Volume 4, Issue 1, January 2014 ISSN: 2277 128X

International Journal of Advanced Research in Computer Science and Software Engineering

Research Paper

Available online at: www.ijarcsse.com

Power System Design & Stability Analysis

Sandeep Kaur
Department Of Electrical & Electronics Engineering,
Chandigarh University,Gharuan(Mohali),Punjab, India

Dr. Raja Singh Khela
Director, Quest College Of Engineering & Technology ,
Jhanjeri (Mohali),Punjab, India

Abstract: The objective of this paper to investigate and understand the stability of power system, with the main focus on stability and power system modeling. The work look into the effects that advanced control techniques have on electrical power generation system and transmission system.The performance of the power system is simulated with the proposed advanced control technique. The work of power system stability, modelling and simulation of power system would be done using MiPower software techniques. In this work, a power system modelling would be attempted. Simulations would be performed on the power system model to acquire the conditions of the system model in an event of an occurrence of symmetrical fault or unsymmetrical faults. The ability to maintain system stability in a deregulated power system environment is a major challenge. Stability phenomena can cause significant damage economically, thus the limits of stability and the reliability and efficiency of the power system are much sought after issues.

Key words: power system modeling, mipower software techniques, simulations, symmetrical fault ,unsymmetrical faults. reliability

I. INTRODUCTION

The aim of this paper is to investigate the various power system stability problems, the effect of a fault on the stability condition of the system and also the post-stability condition of the system. There are two primary technical contributions of this work. The first is the development of a power systems design project .The project requires the study of the transient stability of a system, evaluate the effect of the stability limitations economically and socially, and then recommend changes that are technically, economically, and politically justifiable. The second technical contribution of this work is the development of an integrated package of power systems stability analysis by using MiPower software.

II. POWER SYSTEMS DESIGN

Most capstone projects are essentially the design and implementation of a new device to meet a given need. In Electrical Engineering, students are often asked to design and build a moderately complex electrical circuit to perform a given function. The project is almost always the design of a completely new product. On the other hand, electrical power systems are inherently large and old. Therefore, design within the context of a power system is necessarily distinct from the design of a new electrical device

III. NEED FOR SYSTEM ANALYSIS IN PLANNING AND OPERATION OF POWER SYSTEM

The system being planned are to be optimal with respect to cost, performance and operating efficiency. For this better planning tools are required.in general, the major power system tools are

1. Load Flow Analysis
2. Short circuit analysis or fault calculations
3. Stability analysis

A. Load flow studies

A load flow study is the determination of voltage, current, real power and reactive power at various points in an electric network.The main objective of load flow analysis is to identify the potential problems in terms of unacceptable voltage condition, overloading, decreasing reliability or any failure of the transmission system to meet performance criteria.The satisfactory operation of the system depends upon knowing the effects of interconnections, new loads, new generating stations or new transmission lines etc, before they are installed. They also help to determine the best size and favourable locations for the power capacitors both for improvement of the power factor also raising the bus voltage of the electrical network.

B. Short circuit analysis or fault calculations

A fault may occur on a power system due to a number of reasons. Some of the causes are

1. Insulation failure of the system
2. Falling of a tree along a line
3. Wind and ice loading on the transmission lines
4. Vehicles colliding with supporting structures

5. Overloading of underground cables
6. Birds shorting the lines etc.

C.Need for short circuit study

Short circuit analysis or fault calculation to be done in power system for the following reasons

1. To determine the magnitudes of currents flowing throughout the power system at various time intervals after a fault occurs.
2. To select the rating for fuses, breakers and switchgear in addition to setting up of protective relays.
3. To make the cable joints accordingly in power station and in substation.
4. To check the MVA rating of the exiting circuit breakers when new generators are added into a system.
5. To design the grounding system properly.

IV. CLASSIFICATION OF FAULTS

Faults may occur at different points in a power system and accordingly the magnitude of fault current varies faults are basically classified as

1.Symmetrical faults
2.Unsymmetrical faults

A.**Symmetrical faults**

In symmetrical faults, all the three phases are short circuited to each other and to earth also.A three-phase short circuit occurs rarely but it is the most severe type of fault involving largest fault currents. For this reason, the balanced short circuit calculations are performed to determine these large currents to be used to determine the rating of the circuit breakers.

