Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 7, Issue, 12, pp.24707-24710, December, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

ANALYSIS OF TRANSIENTS RECORDED BY NUMERIC RELAYIN 220/ 400 KV SYSTEM

*SupriyaTripathi, Dr. Zadgaonkar, A. S. and Dr. Tripathi, N.

Department of Electrical, Bhilai Institute of Technology Durg, India

ARTICLE INFO

Article History:
Received 18th September, 2015
Received in revised form
15th October, 2015
Accepted 17th November, 2015
Published online 30th December, 2015

Key words:
Transients,
Numeric relay,
FFT.

ABSTRACT

An electric power system comprises of generation, transmission and distribution of electric energy. Transmission lines are used to transmit electric power to distant large load centers. The rapid growth of electric power systems over the past few decades has resulted in a large increase of the number of lines in operation and their total length. These lines are exposed to faults as a result of lightning, short circuits, faulty equipment, mal-operation, human errors, overload, and aging. The un-interrupted and reliable power supply in the need of the today world. Faults cause short to long term power outages for customers and may lead to significant losses especially for the manufacturing industry and nation`s economy as a whole . Fast detecting, isolating, locating and repairing of these faults are critical in maintaining a reliable power system operation. The symmetrical faults (LG, LLG, LLL/LLLG and transients) are most commonly occurring faults in power system. Amongst the all the faults discussed above the behavior of the transient in power system is most unpredictable. This paper aims to provide an insight for the recognition of the transients fault in the power system using FFT analysis.

Citation: SupriyaTripathi, Dr. Zadgaonkar, A.S. and Dr. Tripathi, N., 2015. "Analysis of Transients Recorded by Numeric Relayin 220/ 400 kV system", *International Journal of Current Research,* 7, (12), 24707-24710.

INTRODUCTION

Under normal conditions, a power system operates under balanced conditions with all equipments carrying normal load currents and the bus voltages within the prescribed limits. This condition can be disrupted due to a fault in the system. A fault in a circuit is a failure that interferes with the normal flow of current. A short circuit fault occurs when the insulation of the system fails resulting in low impedance path either between phases or phase(s) to ground. The transients in power system unlike other faults LF, LLG, LLL, and LLLG are different in sense that along with interruption in power supply it is also responsible for the power quality issues. This paper aims at providing an insight of the transient recorded by the numeric relay in 220/400 kV lines. The analysis of the transients has been done using FFT analysis.

Necessity for Protection

Electrical power system operates at various voltage levels from 415 V to 400 kV or even more. A tree falling or touching an overhead line may cause a fault. A lightning strike can cause insulation failure. Pollution may result in degradation in performance of insulators which may lead to breakdown.

Corresponding author: SupriyaTripathi,
Department of Electrical, Bhilai Institute of Technology Durg, India

Under frequency or over frequency of a generator may result in mechanical damage to its turbine requiring tripping of an alternator. Even otherwise, low frequency operation will reduce the life of a turbine and hence it should be avoided. It is necessary to avoid these abnormal operating regions for safety of the equipment. Even more important is safety of the human personnel which may be endangered due to exposure to live parts under fault or abnormal operating conditions. Hence, every electrical equipment has to be monitored to protect it and provide human safety under abnormal operating conditions. This job is assigned to electrical protection systems. It encompasses apparatus protection and system protection.

Types of Protection: Protection systems can be classified into two types:

- Apparatus protection
- System protection

Apparatus Protection

Apparatus protection deals with detection of a fault in the apparatus and consequent protection. Apparatus protection with reference to the power system can be further classified into following:

- Feeder protection
- Transformer Protection
- Generator Protection

- Motor Protection
- Busbar Protection

Transients in power system

From electric circuit theory point of view "transient" originates whenever there is transition in voltage and current component during transition from one steady-state to another steady state. Switching are the main cause of such transients in the circuits. Whereas in power systems the term transient is used in a slightly different way: it denotes those phenomena in voltage and current with a short duration. There is no clear limit, still phenomena with a duration of less than one cycle (of the power-system frequency are referred as transients. The interest in power system transients has traditionally been related to the correct operation of circuit breakers (Greenwood, 1991), (Van Der Sluis, 2001) and to over voltages due to switching of high-voltage lines (Hileman, 1999). Relations have to be established between waveform characteristics and equipment performance; methods have to be developed to extract information on the cause of transient waveforms; and methods are needed to quantify site and system performance. Power system transients are due to a range of causes, the main ones being lightning strokes to the wires in the power system or to ground and component switching either of network components or of end-user equipment.

