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Measurement &Verification off Voltage Optimization by Using Voltage Optimizer for Conserving Energy.

Tarang Chandresh Mehta
Department Of Electrical Engineering, Atharva College Of Engineering, India
Corresponding Author: Tarang Chandresh Mehta

Abstract: *Talking of Voltage Optimization, concerned topic of interest so far, has been related to a co-ordinate control & reduction of power. We receive power from an energy consumer to reduce the energy use with meeting the reactive power demand. Mostly in Japan, these units are essentially installed at commercial sites in between the raw main transformers & main low voltage distribution board. Voltage optimizer is the device used for this purpose. The savings we achieve in terms of energy by applying this technique is actually aggregation of the efficiency that is improved which further leads to improvements in power quality problems.*
Keywords: *Reactive Power, Energy Storage, power quality problems, energy savings, generalized transformer, Voltage Optimizer.*

I. Introduction

A complete study has to be taken into consideration by the managers of the VO Company and the one providing the facility to check how the supplies could benefit the owner & how reducing the voltage to be supplied to consume could benefit the owner as a whole. This way the owner only purchases a VO of the correct size and not one that's for all supplies[1]. Thus installing a VO unit to 'optimize' all supplies would give a longer return on investment, a higher capital outlay and makes no commercial sense. It is possible to make a substantial energy saving and also to increase the life expectancy of the machine. Unfortunately the electrical infrastructure in India has been designed as per 230V standard supply. The reason is, it reduces the transmission & distribution losses, and helps to maintain the supply. Due to which all the electricity companies have no other alternative but to produce voltage at highest sanctioned level. Tests at Manchester University showed a 10°C reduction in motor temperature under voltage optimization due to the reduced losses in the motor.

II. Common Power Quality Problems

A. Transient

Quantitatively the transient can be behavior of the electrical system when it is not constant in time that happens periodically in a very controlled and desired manner. Power system operates in steady-state. But the abnormal operations in system will make it stable.

B. Over voltages

The appropriate selection of these systems, however, remains a critical task because the exact nature of transients in the real world is at best only statistically defined, so that the choice involves technical and economic decisions based on calculated risks rather than certainties. Nevertheless, information has been collected and reviewed by various groups concerned with the problems of transient protection. This work will result eventually in guideline descriptions of the transient environment and proposed standard tests. Such guides and standard tests will simplify the task of ensuring protection.

III. Solution to Problem

A. Using a voltage optimizer

This means that voltage is taken from the grid and the excess (what is not needed by a site) is removed and sent in the direction of the supply. For example, to reduce the voltage from 240V to 220V, only the 20V are transformed and these are then subtracted from the input voltage by inducing a voltage in the opposite direction. This ensures that only around a tenth of the power is transformed which results in a reduction of voltage, and current, thus significantly saving a large amount of energy.

Voltage optimizer does much more than simply adjust and stabilize the voltage; it also cleans and conditions the power supply providing additional benefits including:

- Improved power quality
- Removal of harmonics
- Reduction of transients

- Improvement of power factor

For most sites, the installation will pay for itself from the savings in 2-3 years, which represents a return on Equipment lifetimes will also be extended as over-voltage is corrected and harmonics are reduced.

Electrical utilities transmit electricity at high voltages, and as a result every building is served by at least one electrical transformer to lower the voltage so it can be utilized by the building. For many buildings this transformer is provided by the electrical utility company and may be located on-site or mounted off-site, somewhere nearby. The high voltages are reduced by the transformer to the lower voltage levels before it enters the main building.

In this scenario the type of power optimization to be considered is LV side optimization. Some larger buildings can receive electricity more efficiently by obtaining their electricity from the utility at the higher voltage levels and supplying their own on-site transformer to reduce voltage levels before it enters their building. For many buildings this transformer is provided by the electrical utility company and may be located on-site or mounted off-site, somewhere nearby.

IV. Difference between Voltage Optimizer & transformer

- ✓ A transformer changes high voltage, low current, into high current, low voltage, or vice versa. Whereas a voltage optimizer tries to maintain a constant output voltage, regardless of fluctuations at the input. A transformer reduces the voltage by a fixed percentage, whereas an optimizer reduces the voltage to a fixed (pre-set) value[6].
- ✓ The trouble with transformer is that it solves only the problem of over voltage. Having a better alternative or solution is to use a voltage optimizer dedicated for its operation which will constantly adjust supply incoming voltage[7].
- ✓ They do not require any kind of maintenance or any person for its monitoring and control. Also it does work well satisfactorily for many years ahead with no need of replacement.
- ✓ Electronic stabilizers work by constantly measuring the voltage of the waves that make up the incoming electricity supply and comparing them with the voltage you say you want.
- ✓ A voltage regulator is usually a more expensive solution than a simple step-down transformer, but it can save half as much energy again, giving overall energy savings of 10-20 percent.
- ✓ A Voltage regulator has lower energy and maintenance costs. They also have a payback for the planet: by cutting your energy consumption and therefore contribute to tackling adverse changes like climatic changes.

