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Research Article

A brief summery on voltage Sag & effects of Voltage Sag on Industrial Power Plant equipment

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Abstract :With The Increasing Use Of Electronic Equipment's In Industrial Areas, Power Quality Issues Have Received More And More Attention From Utilities Building Owners And Manufacturing During The Last Years .Recently, Several Topologies Of Active Power Filters Have Been Proposed As A Solution To Minimize Power Quality Problems. Voltage Dips Are One Of The Major Quality Problems, Requiring Solutions At Both Utility And Customer Level, Indeed The Equipment Usually Used In Conventional Industrial Processes, Such As Contactors, Ground Fault Relays, Adjustable Speed Drives, Computer Or Motor Contactors Are Highly Sensitive To Voltage Dips.

Keywords: Voltage Sag; Contactor; Rectangular curve; CBEMA Curve.

INTRODUCTION

Voltage Sag or **Voltage Dip** (IEC term) is defined by the IEEE 1159 as the decrease in the RMS voltage level to 10% - 90% (1% - 90% for EN 50160) of nominal, at the power frequency for durations of ½ cycle to one (1) minute. Voltage sag is classified as a short duration voltage variation phenomena, which is one of the general categories of power quality problems mentioned in the second post of the power quality basics series of this site. Voltage sag (dip) durations are subdivided into three categories: instantaneous (½ cycle to 30 cycles), momentary (30 cycles to 3 seconds), and temporary (3 seconds to 1 minute). These durations are intended to correlate with typical protective device operation times as well as duration divisions recommended by international technical organizations. Sags are widely recognized as among the most common and important aspects of power quality problems affecting commercial and industrial customers - they are virtually unnoticeable by observing lighting blinks but many industrial processes would have shutdown. Possible effects of voltage sags would be system shutdown or reduce efficiency and life span of electrical equipment, specifically motors. Therefore, such disturbances are particularly problematic for industry where the malfunction of a device may result in huge financial losses [1].

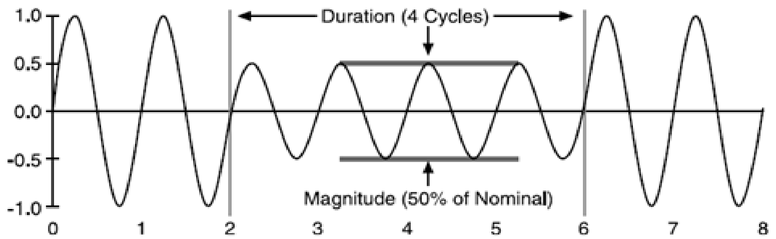


Fig. 1 Voltage Sag (Dip)

Voltage Sag (Dip) Terminology Usage: The term voltage sag has been used in the power quality community for many years to describe a specific type of power quality disturbance - a short duration voltage decrease. The IEC definition for this phenomenon is voltage dip. The two terms are considered to be interchangeable. Generally, sag is preferred in the US and dip is common in European countries. Terminology used to describe the magnitude of voltage sag is often confusing. According to IEEE 1159-1995, the recommended usage is sag to 65%", which means that the line voltage is reduced down to 65% of the normal value, not reduced by 65%. Using the preposition "of" (as in sag of 65%", or implied in "a 65% sag") is deprecated. This preference is consistent with IEC practice, and with most disturbance analyzers that also report remaining voltage. Just as an unspecified voltage designation is accepted to mean line-to-line potential, so an unspecified sag magnitude will refer to the remaining voltage. Where possible, the nominal or base voltage and the remaining voltage should be specified [1].

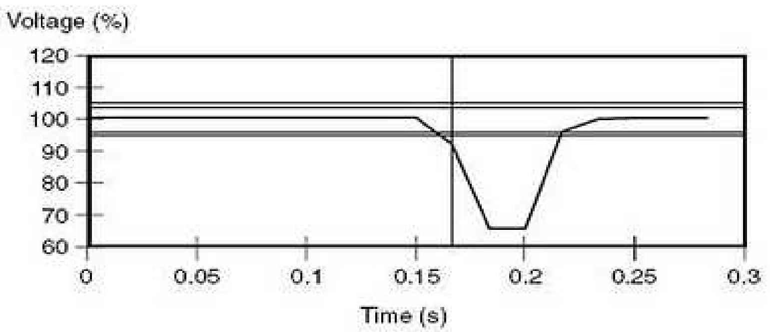


Fig.2 Sample Voltage Sag to 65%

COMMON CAUSES OF VOLTAGE SAGS OR DIPS

Voltage sags are generally caused by weather and utility equipment problems, which normally lead to system faults on the transmission or distribution system. For example, a fault on a parallel feeder circuit will result in a voltage drop at the substation bus that affects all of the other feeders until the fault is cleared. The same concept would apply for a fault somewhere on the transmission system. Most of the faults on the utility transmission and distribution system are single-line-to-ground (SLG) faults. Voltage sags can also be caused by the switching of heavy loads or the starting of large motors. To illustrate, an induction motor can draw six to ten times of its full load current during starting. If the current magnitude is relatively larger than the available fault current at that point in the system, the voltage sag can become significant [1].