MATERIALS AND METHODS

- Data collection from three different location (220/400 kV sub-station).
- Separation of the different faults recorded by the Numeric relay.
- Numeric relay provides all the information of the faulty signals like amplitude, phase ,frequency etc
- Numeric Relays records Disturbance signal in MiCom platform (software)
- FFT analysis of signal in MatLab platform.

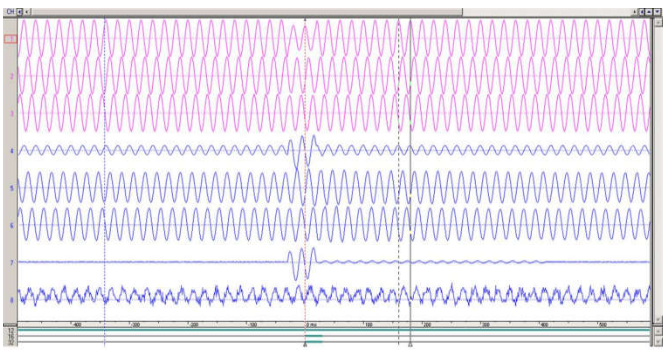

Figure 1. Waveform of transient in transmission line as recorded by numeric relay

RESULTS

The transient fault recorded by the numeric relay is shown in figure1. The FFT response of the recorded signal during healthy and faulty condition is shown in figure 2-7 below. The comparison between the Kurtosis and the RMS values of the voltage and current during faulty and healthy condition was minutely observed is shown as bar graph in figure 8-11. These values were helpful in finding the important conclusion regarding the performance of the Numeric relay during transients in 220 / 400 kV lines.

