DISTANCE PROTECTION SCHEME AND COORDINATION FOR TRANSMISSION LINE

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NOVEMBER 2005

"I admitted that I have read this report and in my opinion this report are fulfillment the scope and quality for the Degree of Bachelor in Electrical (Power Industry) graduation."

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DATE :.....22 November 2005.....

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This Report Is Submitted In Partial Fulfillment Of Requirements Or The Degree Of Bachelor In Electrical Engineering (Power Industry)

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NOVEMBER 2005

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the reference."

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" For my beloved father and mother
En. Jamaludin Bin Amin and Pn. Norainy Binti Abdul Rahim. In appreciation
of support and understanding during my project
In progressing "

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Bismillahirrahmanirrahim.

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ABSTRAK

Laporan ini menerangkan kerja perlaksanaan "Analisis Skim Perlindungan jarak Dan Koordinasi Bagi Talian Penghantaran" yang digunakan oleh Tenaga Nasional Berhad. Sistem perlindungan jarak berfungsi mengasingkan kegagalan yang berlaku pada talian penghantaran dengan mengira perbezaan galangan pada talian penghantaran. Sistem ini akan bertindak menghantar isyarat kepada panel kawalan bagi memutuskan penghantaran tenaga jika kegagalan yang berlaku adalah kegagalan kekal. Analisis yang dijalankan dengan bagi memastikan kelancaran penghantaran tenaga elektrik dan sistem perlindungan yang digunakan berkendali dengan baik. Dengan menggunakan perisian program PSCAD, analisis dilakukan bagi membuat perbandingan di antara simulasi dan keadaan sebenar kendalian sistem perlindungan jarak. Simulasi dilakukan pada talian penghantaran di antara dua pencawang masuk utama 132 kV dengan menggunakan geganti perlindungan jarak sebagai peralatan perlindungan. Penatahan bagi geganti perlindungan jarak dimasukkan mengikut nilai galangan pada talian penghantaran tersebut. Peratus kawasan perlindungan diambil kira sebagai penatahan.Keputusan yang terhasil akan dibandingkan dengan keadaan sebenar.

ABSTRACT

This report describing in depth about the management process of the "Distance Protection Scheme and Coordination for Transmission Line Analysis", which has been used by Tenaga National Berhad (TNB). In fact, distance protection system responsible in separating the failure occurred within the transmission line by counting the failure difference within the transmission line. This system will act by sending the signal to the control panel, so that the electrical energy transmission might be stopped promptly if the failure occurred is kind of a transient failure. An analysis is been done in order to ensure the smooth transmission of electrical energy and the protection system used is working properly. The analysis is accomplished by using the PSCAD programmed software in order to show the comparison between the simulation and the actual condition of the distance protection operation. Simulation is being done for the transmission line between the two substations 132kV by using the distance protector hub as the protective tool. The value of the line impedance is set for distance relay. Percentage of the protection region is regarded as setting. The ultimate result will be compared with the actual condition.

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CHAPTER 1

INTRDUCTION

1.1 Distance protection and coordination scheme.

Distance protection and coordination scheme for transmission line is the system where to protect any fault which could happen on the transmitting the energy and to protect all the equipment in use of damage. Distance protection and coordination scheme detect and separate the fault and make sure that the power transmitting will be smooth and clear. The important equipment in distance protection system is [1] :

1. Distance protection relay
2. Current transformer
3. Voltage transformer
4. Circuit breaker

The distance relay is used to compare the line impedance setting value and to locate the protection zone. The setting will be set by the Tenaga National Berhad with the accordance of the value of the line impedance. The setting was not same between theoretical and actual situation.

1.2 Project Objective

1. Distance protection and coordination system simulation by using PSCAD.
2. To ensure the system will be operated with a different setting.
3. Relay setting comparison between theoretical and actual situation.
4. To ensure all system device will function and follow specification.
5. To study the distance protection relay characteristics.

