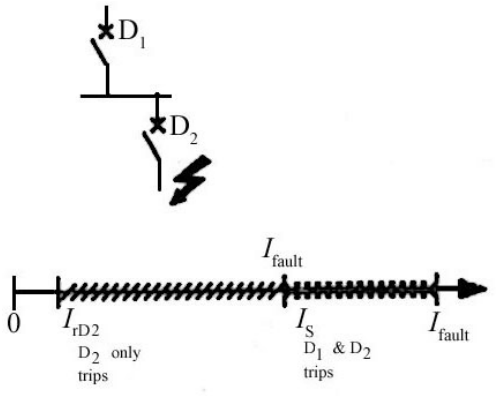


Fig. 16: Discrimination and Sequence of Tripping

Distinction is made between series discrimination involving different over-current protective devices passing substantially the same over-current and network discrimination involving identical protective devices passing different proportions of the overcurrent. In LV networks, discrimination is recommended in order to obtain higher levels of supply continuity and protection, ensuring better safety of installations and minimum cost overruns.

Cascading principle in limiting CBs can enhance the discrimination levels. It is recommended that the manufacturer provide the relevant data in terms of discrimination charts and cascading levels for various combination of CBs (upstream and downstream) and fault current as per the laboratory test results.

A discrimination current I_s is defined such that if; a) $I_{fault} > I_s$: both circuit-breakers trip, and b) $I_{fault} < I_s$: only D_2 eliminates the fault.

C-3.2 Discrimination Quality

The value I_s is compared with assumed $I_{sc}(D_2)$ at point D_2 of the installation.

a) total discrimination: $I_s > I_{sc}(D_2)$; discrimination is qualified as total, that is whatever the value of the fault current, D_2 only will eliminate it.

b) partial discrimination: $I_s < I_{sc}(D_2)$; discrimination is qualified as partial, that is up to I_s, only D_2 eliminates the fault. Beyond I_s ,both D_1 and D_2 open.

where $I_{sc}(D_1)$: short-circuit current at the point where D_1 is installed, $I_{cu}D_1$: ultimate breaking capacity of D_1.

C-3.3 Types of Discriminations

C-3.3.1 *Current Discrimination*

This technique is directly linked to the staging of the Long Time (LT) tripping curves of two serial-connected circuit-breakers (*see* Fig. 17).

The discrimination limit I_s is, a) $I_s = I_{sd2}$ if the thresholds I_{sd1} and I_{sd2} are too close or merge, and b) $I_s = I_{sd1}$ if the thresholds I_{sd1} and I_{sd2} are sufficiently far apart.

Current discrimination is achieved when,

a) $I_{r1} / I_{r2} < 2$

b) $I_{sd1} / I_{sd2} > 2$

The discrimination limit being $I_s = I_{sd1}$

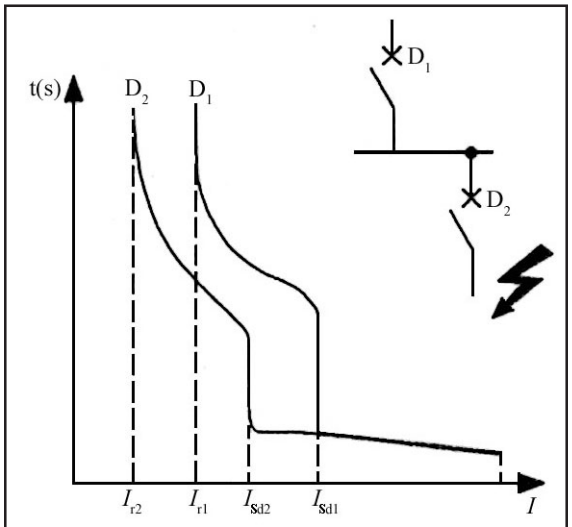


Fig. 17: Current Discrimination

C-3.3.1.1 *Discrimination quality*

Discrimination is total if $I_s > I_{sc}(D_2)$, that is $I_{sd1} > I_{sc}(D_2)$.

This normally implies, a relatively low level $I_{sc}(D_2)$, a large difference between the ratings of circuit-breakers D_1 and D_2.

Current discrimination is normally used in final distribution.

C-3.3.2 *Time Discrimination*

This is the extension of current discrimination and is obtained by staging over time of the tripping curves. This technique consists of giving a time delay of t to the Short Time (ST) tripping of D_1 (*see* Fig.18).

The thresholds (I_{r1}, I_{sd1}) of D_1 and (I_{r2}, I_{sd2}) comply with the staging rules of current discrimination. The discrimination limit I_s of the association is at least equal to I_{i1} the instantaneous threshold of D_1.

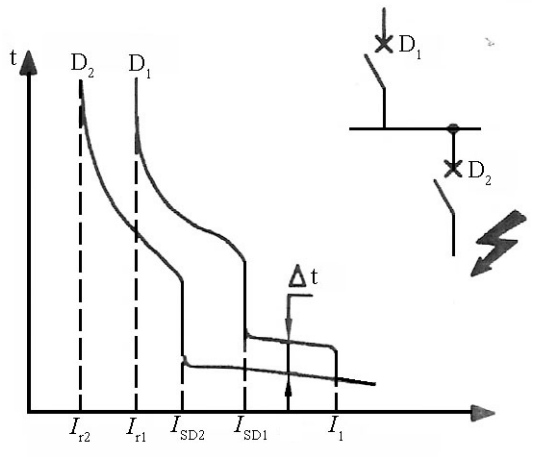


Fig. 18: time discrimination

C-3.3.2.1 *Discrimination quality*

For discrimination on final and/or intermediate feeders, A category circuit-breakers can be used with time-delayed tripping of the upstream circuit-breaker. This allows extension of current discrimination up to the instantaneous threshold I_{i1} of the upstream circuit-breaker:

$I_s > I_{i1}$. If $I_{sc}(D_2)$, is not too high (case of a final feeder) total discrimination can be obtained.

On the incomers and feeders of the MSB, as continuity, of supply takes priority, the installation characteristics allow use of B category circuit-breakers designed for time-delayed tripping. These circuit-breakers have a high thermal withstand (I_{cw} > 50 percent I_{cn} for t = I_s):

$I_s > I_{cw1}$. Even for high $I_{sc}(D_2)$, time discrimination normally provides total discrimination:

$I_{cw1} > I_{sc}(D_2)$.

NOTE: *Use of B category circuit-breakers means that the installation must withstand high electrodynamic and thermal stresses. Consequently, these circuit-breakers have a high instantaneous threshold I_i, that can be adjusted and disabled in order to protect the busbars if necessary.*

C-3.4 Enhancement of Current and Time Discrimination

C-3.4.1 *Enhancement by Limiting Downstream Circuit-Breakers*

Use of a limiting downstream circuit-breaker enables the discrimination limit to be pushed back. On referring to Fig.19, a fault current I_d will be seen by D_1, equal to I_d for a non-limiting circuit-breaker, and equal to $I_{Ld} < I_d$ for a limiting circuit-breaker. The limit of current and time discrimination I_s of the association $D_1 + D_2$ is thus pushed back to a value that increases when the downstream circuit-breaker is rapid and limiting.

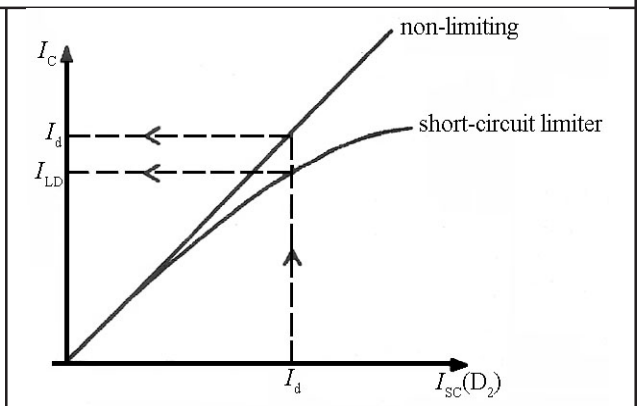


Fig. 19: enhancement of discrimination

C-3.4.2 *Discrimination Quality*

Use of a limiting circuit-breaker is extremely effective for achievement of total discrimination when threshold settings (current discrimination) and/or the instantaneous tripping threshold (time discrimination) of the upstream circuit-breaker D_1 are too low with respect to the fault current I_d in $D_2 - I_{sc}(D_2)$.

C-3.4.2.1 *Logic discrimination or "Logic Discrimination Zone (ZSI)"*

This type of discrimination can be achieved with circuit-breakers equipped with specially designed electronic trip units. Only the Short Time Protection (STP) and Ground Fault Protection (GFP) functions of the controlled devices are managed by Logic Discrimination. In particular, the Instantaneous Protection function (inherent protection function) is not concerned.

C-3.4.2.2 *Settings of controlled circuit-breakers*

a) *Time delay*: staging (if any) of the time delays of time discrimination to be applied (t D_1 > t D_2 > t D_3)

b) *Thresholds*: natural staging of the protection device ratings must be complied with ($I_{cr}D_1 > I_{cr}D_2 > I_{cr}D_2$).

NOTE: *This technique ensures discrimination even with circuit-breakers of similar ratings.*

C-3.4.2.3 *Principles*

Activation of the Logic Discrimination function is via transmission of information on the pilot wire for ZSI input,

a) *Low level (no downstream faults):* the Protection function is on standby with a reduced time delay (<0.1)

b) *High level (presence of downstream faults)*: the relevant Protection function moves to the time delay status set on the device.

Activation of the Logic Discrimination function is via transmission of information on the pilot wire for ZSI output,

a) *Low level*: the trip unit detects no faults and sends no orders.

b) *High level*: the trip unit detects a fault and sends an order.

C-3.4.2.4 *Operation*

A pilot wire connects in cascading form the protection devices of an installation (*see* Fig. 20). When a fault occurs, each circuit-breaker upstream of the fault (detecting a fault) sends an order (high level output) and moves the upstream circuit-breaker to its natural time delay (high level input). The circuit breaker placed just above the fault does not receive any orders (low level input) and thus trips almost instantaneously.

C-3.4.2.5 *Discrimination quality*

This technique enables easy achievement as standard of discrimination on 3 levels or more, easy achievement of downstream discrimination with non-controlled circuit-breakers, elimination of important stresses on the installation, relating to time-delayed tripping of the protection device, in event of a fault directly on the upstream busbars. All the protection devices are thus virtually instantaneous.

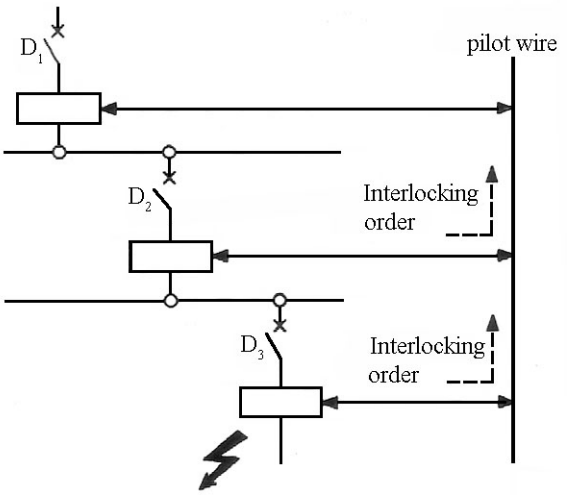


Fig. 20: Logic Discrimination(ZSI)

C-3.5 Discrimination Rules

C-3.5.1 *Overload Protection*

For any overcurrent value, discrimination is guaranteed on overload if the non-tripping time of the upstream circuit-breaker D_1 is greater than the maximum breaking time of circuit-breaker D_2.

The condition is fulfilled if the ratio of Long Time (LT) and Short Time (ST) settings is greater than 2. The discrimination limit I_s is at least equal to the setting threshold of the upstream Short Time (ST) time delay.