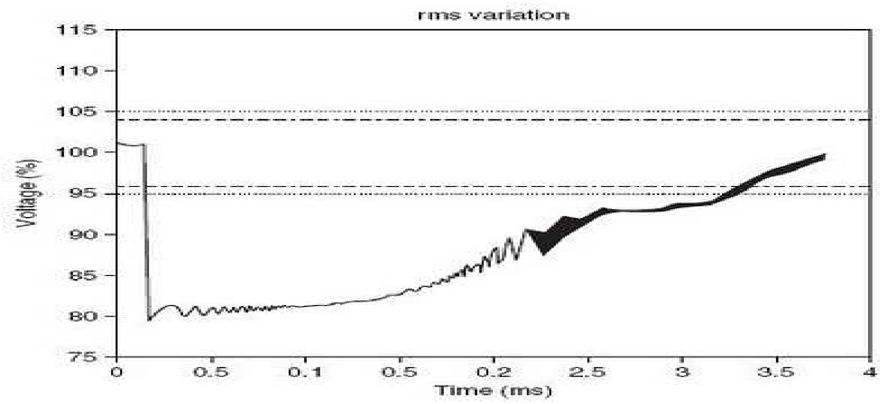


Fig.3 Voltage Sag Caused By Motor Starting

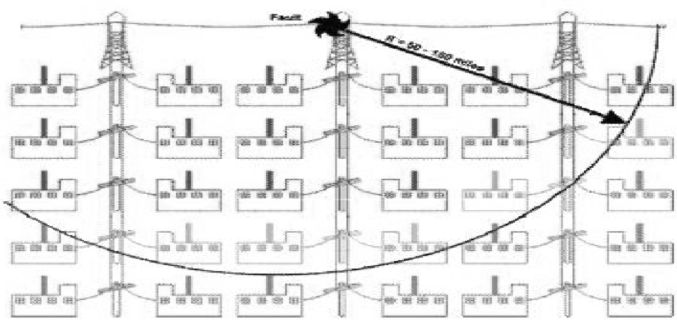


Fig.4 Voltage Sag or Dip Protection

In addition, voltage sags can affect large areas, particularly if the fault occurs upstream. Events usually start on the transmission or distribution system-faults and switching.
Voltage sags or dips can be alleviated by cooperation of the utility, end-user and the equipment manufacturer in order the number and severity of its effects and to reduce the sensitivity of equipment to such problem.

1. Incorporate voltage sag ride-through capability into the equipment. This is generally the less costly and best solution. Tips on ensuring voltage sag ride-through are as follows:
Equipment manufacturers should have voltage sag ride-through capability curves available to their customers, who should begin to demand these types of curves to be made available so that they can properly evaluate the equipment. The company procuring new equipment should establish a procedure

that rates the importance of the equipment. If the equipment is critical in nature, the company must make sure that adequate ride-through capability is included when the equipment is purchased.

Equipment should at least be able to ride through voltage sags with a minimum voltage of 70 percent (ITIC curve). A more ideal ride-through capability for short-duration voltage sags would be 50 percent, as specified by the semiconductor industry in Standard SEMI F-47.

2. Apply an uninterruptible power supply (UPS) system or some other type of power conditioning to the machine control. This is applicable when the machines themselves can withstand the sag or interruption, but the controls would automatically shut them down.

3. Backup power supply with the capability to support the load for a brief period.

4. Utility power system improvements to significantly reduce the number of sags and interruptions (e.g. replacement of relays).

Influence of Voltage Dips on Industrial Equipment: With the increasing use of electronic equipment's in industrial areas, power quality issues have received more and more attention from utilities building owners and manufacturing during the last years .Recently, several topologies of active power filters have been proposed as a solution to minimize power quality problems. Voltage dips are one of the major quality problems, requiring solutions at both utility and customer level, indeed the equipment usually used in conventional industrial processes, such as contactors, ground fault relays, adjustable speed drives, computer or motor contactors are highly sensitive to voltage dips [2].

INDUSTRY EQUIPMENT SENSITIVITY TO VOLTAGE DIPS

AC Contactor, Industrial computer, Ground fault relay, Adjustable speed drive, Lighting loads,

In most of electrical equipment's their response to voltage dips is expressed in terms of both magnitude and duration of dip. These two parameters are denoted as values defining the rectangular voltage – tolerance curve.

