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## Power Fluctuations – usage of servo voltage stabilizers in industries

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### ABSTRACT

The usage of electric and electronic products is increasing rapidly. To provide power supply, the Indian power sector faces the crisis of bridging the gap between the demand and supply of power. The unstable power supply so produced has led to loss in industrial equipments. To combat the problems of power fluctuations, industries depend on servo voltage stabilizers to stabilize the power supply connected to their expensive machineries. The article focuses on the electrical hazards, consequences of electrical hazards, symptoms of electrical hazards, analysis of the situation in industries, types of stabilizers, servo voltage stabilizers, applications, advantages, history of servo voltage stabilizers and market potential. With the increasing growth of the consumer electronic/electrical products, the need for servo stabilizers is rising rapidly. Even in the future years the servo voltage stabilizers will continue to be an essential product used in industries.

**Keywords:** Electric/electronic products, equipment, servo voltage stabilizers, power fluctuation and industries.

### Introduction

India is the world's sixth largest energy consumer consuming about 3% of the world's total energy per year. India's population growth coupled with continued economic growth is driving energy demand to levels above the country's production capacity. Indian power industry has been characterized by peak power shortages, with demand of electricity exceeding supply by nearly 7% and 12% in terms of total and peak requirements. The country's projected increase in electrical consumption of between 2.6% and 4.5% is up to 2020, is the highest for any major country. In the face of growing demand, India's electricity sector faces problems of capacity, poor reliability and frequent black outs. The anticipated power shortage is between 11-18% (UNDP, 2005). Based on the study of the Indian power sector, there is a huge demand for power in some Indian states due to rapid urbanization and industrialization and the total installed capacity will add around 45000 MW by 2013-14. However, demand is much higher than supply resulting in deficit (RNCOS, 2010).

In this digital world, nearly every aspect of our life depends upon some electrical device. Whether equipment is in the home or office it needs clean and consistent power to operate reliably. In India the power supply industry has been under the pressure to bridge the gap between the supply and demand. The electric power in industries is often unstable - voltage dips, surges and power cuts are a common occurrence. Unfortunately, a power disturbance due to lightning strikes or a temporary glitch in the electricity supply is all it takes to lose the valuable electronic equipment. The sensitive Computerized Numerically Controlled (CNC) machines which require heavy investment are prone to breakdown even due to slight

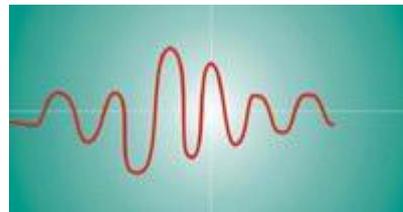
variation in voltage. The fluctuating voltage is hazardous to expensive electronic cards of these hi-tech machines.

### Electrical hazards

Electricity equipment is designed to accept a wide range of input voltages about its nominal design centre. However if the actual supply is higher than the required, the equipment will consume more power. A 230V linear device operating at 240Volts will consume 9% more power, equipment life is reduced by up to 45% effectively increasing the cost of ownership (Claude Lyons, 2007). There are four common types of electrical hazards, they are:

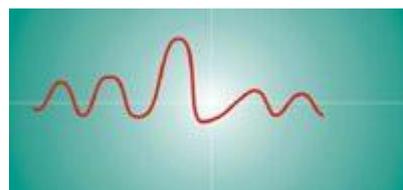
#### Surges

Surge is a short-term increase in voltage which lasts at least 1/120 of a second. Surges result from presence of high-powered electrical motors like in air conditioners and electric pumps. When this equipment is switched off, the extra voltage is dissipated through the power line. Surges may happen for many reasons. Lightening can obviously cause a surge. Any item that has a large motor that starts rapidly can cause a surge or drop in the line current. In reality surges are happening all the time, though generally they are small enough not to impact the attached equipment.



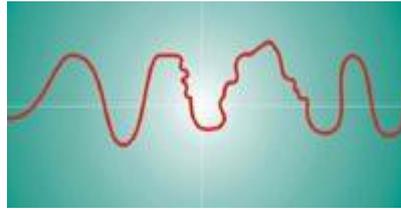
#### Spike

Spike is a very high but momentary rise in voltage. The worst spikes are from lightning strikes on the power wiring which can damage your servers seriously. Spikes can also originate from the power grid. Spikes and surges can progressively damage power supply and other components. Fortunately, direct lightning strikes to power lines are rare because a power line is usually well isolated from earth, and lightning.