C-3.5.2 *Short-circuit Protection*

C-3.5.2.1 *Time discrimination*

Tripping of the upstream device D_1 is time delayed by *t*, the conditions required for current discrimination must be fulfilled and the time delay *t* of the upstream device D_1 must be sufficient for the downstream device to be able to eliminate the fault. Time discrimination increases the discrimination limit I_s up to the instantaneous tripping threshold of the upstream circuit-breaker D_1 (*see* Fig.21).

Discrimination is always total if circuit-breaker D_1 is of category B, has an I_{cw} characteristic equal to its I_{cu}.

Discrimination is total in the other cases if the instantaneous tripping threshold of the upstream circuit-breaker D_1 is greater than the assumed I_{sc} in D_2.

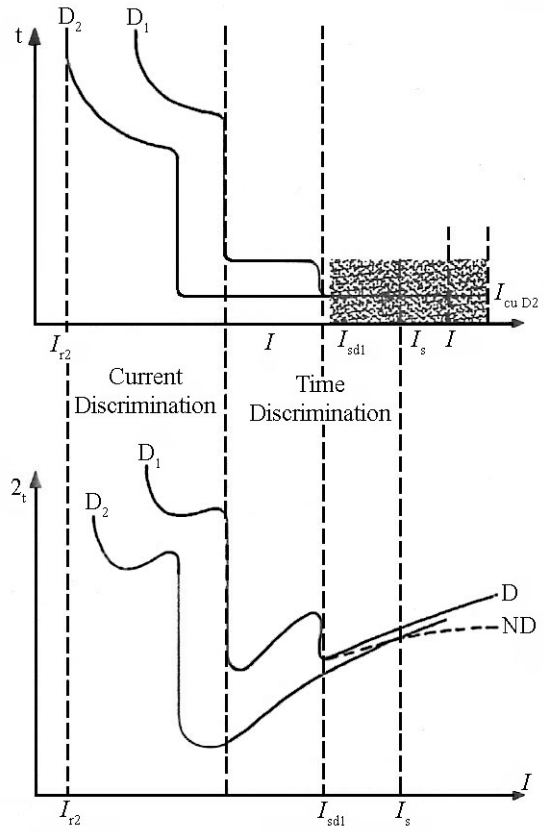


Fig. 21: Discrimination at Various Fault Currents

C-3.5.2.2 *Logic discrimination*

Discrimination is always total.

C-3.5.2.3 *General case*

There are no general discrimination rules. The time/ current curves clearly supply a value of I_{sc} (limited or assumed) less than the Short Time tripping of the upstream circuit-breaker; discrimination is then total. If this is not the case, only tests can indicate discrimination limits of coordination, in particular when circuit-breakers are of the limiting type. The discrimination limit I_s is determined by comparison of curves,

a) in tripping energy for the downstream circuit-breaker, and

b) in non-tripping energy for the upstream circuit-breaker.

The potential intersection point of the curves gives the discrimination limit I_s. The manufacturers indicate in tables the tested performance of coordination.

C-3.6 Earth Leakage Protection Discrimination

C-3.6.1 According to the Earthing System, discrimination only uses coordination of overcurrent protection devices. When the insulation fault is treated specifically by earth leakage protection devices (for example in the TT system), discrimination of the residual current devices (RCDs) with one another must also be guaranteed. Discrimination of earth leakage protection devices must ensure that, should an insulation fault occur, only the feeder concerned by the fault is de-energized. The aim is to optimize energy availability.

C-3.6.2 *Types of Earth Leakage Protection Discrimination*

C-3.6.2.1 *Vertical discrimination*

In view of requirements and operating standards, discrimination must simultaneously meet both the time and current conditions (*see* Fig. 22).

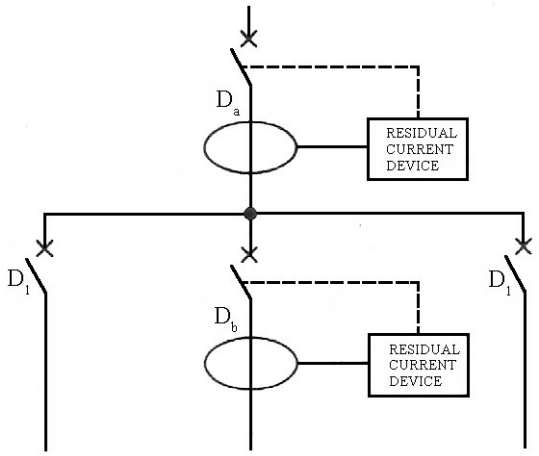


Fig. 22: Vertical Discrimination

C-3.6.2.1.1 *Current condition*

The RCD must trip between I_n and $I_n/2$, where I_n is the declared operating current. There must therefore exist a minimum ratio of 2 between the sensitivities of the upstream device and the downstream device. In practice, the standardized values indicate a ratio of 3.

C-3.6.2.1.2 *Time condition*

The minimum non-tripping time of the upstream device must be greater than the maximum tripping time of the downstream device for all current values.

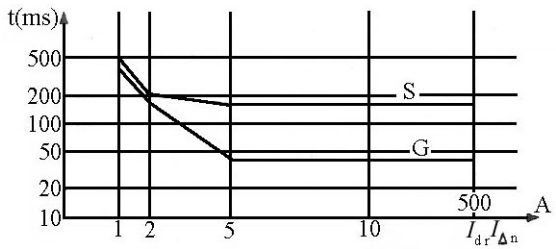


Fig. 23: Operating Time Curves

NOTE: *The tripping time of RCDs must always be less than or equal to the time specified in the installation standards to guarantee protection of people against indirect contacts.*

For the domestic area, standards IS 12640 (Part 1) (residual current circuit-breakers) and IS 12640 (Part 2) (residual current devices) define operating times. The values in the table correspond to curves G and S. Curve G (General) correspond to non-delayed RCDs and S (Selective) to those that are voluntarily delayed (*see* Fig.23).

C-3.6.2.2 *Horizontal discrimination*

Sometimes known as circuit selection, it allows savings at the supply end of the installation of an RCD placed in the cubicle if all its feeders are protected by RCDs. Only the faulty feeder is de-energized, the devices placed on the other feeders do not see the fault (*see* Fig. 24).

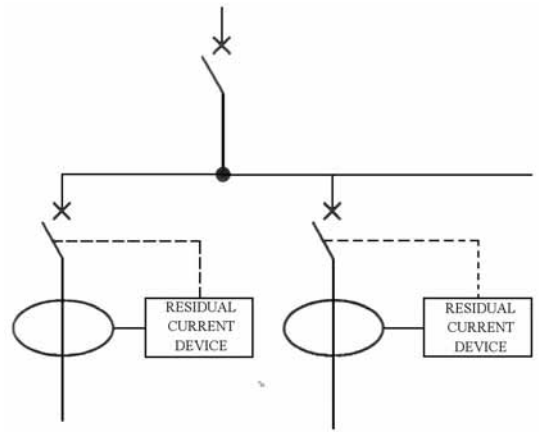


Fig. 24: Horizontal Discrimination

Table 2 Standardized Values of Operating Times

Type	I_n	$I_{\Delta n}$	Standardized Values of Operating Time and Non-operating Time (in s) at:				
			$I_{\Delta n}$	$2I_{\Delta n}$	$5I_{\Delta n}$	500A	
General instantaneous	All values	All values	0.3	0.15	0.04	0.04	Maximum operating time
Selective	>25	>0.030	0.5	0.2	0.15	0.15	Maximum operating time
			0.13	0.06	0.05	0.04	Maximum operating time

Courtesy: Extracts from National Electrical Code 2011

THE ELECTRIC BUS – CHARGED IN 15 SECONDS

Top of Form

European technology giant ABB says it has developed a new technology that will help power the world's first high-capacity flash charging electric bus system – meaning a fully loaded bus can get 15-second "top up" charges when it stops to pick up and unload passengers. ABB says it is working together with Geneva's public transport company (TGP), the Office for the Promotion of Industries and Technologies (OPI) and the Geneva power utility SIG on what it calls the **TOSA** electric bus system pilot project – which will run between Geneva airport and the city's international exhibition center, Palexpo. The new boost charging technology will be deployed for the first time on a large capacity electric bus, carrying as many as 135 passengers. The bus will be charged directly at selected stops with a 15-second energy boost while the passengers enter and leave the bus, based on a new type of automatic flash-charging mechanism. The system uses a laser-controlled moving arm, which connects to an overhead receptacle for charging at bus shelters, instead of the usual trolley poles to overhead lines."Through flash charging, we are able to pilot a new generation of electric buses for urban mass transport that no longer relies on overhead lines," said Claes Rytoft, ABB's acting Chief Technology Officer. "This project will pave the way for switching to more flexible, cost-effective, public transport infrastructure while reducing pollution and noise."

Bottom of Form

TOSA stands for Trolleybus Optimisation Système Alimentation. It is billed as a zero-carbon-emission solution as the electricity used comes entirely from clean hydro power, at least in Geneva. ABB says the charging time is so quick that it does not interfere with the bus schedule and does not need overhead lines while providing greater route flexibility. The system uses a laser-controlled moving arm, which connects to an overhead receptacle for charging at bus shelters, instead of the usual trolley poles to overhead lines.

Top of Form

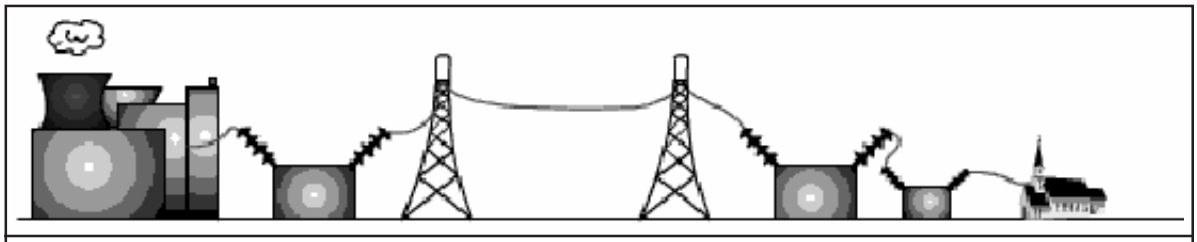
ABB says onboard batteries can be charged in 15 seconds with a 400 kilowatt boost at selected stops. At the end of the bus line a 3 to 4 minute boost enables the full recharge of the batteries. According to its press release, an innovative electrical drive system means energy from the roof-mounted charging equipment can be stored in compact batteries, along with the vehicle's braking energy, powering both the bus and its auxiliary services, such as interior lighting.