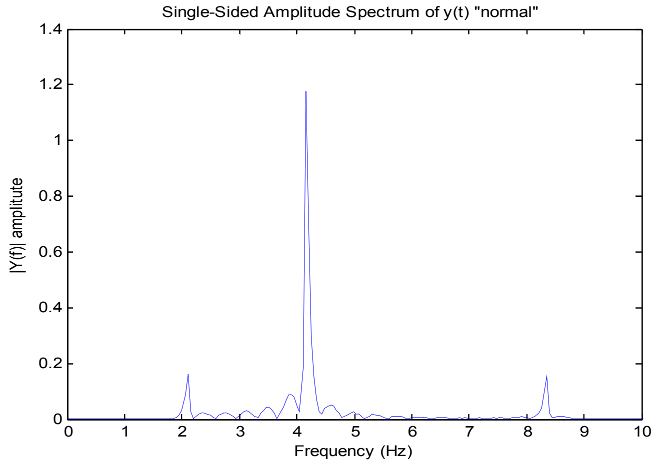

Figure 2. FFT response of Voltage during healthy condition

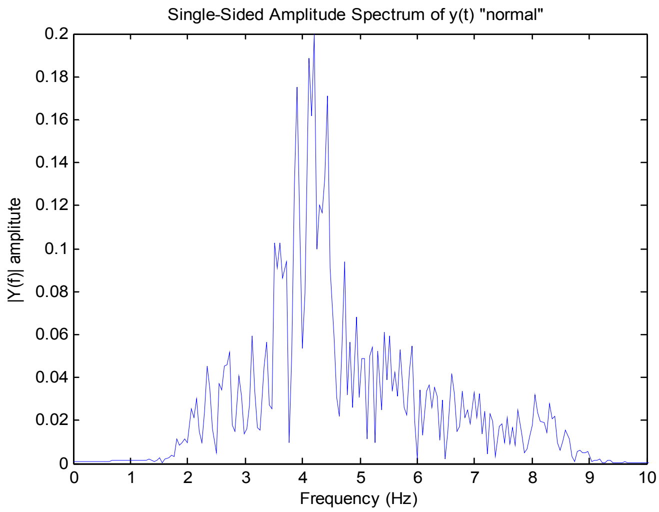

Figure 3. FFT response of Voltage (Faulty phase Va) during transient fault

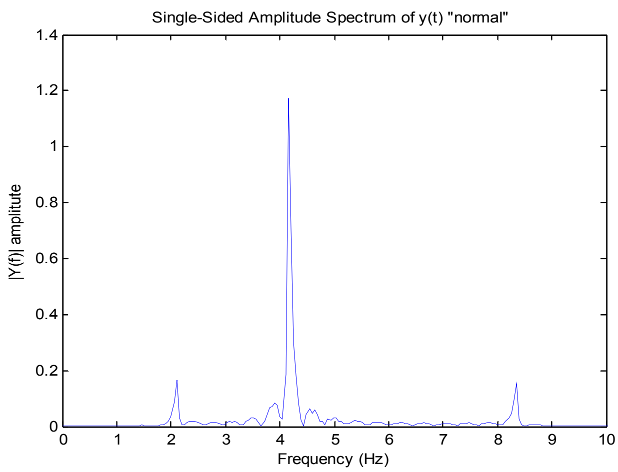

Figure 4. FFT response of current during healthy condition

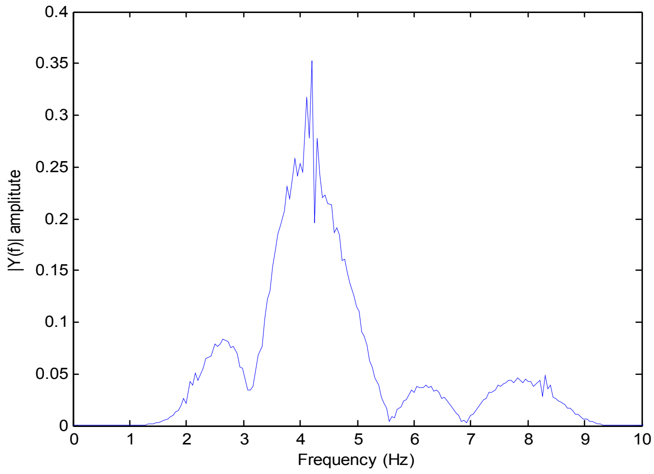

Figure 5. FFT response of current (Faulty phase Ia) during transient fault

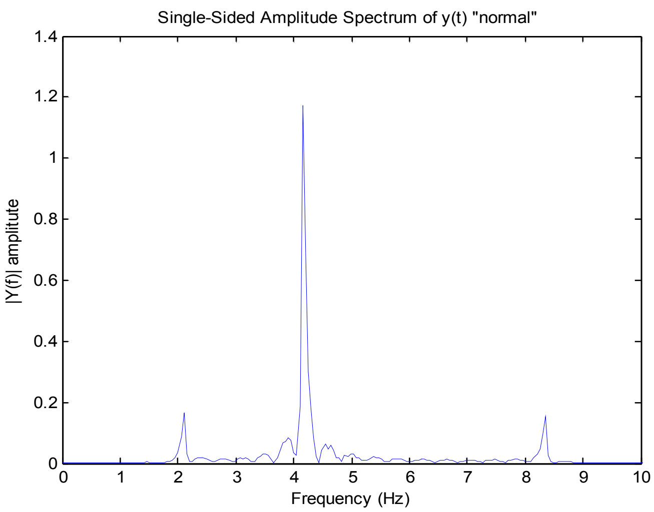

Figure 6. FFT response of the Neutral Current during healthy condition

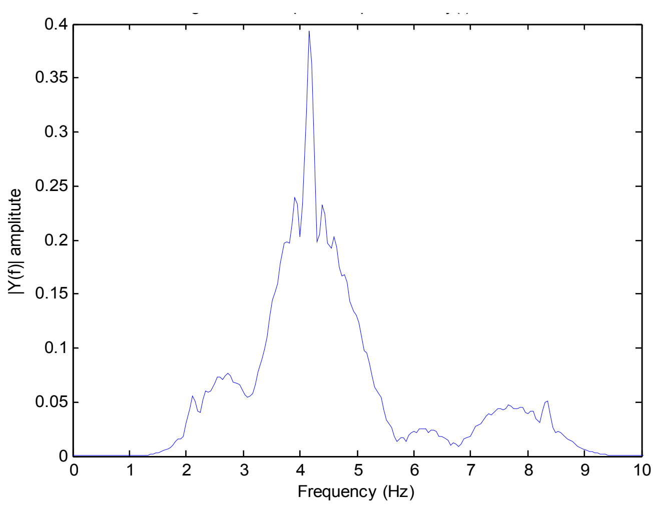

Figure 7. FFT response of the Neutral Current during transient fault

