Review: Importance of Power System Reliability

Prof. A. S. Kakad
Department of Electrical Engineering,
MGICOET Shegaon.
aishkakad@gmail.com

Mr. Mohammad. Zubair
Student M.E (EPS)
MGICOET Shegaon.
muhd.zubair2016@gmail.com

Prof. K. K. Rajput
Department of Electrical Engineering,
MGICOET Shegaon.
kkrajput2702@gmail.com

Prof . V. A. Ghodeswar
Department of Electrical Engineering,
MGICOET Shegaon.
ghodeswarvaibhav@gmail.com

Prof. P. S. Dorale
Department of Electrical Engineering,
MGICOET Shegaon.
piyush.dorale@gmail.com

Abstract:— Now a days, the electrical power system contains generation, switching stations, transmission, sub-transmission and radial distribution networks. The need of electrical power system is getting the acceptance from customer side. These parameters are necessary to concern in today's electric utility environment. The highlights of paper is the synchronizing force in power system reliability. The stability margin also has great importance in the element of power system. This paper contains the part of power system stability and reliability for enhancing the overall power system to smooth out conduction of electrical power system.

Keywords:-reliability, power system, electric utility, transmission, conduction, synchronizing.

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I. INTRODUCTION

A measure of the ability of a system, generally given as numerical indices, to deliver power to all points of utilization within acceptable standards and in amounts desired. Power system reliability (comprising generation and transmission & distribution facilities) can be described by two basic functional attributes: adequacy and security. The reliability is the probability of a device or a system performing its function adequately, for the period of time intended, under the operating conditions intended. Basically reliability having simple classification.

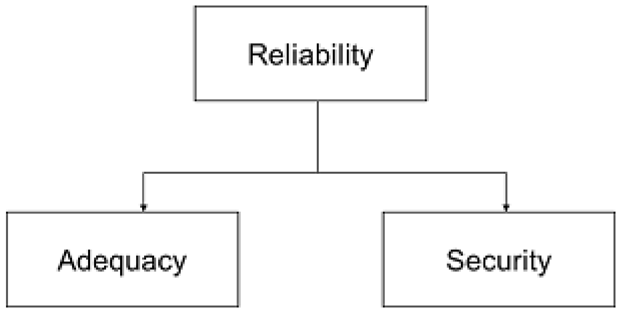

Figure.1 Types of Reliability

1) Adequacy: Adequacy relates to the existence of sufficient facilities within the system to satisfy the consumer load demand at all times so it is matching between supply and load. The supply should be equal to load demand but it is not practically possible, as there are always changes in load hence, it becomes difficult to manage synchronism.

2) Security: It is more important that adequacy here is opportunity for power engineer to create system with good security arrangement by means using various protective devices.

II .UTILITY RELATED PROBLEMS

To gain a broader understanding of power system reliability, it is necessary to understand the root causes of system faults and system failures. A description of major failure modes is provided below.

1) Underground Cable: Existing cable can be tested and replaced if problems are found. One way to do this is to apply a DC voltage withstand test (approximately 3 times nominal RMS voltage). Since cables will either pass or not pass this test, information about the state of cable deterioration cannot be determined.
2) Transformer Failures: Overloads rarely result in transformer failures, but do cause thermal aging of winding insulation**.** Extreme hot-spot temperatures in liquid-filled transformers can also result in failure.
3) Lightning: A lightning strike occurs when the voltage generated between a cloud and the ground exceeds the dielectric strength of the air. This results in a massive current stroke that usually exceeds 30,000 amps**.** To make matters worse, most strokes consist of multiple discharges within a fraction of a second.
4) Interruption: Trees continuously grow**,** can fall over onto conductors can drop branches onto conductors.
5) Birds: Birds are the most common cause of animal faults on both transmission systems and air insulated substations. Different types of birds cause different types of problems.
6) Vandalism: Vandalism can take many different forms, from people shooting insulators with rifles to professional thieves stealing conductor wire for scrap metal.

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To understand the reliability approach more clearly the following state transition diagram is used.It concern with various operating events in power system.

III. STATE TRANSITION DIAGRAM:

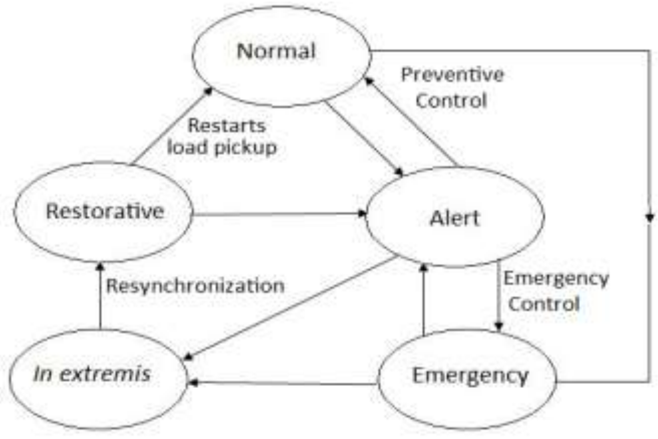

Figure.2 State Transition Flow

It is having following various states, the power system operates in these states for reliability every state should follow the direction of arrows effectively.

Power System Operating States (1):

Normal State:

- All system variables are in the normal range and no equipment is being overloaded. The system operates in a secure manner and is able to withstand a contingency without violating any of the constraints.