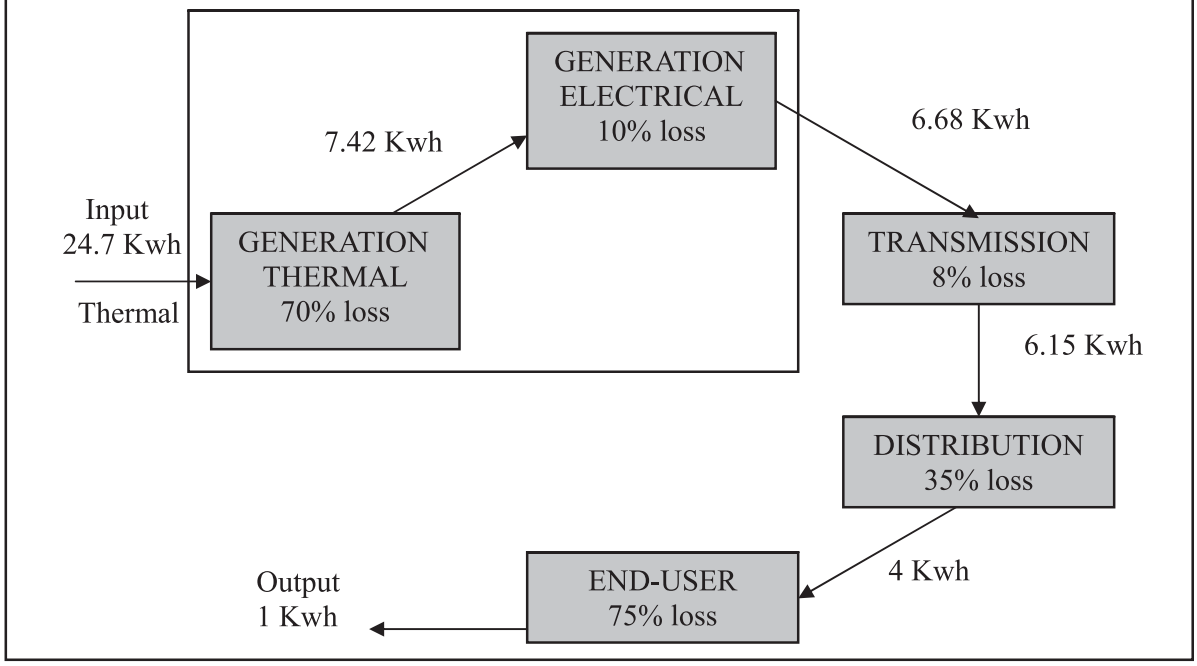
***We cannot command Nature except by obeying her.* – FRANCIS BACON**

ENERGY STORY

ENERGY EFFICIENCY – THE FIFTH FUEL - PART 3

We saw in the First part about the losses at different stages of Electricity Generation to end use.





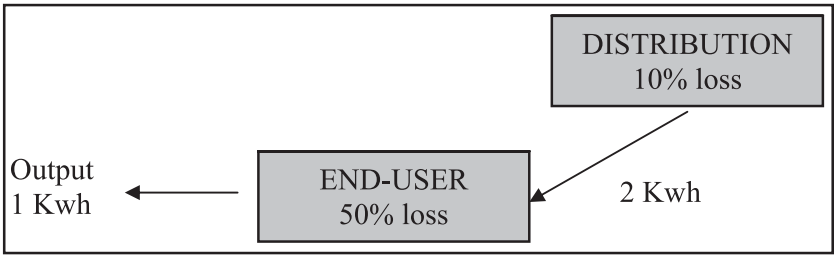
Focussing on the last 2 stages of the chain, we see that the Distribution losses account for about 35% and some of the efforts taken by the Bureau of Energy Efficiency is to focus on Efficiency levels of Distribution Transformers, particularly of ratings between 25 to 200 KVA, which form the bulk of Distribution Transformers employed in the distribution system by the utilities. The total number of theseTransformers all over the country can be approximated as 2.5 Million andsome calculations of "Fifth Fuel" based on this assumption are given below.

Present approximate consumption of Electricity in the country is about 800 Billion Units

The MTOE (Million Tons of Oil Equivalent) Equivalent of this is $(800 \times 10^9 \times 860) / 10^9 \times 10^4 = 69$ MTOE

As seen in the above Energy Chain diagram, to get the 800 Billion Units to the 'End Use', 4800 Billion Units Equivalent or about 414 MTOE Energy resources are used which includes Coal, Oil, Hydel, Nuclear and Renewable Sources like Wind, Biomass etc.

Focussing on the Distribution losses portion in the Electrical Energy Chain Diagram, about 400 Billion Units are lost as Distribution Losses. As per International standards, if these losses could be reduced to 10 % or 90 Billion Units, the saving of about 310 Billion Units are enormous saving.



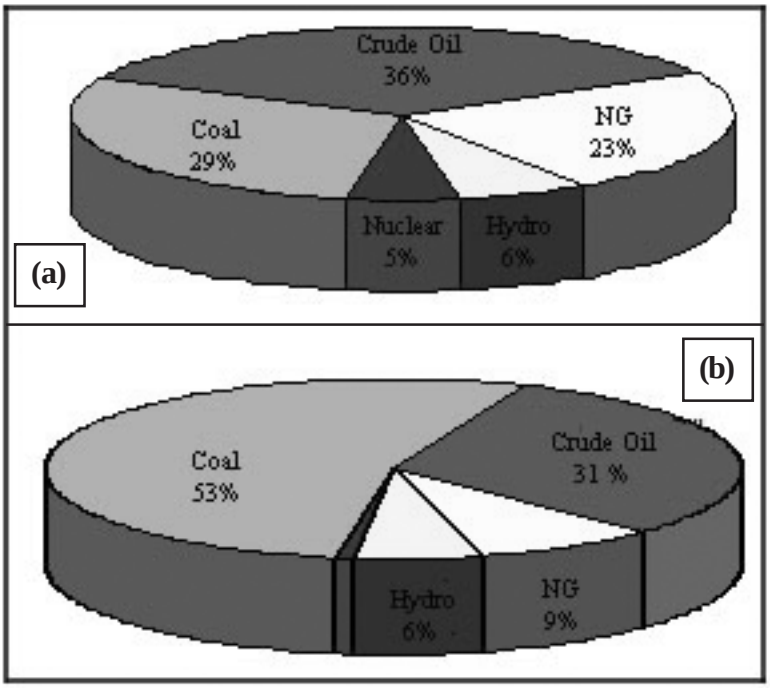
Saving of almost 140 MTOE which is enormous. A look at current Primary Energy Consumption of the world and India with the break up of different Primary Energy Sources will illustrate the point.

Energy Efficiency "STAR MARKING" Initiative of BEE for Distribution Transformers – Some Energy Saving Calculations:

The Distribution Transformer is the major component in the Distribution System and it is necessary to review the Efficiency Levels.

Assumptions of Loading levels as well as the losses Levels which are currently followed in most of the purchases deserves review to save substantially save on the Technical Losses.

Our environment, the WORLD in which we live and work, is a mirror of our attitudes and expectations.



a: World Energy Consumption: 11,299MTOE

b: India Energy Consumption: 524 MTOE

It is also to be noted that there are lot of improvements in Design practices and Materials available in India and there is very good scope to reduce losses and improve Efficiencies.

These deserve all attention particularly in the present context of Energy Concerns and Drive for Energy conservation. This aspect assumes lot of IMPORTANCE in view of a Large number of Distribution Transformers involved in the State and all over the Country.

All India figures of total Distribution Transformers are around 25lac Nos. with average rating of about 63KVA. Out of this Tamilnadu figures as per information available are around 1.9 lac Nos. with over 1.60 lac Nos of them being 100kva rating.

World over Efficiencies are revised upwards, for all Equipments including Distribution Transformers, to meet which, losses have to be reduced. Calculations of Total losses are normally based on 50% loading but in rural as well as urban feeders this could be much more. All these dimensions seem to provide a large scope for savings, which must be explored.

Availability of Copper sufficiently (copper control order of Govt. of India brought in 1971 withdrawn in 1992) clubbed with better core materials can help lot of Power Savings.

BEE has recently announced the Standards and Labeling Program for Distribution Transformers, which is really a Positive Move towards Energy Conservation through Energy Efficiency.

Given below is the BEE Announcement regarding Labeling Program and the Details of Star Rating and Basis are also given for Information.

Ratings of 100 Kva and 63 KVA are considered along with REC Standards of Losses as REC standards were followed for very long and many existing Transformers will be with these loss levels are more.

Basis: The existing efficiency or the loss standards are specified in IS 1180 (part 1). This standard defines load losses and no load losses separately. For the BEE labeling program total losses at 50% and 100% load have been defined.

The highest loss segment is defined as star 1 and lowest loss segment is defined as star 5. The existing IS 1180 (part 1) specification losses are the base case with star 1.The basis for star rating plan is as follows:

Case	Basis of losses (Total at 50% Load Condition)
Base case Star 1	Current purchasing practice (IS 1180 (part 1)Max Losses)
Star 2	Some utility purchase specs like AP, NDPL
Star 3	Losses from TOC design (Moderate)
Star 4	Losses from lowest TOC design
Star 5	High efficiency design

The most Important Point to note is that for Star Marking Basis, the Total Losses at 50% and 100% Loads alone are considered giving Designers ample scope to arrive at Efficient and Economical Designs

Star Rating plan:

The total losses at 50% and 100% loading shall not exceed the values given below:

Rating	1 star		2 star		3 star		4 star		5 star	
kVA	Max Losses at 50% (Watts)	Max Losses at 100% (watts)	Max Losses at 50% (Watts)	Max Losses at 100% (watts)	Max Losses at 50% (Watts)	Max Losses at 100% (watts)	Max Losses at 50% (Watts)	Max Losses at 100% (watts)	Max Losses at 50% (Watts)	Max Losses at 100% (watts)
16	200	555	165	520	150	480	135	440	120	400
25	290	785	235	740	210	695	190	635	175	595
63	490	1415	430	1335	380	1250	340	1140	300	1050
100	700	2020	610	1910	520	1800	475	1650	435	1500
160	1000	2800	880	2550	770	2200	670	1950	570	1700
200	1130	3300	1010	3000	890	2700	780	2300	670	2100

What are the REC (Rural Electrification Corporation) Standards of Losses which are also followed in many places:

Losses of D T - As per REC

KVA	Fixed Losses Watts	Load Losses at F/L Watts
25	100	685
50	150	1020
63	180	1235
100	260	1760

These losses are maximum allowable and there would not be any plus tolerance

Let us consider Examples of 63 KVA and 100 KVA ratings, which are very largely in use in TNEB

Almost 100% of these transformers are Al.Wound and procured with REC Recommendations of Losses. Every one of these Transformers would have definitely faced 'Burn Out' and undergone Repairs of all kinds. It would therefore be reasonable to Estimate increase of Losses by at least 10%.

100 KVA

Full Load Losses as per REC = 260 + 1760 Watts = 2020 Watts
+10% Estimate = 2222 Watts
Full Load Losses of 5 STAR Transformer = 1500 Watts
Potential Savings per Hour = 722 Watts

For 8000 Hours (F/L) per Annum = 8000x.722 = 5776 Units

Half Load Losses as per REC = 260 + 1760/4 = 700 Watts
+10% Estimate = 770 Watts
Half Load Losses of 5 Star Transformer = 520 Watts
Potential Savings per Hour = 250 Watts

For 8000 Hours (Half Load) per Annum = 8000x 0.250 = 2000 Units

63 KVA (Calculations as above)

Potential Savings for Full Load Working = 4048 Units

Potential Savings for Half Load Working = 1904 Units

It will be beneficial if moves are initiated for measurement of EFFICIENCIES and LOSSES of Transformers in SERVICE and Estimate SAVING POTENTIAL. Plans and Programs even for replacement of all existing Distribution Transformers with 4 or 5 Star Rated Transformers could help save substantially. ***(To be continued)***

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

NTPC COMMISIONS 5MW SOLAR PLANT IN PORT BLAIR

NTPC Ltd has commissioned and synchronized a 5 MW solar photo-voltaic power project in Port Blair, Andaman and Nicobar Islands. It is the first Grid-connected Solar PV Project in these islands. It is also NTPC's first greenfield renewable solar PV project. Overcoming serious challenges, including lack of skilled manpower, machinery and inclement weather conditions on the islands, NTPC commissioned the plant in a record six-and-a-half months. The Project was executed by photon Energy Systems over 10 hectares.

The power major is in the process of implementing several renewable energy projects in the country.

