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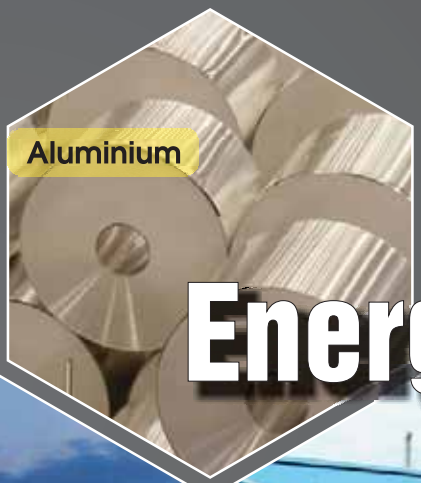
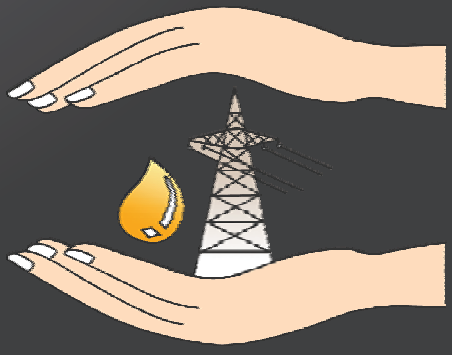
2nd Edition

Survey of Energy Conservation in India 2014

India's first book of its kind on ENCON



ENERGY SAVED IS ENERGY PRODUCED



Energy Audit and Accounting - The way to reduce Power Wastages

*- by **Haren Shah***
Sr Marketing Executive, Meco Instruments Pvt Ltd

The Indian power sector scenario remains gloomy, surrounded by the dark clouds. Although power reforms were started about a decade ago, the achievements are only dismal. The financial health of most of the State Electricity Boards (SEBs) remains critical, mainly due to the uncontrolled use of inefficient power intensive equipment and appliances, heavy subsidies for agricultural sector, T&D losses, and huge power thefts/pilferage.

The losses at SEBs and other utilities also depend on pattern and nature of demand, load density and the capability and configuration of system, equipment used and vary for various system elements.

Energy Audit and Accounting

Energy audit and accounting help in determining the steps to bring wastage within optimum permissible limits. While energy accounting gives an overall picture of energy availability and its use, energy audit analyses the data in a meaningful manner to evolve

with measures those help in reducing losses from leakages and improve technical performance.

Steps involved in energy audit of SEB's and other utilities:

- Review of technical efficiency of system elements in the T&D system.
- Review of performance of the equipments, meters, control panels, and distribution transformers, etc.
- Analysis of the techniques for measuring energy received, energy billed and revenue collection.
- Review and up-gradation of procedure for energy accounting.
- Establishment of norms for checking the consumption of various categories of consumers and overall energy balance in the circle.
- Discrete audit of the segregation of technical and non-technical losses.
- Feeding of data in to computerised billing system and generation of MIS report for each feeder.

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What should be the size of an energy audit report?

"In Malaysia, one of the energy managers during negotiation asked me about the size of the report I was going to submit. I told him I can even give a 5 kg report if that is what he wants. He then kept quiet. Another typical manager in a nearby country!"

"We also sometimes do add a few pages of catalogue to make the report look big on the pretext of helping the customers with ready information if we do not get sufficient ECOs. The bigger the size of the report, the better is the output is the mindset of the majority of people."

-P Balasubramanian, author of "Energy Auditing Made Simple"

Harmonics - A Power Quality Problem

- by ***Haren Shah***
Sr Marketing Executive, Meco Instruments Pvt Ltd

Power quality is defined as any problem manifested in voltage, current or frequency deviation that results in failure or malfunctioning of equipments. For quality performance of various power system/devices, it is necessary to understand the problems due to harmonics deeply and take remedial measures for improvement and better performance.

Harmonics – A Power Quality Problem

- Harmonics, voltage flicker, voltage regulation, voltage sag, voltage swell and transients usually characterise the quality of electric power.
- The presence of harmonics distorts the waveform shape of voltage and current, increases the current level and changes the power factor of supply, which in turn creates lot of disturbances.

Sources and causes of Harmonics

- Rapid use of energy conservation devices in both domestic and industrial sectors such as electronic chokes for tube lights, electronic energy controllers for the motors and electronic fan regulators etc., also inject harmonics substantially.
- Wide use of the shunt capacitors to improve power factor and stability has significant influence on harmonic levels. The supply system converters and traction are the major causes of generation of harmonics.
- More use of solid state power converters for industrial furnaces in mini steel and non-ferrous metal plants, use of thyristors for locomotives, extensive use of single phase electronic loads in domestic sector are also causes of harmonic generation.
- A growing power quality concern is harmonics distortion that is caused by the non-linearity of customer loads.

Harmonics impact on various equipments

Transformers:

The primary effect of power system harmonics on transformers is the additional heat generated by the losses caused due to the harmonics content in the load current. Magnetic loss increases due to higher frequency level of harmonic current. Copper loss increases in winding due to third harmonic current present with load current. Also copper loss increases in the delta connected transformer windings due to extra circulating zero sequence currents.

