ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.6

Voltage Instability Detection & Solution in Power System

Hitesh B. Renuka
Lecturer
Department of Electrical Engineering
Dr.J.N.Mehta Government Polytechnic, Amreli, India

Abstract:
The power system stability is the return to stable operation after disturbance in interconnected power system. It means that instability is a condition which denoting falling out of step. Voltage stability is the ability of a power system to maintain voltage level. System stability problem divide in basic three part (i) steady state (ii) dynamic state (iii) transient state. In this paper voltage instability detection and its solution by using support vector machine, non- synchronizing measurement, synchronizing phasor measurement, using high speed excitation system etc.

Keywords: Voltage instability, Steady state-dynamic-transient stability, Power swing, Detection, Wide area monitoring, Phasor measurement, Non- synchronizing measurement, Synchronizing phasor measurement.

I. INTRODUCTION

Voltage stability as one of the major limitation in the transmission of power to consumer [1]. Voltage instability not related to weak and long lines but also due to the loading-unloading line in the highly developed network. Planning and operation of power system is depending on the stable or unstable condition of interconnected power system. Maintain voltage level at all bus in the system under normal condition and hence identifies the load buses which are close to the voltage collapse [4]. System security and reliability increase by detecting the voltage instability. One reason of system instability is the load power restoration due to the Load Tap Changers. While maximum power provide to the load, it will reduced the reactive power due to the over excitation of generator. Steady state instability is related with the loading gradually before losing synchronism. Dynamic instability occur due to the small disturbance like variation in loading, change in turbine speed etc. Transient instability arise due to the disturbance in rotor speed, rotor angular differences and power transfer undergo fast changes. Transient instability is a fast phenomenon arises within 1s for a generator to the close to the cause of disturbance. During the fault nearby generator is most affected while power from remote generator less affected. Sometimes system will be stable with fault while some times system will be stable only if the fault cleared. System become stable or unstable is not only depending on the system but also depend on the types of fault, fault location, time to clear the fault and method of clearing.

II. FACTOR AFFECTING THE SYSTEM STABILITY

Transient stability is depending on the types and location of fault. 3 phase fault is generally more difficult and it will affect the power transfer. When a machine is connected to the infinite bus system stability improve by increasing the inertia constant M of the machine but cannot employed in practice. From fig 1 easily seen that for a given clearing angle accelerating area decrease but decelerating area increase as the limit of maximum power at different power angle curves increase. Maximum steady power of a system can be increased by reducing the transfer reactance.

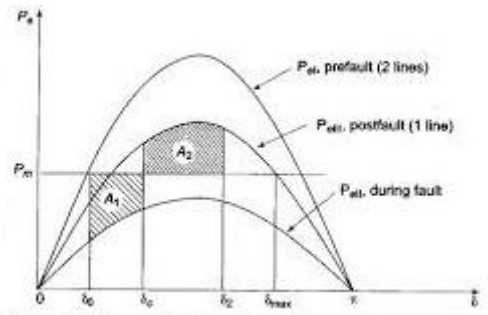

Figure.1. Fault on middle of one line of the system with $\delta_c < \delta_{cr}$

Voltage stability of power system improve by

1. Increase of system voltage, use of AVR
2. Use of high speed excitation system
3. Reduction in system transfer reactance
4. Use of high speed reclosing breakers

In recent trends by using HVDC link with thyristors would improve the stability problem. Also connect the breaking resistor near the generator bus which compensates some of the load connected with the generator. Short circuit current limiters are used in long transmission lines and transfer the impedance during the fault condition so the system voltage improved.

III. SIMPLE VOLTAGE MONITORING

The Phasor measurement Unit(PMU) technology developed with advance in computational facilities, networking infrastructure and communications for wide area monitoring system in general [2]. PMU enhance the system by identify the voltage stability and prevent the system breakdown and also economical losses. PMU is the most useful for stability detection near future technology. Synchronized phasor measurement has strongest capability to detect and solve voltage instability with some prospect. As regard preventive aspect, PMU can help improving the quality of present day state estimation so that better initial operating points are

available for real time voltage assessment application and can also improving accuracy [3]. Fig 2. Shows unstable condition increases step by step a three phase fault cleared by permanently open the faulty line. The initial operating point is insecure with respect to the considered disturbance [2]. Curves show the different load condition of induction motor.

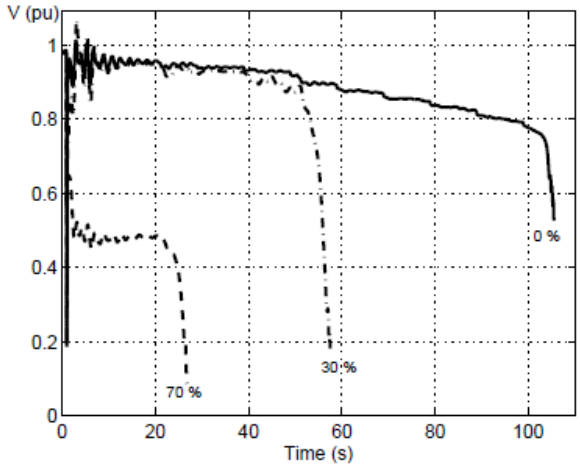

Figure.2. Unstable evolution of a transmission voltage by induction motor [2].