V. Voltage optimizing at home

Leading Yorkshire based voltage optimization company, VO4HOME, was a primary exhibitor at the 2011 National Home Improvement Exhibition (NHI) at Earls Court, which was running between the 30th September and 2nd October.[8]

Voltage optimizer is a cost effective solution that delivers tangible savings on energy consumption. Not only can it be quickly and simply installed but pay-back is usually within 4-5 years, which means that not only is it a sound investment, but it also comes with a 5-10 years product warranty.

VI. Case Study {Savings Calculator}

The root footprints of the case study have been adopted from a very renowned company that looks after the welfare and constructive organization of the Multinationals in the world.
Voltage optimization can be explained using the basics of Ohm's Law:

Power = [Voltage] ^{2} ***÷ Resistance***

These calculations are based on a constant resistance (R) of 100Ohms (Ω), a non-optimized voltage (V) of 235V and an optimized voltage of 220V, with a cost of 3.11 Rs/kWh.

Categories {Formula} $P=V^2/R$	**Savings Calculator**		
	Without Optimization	***With Optimization***	***Remarks***
Supply Voltage	**235**	**220**	
Total Resistance	**100**	**100**	
$P=V^2/R$ (Watts)	$(235)^2/100$ **552.25W**	$(220)^2/100$ **484W**	
In Kilowatts (W/1000)	552.25/1000 **0.552KW**	484/1000 **0.484KW**	(W/1000)
Cost per Kwh is Rs. 3.11	0.552*3.11 **1.71 Rs/hr**	0.484*3.11 **1.50 Rs/hr**	(*3.11)

Categories {Formula} $P=V^2/R$	**Savings Calculator**		
	Without Optimization	***With Optimization***	***Remarks***
Cost per day (Rs/hr *24)	1.71*24 **41.04 Rs/Day**	1.50*24 **36.12 Rs/Day**	(Rs/hr *24)
Cost/month (Rs/day *30)	41.04*30 **1231.2 Rs/Mth**	36.12*30 **1083.7 Rs/Mth**	(Rs/day *30)
Fixed charge (+80)	1231.2+80 **1311.2 Rs**	1083.7+80 **1163.7 Rs**	(+80)
FAC (-23.78)	(1311.2) – (23.78) **1288 Rs**	(1163.7) – (23.78) **1139.9 Rs**	(-23.78)
Electricity Duty (16%)	1288+206.08 **1494 Rs**	1139.9+182.348 **1322.2 Rs**	(16%)
Wheeling Charges	1494+241 **1735 Rs**	1322.2+241 **1563.2 Rs**	(+241)
Other Charges (+315)	1735+315 **2050 Rs**	1563.2+315 **1878 Rs**	(+315)
Total	**2050 Rs**	**1878 Rs**	

Savings Incurred: 172 Rs/Month

VII. Advantages of Voltage Optimizer

- ✓ Can save 330-500lbs of CO2 emissions each year.
- ✓ Can save money on power bills by around 5000 Rs a year.
- ✓ Comes with guaranteed savings.
- ✓ Will improve the life expectancy of electrical equipment.
- ✓ Will improve the power quality (reduce harmonics and improve the power factor).
- ✓ Easy installation – no need to change electricity provider, no rewiring require, no maintenance required, no moving parts.
- ✓ Comes with a 5-10 years warranty.

VIII. Conclusion

It can be treated as a fit and forget solution, which requires no change to lifestyle or business operation. The units do operate on all circuit and has a working assurance of 24 hours a day, 7 days a week and no maintenance is required. The Installation is quick and simple, as a result no change to electricity supplier needed. Savings do start the moment it is installed and comes with typical paybacks under 4-5 years.

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Tarang Chandresh Mehta
TE, Department of Electrical Engineering, Atharva College Of Engineering, Malad–{W}, Mumbai.
Mail@: tarang.mehta19@gmail.com
Contact: 9773089188