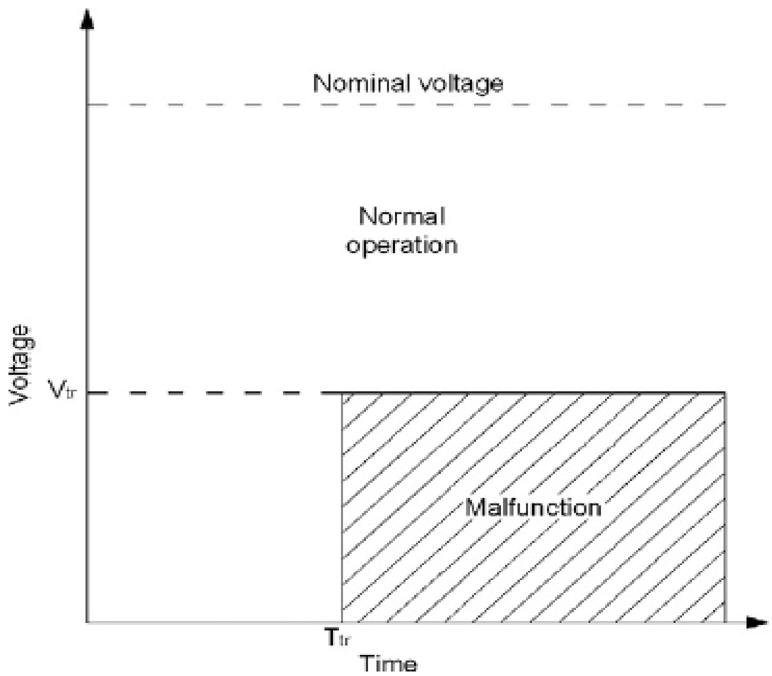


Fig. 5 Rectangular Voltage Curve

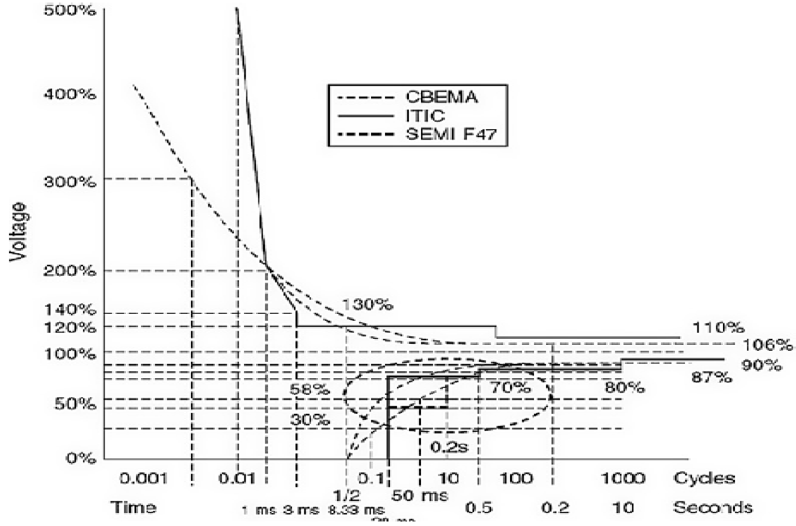
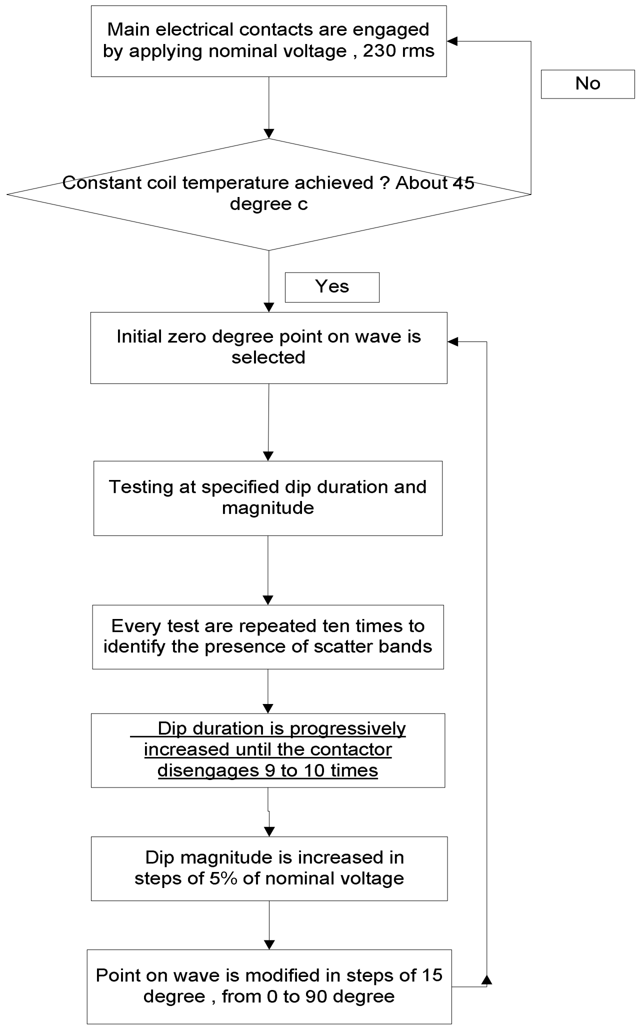