Motor run without load long time create a voltage instability leading to fall after the fault occurrence. System develops under the effect of over excitation limiters (OELs) and load tap changers (LTCs). Decreasing the voltage before the final collapse allows using the voltage as a triggering emergency signal. Reduces the load after a delay of 2 to 3 seconds leaving time to recover voltage after fault clearing. In Fig.1 the curve obtained with 30% of induction motor load shows a more severe situation where voltage stays a rather high value before it drop sharply [2]. It can be done due to the decreasing the voltage from generator under the field current limit. Actually protection react the fall down of voltage rapidly and allowing voltage recovery after fault clearing.

IV. VID FROM MEASUREMTS

Voltage instability is the inability of generation-transmission system. To this purpose to this purpose the early work on measurement –based VID and a number of subsequent related contributions referred to the impedance matching condition.

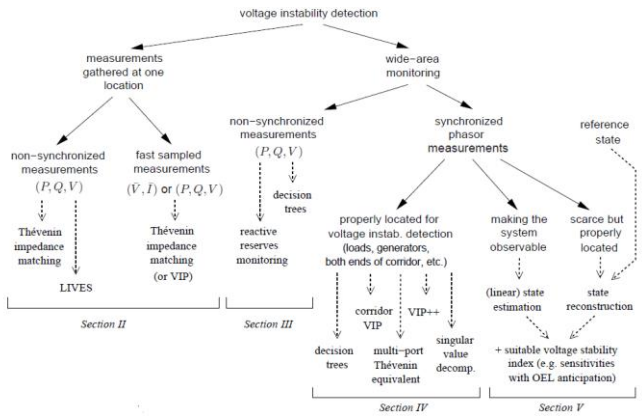

Figure. 3. Classification of method [2].

Fig 3. Shows the method of VID real time measurement. It is based on the underlying real time measurement with the normal configuration located on left and more popular on the right. The various method link defined by dotted line.

The whole power system seen from the Thevenin equivalent as shown in Fig 4. At constant power factor load power is maximized when Thevenin and load impedance are equal in magnitude.

$$|Z_{th}| = |Z_\ell| \qquad (1)$$

Where Z_{th} is shown in Fig.4 and Z_l is the apparent load impedance

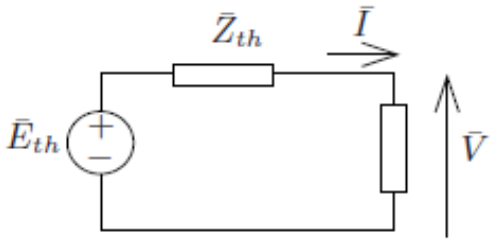

Figure. 4. Thevenin equivalent and load

$$\bar{Z}_\ell = \frac{V}{\bar{I}} \qquad (2)$$

Where is the V is the complex voltage across the load. In the maximum load power condition active and reactive power consumed depend on the power factor is equivalent to :

$$|E_{th} - V| = |V| \qquad (3)$$

The voltage drop in the venin and load impedances are equal in magnitude. Thevenin parameters are expected to change when a generators has its field current limited , since the incremental behavior of that generator changes dramatically [2]. Data collect from one bus and obtain Thevenin equivalent of that load bus as well as Z_l(apperent load impedance). This method call as Voltage Instability Predictor(VIP). Short circuit current for large network calculate by Thevenin theorem. This system is faster, reliable and easily adopted. Two methods relating the Thevenin theorem. One is based on the measurement samples to identify the relationship between active and reactive powers of loads and second is related to back to back Thevenin equivalents at a transmission bus.

V. CONCLUSION

From this paper it can be concluded that there are various methods of detection of voltage instability. This methods should be scrutinized on different test system on the basis of cost and flexibility. This paper also suggests the aim of developing a wide area criterion to detect long term voltage instability. Of main interest is to determine the reasons that are responsible for voltage instability in the system and should be resolved in short time as possible, so that system does not collapse and becomes stable in a certain time which also proves to be quite economical.

VI. REFERENCE

[1]. Yaser Habibi ,Gholam-Hosein Sheisi, Hamdi Abdi, "Voltage Instability Detection in Power System Using Support Vector Machine(SVM), TJEAS Journal-2015-5-2//22-26

[2]. Mevludin Glavic, Thierry Van Cutsem, "A short Survey of Method for Voltage Instability Detection", IEEE.

[3]. Mevludin Glavic, Thierry Van Cutsem, "Wide-area Detection of Voltage Instability from Synchronized Phasor Measurement. Part I: Prinicipal" IEEE.

[4]. O.P.Rahi, Amit Kr Yadav, Hasmat Malik, Abdul Azeem, Bhupesh Kr, " Power System Voltage Stability Assessment through Artificial Neural Network ",ELSEVIER, International Conference on Communication Technology and System Design 2011.

[5]. I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", New Delhi: McGraw Hill.