1.3 Project scope

1. Analysis of TNB distances protection system.
2. Comparison between theoretical and actual situation.
3. Analysis of distance relay characteristics and relay setting.
4. Circuit breaker operation analysis on transmission line.
5. To determine distance relay coordination.
6. Simulate protection distance system by using PSCAD program.

CHAPTER 2

LITERATURE REVIEW

2.1 Distance protection scheme

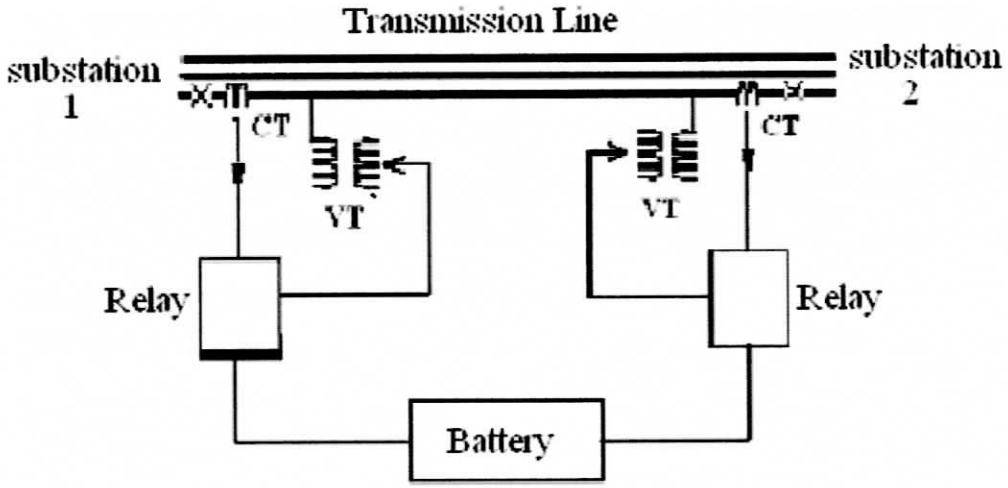

Figure 2.1: Distance Protection scheme

Distance protection scheme is shown in Figure 2.1, where two substations were transmitted the power to each other by grid national. On the distance protection scheme, the current transformer (CT) and voltage transformer (VT) will be communicating with distance relay.

2.2 The concept of zoning in distance protection.

The basic requirement of distance protection schemes is to provide high speed protection for fault within the protected line and time delayed protection over a remaining section of the power system. The impedance measuring element cannot however to be set to 100% of line length due to several limitations such as.

a) Errors generated by protective current and voltage transformer.
b) Errors in available data which is specific to the primary value of line constant for the protected circuit.
c) Relay calibration and transient errors.

If a measuring element is given 100% setting, it could be impossible to ensure that relay generation does not take place for an external fault just beyond the remote end of the protected circuit. Thus, the high speed protective zone cannot be set to cover the complete length of the line, and z reduced line coverage is accepted. Three protective zones are usually provided in a distance protection scheme, stepped time-distance characteristic is shown Figure 2.2