Power System Operating States (2):

Alert States:

- Security level falls below a certain limit of adequacy or if the possibility of a disturbance increases due to adverse weather conditions such as the approach of severe storms. All system variables are still within the acceptable range and all constraints are satisfied. However the system has weakened to a level where a contingency may cause equipment to get overloaded and reach an emergency state. If the contingency is very severe we could land up directly in the extremis state (extreme emergency).
- Preventive actions such as a generation re-dispatch could bring the system back to normal state else it might remain in alert state. The alert through advance software of monitoring the system parameter under the various situations can be performed by SCADA.
- Supervisory Control and Data Acquisition (SCADA) system is the heart of Distribution Management System (DMS) architecture. A SCADA system should have all of the infrastructure elements to support the multifaceted nature of distribution automation and the higher level applications of a DMS. A Distribution SCADA system's primary function is in support of distribution operations telemetry, alarming, event recording, and remote control of field equipment. A modern SCADA system should support the engineering budgeting and planning functions by providing access to power system data without having to have possession of an operational workstation. A modern SCADA system should support the engineering budgeting and planning functions by providing access to power system data without having to have possession of an operational workstation.

Power System Operating States (3):

Emergency state:

- Sufficiently severe disturbance under alert state leads to an emergency state. Voltages at many buses become low and equipment loading exceeds the short term emergency ratings. System is still intact.
- System can be restored back to alert state by emergency control actions such as fault clearing, excitation control, fast valving, generation tripping, generation runback, HVDC modulation and load shedding.

Power System Operating States (4):

In extremis state

- If the emergency measures are not applied or are ineffective, the system goes to in extremis state, the result is cascading outages and the possibility of shutdown of major part of the system.
- Control actions such as load shedding and controlled separation could save much of the system from a possible blackout.

Power System Operating States (5):

Restorative State

- This represents a condition where control action is being taken to reconnect all the facilities as well as the affected loads.
- System could either go directly to the normal state or through the alert state depending on the condition.

The following cross coupling of P-F and Q-V is helpful in maintaining the reliability.

1. ALFC loop (P-F)
2. AVR loop (Q-V)

The basic role of ALFC is

1. To maintain the desired megawatt output power of a generator matching with the changing load.
2. To assist in controlling the frequency of larger interconnection.
3. To keep the net interchange power between pool members, at the predetermined values.

The basic role of AVR loop

1. Regulate the terminal voltage |V| to within required static accuracy limit.
2. It should have sufficient speed of response.
3. It must be stable.

The voltage of the generator is proportional to the speed and excitation (flux) of the generator. The speed being constant, the excitation is used to control the voltage. Therefore, the voltage control system is also called as excitation control system or automatic voltage regulator (AVR).

IV. ADVANCE TREND FOR PROTECTION:

Now a days some advance system used for protection such as

1. Gas insulated substation: A gas-insulated substation (GIS) uses a superior dielectric gas, SF_6, at moderate pressure for phase-to phase and phase-to-ground insulation. The high voltage conductors, circuit breaker interrupters, switches, current transformers, and voltage transformers are in SF_6 gas inside grounded metal enclosures. The atmospheric air insulation used in a conventional, air-insulated substation (AIS) requires meters of air insulation to do what SF_6 can do in centimeters. GIS can therefore be smaller than AIS by up to a factor of 10. A GIS is mostly used where space is expensive or not available. In a GIS the active parts are protected from the deterioration from exposure to atmospheric air, moisture, contamination, etc. As a result, GIS is more reliable and requires less maintenance than AIS.

2. SF_6: Sulfur hexafluoride is an inert, nontoxic, colorless, odourless, tasteless, and nonflammable gas consisting of a sulfur atom surrounded by and tightly bonded to six fluorine atoms. It is about five times as dense as air. SF_6 is used in GIS at pressures from 400 to 600 kPa absolute. The pressure is chosen so that the SF_6 will not condense into a liquid at the lowest temperatures the equipment experiences. SF_6 has two to three times the insulating ability of air at the same pressure. SF_6 is about 100 times better than air for interrupting arcs. It is the universally used interrupting medium for high voltage circuit breakers, replacing the older mediums of oil and air. SF_6 decomposes in the high temperature of an electric arc, but the decomposed gas recombines back into SF_6 so well that it is not necessary to replenish the SF_6 in GIS.

3. Air Insulated Substation:
In large, modern AC power systems. The transmission and distribution systems function to deliver bulk power from generating sources to users at the load centers. Transmission systems generally include generation switchyards, interconnecting transmission lines, autotransformers, switching stations, and step-down transformers. Distribution systems include primary distribution lines or networks, transformer banks, lines or networks, all of which serve the load area. It is economically efficient, and fosters individual choice and competition in power markets. In addition, it reduces opportunities for strategic behavior and provides a simple mechanism to determine reserves and their trading price.

V.NEED OF POWER SYSTEM RELIABILITY

The modern electrical power system is made up of a highly complex and sensitive set of electrical, mechanical and electronics components. With the increasing load demand and requirement on quality from the consumer, the Electric Utility Company will have to ensure very high availability of service from all elements in delivery of electrical power.

VI.CONCLUSION

This paper explain power states and their importance every state is having some equality and inequality constraints. Reliability is nothing but response of states in various situation responses should be rapid and proper. Every reliability margin is due to control of voltage and frequency in tolerable limit the cross coupling of these loops should be proper. The extreme aim of this paper is to highlight reliability importance and way to maintain it.

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