Courtesy: IEEMA journal, May 2013

CONSUL LAUNCHES INNOVATIVE POWER SOLUTIONS FOR ATM'S

To improve the uptime and reduce operational costs of ATMs Chennai, 21 January, 2013: Chennai based Consul Consolidated Pvt. Ltd;the leading manufacturer of enterprise energy solutions (UPS, Solar Power Packs, Inverters& Voltage Stabilizers) announced the launch of iPEMS-ATM and ATMSure.The new solutions will improve the uptime and reduce operational costs of ATMs operated by public sector banks, private sector banks and ATM service providers. The iPEMS-ATM (Intelligent Power and Energy Management System for ATMs) is a modular full service suite product that can be deployed for both new ATM sites and as a retrofit for any existingATMs. The iPEMS – ATM increases the ATM availability to as high as 97% to 98% and reduces the energy bills by 25% to 40% apart from eliminating the need to man ATM sites which helps reduce the operational costs of current ATMs by another 25%. Special features of iPEMS are-ATMSureis the first UPS, designed specifically for ATM sites in India which includes features Commenting on the launch, Mr. Sriram Ramakrishnan, CEO, Consul Consolidated said, "With iPEMS- ATM and ATMSure we are offering innovative, reliable and cost effective solutions to the banks and ATM service providers. Our products are supported on a 7 x 24 x 365 basis through our Pan India service network, ensuring the highest level of service and uptime to our banking customers".

Consul with its newly launched products and solutions will capitalize on the growing demand for robust power backup and remote management solution for proposed Ministry of Finance (MOF) and White label ATM roll-outs planned in Tier 2 and Tier 3 cities across India.

About Consul Consolidated:

Consul Consolidated Pvt Ltd is a leading Indian company in the manufacture and supply of a full range of power conditioning & power back-up products, services and solutions. Founded in 1981 Consul solutions and products are backed with more than 3 decades of field experience in developing customized power products that meet the exacting standards of clients in supporting critical and sensitive equipment in various industrial and commercial applications. The company currently has 2 modern manufacturing facilities located in Chennai which are ISO 9001 & 14001 certified. In addition Consul has also received the CE certification for its products.Consul has a

1. Offers built-in security feature to prevent theft and damage of physical assets in the ATM site.

2. Has built-in energy saving and timer based controls for the ATM air conditioner and lights of the lobby, backroom and signage.

3. Enables 24/7 monitoring of the ATM facility. ATM Managers can review all the vital parameters of each ATM across circles through the online web based iRMS (Intelligent Remote Management System) service.

4. The iPEMS acts like a force multiplier for the service managers as they can call on real time data for each location, monitor a wide range of parameters, generate reports and receive alerts on SMS and emails, diagnose potential issues and resolve problems proactively like remotely rebooting hung-up

ATM, modems or CCTV DVR.

1. It is a cost effective and green alternative to Diesel gensets at locations which face extended power outages or low voltage issues.

2. It can operate over a wide input voltage range without going to battery and also has a powerful charger to quickly re-charge batteries after an extended power outage.

3. The battery management technology when combined with maintenance free batteries extends the reliability and useful life of batteries and thereby eliminating a major failure mode in the downtime of UPS used in ATM applications especially in rural and semi-urban locations.

HUGE POTENTIAL TO TAP RENEWABLE ENERGY

Stating that there was a huge potential to tap renewable in the country, a senior official with Union Ministry of New and Renewable Energy (MNRE) has said that there were plans to add another 30,000 MW of renewable power during the 12th Five-Year Plan.

Speaking at a workshop MNRE Director, Mr. V K Jain said that currently the installed capacity of renewable power is over 27,000 MW which is about 12% of the total installed power generation capacity in the country.

He said that 150 million tones of surplus crop residues annually in the country have potential to generate more than 16,000 MW of power while 5,000 MW of power can be generated in sugar mills through bagasse cogeneration. D R Joshi, Director, Gujarat Energy Development Agency claimed that Gujarat is the only state producing 16% of power through renewable energy sources.

Courtesy: IEEMA Journal, May 2013

The wounds of fire would have gone with the time but not the wounds caused by words

SIR SUBBIER SUBRAMANIA IYER

Sir Subbier Subramania Iyer KCIE (Tamil: Rgi gaH Rggµuk z a maaH) (October 1, 1842 – December 5, 1924) was an Indian lawyer, jurist and freedom fighter who, along with Annie Besant, founded the Home Rule Movement. He was popularly known as the "Grand Old Man of South India".

Subramania Iyer was born in the Madura district of Madras Presidency. On completion of his schooling in Madura, Subramania Iyer qualified as a lawyer from the University of Madras, and went on to practice as a lawyer in Madura and Madras, before being appointed a Judge of the Madras High Court, in 1891. He also served as the first Indian Chief Justice of the Madras High Court, before retiring in 1907.

Early life and education

Subramania Iyer was born in Madura in the Madras Presidency, on 1 October 1842. His father *Sooravally* Subbier Aiyer (1794–1844) was the legal agent of the Raja of Ramnad's zamindari, but died when Subramania Iyer was barely two years old. He had his early education at the English Mission School, Madura, joining the Zilla School, Madura, in 1856, from which institution he completed his schooling.

As his mother was not willing to send him to Madras for a higher education, Subramania Iyer decided to join the administrative service. He served as a clerk in the Deputy Collector's Office, Madura, Deputy Collector's Office, Ramnad, and the Collector's Office, Madura. While working in the Collector's Office, he studied privately for the Pleader's Examination and stood first among the successful candidates.

Though unable to secure a 'Sanad' to practise, he was appointed the Public Prosecutor, when the Criminal Penal Code came into force, in 1862. Desiring to practise as a lawyer, he studied privately for the Matriculation Examination and passed the same in 1865, followed by the First Arts (F.A.) examination in 1866. Two years later, in 1868, he passed the B.L. examination from Presidency College, Madras, standing first (in the Second Class) among all successful candidates. He served as an apprentice under J. C. Mill, Barrister-at-Law, and thus qualified himself to practise as a *Vakil*.

Professional career

Practising as a *Vakil* at Madura from 1869 to 1885, he appeared in some important cases, the most notable among them being the Ramnad Zamindar's Case and the Meenakshi Temple Funds Misappropriation Case. While at Madura, he also earned a reputation as a public worker, being appointed a Municipal Commissioner of Madura and a member of the Local Board, besides being elected a member of the Devasthanam Committee of the Meenakshi Temple at Madura.

He presented an 'Address of Welcome', on behalf of the people of Madura, to the Prince of Wales, who visited Madura in 1875. In 1877, he gave evidence and pleaded for the necessity of protecting tenants from arbitrary eviction by the landlords, before the Famine Commission when it visited Madura. He also served as the Vice Chairman of the Madura Municipality, from 1882 until his departure for Madras. After his wife, Lakshmi's death in 1884, he shifted to Madras, where he emerged as a formidable rival to the redoubtable lawyers Bhashyam Aiyangar and Eardley Norton. Recognising his merit, the Government appointed him Government Pleader and Public Prosecutor in 1888, the first Indian to be appointed so. As Government Pleader, he appeared in two sensational cases - the Nageswara Iyer Forgery Case and the Tirupati Mahant Case. He was appointed an Acting Judge in 1891 and continued in that position until being appointed a Judge of the Madras High Court in January, 1895, succeeding Sir Muthuswamy Iyer to the bench of that Court.

As Judge, amongst other cases, he presided over the insolvency court which investigated into the crash of a Madras bank, Arbuthnot & Co, in 1906. He also acted as the Chief Justice of the Madras High Court in 1899, 1903 and 1906, the first Indian to do so. After serving as a judge of the Madras High Court for 12 years, he resigned on 13 November 1907 due to failing sight, and was succeeded by Mr. Chettur Sankaran Nair. He presented the Welcome Address to the Prince of Wales, in 1914, on behalf of the public of Madras.

Be kind whenever possible. It is always possible.

Political career

Subramania Iyer was nominated a member of the Legislative Council of Madras by the Government, in 1884 and left a creditable record as a non-official member of the Council although the rules did not permit non-official members to play a very useful role. Serving as a member of the Malabar Land Tenure Committee (1885), largely due to his initiative, an act was passed providing compensation for tenants' improvement in Malabar. Nominated for a second time, Subramania Iyer made his association with the Council as useful as possible under the system extant then.

One of the founding members of the Indian National Congress, he led the Madras delegation to its first session at Bombay, in December 1885, where he seconded a resolution proposed by K. T. Telang urging the increase of the elected element in the Legislative Councils and for councillors to be given real and effective powers, and where he made the following statement, as published in the annals of the Indian National Congress of 1885:

"All of us have the utmost faith and confidence in the justice and the fairness of the English people, and we only have to solicit an enquiry into the facts, being content to leave the issue in the hands of their great political leaders." He used to attend sessions of the Congress until he became a Judge of the High Court and contributed in no small measure to the strengthening of the Congress's organisation in the Madras Presidency.

He was close to Sir Arthur Lawley, whom he is held to have substantially influenced and assisted in his administration of the Madras Presidency, in a private capacity.

As Chairman of the Reception Committee, he welcomed the delegates to the 29th session of the Indian National Congress held at Madras in 1914. He presided over a public meeting at Madras in 1915 organised to welcome Mr. M. K. Gandhi just then returned from South Africa. Welcoming Mr. Gandhi, he suggested the lines on which national work in India should proceed:

"We want the soul-force which Mr. Gandhi is trying to work up. Soul-force consists in a man being prepared to undergo any physical or mental suffering, taking the precaution that he will not lay a single finger to inflict physical force upon the other side. It was that soul-force that was manifested by the South African Indians and it is the same force that should be developed in this country."

He agreed to serve as the Honorary President of the All India Home Rule League established in Madras on 1st September 1916, by Mrs. Annie Besant, whose arrest was ordered on 16th June 1917, by Lord Pentland, Governor of Madras. As President of the League, he took up the cause of Mrs. Besant and her colleagues and started a movement for their release, which occasioned his rupture with the Government.

Immediately after Mrs. Besant was interned, Sir Subramania Iyer wrote a letter to Woodrow Wilson, President of the United States of America describing British Rule in India and appealing for the sympathy and support of the American Government and people, in which he stated:

"Officials of an alien nation, speaking a foreign tongue, force their will upon us; they grant themselves exorbitant salaries and large allowances; they refuse us education; they sap us of our wealth; they impose crushing taxes without our consent; they cast thousands of our people into prisons for uttering patriotic sentiments-prisons so filthy that often the inmates die from loathsome diseases." Subjected to scathing criticism in the House of Commons and the House of Lords, the Secretary of State, Edwin Montagu, and the Viceroy, Lord Chelmsford, rebuked him when he met them in Madras in 1918 to make a representation on the proposed political reforms. A few days later, Sir Subramania Iyer renounced his knighthood and returned the insignia to the Government.

Academic interests and career

His interest in the scholarly aspects of law led to his residence, the *Beach House* on the Marina at Mylapore, being used for the "Saturday Club" that met at 11 a. m. every week, between 1888 and 1891, with all leading members of the Madras Bar participating, and cases being critically analysed. At one of these meetings it was decided to start 'The Madras Law Journal', which was inspired by the then recently established periodicals the 'Law Quarterly Review', started by Sir Frederick Pollock in England in 1885 and 'The Harvard Law Review' established by the Harvard Law School Association in 1887. During his tenure as Judge of the Madras High Court he introduced the practice of referring to American jurisprudence in addition to the English, which had been the sole point of reference until then.

He was nominated Senator of the Madras University in 1885 and continued to be connected with that institution till 1907. As a member of the Senate, he advanced many reforms in education. He was a member of the Syndicate for the University for some time and was appointed Vice-Chancellor of the University in 1896. The Madras University conferred on him the Honorary Degree of Doctor of Law in 1908, making him the first recipient of an honorary degree from the University. He presided over the Madras Students' Convention in 1916 and delivered the Presidential Address. He also served as the Chairman of the Council of Native Education for two years. He delivered a series of lectures at Madras University on *Ancient Indian Polity,* in 1914 which were published in 1916. He extended his co-operation to Mrs. Besant in the establishment of the Central Hindu College at Benares which subsequently became the nucleus of the Benares Hindu University.