#### Line Noise

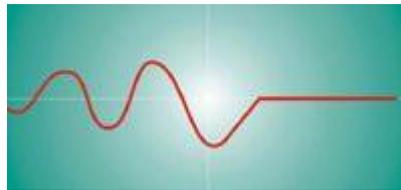
There are many subtle forms of power line noise. Digital audio components, vacuum cleaners, television, etc can create ground or neutral interference that can impact other electrical equipments. Electro-magnetic Interference/Radio



Frequency Interference may occur due to electromagnetic noise from devices like printers, radio transmitters, and industrial equipment. It may cause mysterious hangs and other problems.

### Power Failure

Power outages do occur. Power is not perfect because it is not always there. Power failure is any loss of power of more than 1/120th second (Gupta, 2003).



### Consequences of electrical hazards

Voltage is the difference of electrical potential between two points of an electrical or electronic circuit, expressed in volts. Depending on the difference of electrical potential it is called extra low voltage or extra high voltage. In India all the electrical equipment are rated at 400 / 415 Volts three phase and 220 / 230 Volts single phase. If the system voltage is higher / lower than the rated voltage, the following consequences have been observed in Table 1:

**Table 1:** Consequences of under voltage and over voltage

Components	Under Voltage	Over Voltage
A.C. Motors	It reduces the capacity of the motor thereby raising the temperature of the motor and reduction in motor life and thereby decreasing the production efficiency	It results in additional power consumption, premature failure of windings, increased losses of cables, switches, transformer and other associated equipment.
Lighting Equipment	More luminaries will be required to get the normal lighting.	It curtails the service life of the incandescent lamps remarkably and higher power consumption.
Resistive Heaters	Under voltage requires longer warm up periods.	Heater element deteriorates from excessive oxidation in spite of thermostatic control.
Welding Equipment	The weld time cycle is prolonged to prevent cold weld.	Weld will be over-heated resulting in poor quality of the same.
Rectifier Loads	Electroplating deposition rates drops considerably.	It increases Electroplating deposit accordingly.

(Source: <http://www.gttransformers.com/distribution-transformers.htm>)

## Symptoms of electrical hazards

Some of the symptoms of electrical hazards are (i) equipment and switch gear overheating (ii) frequent shutdowns and early failure (iii) reduction in efficiency (iv) power loss (v) equipment malfunction (vi) power factor penalties (vii) increased conductor losses (viii) frequent use of generators (ix) production loss and (x) increased maintenance bill.

## Analysis of the situation by industrial units

The industrial units need to know how much energy the factory consumes, energy loss occurring in the factory, techno-economic feasibility, improvement in safety and protection and methods to curb the losses and save energy. Those industrial units having acute / high failure rate of electrical equipments such as bulbs, tubes, chokes, starters, contractor coils and motors should verify that it may be due to higher voltage. If the input voltage is above 230 volts single phase / 400 volts three phase even for few hours a day, then definitely a stabilizer is required.

## Types of voltage stabilizers

There are mainly two types of stabilizers, they are automatic / line voltage stabilizers and servo voltage stabilizers/regulators. Line voltage stabilizers are used for television, refrigerator and air – conditioners. The voltage ranges from 230 volts $\pm$ 5%. The servo stabilizer capacity ranges from .5KVA to 1000KVA and gives precise voltage 230 Volts $\pm$ 1%.

## Servo Voltage Stabilizers

No electricity board in India can ensure constant voltage to the customers. Voltage is low during daytime and high during night hours. Moreover on holidays, peak hours, rainy days and when agricultural and industrial load is switched off the voltage arises sharply which creates problems to the machineries resulting in financial loss. The 90% of the industrial load consist of motors. In electric motors of smaller capacity up to 7.5 H.P, the higher current requires higher setting of over load relay to avoid the frequent tripping of motors. Higher setting of over load relay has very less safety margin against single phasing and mechanical faults. Suppose the relay setting is 15-20 % higher then actual operating current, then the relay will take 4-6 minutes to trip. The motor can not withstand the high current for such a long time and in most cases it burns out before the motor trip. Servo stabilizers are meant to overcome all the above problems by maintaining a constant level of voltage irrespective of the fluctuating power supply system (GTB, n.d).

