International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Special Issue of ICRTET-2023, pp 253-258, June-2023

International Conference of Recent Trends in Engineering & Technology (ICRTET-2023)

Implementation of Wavelet Transform on Transient Fault

[1]Vimal Patel, [2]Dr. Ashok Jhala

[1]Research Scholar, Department of Electrical Engineering, Bhabha University, Bhopal, India
[2]Professor, Department of Electrical Engineering, Bhabha University, Bhopal, India

***Abstract* - This paper presents the development of an algorithm for information about transient fault. The algorithm devised is based on Discrete Wavelet Transform (DWT) analysis of transient current signals recorded in the event of a short circuit on a transmission line. The DWT analysis of line currents are carried out for normal and various fault condition. Few parameters are defined using detailed coefficients of DWT analysis.**

Keywords: Transmission line faults, Transmission line transients, Wavelet Transform, Discrete Wavelet Transform.

I. INTRODUCTION

The great majority of faults on overhead transmission lines are transitory in nature. Power system transients are fast, short duration events that produce distortions in A C waveform. They are caused by sudden changes in the power system. Some of the more common causes of transients are: lightning strikes, switching operations and electrical faults.

The effects of transients on equipment are cumulative, with every succeeding transient having a greater effect on the equipment. Transients are difficult to detect because of their short duration. About 80- 90% of faults on overhead transmission network are transient in nature. The remaining 10%-20%of faults are either semi-permanent or permanent. For transient fault immediate tripping of one or more circuit breakers clears the fault. Subsequent re-energizing of the line is usually successful. For permanent fault reclosing is very risky to expensive equipment which may be damaged by high fault current during the reclosing procedure. Therefore it is very important to distinguish between transient and permanent faults.

Transients are momentary changes in voltage or current those occur over a short period of time. This interval is usually described as approximately 1/16th of a voltage cycle or about 1ms. Transients are classified into three categories: impulsive transient, oscillatory transient and transient due to fault. The transient is classified in the impulse category when 77% of the peak-to-peak voltage of the pure component is of one polarity. An oscillatory transient is a sudden, non- power frequency change in the steady state condition of voltage, current or both that includes positive and negative polarity values. The transient due to fault is caused by fault conditions, the energization of large loads which require high starting currents or intermittent loose connections in power wiring. Each category of the transient is sub divided in to three types related to the frequencies contained. Each type of transient can be associated with a group of phenomena occurring on the power system.

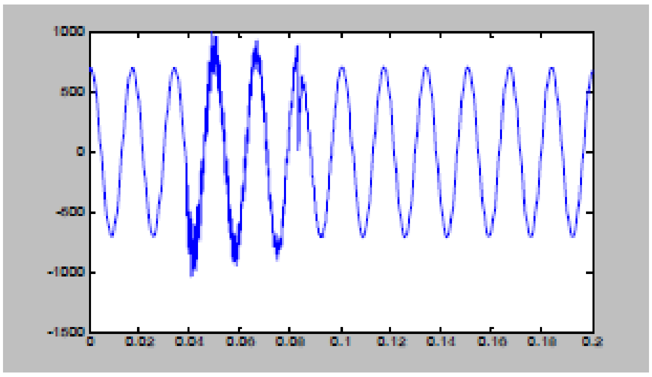


Figure 1 Oscillatory transient

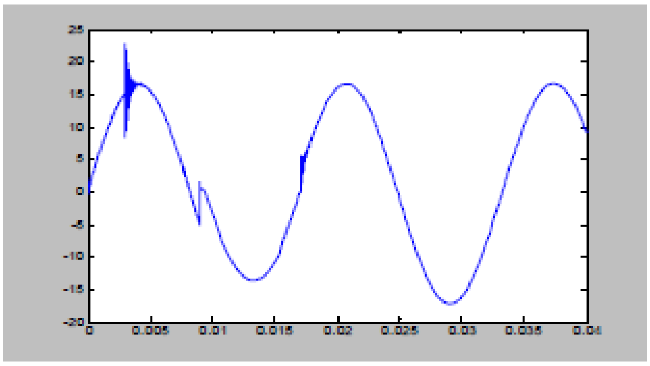


Figure 2 Transient due to fault

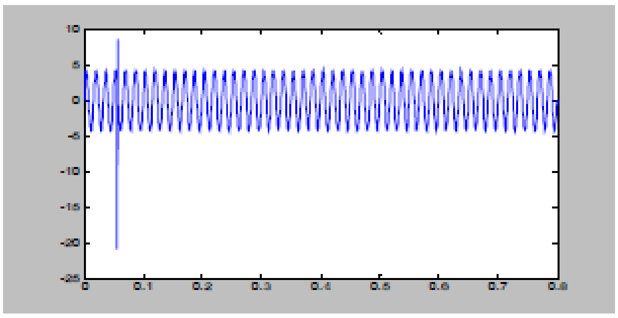


Figure 3 Impulsive transient

ISSN (online): 2581-3048

Volume 7, Special Issue of ICRTET-2023, pp 253-258, June-2023

International Conference of Recent Trends in Engineering & Technology (ICRTET-2023)