Rotating Machines

An increase in operating temperature of motors, generators and turbines will cause reduction in operating life of the rotating machines. Extra audible noise is produced during the operation due to the difference between the time harmonic frequencies. Also harmonics cause variation of mechanical resonance speed of adjustable speed drives, which may do damage due to amplification of the pulsating torques.

Capacitors

The effect of the harmonic component is to cause extra power loss due to decrease of impedance by increasing frequency; which in turn increases the temperature level and shortens the life by early equipment failure. Also it increases the dielectric stress inside the capacitors.

Circuit Breakers

The harmonic distortion of the current can affect the interruption capability of the circuit breakers and thermal magnetic breakers. The extra heat due to losses for frequencies above the fundamental raises the temperature of the thermal device, which in turn may reduce the trip point of the circuit breaker.

Measuring Meters

Wattmeter, watt-hour meter, and electronic energy meter show error from the frequency characteristic of the voltage and current waves affected by harmonics. Linearity of the meters can be degraded when the power factor is low or waveforms have large crest factor caused by the harmonics. Absolute average responding meters calibrated in RMS and peak responding meters give erroneous result under the presence of harmonic distortion.

AC/DC Drives

Voltage surges due to harmonics can damage the power diodes connected at the input of an AC variable frequency drive. Under sustained over voltage and under voltage condition the equipment may be shut down. Input voltage waveform containing of harmonics may have multiple zero crossing, which may change the firing angle of the thyristors.

Conductors

There are two mechanisms in which harmonic currents can cause heating in conductors that is greater than the RMS value of the current. The first mechanism is due to current

redistribution within the conductor and includes the skin effect and the proximity effect. The second mechanism causes abnormally high current that is due to excessive third harmonic current in the neutral conductor.

Cables

Harmonics cause extra heating, which in turn causes a degradation of dielectric, production of cable jacket both in its dielectric role and its mechanical protection role, reduction of life span due to oxidation and a possible overall reduction of maximum operating capacity of the cable.

Computer Networks, Control Room, SCADA

Presence of harmonics effects can cause nuisance tripping of sensitive loads. Some computer controlled loads are sensitive to voltage distortion. Data acquisition through SCADA system may get effected due to power disturbance like voltage sag, swell, transient events, and presence of harmonics.

Protective Relays

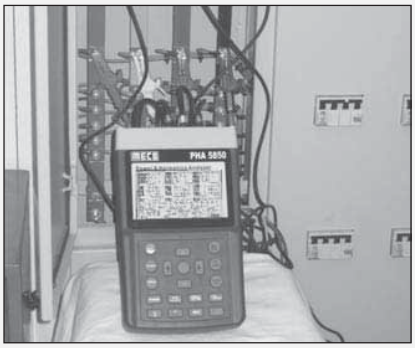
Waveform distortion does affect the performance of protective relays and may cause relays to operate improperly, or not to operate when required as in ground relays due to zero sequence third harmonics and dual input relays by the phase relationship between the respective input harmonics. Changes of operating points, operating torque, and time of static relays may happen due to distortion of waveform, which in turn causes improper high speed operation of difference relays.

Control and remedies for Harmonics

- Limit harmonic current injection from non-linear loads transformer connection can be employed to reduce harmonics in three phase system using parallel delta and wye delta transformers to yield net 12-pulse operation or delta connected transformers to block triple harmonics.
- The harmonic distortion in adjustable speed drives can be controlled within IEEE 519-1992 limits by drive design modification, switching from 6 pulses to higher pulses converters, connection of series reactor.
- Modify system frequency response to avoid adverse interaction with harmonic currents. This can be done by feeder sectionalising adding or removing capacitor banks, adding shunt filters or adding reactors to detune the system away from harmful resonances.
- Applying harmonic like filter harmonic current at the loads or on the system with shunt filters or try to block the harmonic currents produced by the loads. There are number of devices for this. Their selection is largely dependant on the nature of the problems encountered. Solution can be as simple as an in-line reactor (i.e. a choke) as in the PWM based adjustable speed drive applications or complex as designed active filter.
- Monitoring problem manifested in V, I, Hz. data acquisition is the primary step for both the situations. The requirement is the data on the current and voltage distortion both as it exists.
- For quality performance of various power system devices, it is necessary to understand the problems deeply and requires further remedial measures for improvement and better performance.

MECO Power and Harmonic Analyser (Model 5850)

This is a *state of the art* instrument with micro controller technology. It is ideal for vigilance checks, energy audit, surveys and periodic audits. With this instrument, measurements can be done without disconnecting the live loads. Moreover, it can do analysis of almost all the 1/3 phase power system and is also capable of analysing IT standby power consumption to the maximum demand of factory.



It is equipped with LCD display with backlight of 35 parameters in one screen to monitor active, apparent and reactive power, power factor, energy, TRU RMS value, AC current, and average demand and maximum demand with programmable time interval, CT and PT ratios. It can display harmonics upto the 99th order and THD with waveform.

It has features like real time graphic phasor diagram and comes with an in-built memory of 512K for 17000 records and optical isolated RS-232~USB interface with user friendly software for easy downloading of recorded data.

The analyser is available with clamps on CTs having multiple range of 1/10/100A or 10/100/1000A or 300/3000A (flexible CTs) as per application.