ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

An Effective Method of for Identification of Fault Location and Analysis for Double/Single Circuit Transmission Lines by ATP Methods

D.Saidulu Reddy
M.Tech Student,
Sardar Patel College of Engineering,
Andheri, Mumbai 400058.

Ms.Rema Devi C
(M.Tech Electrical), Associate Professor,
Sardar Patel College of Engineering,
Andheri, Mumbai 400058.

Abstract:

Locating faults in a cable system can be done either with the circuit de-energized, or in some cases, with the circuit under power. Fault location techniques can be broadly divided into terminal methods, which use voltages and currents measured at the ends of the cable, and tracer methods, which require inspection along the length of the cable. Terminal methods can be used to locate the general area of the fault, to expedite tracing on a long or buried cable. This paper presents the development and implementation of ATP algorithms for fault analysis in double/single circuit transmission lines. These algorithms helps in correctly identifying the fault point based on voltage and current phasor quantities, calculated by using measurements of voltage and current signals from intelligent electronic devices, located on the transmission-line terminals. The algorithms have access to the electrical parameters of the transmission lines and to information about the transformers loading and their connection type.

Keywords:
Fault Location, Fault Identification, Transmission lines, Voltage, Power, ATP Algorithms.

Introduction:

Electric power transmission is the bulk transfer of electrical energy, from generating power plants to electrical substations located near demand centers. This is distinct from the local wiring between high-voltage substations and customers, which is typically referred to as electric power distribution. Transmission lines, when interconnected with each other, become transmission networks. In very simple wiring systems, the fault location is often found through inspection of the wires. In complex wiring systems (for example, aircraft wiring) where the wires may be hidden, wiring faults are located with a Time-domain reflectometer.

The time domain reflectometer sends a pulse down the wire and then analyzes the returning reflected pulse to identify faults within the electrical wire. Sometimes an insulation fault in a power cable will not show up at lower voltages. A "thumper" test set applies a high-energy, high-voltage pulse to the cable. Fault location is done by listening for the sound of the discharge at the fault. While this test contributes to damage at the cable site, it is practical because the faulted location would have to be re-insulated when found in any case.In a high resistance grounded distribution system, a feeder may develop a fault to ground but the system continues in operation. The faulted, but energized, feeder can be found with a ring-type current transformer collecting all the phase wires of the circuit; only the circuit containing a fault to ground will show a net unbalanced current. To make the ground fault current easier to detect, the grounding resistor of the system may be switched between two values so that the fault current pulses.

Multiterminal transmission networks may use single- or double-circuit lines. As a result, the main branch may use a single transmission line or a double-circuit line (both circuits at the same towers, circuits at different towers and at the same corridor, or circuits at different towers and at different corridors). Fig. 1 illustrates a typical multiterminal transmission network. The main branch connects two terminals (T1 and T2). Alongthe main branch, there are tap points (b1 to bn) where lateral branches are connected. These lateral branches terminate at distribution or industrial substations (terminals Ts1 to Tsn).IEDs installed at T1 and T2 are responsible for recordingvoltage and current signals. These records may or may not be available at other terminals (Ts1 to Tsn). Nonetheless, the proposed system is capable of correctly identifying the fault pointbased only on the signals recorded at T1 and T2, with or without time synchronization. In addition, if the records are available at other terminals, the proposed system uses them in order to improve the accuracy of the results.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Although voltage and current records may not be availableat one or more terminals (Ts1 to Tsn), the proposed system is capable of correctly estimating the load connected to them in order to proceed with the fault location. In addition, it is important to point out that the transformers connected to these terminals may have a grounded-wye/delta/grounded-wye connection type. As a result, a significant part of the fault current may flow through the primary winding of these transformers, for faults involving the ground. This scenario increases the complexity of the problem and since voltage and current records may not be available at these terminals, the mathematical model used to representthe transformers must implicitly consider the current flow through the primary winding.

Fault-Location Methods – Related Work:

Several algorithms for fault location in three terminal transmission lines have been proposed [1]–[6]. However, due to the complexity of the problem, only a few algorithms for fault location in multiterminal transmission lines have been proposed [7]–[10]. In addition, these algorithms do not address all of the requirements described in Section II.References [7] and [8] present fault-location algorithms for multiterminal single-circuit transmission lines. These algorithms are based on synchronized voltage and current measurements at all terminals and on the short transmission-line model.