Servo stabilizer is a system, which provides stable Alternate Current (AC) out put voltage where the input power supply voltage changes drastically. It protects the costly equipments from high and low voltage problems. It also increases the life of equipments and increases the productivity of machineries and reduces wastage and damage of raw materials by providing stable electric supply. The name servo is related with the type of motor which is used to enable the voltage correction by using the Servo motor and variance according with one boosts and buck transformer. This type of stabilizer assures stable out put power supply, protection from low voltage, high voltage, overload and short circuiting (Voltek industries, 2006).



**Figure 1:** Three-phase Servo Stabilizer (Source: General electronic services [GES], 2007)

### **Applications and advantages of Servo Stabilizers**

The servo voltage stabilizers are widely used in engineering units, pharmaceutical units, cold storage, air conditioning plants, offset printing machines, textile mills, cement plants, flour mills oil industries, paper mills rubber industries, tea estates, food processing units, oil and vanaspati plants, footwear and leather units, distilleries and beverages, clubs, hotels, multi-storied buildings, hospitals, nursing homes, export houses and call centers.

There are various advantages of servo voltage stabilizers. Some of them are, (i) the stabilizer protects the life of the equipment from severe voltage fluctuations (ii) overall energy saving above 98% efficiency (iii) no consumables are needed (iv) improvement in quality of goods (v) increased production by reducing the manufacturing defective items (vi) better safety and protection (vii) fewer break downs and (viii) uniform quality of end products.

### **History of Servo Voltage Stabilizers in India**

Automatic Electric (AE) established in 1942, is the pioneers in India for developing Servo Controlled AC Automatic Voltage Stabilizers. The product was first developed exclusively for defense use in mid 1960's. Reason for developing was the massive failure of Defense Equipments due to voltage problems in 1962 Indo-China war. "AE's" Founder Chairman-cum-Managing Director., Late Mr. M.B. Bhat, a well-known technocrat and expert engineer at that time, was invited by the Defense Ministry to study the problem and advise the solution. Accordingly, "AE" designed and developed servo voltage stabilizers firstly in India in 1963-64 exclusively for Defense use, using Mercury sensing Relays. In 1965 this product was also introduced to open market for industrial use as wide- spread voltage fluctuations was common phenomena everywhere in India. Since 1965 the design of "AE's servo voltage stabilizers has undergone several changes from Mercury sensing Relays to Beam Contact Relays, to Electro-magnetic Relays, then to Solid stage "triac" controlled and now with micro-processor control.

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### Market potential and forecast

According to MSME-Development Institute (2010-11), consumer electronics contributes about one third of total electronics production in the country. Servo voltage stabilizers are used along with the electronics equipment to protect them from damage due to voltage fluctuations. Since the item is of great utility, its demand is growing at a rapid pace in keeping with the increasing production of consumer electronics item. As per the Centre for Industrial and Economic Research – [CIER] India (2002-2012), stabilizers are one of the fastest moving items. The sector is likely to stabilize between 5 and 7 per cent growth rate. As per the Report, for 2007 the demand estimation is 7.3 million pieces. The estimation is that by 2011-12, this demand will go up to 9.3 millions.

Studies by various research firms have established that there is a potential market for voltage stabilizers/regulators in Asia, Africa, South Africa and the Middle East. The demand is mainly due to the poor power generation and distribution infrastructure. The market for voltage stabilizers/regulators is open to global competition in developing countries including India. The voltage stabilizers/regulator market has outperformed several other fast growing markets. It is expected that the market for voltage regulators will have a consistent annual growth rate over the coming years (Voltage regulators, n.d).

The Government of India has an ambitious mission of 'Power for all by 2012'. This mission would require the installed generation capacity to be at least 2,00,000 MW by 2012, from the present installed capacity of 1,33,000 MW. With the huge investment planned by the Central, State Utilities as well as by the private players, this area would undoubtedly open up a floodgate of opportunities for the power equipment industries. In this challenge equipment industry in India needs to gear itself to support the initiative by enhancing its capacity and capability (Anand, 2008).

### To sum up

The close substitute for servo voltage stabilizers are Uninterrupted Power Supply (UPS) products. UPS generates alternate current; it is far more priced than servo voltage stabilizers of the same capacity. The market for electronic/electrical products is fast growing and Servo voltage stabilizers are inevitable in this growing market.

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