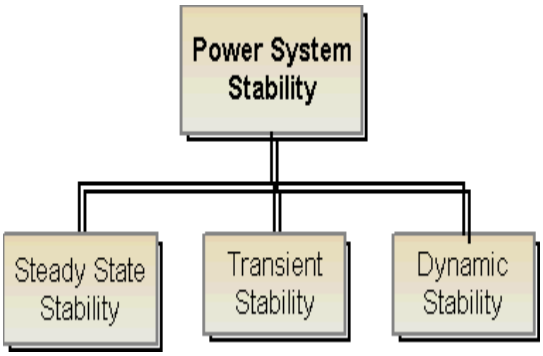
B.Unsymmetrical faults

In unsymmetrical faults only one or two phases are involved.

1. Line to ground fault (LG Fault)
2. Line to Line fault(LL fault)
3. Line to Line to Ground fault(LLG fault)
4.

V. STABILITY

The stability of a system refers to the ability of a system to return back to its steady state when subjected to a disturbance. As mentioned before, power is generated by synchronous generators that operate in synchronism with the rest of the system. A generator is synchronized with a bus when both of them have same frequency, voltage and phase sequence. We can thus define the power system stability as the ability of the power system to return to steady state without losing synchronism. Usually power system stability is categorized into **Steady State**, **Transient** and **Dynamic Stability.**



A. Steady State Stability

Studies are restricted to small and gradual changes in the system operating conditions. In this we basically concentrate on restricting the bus voltages close to their nominal values. We also ensure that phase angles between two buses are not too large and check for the overloading of the power equipment and transmission lines. These checks are usually done using power flow studies.

B.Transient Stability:

Involves the study of the power system following a major disturbance. Following a large disturbance the synchronous alternator the machine power (load) angle changes due to sudden acceleration of the rotor shaft. The objective of the transient stability study is to ascertain whether the load angle returns to a steady value following the clearance of the disturbance.

Aim of transient Stability study

Transient stability studies are aimed at determining whether the system will remain in synchronism following major disturbances such as transmission system faults, sudden load changes, loss of generating units or line switching.There are so many factors which influence transient stability studies. The most predominant factors are listed below.

1. Types of fault
2. Location of fault.

3. Severity of fault
4. Speed of clearing of fault.

C. Dynamic stability:

The ability of a power system to maintain stability under continuous small disturbances is investigated under the name of **Dynamic Stability** (also known as small-signal stability). These small disturbances occur due random fluctuations in loads and generation levels. In an interconnected power system, these random variations can lead catastrophic failure as this may force the rotor angle to increase steadily.

VI. 5-BUS SYSTEM CASE STUDY

Take a 5-bus system consisting i.e. one slack bus or swing bus, two generator buses, two load buses. a50Hz, 220kv transmission line has two generators and an infinite bus as Shawn in figure1. A 500 MVA, 50Hz Generator-1 at bus 2 deliver 325MW over a double circuit line to an infinite bus. This Generator has moment of Inertia 12MJ/MVA, transient reactance X'd is 0.067p.u. And another 300MVA, 50Hz Generator-2 at bus 3 deliver 210MW over a double circuit line to an infinite bus. This Generator has moment of Inertia 9 MJ/MVA, transient reactance X'd is 0.10 p.u., |E'|=1.1 p.u and infinite Bus voltage V=1.0L0O.on base of 100MVA.

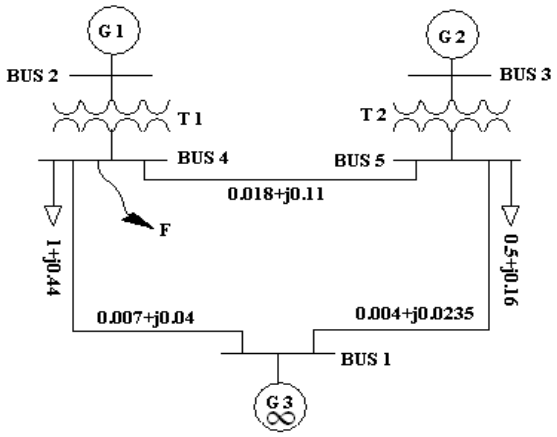


Fig.1 a 5- Bus system single line diagram

5-bus system analysis using Mipower software in that simulation, at 0 sec. a three phase to ground fault was applied at bus-4 and fault cleared at 0.275sec. Simultaneously applied change in transmission line parameter of line-1 connected between bus-4 and bus-5 at 0.275 sec. end time up to 1 sec. With simulation time of frame given from 0 sec. to 1 sec. by the time step is 0.025 sec. As fig.1 shows Transient stability simulation time frame and Disturbances applied in MiPower Software .