As a result, these algorithms may present accuracy errors when handling medium and long multiterminal transmission lines.References [9] and [10] present fault-location algorithms for multiterminal double-circuit transmission lines. These algorithms are also based on voltage and current measurements at all terminals and on the short transmission-line model; therefore, both algorithms may present accuracy errors when handling medium and long multiterminal transmission lines.

The first one presents two different approaches based on synchronized voltage and current phasor quantities at all line terminals. The second one was developed according to certain unusual assumptions, which are difficult to verify, and it is not clear if it depends on time synchronization. Due to these reasons, the main goal of the fault-location method proposed in this paper is to address all of the problems described before in order to present an accurate solution for fault location in multiterminal transmission lines.

FAULT-LOCATION SYSTEM:

The fault-location system proposed in this paper addresses all requirements described in Section II. The identification of the fault point is based on four stages, which are detailed in the following sections. To exemplify the proposed system, consider the network depicted in Fig. below.

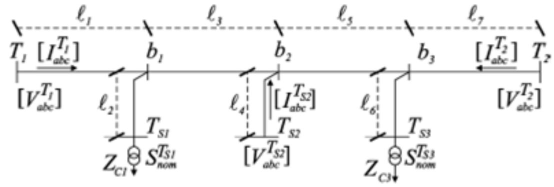

Fig .1. proposed system

This network is composed by single-circuit transmission-line sections. Along the main branch, which connects terminals T1 and T2, there are three tap points where lateral branches are connected. These lateral branches end at terminals Ts1,Ts2, Ts3. Unsynchronized voltage and currentmeasurements are available only at terminals T1, T2 and Ts2, which means that the relative phases of these measurements are unknown.

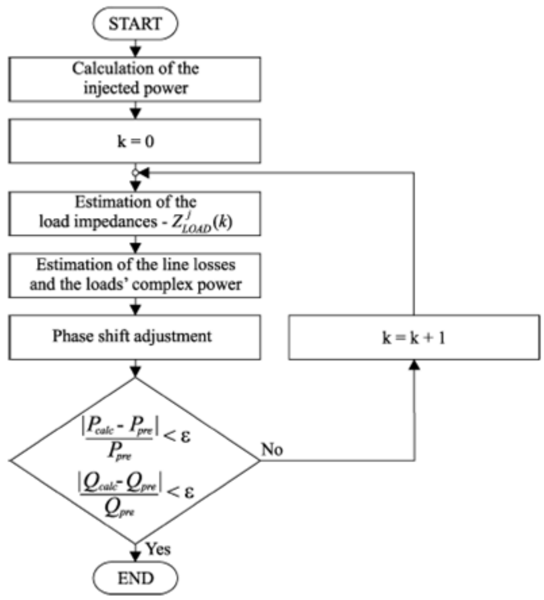

Fig .2. prefault processing

Digital Signal Processing: This stage consists of filtering pre and postfault voltage andcurrent signals at terminals T1,T2 and Ts2, and in order to reduce the effect of the exponential components that take place during the fault .

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

After this step, pre and postfault voltage and current phasor quantities at the respective terminals are calculated by using the one cycle discrete Fourier transform method.

Prefault Data Processing: The prefault processing stage is a recursive algorithm that consists of synchronizing voltage and current phasor quantities at terminals T1, T2 and Ts2 and estimating the load impedances at the remaining terminals (Ts1 and Ts3)

1)Calculation of the Injected Power: The algorithm startsby selecting the reference terminal (T1, for instance) and calculatingthe active and reactive prefault injected power (Ppre and Qpre) using the voltage and current phasor quantities at terminals T1,T2 and Ts2. The calculated injected power correspondsto the sum of the line losses and the load power consumption at terminals Ts1 and Ts3