The impulsive low frequency transient rises in 0.1 ms and lasts more than 1ms.The oscillatory low frequency transient contains frequency components up to 5 kHz. These types are the most common transients recorded on a power system. They are not only propagated but they can also be amplified by a power systems resonance phenomenon. Measurement of these types of transients should be useful for all classes of application. The medium frequency impulsive transient lasting between 5 ns to 1ms and the oscillatory transient between 5 and 500 kHz are less frequent than the low frequency types but have much higher amplitude.

These transients may not propagate as easily as the low frequency types but may cause arcing faults on the power distribution system which result in voltage sag on many user power systems. The high frequency transient types with high amplitude can be observed only near where the phenomenon occurs. The high frequency impulsive transient has duration below 50 ns and the frequency of the high frequency oscillatory type ranges between 0.5 to 5MHz.

Wavelet Transform provides the timescale analysis of the non stationary signal. It decomposes the signal to time scale representation rather than time- frequency representation. Wavelet transform expands a signal into several scales belonging to different frequency regions by using translation (shift in time) and dilation (compression in time) of a fixed wavelet function known as Mother Wavelet. Wavelet based signal processing technique is one of the new tools for power system transient analysis and power quality disturbance classification and also transmission line protection. In other words, the wavelet transform reacts the most to the gradient of a given signal.

The more irregular the disturbance, the higher the gradient will be. In most power signals, the wave shape of a disturbance event is irregular compared to that of its background signal. As a consequence, the wavelet coefficients associated with the disturbance event will have very large magnitudes compared to those of a disturbance-free waveform. The multi resolution analysis (MRA) technique decomposes a given signal into its detailed and smoothed versions. By using the MRA technique, the power system transient signal is decomposed into two other signals; one is the blurred version of the PQ disturbance signal, and the other is the detailed version of the power system transient signal that contains the sharp edges, transitions, and jumps. Therefore, the MRA technique discriminates disturbances from the original signal which analyses them separately.

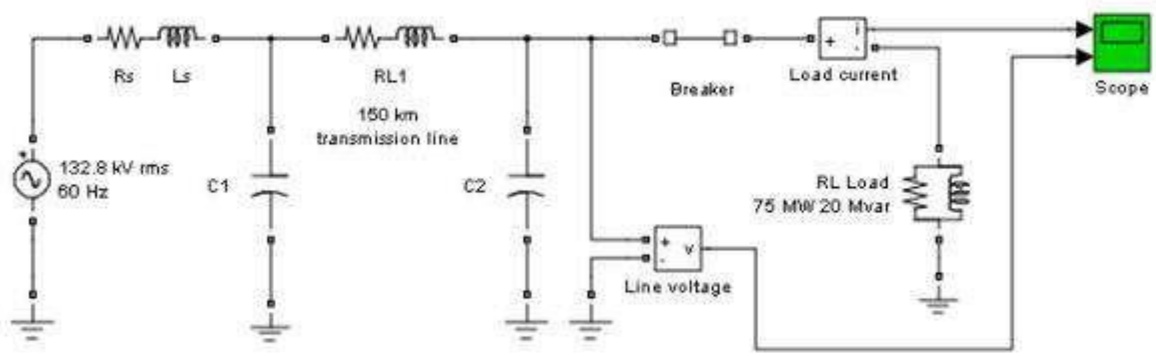


Figure 4: Test system for generation of power system transients

Value of these parameter for normal condition, permanent fault, transient fault, load switching and capacitor switching.

