Fault location of two-parallel transmission line for
double phase-to-earth fault using one-terminal data*

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Abstract: An accurate algorithm for fault location of double phase-to-earth fault on transmission line of di-
rect ground neutral system is presented. The algorithm, which employs the faulted phase network and zero-se-
quence network as fault-location model in which the source impedance at the remote end is not involved, ef-
fectively eliminates the effect of load flow and fault resistance on the accuracy of fault location. The algorithm
achieves accurate location by measuring only one local end data and is used in a procedure that provides auto-
matic determination of faulted types and phases, and does not require the engineer to specify them. Simulation
results showed the effectiveness of the algorithm under the condition of double phase-to-earth fault.

Key words: Fault location, Transmission line, Double phase-to-earth fault

INTRODUCTION

Transmission lines of a power system are subject to many kinds of faults. The principal types are: phase-to-earth; double phase-to-earth (phase-phase-earth); phase-to-phase; three-phase. Following the occurrence of a transmis-
sion line fault, the maintenance crew must find and fix the problem to restore the service as quickly as possible. Rapid restoration of the service reduces outage time and loss of revenue. Therefore, accurate fault location under a variety of fault conditions is an important requirement.

A variety of fault location algorithms have been developed in recent years. Most accurate results were obtained using algorithms that considered the fault data from two terminals of the line together (Kezunovic et al., 1995; 1996; Novosel et al., 1996). However, two-terminal data are not widely available. From the practical viewpoint, it is desirable for equipment to use only one-terminal data (Zamore et al., 1996; Thomas et al., 2001; Bo, 2002; Eriksson et al., 1985; Djuric et al., 1998; Zhang et al., 1998; 1999).

PROPOSED FAULT LOCATION ALGORITHM

The load is not generally contained in the zero-sequence circuit of a faulted power network. Therefore, we use the zero-sequence circuit as the model of fault location to eliminate the effect of load disturbance on the accuracy of fault location. The circuit of a transmission line with dou-
ble phase-to-earth fault is shown in Fig.1.

To simplify the introduction of the algorithm, one model of two-circuit transmission line with-
Fault location of two-parallel transmission line for double phase-to-earth fault

out shunt capacitance is considered. In terms of the superposition principle in linear network, the faulted network is broken into three sequence networks, namely, positive, negative and zero sequence network.

They are given in Figs. 2, 3 and 4 respectively. Thus, the relationship between the voltage $U_b$ and its sequence components $U_{b1}$, $U_{b2}$ and $U_{b0}$ can be expressed as

$$U_b = U_{b1} + U_{b2} + U_{b0}$$  \hspace{1cm} (1)

Applying KVL in Figs. 2, 3 and 4 respectively, sequence component $U_{b1}$, $U_{b2}$ and $U_{b0}$ are

$$U_{b1} = DZ_{10} I_{b10} + R_f I_{b1} + E_{b1} + R_s I_{b1}$$ \hspace{1cm} (2)

$$U_{b2} = DZ_{20} I_{b20} + R_f I_{b2} + E_{b2} + R_s I_{b2}$$ \hspace{1cm} (3)

$$U_{b0} = DZ_{00} I_{b00} + R_f I_{b0} + E_{b0} + R_s I_{b0} + DZ_{a0} I_{b0}$$ \hspace{1cm} (4)

![Fig. 2 Positive-sequence network](image)

![Fig. 3 Negative-sequence network](image)