2)Initial Estimative of the Load Impedances: After calculating the injected power, the algorithm estimates the initial value of the load impedances at terminals Ts1 and Ts3 by assuming that the transformers connected to these terminals operate proportionally to their nominal apparent power, as in

$$P_c^j = P_{pre} \cdot \frac{S_n^j}{\sum_{j=T_{S1}:T_{S3}} S_n^j}$$

and

$$Q_c^j = Q_{pre} \cdot \frac{S_n^j}{\sum_{j=T_{S1}:T_{S3}} S_n^j} \qquad (15)$$

$$Z_c^j = \frac{3 \cdot (V_n^j)^2}{\left(P_c^j + j \cdot Q_c^j\right)^*} \qquad (16)$$

where

T_j — T_{S1} and T_{S3};
S_n^j — transformer nominal apparent power at terminal T_j;
P_c^j — active power at terminal T_j;
Q_c^j — reactive power at terminal T_j;
Z_c^j — initial estimative of the load impedance at terminal T_j;
V_n^j — nominal phase voltage at terminal T_j.

3)Estimation of the Line Losses and Loads' Complex Power: This stage is based on a prefault load flow that depends on thecurrent and voltage phasor quantities at terminals T1, T2, and Ts2, and on the load impedances at terminals Ts1 and Ts3.

This procedure enables the estimation of all line sections' losses and all loads' complex power (pcalc and Qcalc)

4)Phase-Shift Adjustment: The procedure described in the previous section enables the calculation of the voltage and current phasor quantities at terminals T1 and Ts2 by using the voltage and current phasor quantities at terminal at T1 and the estimated load impedances at terminals Ts1 and Ts3. Therefore, it is possible to determine the phase shift of T2 and Ts2 with reference to T1 by comparing the measured and calculated voltage and current phasor quantities at these terminals

5)Estimation of the Load Impedances: The initial estimation of the load impedances may differ from the actual values. Therefore, it is necessary to correct it in order to adapt the complex power of the loads and the line losses to the total amount of injected power. In each iteration, the load impedances are corrected as in

$$Y_c^j(k+1) = Re\left\{Y_c^j(k)\right\} \cdot \frac{P_{\text{pre}}}{P_{\text{calc}}} + j \cdot Im\left\{Y_c^j(k)\right\} \cdot \frac{Q_{\text{pre}}}{Q_{\text{calc}}} \quad (17)$$

where

$Y_c^j(k+1)$ — load admittance at terminal T_j;
k — iteration number.

Postfault Processing:

The postfault processing stage consists of calculating twosets of postfault voltage and current phasor quantities at all tap points. One of them using postfault voltage and current phasor quantities at terminals T1 and the other using postfault voltage and current phasor quantities at terminal T2. This stage is based on (1) and (11). It depends on the load impedances at terminals Ts1 and Ts3 and on the postfault voltage and current phasor quantities at terminal Ts2. It also considers that the system is not faulted in order to perform the calculations. Using this approach, it is possible to determine whether the fault occurred at any lateral branch or at the main branch. In other words:

- if the fault has occurred at a lateral branch, the postfault-voltage phasor quantities at the respective tap point, from both sets, must be equal. In this case, the fault-location system investigates only the respective lateral branch;

- otherwise, the fault occurred at the main branch and all line sections belonging to it must be investigated.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Two algorithms were developed in order to estimate the faultlocation. The first one is based on the postfault voltage and current phasor quantities at both ends (Section III-D). Hence, it is used to locate faults at line sections from the main branch or lateral branches where voltage and phasor quantities are availableat the respective substation terminals. The second one isbased on the postfault voltage and current phasor quantities at one end (Section III-E). Thus, it is used to locate faults at lateral branches where voltage and current phasor quantities are available only at the tap point.

Fault-Location Algorithm—

Voltage and Current at Both Ends: The algorithm proposed in this section is used to locate faults at line sections where voltage and current phasor quantities are available at both ends

Fault-Location Algorithm—

Voltage and Current at One End: The algorithm proposed in this section is used to locate faults at line sections where voltage and current phasor quantities are available only at one end. This line section is delimited by tap point b1 and terminal Ts1 has a length of l2and the fault point is located at an unknown distance x from b1 .From (1) and (11), it is possible to calculate the postfault voltage and current phasor quantities at by using the postfault voltage and current phasor quantities at terminals T1and T2 . Thus, it is possible to estimate the postfault voltage and current phasorquantities at the fault point.