	NORMAL CONDITION	STEADY STATE FAULT	TRANSIENT FAULT	LOAD SWITCHING	CAPACITOR SWITCHING
Qd1	106.4263098	1408.141974	528.242745	382.709125	281.708018
Qd2	292.9447695	3874.122725	1451.60744	1044.69342	773.276446
Qd3	817.3285867	9811.408055	3668.38456	2804.0565	1967.33741
Qd4	2292.226122	17216.02768	6639.37844	6302.46295	4031.02434
Qd5	6360.455925	18212.43725	8554.2601	7360.05473	6810.8956
Qd6	16728.5212	48437.93392	16536.1403	20897.5227	17060.0884

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Special Issue of ICRTET-2023, pp 253-258, June-2023

International Conference of Recent Trends in Engineering & Technology (ICRTET-2023)

Qd7	40504.55277	107509.2751	41626.9146	37702.0452	41626.873
Qd8	49231.52858	150681.1089	49496.758	49518.5875	50496.6192
Qd9	10518.8198	35222.16728	11106.3609	11401.268	10613.4751

Table 1 Values of parameters for various transients conclusion

Qd9=Sum of absolute values of 1st level detailed coefficients of line current
Qd8=Sum of absolute values of 2nd level detailed coefficients of line current
Qd7=Sum of absolute values of 3rd level detailed coefficients of line current
Qd6=Sum of absolute values of 4th level detailed coefficients of line current
Qd5=Sum of absolute values of 5th level detailed coefficients of line current
Qd4=Sum of absolute values of 6th level detailed coefficients of line current
Qd3=Sum of absolute values of 7th level detailed coefficients of line current
Qd2=Sum of absolute values of 8th level detailed coefficients of line current
Qd1=Sum of absolute values of 9th level detailed coefficients of line current

II. NORMAL CONDITION

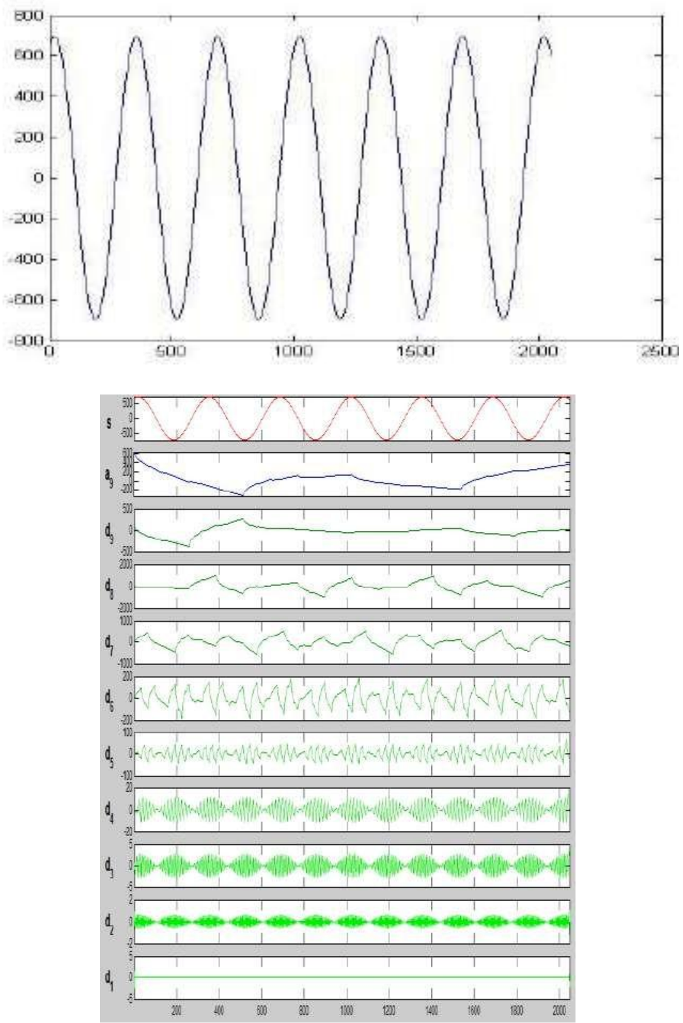
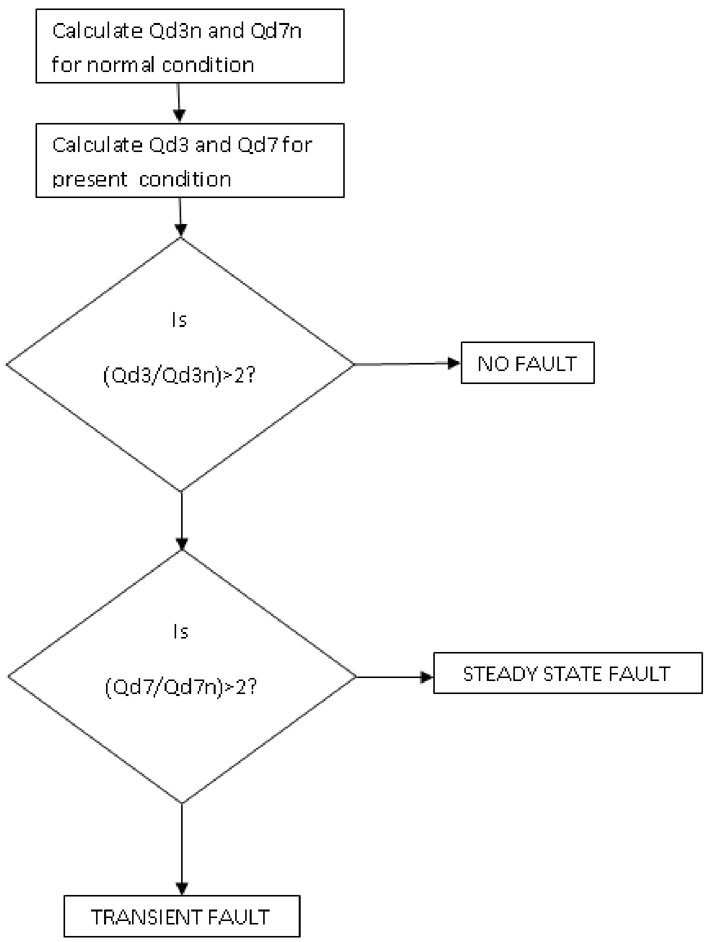