Cultural interests

He was the President of the *Dharma Rakshana Sabha,* which he founded in 1908, and which sought to prevent the mismanagement of the funds of Hindu Religious Endowment and Charitable Trusts. He also worked for the promotion of Sanskritic study, and established two

schools for Vedic Studies in Madura and Thiruparankundram. As the President of the Suddha Dharma Mandala, which he founded, he was instrumental in publishing several important Hindu religious works. Having been greatly interested in spirituality and the study of religion he became interested in the Theosophical Society which he formally joined soon after his retirement. He was also the Vice-President of the Theosophical Society between 1907 and 1911.

As one of the prominent members his literary contributions were a regular feature of the Theosophical Society's publication *The Theosophist* right up to the 1920s. His participation in the activities of the Theosophical Society gradually drew him closer to Annie Besant and the Indian independence movement. The Suddha Dharma Mandala or 'Pure Religion Society' resulted in a rift between himself and the Theosophical Society, since he desired to provide a rival world leader to Jiddu Krishnamurthi, the favoured champion of the Society.

Honours

The Government awarded a Certificate of Merit to Subramania Iyer on 1 January 1877 as a mark of their appreciation of his services to the public, on the occasion of the Proclamation Durbar at Delhi. He was appointed a Companion of the Order of the Indian Empire, in 1890, and was elevated to a Knight-Commander of the same order on New Year's Day, 1900.

In 1893, he had the title of *Dewan Bahadur*, conferred upon him.

Death and Progeny

He died on 5 December 1924 and was survived by three sons borne to him by his wife Lakshmi.

Legacy

The Mani Iyer Hall in Triplicane was built by the Theosophists in his memory and named after him. He is also commemorated by a statue, unveiled in 1935, outside the Senate House of the Madras University.

WHAT IS THE DIFFERENCE?

Between KNOWLEDGE and INFORMATION

The human mind's content is based on the kinds of things that one interacts with on a daily basis. Many a time people perceive things based on either what they have seen, experienced, heard, read, learned or inferred after some experimentation. These perceptions are then categorized in the mind as data, information, knowledge, understanding or wisdom. Unlike wisdom, information and knowledge perceptions are as a result of what the brain has recorded in the past. That said, we need to know how knowledge differs from information (if it does) and if one can exist without the other.

Information refers to data that has been given some meaning by way of relational connection. In computing terms it is data that has been processed. The 'meaning' applied to the data may not necessarily be useful. For instance, data stored in a database can be processed by a procedure or a program to give information about something, for example a banking application can determine how a particular account balance increased by returning the record of the credit that occurred to that account using data stored in a database somewhere, so 'information' would have been retrieved about that transaction. It is important to know that without information, you will not have knowledge.

So what is knowledge?

Knowledge is the concise and appropriate collection of information in a way that makes it useful. Knowledge refers to a deterministic process where patterns within a given set of information are ascertained. We can also positively say that when a person memorizes some information about something, then they have knowledge about it. That knowledge will have some useful and even applicable use to them but even if that's the case, that knowledge doesn't in itself provide for integration such as would infer further knowledge. Take the example of elementary school kids who memorize knowledge of the multiplication table (times table), for instance like the result of 3 times 3 is 9(3*3=9), because they have amassed knowledge of the table. However, the kids will not be able to respond positively when asked the result of 2300*150 as that entry isn't in the table. It takes true analytical ability and the ability to reduce it to empirical factual knowledge, not just some memorized set of knowledge.

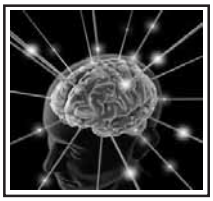
Summary:

1. A Information is processed data whereas knowledge is information that is modeled to be useful.
2. You need information to be able to get knowledge.
3. Information deals with the way data is related while knowledge examines patterns within a given set of information.
4. To get knowledge you need some cognitive and analytical ability while for information you do not need cognitive ability.

POWER YOUR MIND

SNACKS FOR MIND

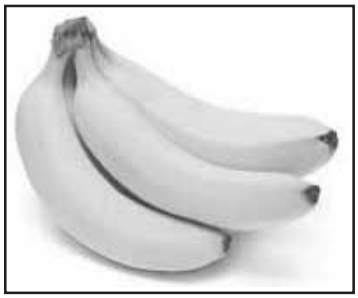
It is better to sleep
Than to slip
For the one gives you rest
The other fall from the best.



Courtesy: Swami Srikantananda

Don't be in a hurry
But postpone indefinitely
Your wrong motives, selfish desires
And immoral activities
That is the only way to escape
From the fury of worry.

BANANA



This is interesting. **After reading this, you'll never look at a banana in the same way again. Bananas contain three natural sugars - sucrose, fructose and glucose combined with fiber. A banana gives an instant, sustained and substantial boost of energy. Research has proven that just two bananas provide enough energy for a strenuous 90-minute workout.**

No wonder the banana is the number one fruit with the world's leading athletes. But energy isn't the only way a banana can help us keep fit. It can also help overcome or prevent a substantial number of illnesses and conditions, making it a must to add to our daily diet.

Depression: According to a recent survey undertaken by MIND amongst people suffering from depression, many felt much better after eating a banana. This is because bananas contain tryptophan, a type of protein that the body converts into serotonin, known to make you relax, improve your mood and generally make you feel happier.

PMS: Forget the pills - eat a banana. The vitamin B 6 it contains regulates blood glucose levels, which can affect your mood.

Anemia: High in iron, bananas can stimulate the production of hemoglobin in the blood and so helps in cases of anemia.

Blood Pressure: This unique tropical fruit is extremely high in potassium yet low in salt, making it perfect to beat blood pressure. So much so, the US Food and Drug Administration has just allowed the banana industry to make official claims for the fruit's ability to reduce the risk of blood pressure and stroke.

Brain Power: 200 students at a Twickenham (Middlesex) school were helped through their exams this year by eating bananas at breakfast, break, and lunch in a bid to boost their brain power. Research has shown that the potassium-packed fruit can assist learning by making pupils more alert.

Constipation: High in fiber, including bananas in the diet can help restore normal bowel action, helping to overcome the problem without resorting to laxatives.

Hangovers: One of the quickest ways of curing a hangover is to make a banana milkshake, sweetened with honey. The banana calms the stomach and, with the help of the honey, builds up depleted blood sugar levels, while the milk soothes and re-hydrates your system .

Heartburn: Bananas have a natural antacid effect in the body, so if you suffer from heartburn, try eating a banana for soothing relief.

Morning Sickness: Snacking on bananas between meals helps to keep blood sugar levels up and avoid morning sickness.

Mosquito bites: Before reaching for the insect bite cream, try rubbing the affected area with the inside of a banana skin. Many people find it amazingly successful at reducing swelling and irritation.

Nerves: Bananas are high in B vitamins that help calm the nervous system.

Overweight and at work? Studies at the Institute of Psychology in Austria found pressure at work leads to gorging on comfort food like chocolate and crisps. Looking at 5,000 hospital patients, researchers found the most obese were more likely to be in high-pressure jobs. The report concluded that, to avoid panic-induced food cravings, we need to control our blood sugar levels by snacking on high carbohydrate foods every two hours to keep levels steady.

Ulcers: The banana is used as the dietary food against intestinal disorders because of its soft texture and smoothness. It is the only raw fruit that can be eaten without distress in over-chronicler cases. It also neutralizes over-acidity and reduces irritation by coating the lining of the stomach.

Temperature control: Many other cultures see bananas as a "cooling" fruit that can lower both the physical and emotional temperature of expectant mothers. In Thailand , for example, pregnant women eat bananas to ensure their baby is born with a cool temperature.

Seasonal Affective Disorder (SAD): Bananas can help SAD sufferers because they contain the natural mood enhancer tryptophan.

Smoking &Tobacco Use: Bananas can also help people trying to give up smoking. The B 6, B 12 they contain, as well as the potassium and magnesium found in them, help the body recover from the effects of nicotine withdrawal.

Stress: Potassium is a vital mineral, which helps normalize the heartbeat, sends oxygen to the brain and regulates your body's water balance. When we are stressed, our metabolic rate rises, thereby reducing our potassium levels. These can be rebalanced with the help of a high-potassium banana snack.

Strokes: According to research in The New England Journal of Medicine, eating bananas as part of a regular diet can cut the risk of death by strokes by as much as 40%!

Warts: Those keen on natural alternatives swear that if you want to kill off a wart, take a piece of banana skin and place it on the wart, with the yellow side out. Carefully hold the skin in place with a plaster or surgical tape!

So, a banana really is a natural remedy for many ills. When you compare it to an apple, it has four times the protein, twice the carbohydrate, three times the phosphorus, five times the vitamin A and iron, and twice the other vitamins and minerals. It is also rich in potassium and is one of the best value foods around So maybe its time to change that well-known phrase so that we say, "A banana a day keeps the doctor away!"

Never, put your banana in the refrigerator

PS: Bananas must be the reason monkeys are so happy all the time! I will add one here; want a quick shine on your shoes?? Take the INSIDE of the banana skin, and rub directly on the shoe...polish with dry cloth. Amazing fruit!

TEETH CARE TIPS

Everyone needs dental care every day. Brushing and flossing are crucial activities that affect our health. In fact, dental care is just as important to your client's health and daily routine as taking medications and getting physical exercise. A healthy mouth helps people eat well, avoid pain and tooth loss, and feel good about themselves.

- Brush your teeth once/twice a day prior to sleeping using a medium tooth brush.
- Massage your gums once a day with your finger for one minute.
- Avoid using abrasive tooth powders, salt, tobacco, etc. for cleaning the teeth.
- Avoid use of any other person's tooth brush.
- Change your tooth brush at least once every 90 days.
- Use dental floss for removing food particles; avoid the use of pins, etc.
- Do not smoke, use tobacco, chew gum, eat chocolate, candy etc.
- Eat plenty crunchy fresh vegetables and fruit.
- In case of irregular, sharp, broken teeth, contact your dentist.
- Do not apply medicine without consulting your doctor.
- In case of tooth ache, gum bleeding, ulcers of the gum and cheek, white patches, etc, consult your dentist.
- Regular dental check ups every six months; especially for growing children is essential
- Wash your mouth immediately after eating any chocolates.

Tips for Dental Care

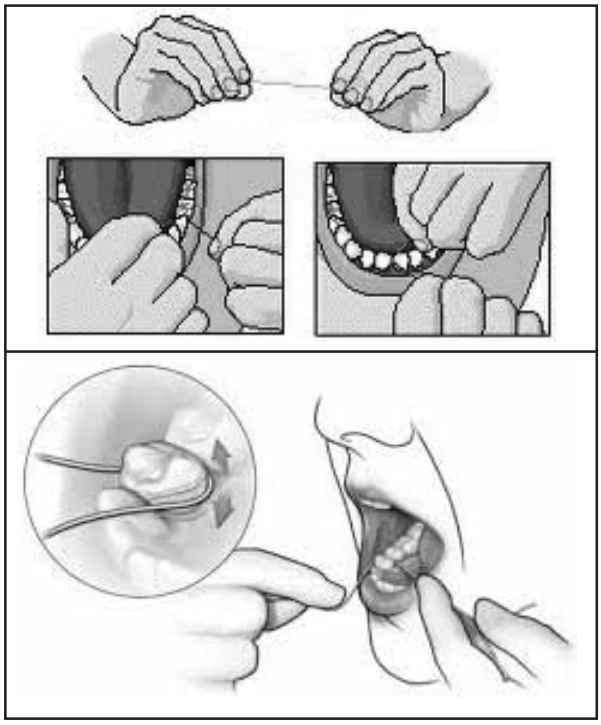
Things have come a long way since we put baking soda on our fingers to clean our teeth and had to wear wooden dentures if they fell out! Thank goodness! Nowadays, we have an enormous assortment of dental health and dental care products to help us get rid of plaque and bacteria that are gentle on our gums. Still, people are visiting the dentists so what is going wrong? There is so much more to know about dental health than simply brushing twice a day to get white, cavity free teeth, so we have compiled a list that covers everything you need to know about oral care.

