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Factors Affecting Stability and Quality of the Power System with Its Compensation Techniques In Brief

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Abstract:-The purpose of this paper is to provide the practical information about the factors responsible for affecting power system stability and power quality. Some compensation techniques are also discussed to improve the behavior of the system.

I. INTRODUCTION

Each and every power system encompasses various synchronous machines including generators, motors and other rotating machines, which are working in power system by maintaining proper synchronism under all steady state conditions. So, our primary aim is to maintain synchronism. Synchronism of a power system gets disturbed, when disturbances occur in power system. In other words disturbances occur when the parameters of power system component's characteristics deviate from their normal working range. Disturbances occur may be small or large. The ability of a power system to overcome from the disturbances and reach to the designed working range is termed as stability of power system. Now the fitness of power which is supplied by electrical utility to the consumer is decided by power quality. As we all know that, Power itself is a union of voltage and current, so deviation of voltage or current from normal prescribed value results in power distortion or affect power quality. Impure power affects power system equipments and increases variety of losses in power system equipments, causes overheating of equipments and sometimes it also causes visual flickering in lightning equipments. So, power quality has required a special concerned.

II. POWER SYSTEM STABILITY

Power system stability is the ability of power system to return to its stable equilibrium state after large or slow disturbances. And Stability limit can be defined as the maximum amount of power delivered from the system without loss of synchronism or maximum amount of power transfer in the synchronized state decides the stability limit of power system. A power system must be capable to develop restoring force whose value is greater than or equal to disturbing force in order to achieve synchronized state again. Now, Power system stability can be further classified depending upon type of disturbance and each type of stability mentioned below is discussed one by one. The Stability is classified into three categories as follows:

Steady State Stability

Transient Stability

Dynamic Stability

A. Steady State Stability

Steady State Stability defines the ability of power of system to regain stable state after being subjected to disturbances. The gradual change in loads or operation of automatic voltage regulator. In case of any uncertainty, flow of power exceeds the maximum value and the power system equipments still operates in synchronism which will further leads to more disturbances. So, in this case the system has been reached to its steady state limit .The steady state limit of system is the limit up to which the maximum power can be transferred from the system without losing synchronism.

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B. Transient Stability

The Transient Stability defines the ability of power system to attain synchronism after large disturbances. It's an ability of system to remain in equilibrium state during large disturbance is going on. The large disturbances include sudden load changes in large loads, power system switching operation, line interruption, fault on the system and problem in governing system.

C. Dynamic Stability

The Dynamic Stability defines the ability of power system to maintain its synchronism after the transient stability period until the new equilibrium point is obtained. These disturbances last for 10 to 30 seconds. If dynamic instability is ignored, then the rotor of machine may go out of step.
The Stability analysis becomes necessary to determine following given below

Maximum power flow between two systems.
To check the layout of protective system used in the system.
Determination of voltage and current levels.
To determine fault clearing time.

III. POWER QUALITY

The quality of power is considered clean, but the clean power is converted into dirty power when the basic electrical quantity like current or voltage deviates from its ideal behavior. This results in improper phase and frequency between current and voltages. The factors responsible for these disturbances include Transient disturbances, R.M.S. disturbances and Steady State disturbances. And these disturbances further leads to following problems and one by one problem is stated below:-

Over voltage and Under voltage:-Over voltage or Under voltage occurs due load variations and switching of inductive loads, when there is either increase in voltage greater than 110% or decrease in voltage lesser than 90% at power frequency for the period longer than 60 second.

Voltage Sag or Voltage Swell:-Swelling or Sagging of voltage occurs when there is either increase in r.m.s. line voltage of the above 110-180% of nominal for 0.5 cycles to 60 seconds or decrease in r.m.s. line voltage of the below 90% of nominal for 3 to 10 second takes place.

Outage:-When the voltage level is fallen to zero there is outage of line or complete line interruption.

Harmonics:-The smooth sinusoidal waveform becomes distorted or jagged due to the addition of harmonics frequencies to the fundamental frequency of the waveform. Harmonics occurs in the power system due to the application of non linear loads.

Transients:-Electrostatic discharge, Line Switching, Load Switching, Faulty wiring and Improper grounding causes system voltage deviation from ideal voltage.

Flickering:-When there is small change in amplitudes of voltage level at a frequency less than 25Hz, flickering of equipment specially flickering of light takes place.

The above phenomenon leads to following problems

Causes damage to Electronics Chips.
Responsible for Motor Stalling and Overheating.
Responsible for production losses and Complete Shutdown of equipments.
Shortens the life of winding conductors and lightning filaments.
Causes flickering of lights.
Sometimes these are also responsible for relay trip and fuse blow.
To overcome from above problems power quality conditioning equipments just like Isolation Transformers, Filters, Ferro-resonating Transformer, Voltage Regulators, Static VAR System and backup generators are used. These devices reduce the impact

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of non-sinusoidal distorted wave on the power system equipments and improve power quality.