Figure 5 Line current and its DWT decomposition for normal condition



Algorithm for steady state transient fault classification

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Special Issue of ICRTET-2023, pp 253-258, June-2023

International Conference of Recent Trends in Engineering & Technology (ICRTET-2023)

III. PERMANENT FAULT

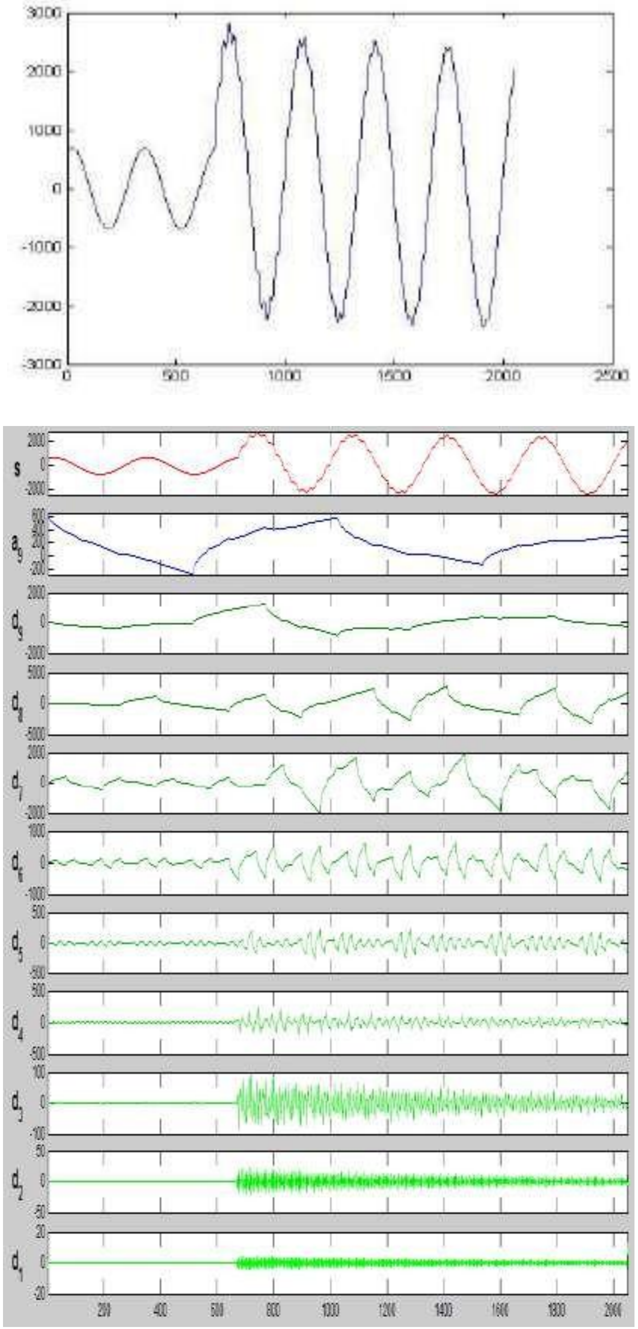


Figure 6 Line current and its DWT decomposition for permanent fault