RESULT ANALYSIS

1. Fault ABC

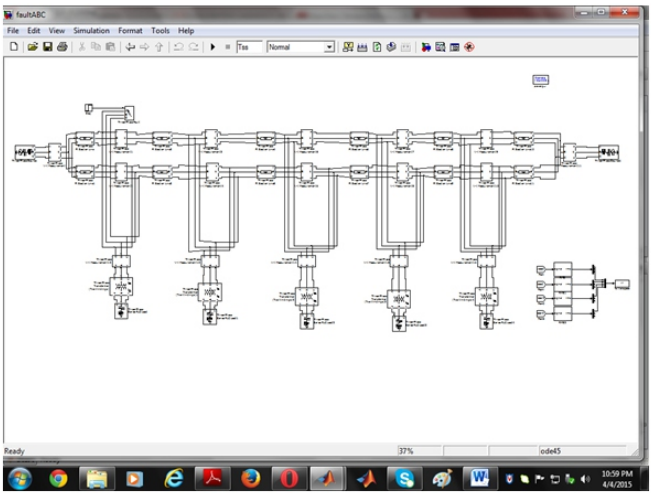

Fig.Simulation diagram of fault ABC

2. Fault AN

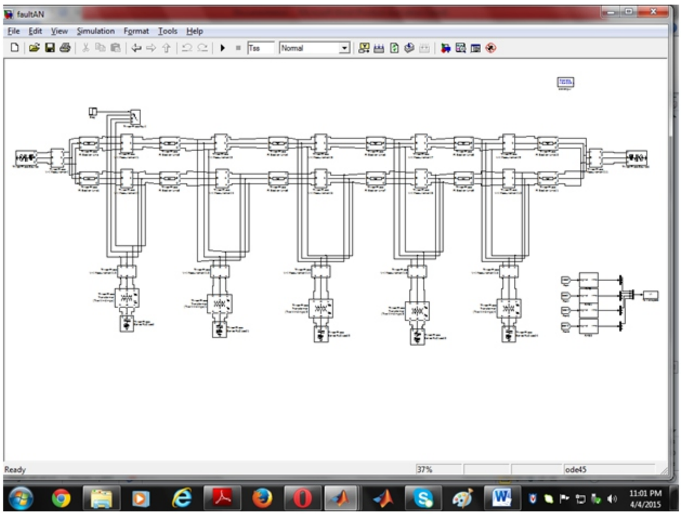

Fig.Simulation diagram of fault AN

3. Fault BCN

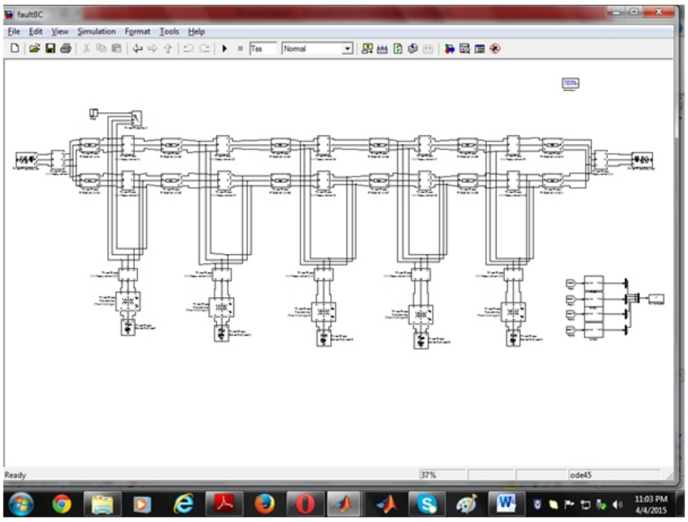

Fig Simulation diagram of fault BCN

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

4) Fault circuit

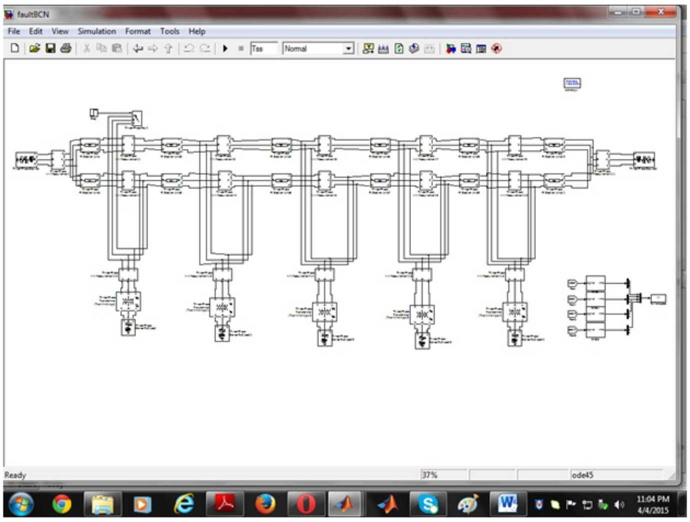

Fig fault circuit

CONCLUSION:

This paper presented the development, implementation, and test results of a fault-location system for multiterminal transmission lines.This proposed algorithm is based on synchronized measured voltage and currents, at the both the line terminals use of efficient transmission between two synchronized measurement units are installed at the line terminals. It doesn't require the line parameters to determine the fault location and length. In this paper we present the most common fault type the single line to ground fault is thoroughly tested. This can be derived in the spectral domain and based on the processing of voltage and current phasors. Further we extend the long transmission lines fault location based on parameter identification using one terminal data and to overcome by using fact's devices.

REFERENCES:

[1] Manassero, G. ,Senger, E.C. ; Nakagomi, R.M. ; Pellini, E.L. ; Rodrigues, E.C.N., Fault-Location System for Multiterminal Transmission Lines,IEEE Transactions on power Delivery, (Volume:25 , Issue: 3)

[2] R. K. Aggarwal, D. V. Coury, A. T. Johns, and A. Kalam, "A practical approach to accurate fault location on extra high voltage teed feeders," IEEE Trans. Power Del., vol. 8, no. 3, pp. 874–883, Jul. 1993.

[3] A. Girgis, D. Hart, and W. Peterson, "A new fault location technique for two and three terminal lines," IEEE Trans. Power Del., vol. 7, no. 1, pp. 98–107, Jan. 1992.