1. Brushing

Use a soft bristled brush, preferably one with rounded, synthetic bristles. Replace your toothbrush approximately every two to three months or as soon as the bristles are worn or bent. A worn-out toothbrush does not clean your teeth properly, and may actually injure your gums. You should also replace your toothbrush after you've had a cold.

- Be sure your brush is the right size (in general, smaller is better than larger).
- Place the bristles at a 45 degree angle to the gum line, and slide the tips of the brush under the gums.
- Gently jiggle the bristles or move it in small circles over the tooth and gums.
- Brush the outside, the inside, and the chewing surfaces of your teeth. For chewing surfaces, use a light back and forth motion.
- For the front teeth, brush the inside surfaces of the upper and lower jaws: Tilt your brush vertically and make several strokes up and down with the front part of the brush over the teeth and gum tissues.
- Brushing your tongue will help freshen your breath. Debris and bacteria can collect on your tongue and cause bad breath.
- Since your toothbrush will only clean one or two teeth at a time, change its position to clean each tooth properly.
- Brush **at least** once every day, preferably at bedtime. Adding a brush time after breakfast increases your chances of thorough daily plaque removal.
- Take your time: A thorough brushing should take at least 3 minutes.
- Don't brush your teeth too vigorously, and don't use a hard bristled toothbrush, since it causes the gums to recede and exposes root surfaces. It also wears down the tooth structure. Both of these conditions can lead to tooth sensitivity.
- A pea-sized amount of fluoridated toothpaste is sufficient.
- Replace your brush when the bristles begin to spread, as a worn out toothbrush will not properly clean your teeth.

2. Flossing

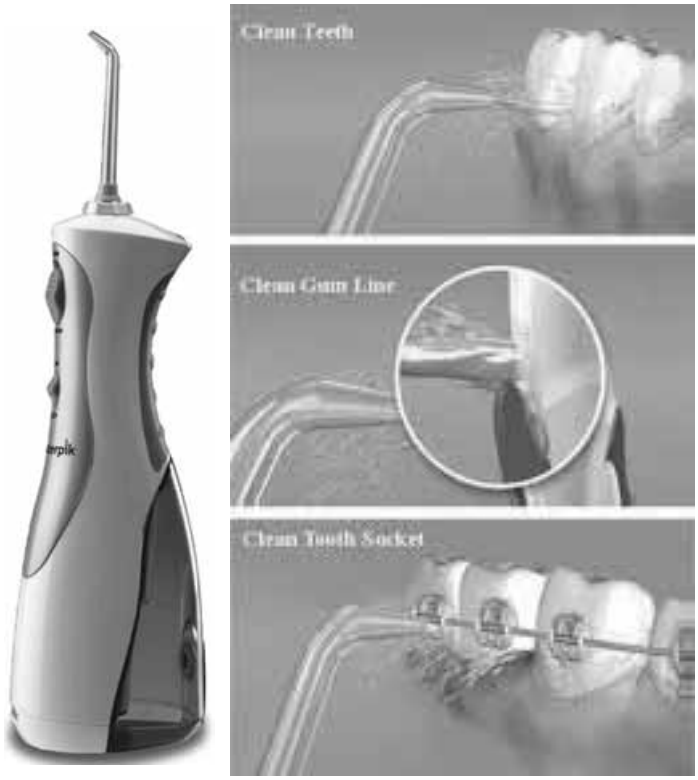


- Wrap about 18 inches of floss around the middle fingers of your hands.
- Hold the floss tightly, using your thumbs and forefingers, and gently guide it between your teeth. Don't "snap" the floss as this can cut the gums!
- When the floss reaches the gumline, curve it into a C-shape against one tooth and gently slide it into the space between the gum and the tooth until you feel pressure against the tooth.
- Gently scrape the side of the tooth with the floss.
- Repeat this method on all your teeth.
- Move to a clean area of floss after one or two teeth.

3. Electric toothbrushes

Electric toothbrushes are recommended by a large number of dental professional for their superior performance when compared to manual brushing. Electric toothbrushes tend to have small brush heads that cup around the tooth and are faster and more efficient in cleaning areas of the mouth where bacteria and plaque collect.

4. Waterjets



Waterjets, or Oral Irrigators, used instead of flossing, are devices where pressurised streams of water are blasted out of the device to remove plaque from the areas between the teeth not reached by brushing alone. Tests have shown that if you use a waterjet inconjunction with daily brushing, you will remove 99% more plaque than via brush alone. Gum health is also improved by up to 93%, compared to brushing alone and gingivitis and calculus are significantly reduced after only 2–4 weeks of use.

5. Avoiding dry mouth

Saliva provides an essential defence against tooth decay and periodontal disease. Where there is insufficient saliva serious dental health problems can arise. Persistent dry mouth could be a symptom of a disease or a side effect of certain medicines. For dry mouth sufferers there are a number of highly effective products that either stimulate saliva production or replace it altogether. For more information read: Dry Mouth Symptoms And Treatments.

6. Fresh breath

There are a number of causes of bad breath, the most common of which is poor oral care. Volatile Sulphur Compounds (VSC) are produced when naturally occurring bacteria break down plaque and food debris in the mouth. By keeping plaque and debris in check bacteria have less to feed on and reproduce less frequently. In addition to cleaning thoroughly between the teeth it is recommended that you also clean your tongue on a daily basis.

7. Use of mouthwash

If you are looking for a good mouthwash then make sure it is alcohol-free, as alcohol is an irritant and can dry out the mouth. This will have the effect of reducing the amount of saliva present, and make your teeth more susceptible to bacteria. The benefits of a mouthwash are that they can reach areas not touched by brushing alone. Rinse twice a day – once in the morning and last thing at night and always after brushing.

8. Whiter teeth

A white smile eludes health and happiness but particularly difficult to achieve for those who smoke, drinking red wine and other tannin containing drink. Luckily there are a number of products available that will enable you have the smile you've always wanted. Find more information about home teeth whitening here.

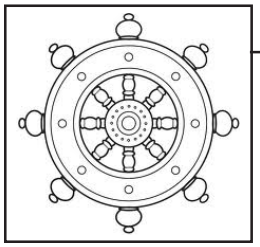
9. Clean your tongue

A major cause of bad breath can actually come from bacteria building up on your tongue with a high percentage of it accumulating at the back, making it hard to reach. Use a proper tongue scraper every morning to remove tongue plaque and freshen your breath. A daily tongue scraping will help banish harmful bacteria and remember, using a tongue scraper is more effective than brushing your tongue with a toothbrush.

Courtesy: http://www.dentocare.co.uk
www.prevention.com
http://www.affordable-dental-insurance-plans.biz

***The greatest barrier to success is the fear of failure* - SVEN GORAN ERIKSON**

DHARMA - 2



Vedas-The Sole and Ultimate Authority

The four Vedas, the Smriti texts, the behaviour of those who have entered into their spirit (the spirit of the Vedas) and act according to their injunctions, the conduct of holy men and satisfaction of one's own self- these are the bases of Dharma. In the matter of Dharma, the Vedas are the ultimate authority. You cannot know the truth about Dharma through any source of knowledge other than the Vedas. Reason cannot be the authority in the matter of Dharma. Among the scriptures of the world, the Vedas are the oldest. This is supported by all leading scholars and antiquarians of the entire civilised world. They all declare with one voice, that of all books, so far written in any human language, the Rig-Veda Samhita is undoubtedly the oldest. No antiquarian has been able to fix the date when the Rig-Veda Samhita was composed or came to light.

The Changing Dharma

Just as a doctor prescribes different medicines for different people according to their constitution and the nature of their disease, so also Hinduism prescribes different duties for different people. Rules for women are different from the rules for men. The rules for different Varnas (castes) and Ashramas (the four stages of life) vary. But, non-violence, truth, non-stealing, cleanliness and control of the senses, are the duties common to all men.

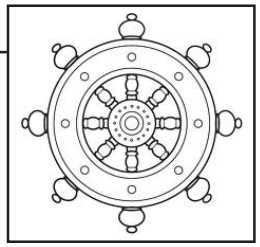
Dharma depends upon time, circumstances, age, degree of evolution and the community to which one belongs. The Dharma of this century is different from that of the tenth century.

There are conditions under which Dharma may change its usual course. Apad-Dharma (apad = distress) is such a deviation from the usual practice. This is allowed only in times of extreme distress or calamity.

What is Dharma in one set of circumstances becomes Adharma in another set of circumstances. That is the reason why it is said that the secret of Dharma is extremely profound and subtle. Lord Krishna says in the Gita: "Let the scriptures be the authority in determining what ought to be done and what ought not to be done" - Gita (Ch.16- 24). The truth of Dharma lies hidden. Srutis and Smritis are many. The way of Dharma (which is) open to all is that which a great realised soul has traversed.

Dharma in Other Religions

All other religions also lay stress on Dharma. Buddhism, Jainism, Christianity, Sikhism, Zoroastrianism and Islam are all remarkably alive to its value. Plato, Socrates, Aristotle, Kant, Swedenborg and Spinoza are all striking examples in the interesting history of Western philosophy for the high pedestal on which they have placed morality, duty and righteousness, and adored them all as the only means to the attainment of the goal of life. Each religion lays greater stress on certain aspects of Dharma.



Benefits of the Practice of Dharma

Of the four grand objects of human aspirations (Purusharthas), viz., Dharma, Artha, Kama and Moksha. Dharma is given the foremost rank in the scriptures. Dharma alone is the gateway to Moksha, to immortality, infinite bliss, supreme peace and highest knowledge. Dharma alone is the primary Purushartha. Dharma is the first and foremost Purushartha. Through the practice of Dharma alone can you ever hope to achieve the crowning glory of all human endeavours, viz., Moksha (liberation) which is the best and the highest of all desirable things.

Practice of Dharma leads to the perfect realisation of essential unity or the final end, the highest good, namely, Moksha (liberation). The practitioner experiences peace, joy, strength and tranquillity within himself. His life becomes thoroughly disciplined. His powers and capacities are exceedingly intensified. He realises that there is one underlying homogeneous essence, a living truth, behind these names and forms. He is transmuted into divinity. His whole nature gets transformed. He becomes one with the Eternal. He beholds Brahman (the Supreme Reality) above, Brahman below, Brahman to the right, Brahman to the left, Brahman in front, Brahman at the back, Brahman within, Brahman without and Brahman pervading the whole world.

Kinds of Dharma

Dharma can be classified under two heads: ***1) Samanya or the general, universal Dharma; 2) Visesha or the specific, personal Dharma.***

1.Contentment, 2.forgiveness, 3.self-restraint, 4.non-stealing, 5.purity, 6.control of senses, 7.discrimination between right and wrong, as also between the real and the unreal, 8. spiritual knowledge, 9.truthfulness and 10.absence of anger come under the general or universal Dharma.

The rules of the castes and orders of life are specific Dharmas. These are the tenfold characteristics of Dharma according to Manu. Dharma assumes various kinds: **Sanatana Dharma** (Eternal Law), **Samanya Dharma** (general duty), **Visesha Dharma** (special duty), **Varnashrama Dharma** (duties of caste and Order), **Svadharma** (one's own duty), **Yuga Dharma** (duty of the age or period in history), **Kula Dharma** (duty of family), **Manava Dharma** (duty of man), **Purusha Dharma** (duty of male), **Stri Dharma** (duty of female), **Raja Dharma** (duty of king), **Praja Dharma** (duty of subjects), **Pravritti Dharma** (duty in worldly life) and **Nivritti Dharma** (duty in spiritual life).