IV. TRANSIENT FAULT

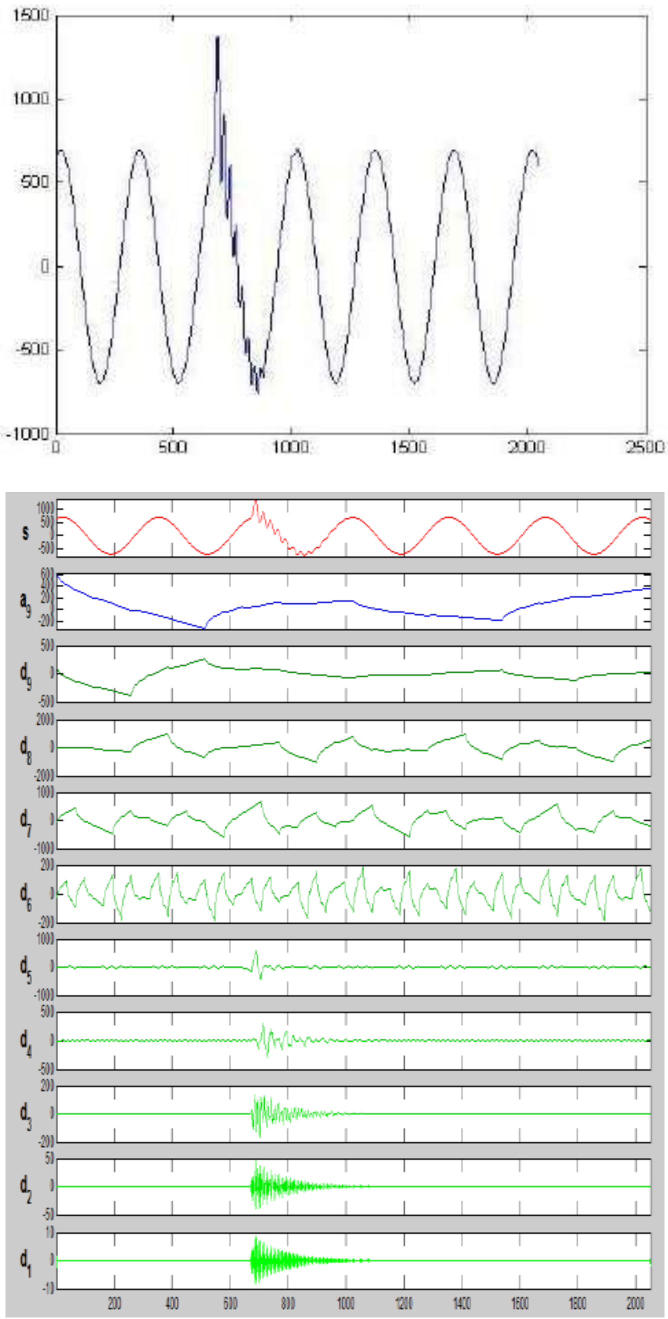


Figure 7 Line current and its DWT decomposition for transient fault

International Research Journal of Innovations in Engineering and Technology (IRJIET)
ISSN (online): 2581-3048
Volume 7, Special Issue of ICRTET-2023, pp 253-258, June-2023
International Conference of Recent Trends in Engineering & Technology (ICRTET-2023)