[4] C. Yu, C. Liu, and Y. Lin, "A fault location algorithm for transmission lines with tapped leg—PMU based approach," in Proc. IEEEPower Eng. Soc. Summer Meeting, Vancouver, BC, Canada, 2001, pp. 915–920.

[5] A. D. Tziouvaras, J. B. Roberts, and G. Benmouyal, "New multi-ended fault location design for two- or three-terminal lines," in Proc. 7th Inst.Elect. Eng., Developments in Power System Protection Int. Conf., Amsterdam, The Netherlands, 2001, no. 479, pp. 395–398.

[6] Y. Lin, C. Liu, and C. Yu, "A new fault locator for three-terminal transmission lines using two-terminal synchronized voltage and current phasors," IEEE Trans. Power Del., vol. 17, no. 2, pp. 452–459, Apr. 2002.

[7] M. Abe, N. Otsuzuki, T. Emura, and M. Takeuchi, "Development of a new fault location system for multi-terminal single transmission lines," IEEE Trans. Power Del., vol. 10, no. 1, pp. 159–168, Jan. 1995.

[8] S. M. Brahma, "Fault location scheme for a multi-terminal transmission line using synchronized voltage measurements," IEEE Trans.Power Del., vol. 20, no. 2, pt. 2, pp. 1325–1331, Apr. 2005.

[9] T. Nagasawa, M. Abe, N. Otsuzuki, T. Emura, Y. Jikihara, and M. Takeuchi, "Development of a new fault location algorithm for multiterminaltwo-parallel transmission lines," IEEE Trans. Power Del., vol.7, no. 3, pp. 1516–1532, Jul. 1992.

[10] T. Funabashi, H. Otoguro, Y. Mizuma, L.Dube, and A. Ametani, "Digital fault location for parallel double-circuit multi-terminal transmission lines," IEEE Trans. Power Del., vol. 15, no. 2, pp. 531–537, Apr. 2000.

[11] W. I. Bowman and J. M. McNamee, "Development of equivalent Pi and T matrix circuits for long untransposed transmission lines," IEEETrans. Power App. Syst., vol. PAS-83, no. 6, pp. 625–632, Jun. 1964, 653-657.