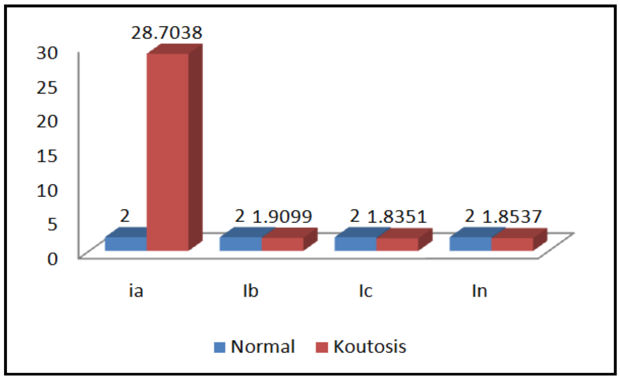

Figure 8. Comparison of the Kurtosis value of current during transient

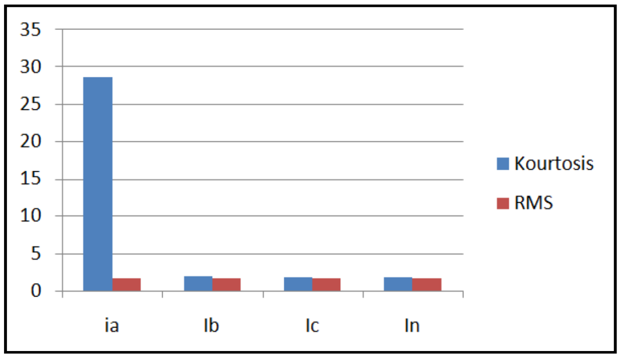

Figure 9. Comparison of RMS values of Current

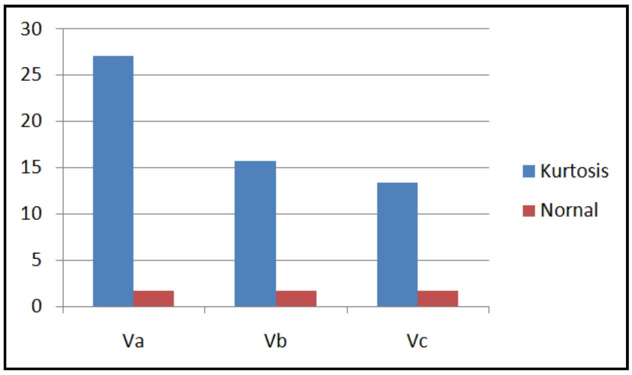

Figure 10. Comparison of Kurtosis values of Voltages

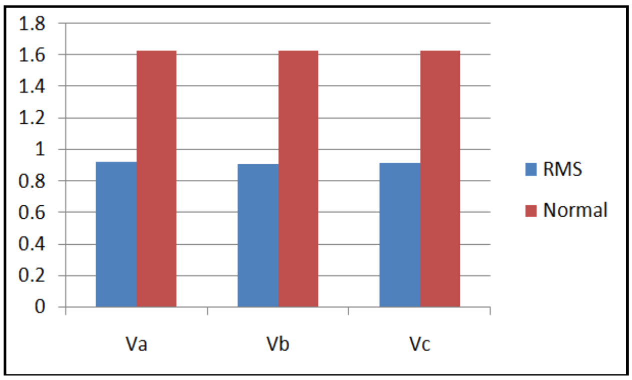

Figure 11. Comparison of RMS values of Voltages

Conclusion

On the basis of the FFT analysis of the signal recorded by numeric relay during transient following conclusion are drawn. The bar graph was plotted for the comparison of the Kurtosis valueans RMS values of voltage and current signal during healthy and faulty condition