(To be continued)

Leave alone whatever arises in the mind. Do not seek to change or alter anything. It is all PERFECT as it stands.

HOME FESTIVALS

Adi (July/August)

There are two major home festivals this month. The first is Adi-Perukku, in honour of the Kaveri River. Women and girls go to the nearest river where they place offerings on a bamboo tray (upper left) into the water, then have a feast upon the riverbank. Varalakshmi Vratam ("Vow to bring Lakshmi") is also a ladies' festival, in which paintings of the Goddess of Wealth are made upon the walls (upper right), kumbha pots intended for worship are decorated with Her image. Beside the pot are placed various cosmetics, comb, beads, etc and worship is done. Then the ladies sing songs inviting the Goddess to their home. Kozhukkatai, rice and jaggery cakes are a favourite of the day. In the evening, friends are invited to the home and given clothing, coconuts and sweets.

(To be continued)

HUMOUR

KUTTY CHUTTY Stuffs

Reaching Heaven

A Sunday school teacher asked the children in her class, "If I sold my house and my car, had a big garage sale and gave all my money to the church, would I get into Heaven?"

"No!" the children all answered.

"If I cleaned the church every day, mowed the yard, and kept everything neat and tidy, would I get into Heaven?"

Again the answer was "No!"

"Well", she continued, "then how can I get into Heaven?"

A five-year-old boy shouted out, "You gotta be dead!"

Talking chicken

One day the first grade teacher was reading the story of Chicken Little to her class. She came to the part of the story where Chicken Little tried to warn the farmer. She read, ".... and so Chicken Little went up to the farmer and said, "The sky is falling, the sky is falling!"

The teacher paused then asked the class, "And what do you think that farmer said?"

One little girl raised her hand and said, "I think he said: 'Holy Mackerel! A talking chicken!'"

The teacher was unable to teach for the next 10 minutes.

Use the ATM

A man asks a trainer in the gym: "I want to impress that beautiful girl, which machine can I use?"

The trainer replied; "Use the ATM outside the gym!!!"

SMART LADY!!

A lady rang up St. Joseph 's Hospital and timidly asked, "Is it possible to speak to someone who can tell me how a patient is doing?"

The operator said, "I'll be glad to help, dear, if you tell me the name and room number of the patient?" The sweet lady in a weak, tremulous voice said, "Norma Findlay, Room 302."

The operator said, "Let me put you on hold while I check with the nurse's station for that room."

After a few minutes, the operator returned to the phone and said, "I have good news.... Her nurse just told me that Norma is going normal.... Her blood pressure is fine, her blood report just came in and - all is ok, and by the way her physician, Dr. Cohen, has scheduled her to be discharged tomorrow."

The sweet lady said, "Thank you... That's wonderful..!! I was so worried. God bless you for the good news..!!"

The operator replied, "You're more than welcome... Is Norma your daughter?"

The lady said, "No, I'm Norma Findlay in Room 302... No one tells me anything"

Happiness cannot be owned, earned, worn or consumed.

Happiness is the spiritual experience of living every minute with love, grace and gratitude.

cqfs; Nritapy! nrdid fhty!

mtru Nghy]; - 100

mtru kUjJt rpfpr ir - 108

ehd; NgZk; fhty; Jiwapdh;
xU rhrpUjjf; FOtpduhfNt mikth;.
mzzy; fhejpabfs;

nrdid fhty; Jiwapd; Ntz;LNfhs;

jpUlL Fwwqfis jLf;f vLf;fNtz;ba topKiwfs;

nghJkf;fs; ftdjpwF

- rllk; xOqif epiyehlLtJ, Fwwqfis jLggJ, NghfFtujJ neupriy rhgLjJtJ Nghdw; mdwhl; fhty; Jiwgz;fF kpfTk; Njitggltj; nghJ kffshfpa cqfs; xjJiogG.
- ngUfptUk; kffs; njhif, khwptUk; ehfhfk, tsheJtUk; tpQQhdk; ,itfSld; Nghlb NghlLf; nfhzL Fwwqfis fhtyJiwgy; topfspYk; vjphNehffp jLjJ tUfpwJ.

tLfspy; Fwwqfis jLf;f vdd nraa Ntz;Lk?

1. GoqFk; Neuk; jtpu,gfy; ,uT vgNghJk; tlbd; gpd; gffk; GlbNa ,Uff; Ntz;Lk;.
2. gpd; ,uT 10 kzpfFg; gpwF Kd; thry, nfhyiygGwk; ,uzbd; gffjjpYk; [Nuh thl;] gyG mjpfhiy tiu vupa Ntz;Lk;.
3. tpiy FiwT vdW, jukpyyhj G+lLfs; Nghlhky, jukhd G+lLfis klLNk cgNahfpff; Ntz;Lk;.
4. ntspA+h nryYkNghJ, tlbd; csGwkhf G+lL NghlLf; nfhzL nryy; Ntz;Lk;.
5. cqfsJ ntspA+h tp[aqfis gfpuqfggLjjhky; Nghf; Ntz;Lk;.
6. mffk; gffk; css tlhUld; RKfkhf njhlhGfs; itjJf nfhss; Ntz;Lk;.
7. [ddyfspy; csGwkhf fkgptiy mbAqfs;.
8. khbggb fjTfis Njitaww; Neujjpy; G+lb itff; Ntz;Lk;.
9. tlLrrhtp, gNuh rhtpfs; njhiyeJ tpllnjdwhy, khwWrhtp Nghlhky G+lilNa khwwptpLqfs;.
10. ntspA+H NghFkNghJ gNuhrrhtpfs, tlLrrhtpfs Mfpatwiw ifapy vLjJf nfhzL nryYqfs;.
11. b.tp ghhfFkNghJ, rikay nraAkNghJ tlbd; Kd gpd; fjTfis G+lb tplL teJ clfhUqfs;.
12. vej Neukhdhyk; rhp, fjit ahuhtJ jlbdhy, jlLtJ ahh vdW ftdpAqfs;. gpwF fjitj jpwqfs;.
13. ,utpy]$llH, fhH, irffps Mfpa thfdqfisf fhkgTz;LfF csNs epWjjp G+lb itAqfs;.
14. fhh,]$lh Nghdw thfdk itjjpUggthfs ntspA+h Nghdhy, tzblhqfpd nglNuhiy fhyp nraJtplLr nryYqfs;.
15. cqfs njUggffk myyJ tlLggffk ghprrakpyyhj eghfs elkhllk reNjfk vOkgbahf ,Uejhy tprhhpAqfs myyJ fhtyepiyajjpy clNd jfty nfhLqfs;.
16. tlbd gpd thry fjT, khb fjTfSfF “mbjzlh” fllhak Nghl Ntz;Lk;.
17. tlbid xlb kuqfspy fpisfs tshejpUejhy ntlb tpLqfs;.
18. lhhr iyl Nglhpald vgNghJk tlby itjJ ,Uff; Ntz;Lk;.
19. tlL ntspgGwjjpy fopggiw ,UfFk tLfspy, ,uT ghj&k nryy Nehejhy ahuhtJ xUtiu vOggp ghJfhgghf ,Uffr nrhyytplLr nryYqfs;.
20. ghjjpuqfs, Jzpkzpfs ,utpy tlLgpdGwk ,Uffhky ghhjJf nfhss Ntz;Lk;.
21. mYkpdpa jhogghsfs moFjhd. Mdhy ghJfhggyy. vdNt, Kd thry gpd thry fjTfSfF ,UkG jhogghsfisNa NghLqfs;.
22. tlby nuhffj njhiffis ifapUgghf itjJfnfhstij jtpUqfs;.
23. J}qfr nryYk KdG, tlbd nghWgghd eghfs gpd fjT, Kd fjT G+lb cssjh, mbjzlh NghlLssjh vdW rhpghhjJf nfhsSqfs;.

gfyNeujjpy ghJfhtyh epakpf fggLtJ fllhak

1. ntspA+h nrytjhf ,Uejhy fhty Jiwapd UfF nrhytJ eyyJ. fhty Jiwapdh cqfsJ tlil jpdKk ghJfhgghf ghhjJf nfhsthhfs.
2. cqfs tlBNyh mgghhlnkdbNyh css nrffpA+hplb mej Fbapugpy teJ NghNthhfis gwwp xU Nehl Gjjfjjpy Fwpj Jf nfhss Ntz;Lk;. XtnthU

Fba‰UgGfs‰Yk CCTV Nfkuh nghUjj Ntz Lk.

3. Fba‰Ugg‰y teJ t‰wgid nraAk eghfNsh myyJ t‰skguk nraaf$ba eghfisNah xtnthU Fba‰UgGfFk mDgg $lhJ. mthfis mgghhlnkdbd nts‰a‰NyNa ,Uff nraa Ntz Lk.
4. cqfs njU t‰sfFfs vh‰ahky ,Uejhy rkgejggl mYtyhfSfF jftynfhLqfs.
5. cqfs tlL fjTfSfF eskhd rht‰fs mlqf‰angl bgG+lLfs ghJfhgg‰wF r‰wejJ. tlbd miogG kz‰ xy‰fFkNghJ tej‰Uggtiu njh‰eJ nfhss [ddy to‰ahfNth, fjt‰y nghUej‰a nyd] to‰ahfNth ghhjj g‰dG myyJ etd vyfluhd‰f]gffh %yk Ngr‰Nah fjit j‰wffyhk.
6. thry kwWk Kd fjTfSfF $Ljyhd f‰h‰y fjTfs kwWk fjTfSld css rqf‰y‰ ,izgGfs ,yy ghJfhgig gyggLjJk.
7. cqfs tlbd f‰h‰y rddyfis]FU Kiwa‰y nghUjjhky Rtww‰y Mokhfnrh Uf‰ nghUjJtJ ghJfhgghdJ.
8. Fs‰ayiw kwWk VHfzb\d [ddyfSfF $Ljy f‰h‰y fkg‰ ghJfhgG nfhLqfs.
9. cqfs nkhlil khba‰y ,Uej khbggb to‰ahf tlbDs tu VJthf ,yyhj tifa‰y jLgG RtH kwWk fjTfis miljJ NjitggLkNghJ j‰wffTk.
10. tlil G+lbt‰lL nts‰A+H nrygtHfs gffjJ tlL egHfs‰lk ghHjJf nfhss nrhyyhky Kbejhy njh‰ejtHfis fhty itjJr nryYqfs.
11. gfy Neuqfs‰y jzzH NflNlh, t‰rhuiz vdw ngah‰Nyh, t‰wgidahsHfshfTk, k‰drhuk, njhiyNgr‰h‰gNgH nragtHfshfTk, ghyftH, gioa NgggH thqFgtHfshfTk eiffSfF ghy] NghLgtHfshfTk tLfs‰y Nehllk ghHff j‰UlHfs tUthHfs. vrrh‰fifahf ,UffTk. milahs mlil fhzg‰ff nrhyy‰ NfSqfs.
12. reNjfjj‰wf‰lkhf ahNuDk cqfs tlilNah, njUt‰Nyh Rww‰j j‰h‰ejhy fhtyJiwfF jftynfhLqfs.
13. tlby Ntiyffhu Hfis e‰ak‰fFkNghJ mtHfsJ ,Ugg‰l Kfth‰, kwWk Gifgglk Nrfh‰jJf nfhstJ eyyJ. tlL Ntiyffhuhfs‰lk tlil ghHjJf nfhss nrhytij jt‰HffTk. cqfs gzk kwWk eiffis ghJfhff Ngqf yhffH k‰fr‰wejJ. XU ehs, ,uzL ehsjhNd vdW e‰idff Ntzlhk.
14. mee‰a egHfSfF cqfs tlil thliffF t‰LkNghJ mtHfSila mYtyf njho‰y t‰guqfs, iyrd], Ngqf gh]Gf, gh]NghHl Nghdw milahs efy ngww g‰dG mDkj‰ffTk.