IV. STABILITY IMPROVEMENT TECHNIQUE

Now, we have understood the importance of stability and its improvement provides better as well as reliable operation. According to equal area criterion, if the accelerating area is decreased with increase in decelerating area for a given critical angle. So initial load angle decreases with increase in maximum load angle this increases the critical fault clearing time by increasing power capability of the system which helps the rotor to swing though angle of larger values.

V. CONCLUSION

Power system becomes more reliable and efficient if both power system stability and power quality are considered at a time. This reduces power losses, increases efficiency, reduces fluctuations and prevents system from large disturbances and also improves system synchronism restoring property. In this power system and power quality are briefly described in a concise way.

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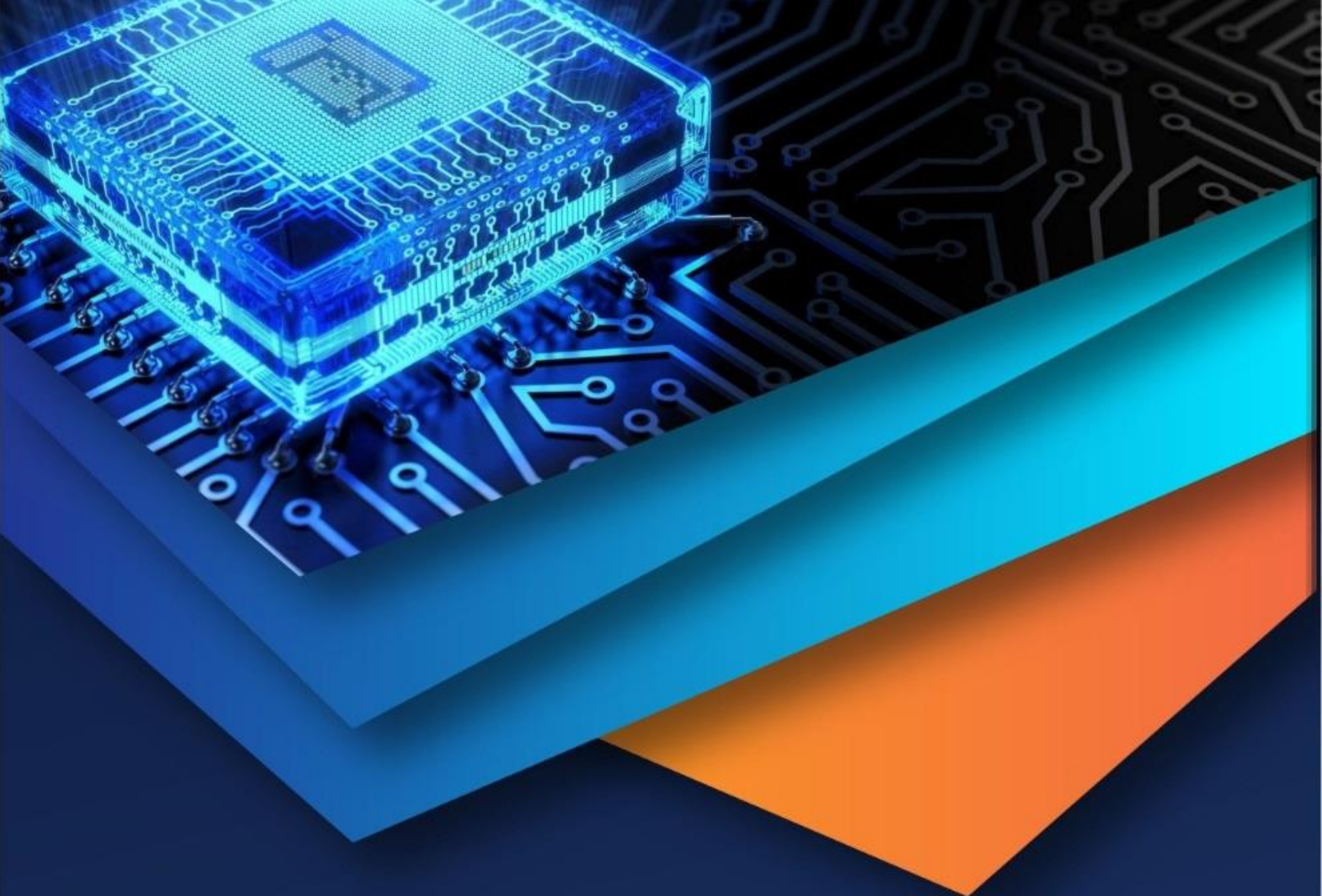

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