- No change in the magnitude of neutral current (I_N) was seen during transient condition where as huge variation are observed in the magnitude of neutral current (I_N) during LG, LLG,LLL and LLLG faults.
- Variation in the kurtosis values of voltage during faulty condition is prominent as compared to RMS values for LG, LLG, LLL and LLL-G fault.
- The increment in the kurtosis values of the current is also observed as compared to the RMS value of the current during transients in power system.
- For the similar nature of the fault the corresponding changes in the Kurtosis values of the voltage and current are also same during transients in power system.
- Switching and loading are the main causes for transients in power system.
- The kurtosis value of voltage increases during switching phenomenon changes.
- The kurtosis value of current increases during loading phenomenon changes.

Finally it is concluded that on the basis of the kurtosis value of voltage and current the transient in the power system can be identified.

REFERENCES

Chaari, O., P. Bastard, and M. Meunier, 1995. “Prony’s method: An efficienttool for the analysis of earth fault currents in Petersen-coil-protectednetworks, ”IEEE Trans. Power Del., vol. 10, no. 3, pp. 1234–1241, Jul.

Dafis, J., C. O. Nwankpa, and A. Petropoulu, 2000. “Analysis of power systemtransient disturbances using an ESPRIT-based method,”inProc. IEEEPower Engineering Soc. Summer Meeting, pp. 437–442.

Dugan, R. C., M. F. Mc Granaghan, and H. W. Beaty, 1996. Electric Power Systems Quality. New York: McGraw-Hill.

Dunsmore, D. M., E. R. Taylor, B. F. Wirtz, and T. L. Yanchula, 1992. “Magnifi-cation of transient voltages in multi-voltage-level, shunt-capacitor-com-pensatedcircuits, ”IEEE Trans. Power Del., vol. 7, no. 2, pp. 644–673,Apr.

Greenwood, A. 1991. Electrical Transients in Power Systems. NewYork: Wiley.

Gu I.Y.H. and M.H.J. Bollen, 2000. “Time-frequency and time-scale domainanalysis of voltage disturbances,”IEEE Trans. Power Del., vol. 15, no.4, pp. 1279–1284, Oct.

Heydt, G. T., P. S. Fjeld, C. C. Liu, D. Pierce, L. Tu, and G. Hensley, 1999. “Applications of the windowed FFT to electric power quality assessment,”IEEE Trans. Power Del., vol. 14, no. 4, pp. 1411–1416, Oct.

Hileman, A. R. 1991. Insulation Coordination for Power Systems.NewYork: Marcel Dekker.

IEEE Recommended Practice for Monitoring Electric Power Quality, IEEE Standard 1159-1995.

Math H. J. Bollen, Fellow, IEEE, Emmanouil Styvaktakis, and Irene Yu-HuaGu, Senior Member, IEEE, Categorization and Analysis of Power System Transients, IEEE Transactions On Power Delivery, Vol. 20, No. 3, July 2005 ,Pp 2298 -2306

Poisson, O., P. Rioual, and M. Meunier, 2000. “Detection and measurementof power quality disturbances using wavelet transform,”IEEETrans. Power Syst., vol. 15, no. 3, pp. 1039–1044, Jul.

Styvaktakis, E. 2002. “Automating power quality analysis,”Ph.D. thesis, Dept.Signals Syst., Chalmers Univ. Technol., Gothenburg, Sweden.

Van Der Sluis, L. 2001. Transients in Power Systems. New York: Wiley.

****