rqf‰y‰, nryNghd, ifgig gw‰gig jt‰Hff

1. ngzfs jd‰ahf eleJ nryYkNghJ nryNghd Ngr‰fnfhzL nryyf$lhJ. mtthW nrdwhy j‰UlHfs nryNghid gw‰jJ nryyf$ba thagGssJ.
2. ifgig gw‰ggij jLff ifgigia tyJ Gwk khllhky ,lJ Gwjj‰y ifgigia khlb nrytJ eyyJ.
3. ngzfs jd‰ahf nts‰a‰y nryYkNghJ reNjf egHfs g‰d njhlHeJ tejhy vrrh‰fifAld nraygll mUf‰y cssstHfs‰lNkh, fhty fllLghll miwAlNdh njhlHG nfhssTk.
4. ngzfs jd‰ahf eiffis mz‰eJ nfhzL Nfht‰y, Fkghg‰N\fk Kjy‰a $llke‰iwej ,lqfSfF nryYkNghJ eiffs‰d kJ jd‰fftdk nrYjjTk.
5. eiffs‰d nfhff‰fSld xU g‰d ,izjJ cqfs Milfs‰y NrHjJ NfhHjJf nfhstJ $Ljy ghJfhgG nfhLfFk.
6. t‰iy caHej nghUlfisNah, eiffisNah vLjJf nfhzL MlNlh kwWk fhy lhfr‰a‰y gazk nraAkNghJ thfdjj‰d vzfis Fw‰jJf nfhstJld biutHfisAk edF milahsk ghHjJf nfhsSqfs.
7. ,uT Neuqfs‰y [ddyfis j‰weJ itjJf nfhzLk, nkhlil khba‰y fhwW trj‰ffhf J}qFkNghJk ftdk Njit.

cqfs ftdjijj j‰irj‰Ugg‰ elfFk j‰UlLfs

1. eqfs mj‰f gzk vLjJr nryYkNghJ cqfs Mila‰y mUtUffjjff nghUlfis njs‰jJf jzzH nfhLjJ fOTtJ Nghy cqfs ftdjij j‰ir j‰Ugg‰ j‰Ul Kawr‰gghHfs.
2. gzk kwWk eiffis itjj‰UggtHfs‰d ftdjij j‰irj‰Ugg &gha NehlLfis fNo NghlL cqfs gzk fNo f‰lff‰wJ vdW cqfs nghUlfis fsthl Kawr‰gghHfs.
3. cqfis ahuhtJ mioff‰whHfs vdW cqfis j‰irj‰Ugg‰ cqfs nghUlfis j‰ULthHfs.
4. cqfs Foeijfis J}ff‰ cjTtJNghy cqfsJ nghUlfis thqf‰ itggJ Nghy, cqfs eiffs‰d khlyfis thqf‰ ghHggJ Nghy, cqfs ftdjij j‰irj‰Ugg‰ j‰ULgtHfSk czL.
5. NgUeJ kwWk ua‰y‰y neh‰ry‰y VWkNghJ cqfs gzk kwWk ifgigfs‰y kJ ftdk itAqfs. g‰fghfnfl egHfs $ll neh‰ryfis jqfSfF rhjfkhf gadgLjj‰f nfhs‰whHfs.

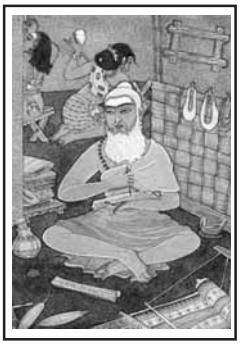
tlby jd‰ahf ,UggtHfs‰d ftdj‰wF

1. eqfs jd‰ahf tlby ,UfFk Neujj‰y cqfs‰d cwt‰dh‰d ngaiu nrhyy‰f nfhzL tUNthiu tlby mDkj‰ffhjHfs.

2. jpdgz lqfis tpskgujjpwfhf nfhz L tUgtHfspik ftdkhf ,UffTk. mtHfs nfhLjj cld rhggplhjHfs. mjpf kaffkUeJ ,Uffyhk.
3. fytuk elffpwJ. ehqfs fhty Jiwia NrHejtHfs. cqfSila eiffis fowwp itjJf nfhs Sqfs vdW $wpdhy mtHfs VkhwWk NgHtopfs. mtHfspik Vkhwhjhfs.
4. ,Urffu thfdg nglbfspy tpiyAaHejgzk, nghUlfs nfhz L nryYk NghJ buhgpf rpfdy kwWk jilffy mUNfepWjJk NghJk nkJthf nryYkNghJk nghUlfs kJ ftdk ,Uff Ntz Lk.
5. thfdqfis nghOJNghfF ,lqfspNyh, flwfiu rhiyfspNyh, xllyfspNyh kwWk rhiyNahuk epWjjkNghJ mjpy Nyglhg, nryNghd, ifgig, Nfkuh Nghdw nghUlfis itjJtpiL nryyhjHfs.
6. ,U rffu thfdqfis tlbwF ntspNa ghJfhggpyyhj ,ljjpy epWjJtij jtpHff Ntz Lk.
7. thfdjij epWjjpr nryYkNghJ rhpahf G+lgglbUffpwjhvdW rhpghHjjy Ntz Lk. ,UkGr rqfpypiaf nfhz L gpizjjpl Ntz Lk.
8. ,uT Neuqfspy rhiy Xuqfspyk, njU Xuqfspyk, kpdtpsfF ntsprrk ,yyhj ,lqfspyk thfdqfis epWjjp nrytij jtpHff Ntz Lk.
9. gioa thfdqfis tpiyfF thqFkNghJ mtthfdjjpd gjpNtLfs, vQrpd kwWk Nrrp] vzfs rhpahf cssdthvd jzpfif nraahky thqFtij jtpHff Ntz Lk.

edw: jukz, fhty rufk

TIRUKKURAL AND MANAGEMENT IN A 'NUTSHELL' - 2



Dwelling on very basic thoughts on Management, we find that some of the "Fundamentals" are brought by some of the very simple statements like:

"Management is basically Relationships and Judgement."

"Even the Best of Ideas can't be implemented without adequate Resources"

Relationship refers to Support and Loyalty of Customers, Suppliers, Employees and other stake holders, which must be strong like Pillars for Buildings.

Tiruvalluvar brings out the essence of these principles simply and beautifully in the following Kural:

Mudalilarkku Oothiyam Illai Mathalaiyam
Saarbilarkku Illai Nilai ***Kural 449***

Kjy,yhHfF Cjpak ,yiy kjiyahk
rhHG,yhHfF ,yiy epiy. **Fws; 449**

"Without adequate Capital, there can be no Success in Business; Without 'Pillar' like support from all connected (depended) there can be no Stability of Business"

Two things help success in life

The way you MANAGE when you have nothing
The way you BEHAVE when you have everything

FRIENDS

A simple friend has never seen you cry.
A real friend has shoulders soggy from your tears.

A simple friend doesn't know your parents' first names.
A real friend has their phone numbers in his address book.

A simple friend brings a bottle of wine to your party.
A real friend comes early to help you cook and clean.

A simple friend hates it when you call after he has gone to bed.
A real friend asks you why you took so long to call.

A simple friend seeks to talk with you about their problems.
A real friend seeks to help you with your problems.

A simple friend wonders about your romantic history.
A real friend could blackmail you with it.

A simple friend, when visiting, acts like a guest.
A real friend opens your refrigerator and helps himself.

A simple friend thinks the friendship is over when you have an argument.
A real friend knows that it's not a friendship until after u've had a fight.

A simple friend expects you to always be there for them.
A real friend expects to always be there for you!

A simple friend will read and throw this letter away.
A real friend will keep sending it until he's sure it's been Received.

The Problem about being a Programmer

Mom said: "Honey, please go to the market and buy 1 bottle of Milk. If they have eggs, bring 6"

Boy came back with 6 bottles of milk.

Mom said: "Why the hell did you buy 6 bottles of Milk?"

Boy said: "BECAUSE THEY HAD EGGS!!!!"

THREE GORGES DAM
THE WORLD'S LARGEST HYDROELECTRIC PLANT

In 2012, the Three Gorges Dam in China took over the #1 spot of the largest hydroelectric dam (in electricity production), replacing the Itaipú hydroelectric power plant in Brazil and Paraguay. The Three Gorges Dam has a generating capacity of 22,500 megawatts (MW) compared to 14,000 MW for the Itaipu Dam. But, over a year-long period, both dams can generate about the same amount of electricity because seasonal variations in water availability on the Yangtze River in China limit power generation at Three Gorges for a number of months during the year.

The height of Three Gorges is about 594 feet (181 meters (m)) and the length is about 7,770 feet (2, 335 m). The dam creates the Three Gorges Reservoir, which has a surface area of about 400 square miles (1,045 square kilometers) and extends upstream from the dam about 370 miles (600 kilometers).

In the United States, the Grand Coulee Dam on the Columbia River, Washington, is the largest, with a generating capacity of about 6,800 MW (5th overall worldwide).

Flood Control:

Since the beginning of the Han Dynasty 2,300 years ago, there have been 214 major floods recorded, averaging 1 flood every ten years. Within this past century, there have been five major floods that were recorded to have claimed hundreds of millions of lives, millions of acres of farmland, destroyed thousands of homes, and billions of dollars of damage. In 1998, a flood of such catastrophic level in the Three Gorges area caused 4,000 casualties, left 14 million people homeless, and created $24 billion in economic loss.

The proponents of the Three Gorges Dam believe that it will serve to protect 15 million people and 1.5 million acres of farmland in areas of the Yangtze River that are vulnerable to flooding. In order to do this, the water height of the reservoir upstream from the dam will change according to season. During the dry season, from November to April, the water level will be allowed to reach 185 meters above sea level, but during the flooding months, the water level will be reduced to 135 meters in order to attempt to contain flood waters.

Hydroelectric Power:

By the time of it's completion in 2009, the Three Gorges Dam will produce enough electricity to supply 3% of China's total energy needs. The demand for energy is increasing so rapidly in China that the initial estimate in 1993 for energy production capacity was 10% of China's total energy needs. With a total of **26 turbines, each generating 700 megawatts, the dam will have a total generating capacity of 18.2 million kilowatts**. The dam will generate as much energy as 18 coal power plants and will have 20 times as much power capacity as the Hoover Dam in the US. The rate of energy production, equivalent to burning 11,000 barrels of oil per hour, is enough to supply Beijing with power for one year.

Navigation:

The Three Gorges dam will enable better navigation to boost Yangtze River trade, which accounts for 80% of China's inland shipping. The Three Gorges area of the Yangtze is notorious for dangerous shipping conditions. The elevated water levels of the reservoir upstream from the dam will enable larger ships to travel further inland on the Yangtze. In order to facilitate transportation, the dam will have a 5 tier ship lock system to enable ships to pass through the dam. A ship elevator is to be installed by the project's completion in 2009 that will be capable of lifting passenger or cargo ships of 3,000 tons. This new transportation system is said to cut transport costs by one third and increase shipping on the Yangtze from 3 million tons to 50 million tons per year.

The river city of Chongqing is expected to undergo great economic development as a result of the increased trade on the Yangtze. Chongqing was recently approved to be the fourth centrally-administered municipality of China, after Beijing, Shanghai, and Tianjin. It is expected to undergo an urbanization rate of 70% within the next 12 years, with it's population reaching 21 million by 2020.

13 Glorious Years of Earthing

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