DETECTION OF FAULT LOCATION IN TRANSMISSION LINES

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Abstract- In transmission lines locating and clearing the fault is very necessary to reduce the damage and severity. In this paper, the location of faults using travelling wave principle is illustrated. The current signals are recorded and then Karrenbauer transformation is applied to the recorded current signal and wave menu is applied. The MATLAB sim power system is used to test and simulate the fault.

Keywords- Travelling Wave, Karrenbauer Transformation, Wave menu, Fault distance.

I. INTRODUCTION

Regulating the faults in HV transmission lines is necessary for the protection of devices. When a fault occurs on a transmission line it is very important to identify the fault location as quickly as possible for improving the reliability of the device. In utmost cases it is not easy to avoid the fault which occurs on the transmission line. So, in order to minimise the faults it is necessary to find the method which gives accurately and adequate protection of the equipment. If a fault location cannot be recognised and get rid of it quickly it may cause severe damage which leads to permanent faults. The frequently occurred faults in the transmission lines are transient faults. The determination of the location of these faults enables effectiveness in order to prevent permanent faults. The most commonly used fault locators are impedance locators, but it is difficult to locate the fault exactly. So in this paper karrenbauer transformation along with travelling wave method is used. In general, there are four different types of faults that occur on transmission lines, such as single – phase to ground fault, line-to-line fault, double line to ground fault, and three-line fault. Majority of the faults on transmission lines are caused by lightening, storms, freezing rain, snow, insulation breakdown.
II. TRAVELLING WAVE

A wave in which the positions of maximum and minimum amplitude travel through the medium then the wave can be referred as travelling wave. A travelling wave is a transient disturbance that moves along the line at constant speed yet maintains its shape. The principle of the travelling wave method is based on the high frequency signals of voltage and current. Among all the transients that happen in the transmission lines, the transients correlated with travelling wave phenomenon are one of the shortest which lasts from microseconds to milliseconds. An abrupt and eloquent change in voltage which occurs in at least one place in HV line leads to generation of an electromagnetic wave, which propagates from the point in two opposite directions, towards the substation A and substation B.

III. SINGLE ENDED TRAVELLING WAVE

Voltage bounce will happen on fault moment that ground fault happens on the transmission Line. The high frequency current which is delivered by voltage transformation on hold is characterized as fault transient travelling wave on the transmission lines, whose speed is near the Speed of the light. So we can exploit double end finished heading out wave rule to decide the Purpose of failure.

Fig: 2 Schematic diagram of single-Ended travelling wave method

Fig: 1 Propagation of electro-magnetic wave in HV lines after the fault
Single end power supply framework is shown in above figure. The travelling waves delivered by the fault point will spread both closures of the line when ground fault happens on the Transmission line. In this it can determine the separation to fault point by utilizing the time Distinction of travelling wave arrived in the line ends. Point K in the figure is the purpose of Failure. Double end terminal technique utilizes the travelling wave delivered by the line fault to Find the fault point. The technique for finding fault point in view of two terminal travelling wave Hypothesis is unique in relation of two terminal electrical quantities which measures and finds Point by the change of voltage, current and different parameters on both closures of the line. Single end terminal travelling wave strategy just needs the period of fault travelling wave Achieving both ends of the line, and the speed of light is accurate to the speed of the travelling Wave. Distance of fault location can be expressed as

\[ D = \frac{L + V(t_b - t_a)}{2} \]  

(1)

Where

- \( D \) = distance of the fault location
- \( L \) = length of the line
- \( V \) = velocity of the travelling wave
- \( t_a \) = The time taken for wave to reach the terminal A
- \( t_b \) = The time taken for wave to reach the terminal B

The single ended travelling wave strategy is utilized to recognise the wave when it Achieves both ends of the transmission line. At the point when transmission line fault happens, There is a change in both voltage and current. So to examine the travelling wave signal, it takes The technique for karrenbauer transformation, which is delicate to frequency when handling the Discrete signal. At the point when the frequency of wave signal changes, the karrenbauer Transformation will change. The approach time of initial surge travelling wave at both ends can Be known by the progressions, the sample frequency and the beginning and end time. At that Point we can ascertain total time distinction.

IV. TYPES OF FAULTS

Faults in power system can be categorized as shunt faults and series faults. The most happening sort of shunt faults is single line to ground faults(SLG), which one of the four sorts of shut faults, which happen along the electrical cables. This sort of faults happens when one transmitter tumbles to
ground or gets the neutral wire. It could also be the consequence of falling trees in a winter storm. The second most happening sort of shunt faults on two conductors being short circuited. Third kind of fault is the Double line to ground fault. This can be the consequence of a Tree falling on two of the electrical cables, or different causes. The fourth and least happening sort of fault is the balanced three phase which can happen by a contact between the three electrical cables in a wide range of structures.

V.WAVE REFLECTION AND REFRACTION

At the point when a fault happens on the transmission line, there will be a forward and a backward travelling wave towards two sides of transmission line. Amid this time, at the point of wave impedance change, the travelling wave will reflect and transmit.

VI.KARRENBAUER TRANSFORMATION

Karrenbauer transformation is used to change the phase values to modal values. The karrenbauer transformation matrix is as follows

\[
\begin{bmatrix}
0 \\
\alpha \\
\beta \\
\gamma
\end{bmatrix} = \frac{1}{3}
\begin{bmatrix}
1 & 1 & 1 \\
1 & -1 & 0 \\
1 & 0 & -1
\end{bmatrix}
\begin{bmatrix}
a \\
b \\
c
\end{bmatrix}
\]

The 0 modal is referred as zero modal. The \( \alpha \) modal and \( \beta \) modal are referred as Line modal. The \( \alpha \) modal is the modal between phases A and B. The \( \beta \) modal is the modal between phases A and C. In order to get the modal value between Phases B and C, \( \gamma \) – modal is introduced.

\[
\begin{bmatrix}
0 \\
\alpha \\
\beta \\
\gamma
\end{bmatrix} = \frac{1}{3}
\begin{bmatrix}
1 & 1 & 1 \\
1 & -1 & 0 \\
1 & 0 & -1
\end{bmatrix}
\begin{bmatrix}
a \\
b \\
c
\end{bmatrix}
\]
Fig:3 Simulation model of Fault location in transmission line
Fig: 4  Output of the current wave form when fault occurs

Fig: 5  After karrenbauer transformation is applied the result of current wave form
VII. RESULT

Table-1

<table>
<thead>
<tr>
<th>Actual Fault Distance(km)</th>
<th>Calculated Fault Distance(km)</th>
<th>% Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>99.73</td>
<td>-0.27</td>
</tr>
<tr>
<td>150</td>
<td>150.11</td>
<td>0.07</td>
</tr>
<tr>
<td>200</td>
<td>200.18</td>
<td>0.09</td>
</tr>
<tr>
<td>250</td>
<td>250.25</td>
<td>0.1</td>
</tr>
</tbody>
</table>

The actual distance where the fault is created is compared with calculated fault distance using karrenbauer transformation and the error between those two fault distance are tabulated as shown in above table.

VIII. CONCLUSION

This paper determines a single ended method of travelling wave fault location to find the fault point when line fault occurs and uses simulation software to do simulation for obtaining the accurate fault location. The method can obtain the distance of the fault point by calculating the time of initial wave reaching the ends of the terminals.

IX. REFERENCES