Fig. 6 Comparison between ITIC, SEMI, and CBEMA curve

PROCEDURE DESIGNED TO TEST INDUSTRIAL EQUIPMENT



This curve indicates that a voltage dip longer than the specified duration and deeper than the specified voltage will lead to malfunction, threshold valves of the rectangular voltage –tolerance curve vary inthe range from 40% to 80 % of the nominal voltage for the magnitude and from 0.5 cycles to 4-5 for the duration. From the manufacturer point of view, standards are needed as reference data sheets to manufacturer devices according to their requirements. The most commonly cited industry Standard for ride through has been developed by the information technology industry council (ITIC), which updates the computer business equipment manufacturer association (CBMA) curve[2].

ITIC curve describes the tolerable input voltage range for computing equipments[3]. The area between the upper and lower limit is a safe area for operation of the equipment and outside area is consider as dangerous region. Another major equipment standard is provided by the semiconductor industry (SEMIF47-0706), as can be seen in fig.2, unlike ITIC curve, SEMI curve has deeper voltage dip characteristic. However, some equipment could meet the SEMI requirements but not fulfill the ITIC cure requirements. The main types of classified into this category are industrial relays and contactors.

EXPERIMENTAL RESULTS-GENERAL OVERVIEW

Different tests have been performed with five conventional industry equipment, namely , AC contactor , ground fault relay, adjustable speed drive equipped with a toroid current sensor , industrial computer, and lighting load . **Table 1** depicts the specifications of tested industry equipment's. The experimental set up consists of a power supply source allowing generating user defined voltage waveforms and a multimeter composed of a thermocouple to measure working temperature.We can designed different type of equipment by this procedure and We can protect industrial equipment through voltage sag[4].

Table-1: Specifications of Tested Industry Equipments

Device	Parameter	Value
Contactor	Coil Voltage Nominal Power	230 VD 4KW
Ground Fault Relay	Input Voltage Rated Relay Voltage Current Rating of CT	220-240VDC 5Vcc 250 A
Adjustable Speedy drive	Input Voltage single phase Input Current Output voltage three phase Output Current	220- 240VDC 1.43A 0-230 VDC 7A
Industrial Computer	Input Voltage	230 VDC
Fundamental Lighting	Nominal Lamp Power	58 W
Induction Lighting	Nominal Lamp Power	165 W
Metal Handle Lighting	Nominal Lamp Power	150 W

CONCLUSION

Minimization of voltage sag requires carefully inspection of characteristics of process and of the nature and origin of sag event.The installation of minimization devices (normally the only choice of the customer) can be seen only short term solution. The mitigation capability of these devices mainly limited by energy storage capacity. Only improvement of system performance (for long deep sags) and equipment tolerance (short, shallow sags) can solve problem for long term in industrial power plant.Different instrument effected through sag in industry we can minimise the voltage sag by using of standard and specified instrument. We can design standard equipment by using specification of their instrument can be minimise voltage sag in industry.

REFERENCES

1. R.Dugan, M.McGranaghan, S.Santoso, and H.W. Beaty,. *Electrical Power systems uality (2nd Ed.)*, 2004.New York: McGraw-Hill.
2. S.Z. Djokic, J. Desmet, G .Vanalme, J.V. Villanovic, K .Stockman, sensirivity of personal computers to voltage sags and short interruptions , *IEEE Transpower Deliv*,2005.**20**(1), 375.
3. L.D. Zhang, M.H.J. Bollen, A method for characterizing unbalanced voltage dips (sags) with symmet- rical components, *IEEE Power Engineering Review*, **18**, 7, and 50.
4. M.H.J.Bollen, L.D. Zhang, Analysis of voltage tolerance of adjustable-speed drives for three-phase balanced and unbalanced sags, in IEEE Industrial and Commercial Power Systems Technical Conference, Sparks, Nevada, May 1999. Scheduled to appear in IEEE .Transactions on Industry Applications, May June. 2000

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