Transient Stability Result

Time	**Delta(Degree)**		**P Gen(MW)**	
	Bus2	**Bus3**	**Bus2**	**Bus 3**
0.000	19.4	18.3	325	210
0.025	19.7	18.3	17.4	183
0.050	21.2	18.5	17.7	185
0.075	24.1	18.8	18.3	189
0.100	28.4	19.3	19	194
0.125	34.1	19.3	19.8	200
0.150	41.3	20.4	20.7	207
0.175	49.9	21.1	21.5	215
0.200	60.0	21.7	22.4	222
0.225	71.4	22.2	23.1	230
0.250	84.3	22.6	23.7	236
0.275	98.6	51.7	24.1	242
0.300	113	22.8	823	284
0.325	62.8	6.94	719	284
0.350	138	21.6	599	280
0.375	149	20.3	472	271
0.400	158	18.6	390	259
0.425	167	16.6	765	246
0.450	175	14.4	630	227
0.475	181	12.1	269	207
0.500	187	9.85	-20.7	187
0.525	195	7.71	-240	171

0.550	205	5.81	-227	158
0.575	218	4.23	-507	147
0.600	235	3.04	-660	142
0.625	257	2.25	-755	143
0.650	283	1.89	-704	147
0.675	314	1.91	-433	155
0.700	348	2.27	37.3	166
0.725	384	2.9	534	180
0.750	419	3.71	844	196
0.775	451	4.61	870	214
0.800	482	5.48	652	233
0.825	511	6.21	683	253
0.850	538	6.67	6.9	267
0.875	567	6.78	-497	280
0.900	600	6.45	-736	289
0.925	637	5.64	-682	292
0.950	679	4.33	-251	287
0.975	723	2.54	382	276
1.000	767	0.35	830	261

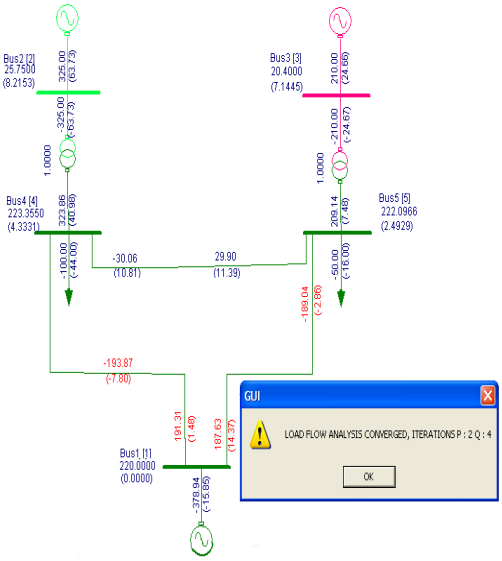


Fig. 2 Load flow Plot of 5-Bus System

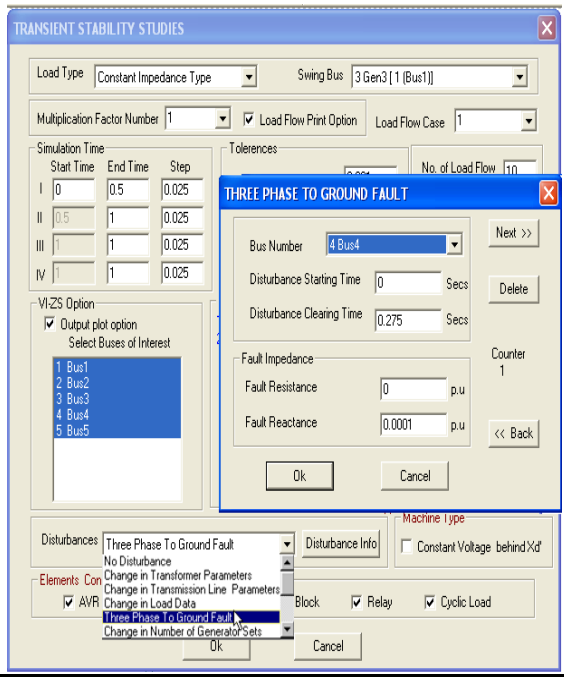


Fig.3 Transient Stability Analysis Simulation Time Frame & Disturbances

Graph:

Graph is generate automatically in Migraph utility which Provide swing curve or plot between power angle (degree) & to time (sec.).here fig.5 show curve for machine-2&3 which are connected at bus-2&3.