V. TRANSIENT DUE TO SWITCHING OF LOAD

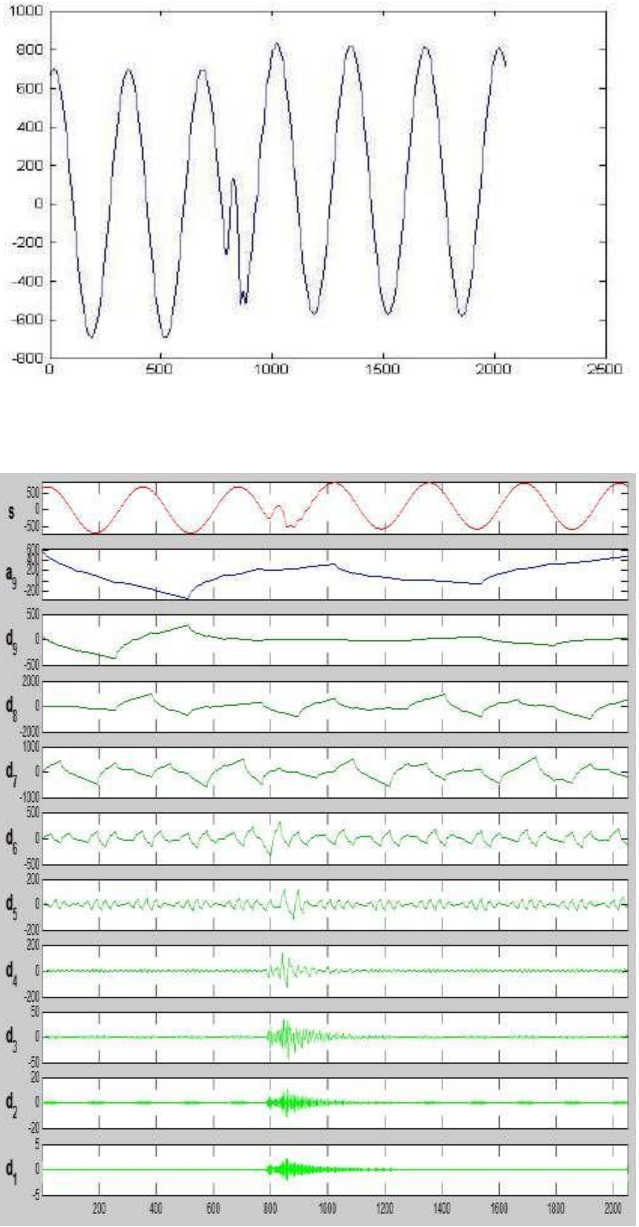


Figure 8 Line current and its DWT decomposition for transient due to switching of load

This circuit is a simplified model of a 230 kV three-phase power system. Only one phase of the transmission system is represented. The equivalent source is modeled by a voltage source (230 kV rms/sqrt(3) or 187.8 kV peak, 60 Hz) in series with its internal impedance (Rs Ls) corresponding to a 3-phase 2000 MVA short circuit level and X/R = 10. (X = 230e3^2/2000e6 = 26.45 ohms or L = 0.0702 H, R = X/10 = 2.645 ohms). The source feeds a RL load through a 150 km transmission line. The line distributed parameters (R = 0.035ohm/km, L = 0.92 mH/km, C = 12.9 nF/km) are modeled by a single pi section (RL1 branch 5.2 ohm; 138 mH and two shunt capacitances C1 and C2 of 0.967 uF). The load (75 MW - 20 Mvar per phase) is modeled by a parallel RLC load block.

VI. CONCLUSION

Analysis of various types of transients was carried out using Discrete Wavelet Transform. Comparison of detailed coefficient for various waveforms was done for identification of transient and steady state fault with respect to healthy condition. Criteria for identification of transient fault were developed.

REFERENCES

[1] T. Jayasree, D. Devaraj and R. Sukanesh, "Classification of Transients using Wavelet Based Entropy and Radial Basis Neural Networks", International Journal of Computer and Electrical Engineering, Vol. 1, No. 5 December, 2009.

[2] Rodney H. G. Tan, V. K Ramachandaramurthy, "Power system transient analysis using scale selection wavelet transform", TENCON 2009 - 2009 IEEE Region 10 Conference 23-26 Jan. 2009.

[3] Anoop Mathew, N.O. Gunasekar, D. Bensiker Raja Singh and S.Uma Mahaswaran, "Detection and Classification of Voltage Swells Using Wavelet Transforms", International Journal of Computer and Electrical Engineering, Vol. 2, No. 3, June, 2010.

[4] A.M. Gaouda, M. M.A. Salama, M. R. Sultan, A.Y.C. Hittani, "Power Quality detection and Classification using Wavelet Multi Resolution Signal decomposition", IEEEtransaction on Power Delivery 14(4) (1999) 1469-1476.

[5] C. H. Lee, Y. Juen, and W. Liang, "A literature survey of wavelet in power engineering applications," Proc. Natl. Sci. Counc. ROC (A), vol. 24, no. 4, pp. 249–258, June 2000.

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Special Issue of ICRTET-2023, pp 253-258, June-2023

International Conference of Recent Trends in Engineering & Technology (ICRTET-2023)

Citation of this Article:

Vimal Patel, Dr. Ashok Jhala, "Implementation of Wavelet Transform on Transient Fault" in proceeding of International Conference of Recent Trends in Engineering & Technology ICRTET - 2023, Organized by SCOE, Sudumbare, Pune, India, Published in IRJIET, Volume 7, Special issue of ICRTET-2023, pp 253-258, June 2023.

****