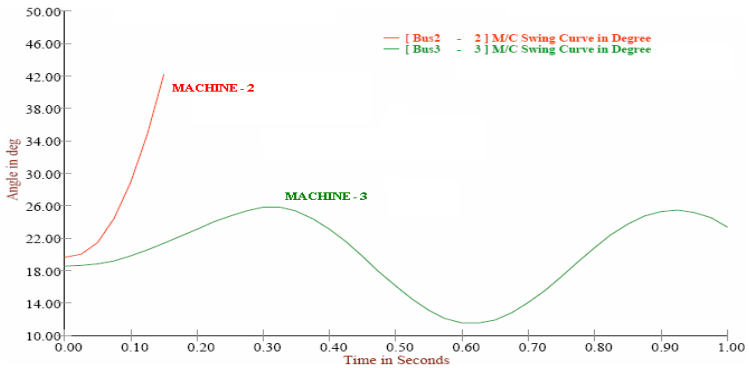


Fig.4 Swing Curve of Machine-2 and Machine-3

VII. CONCLUSIONS

In this case study, A Simulation of Transient Stability of 5-Bus system using MiPower software by Time domain method. My idea was demonstrated by applying two disturbances on system. one of the applying three phase to ground fault at bus-4 and another one by changing trans-mission line parameter (opening of Transmission line).The methodology is built upon state of increases power transfer through healthy portion of network during disturbances, which allow machine to swing through a larger rotor angle from its earing angle. This work aims to present a methodology to transient stability analysis of electrical energy system. This will help and guide the improvement of stability analysis.

REFERENCES

[1] Pranamita Basu, Aishwarya Harinandan "Power system Stability analysis using matlab" from NIT Rourkee,p. 15-16
[2] L.P.Singh, " Advance Power system Analysis & Dynamics",p.344
[3] M.Moechtar ,T.C.Cheng, and L. Hu "Transient Stability of Power System a survey," WESCON/95.conference record "Microelectronics communications Technology producing quality products Mobile & portable power emerging Technologies" SanFrancisco,Nov 1995,p166-171
[4] Wehnekel L.,Van Custem and Ribbens,"An Artificial intelligence frame work for online Transient stability assessment power system",1984,4,(2),p.789-800
[5] S.Krishna and K. R. Padiyar "Transient stability assessment using artificial neural networks"proc.IEEE International conference on Industrial Technology 2000,Goa,India,vol.2,p.627-632.
[6] A.H. El-Abiad and K. Nagappan "Transient Stability regions of multimachine power system",IEEE Trans.power appar.syst.,1966,PAS-85,(2),169-178.
[7] M.A.Pai "Energy function analysis for power system", Kluwer academic publisher Boston 1989
[8] H.D. Chiang, F.F. Wu and P.P. Varaiya "Foundations of direct methods for power system Transient stability analysis," IEEE Trans. circuits and systems,1987,CAS-34,(2),p.160-173
[9] H.D. Chiang, C.C. Chu and G. Cauley "Direct stability analysis of electric power systems using energy function" IEEE ,Nov 1995,vol 83,(11),p1497-1529.
[10] Leonard L. Grigsby "Power system stability and control," chapter 8
[11] P. M. ANDERSON AND A. A. FOUAD, Power System Control and Stability, IEEE Press, 1994.
[12] P. KUNDUR, "Power System Control and Stability", New York: McGraw-Hill, Inc., pp. 3-168, 699-825 and 1103-1166, 1994.
[13] W.D .Stevenson, Elements of Power System Analysis,3rd Edition, McGraw Hill,1975.
[14] R.T.Byerly and E.W Kimbark,Stability of Large Electric Power Systems,IEEE Press 1974.
[15] P.M.Anderson,Analysis of Faulted Power Systems,Iowa State Press,Ames,Iowa,1973
[16] Padiyar, K.R., "Power System Dynamics Stabilityand control", BS Publications, Hyderabad, 2nd edition, 2008
[17] Steinmetz, C.P., "Power Control and Stability of Electric Generating Stations," *AIEE Trans.*, Vol. XXXIX, no.2, pp.1215-1287, July 1920
[18] Wikins, R., "Practical Aspects of System Stability," AIEETrans., pp. 41-50, 1926
[19] Evans, R.D., Wagner, C.F., "Further Studies of Transmission System Stability," AIEE Trans., pp. 51-80, 1926
[20] Edvard. (2010). Historical Review of Power System Stability Problems. Retrieved from http://electrical-engineering-portal.com/historical-review-ofpower- system-stability-problems
[21] Da-Zhong Fang, Chung, T.S., Yao Zhang, Wennan Song, "Transient stability limit conditions analysis using a corrected transient energy function approach," Power Systems, IEEE