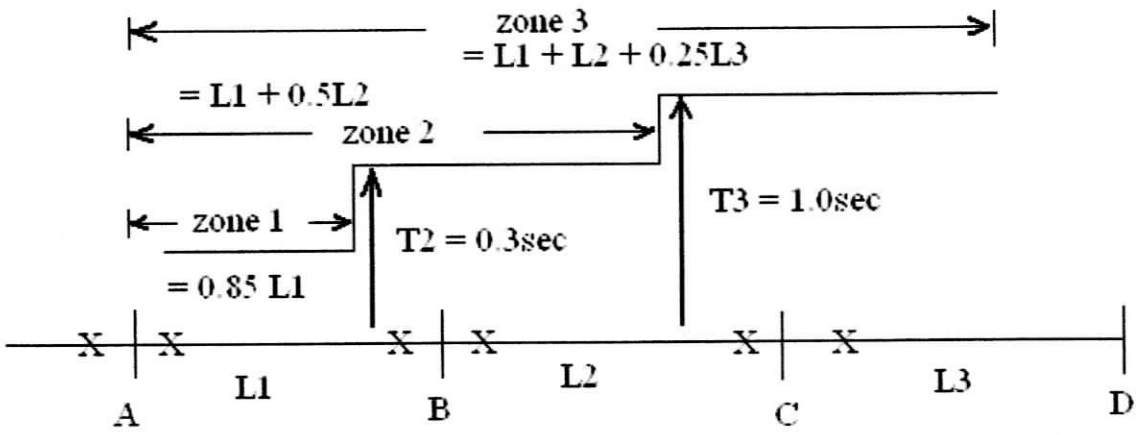

Figure 2.2: Time – distance characteristic of three zone distance protection scheme

The aim of the scheme is to provide correct high speed tripping of the circuit breakers, with adequate discrimination provide between internal and external faults. Faults detected within zone 1 should ideally result in high speed simultaneous tripping at both ends of the protected circuit. This way not be possible for all system arrangements, in which ease high speed tripping is provide at the end closer to the end by zone 2 operation or via an inter tripping channel.

2.3 Zone of protection

Zone protection is the locations where the systems will be protect and detect any fault. The coordination of protective zone must be set by refer the distance protection relay. The mainly three protected zone on the transmission line is zone 1, zone 2 and zone 3.[2]

2.3.1 Zone 1

Normally zone 1 is set to cover 80% to 85% of the line length, in example fault occurring within this section of the line will cause the relay to trip instantaneously. In other words the reach of zone 1 should not extend beyond the far end busbars (i.e does not overreach) in order to maintain discrimination between adjacent lines sections.

2.3.2 Zone 2

Zone 2 covers the remaining 15% - 20% of the shortest adjacent line length. Fault beyond the first zone are covered by a second zone or zone 2 of protection which extends to a point typically half way along the next line section.

The zone 2 provides time delayed (typically 0.25 to 0.4 sec) tripping for fault within the protected circuit that are outside zone 1, together with limited back-up protection adjacent circuit.

2.3.3 Zone 3

Zone 3 reach is set to cover 100% of the protected line plus 100% of the next longest line to provide remote back-up protection. The zone 3 characteristic should provide time-graded tripping for fault within the protected circuit and aver the complete lengths of all adjacent circuit. As shown in figure 2.1, zone 3 typically covers up to 20% into the next section feeder in example 20% of CD and the time delay typically between 1.0 to 3.0 sec.

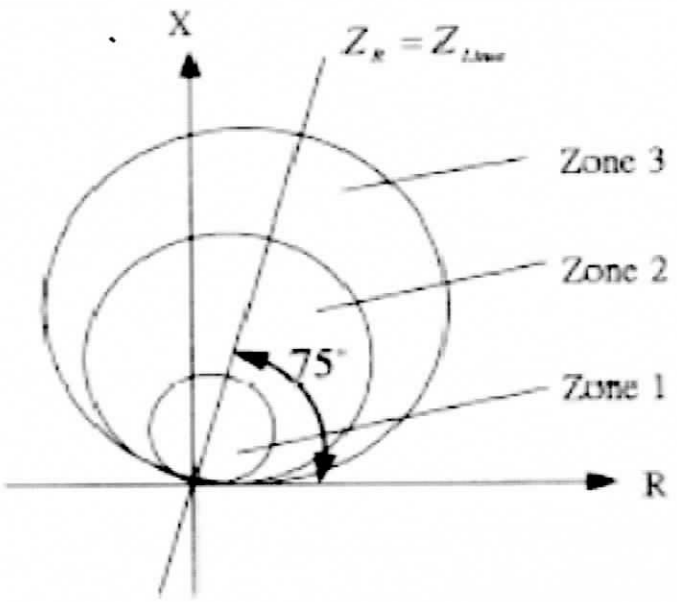

Figure 2.3: Distance relay protective zone

2.4 Tripping arrangement of a typical distance protection.

Figure 2.3, shown as simplified typical tripping arrangement of a distance scheme. A fault inside zone 1 result in operation of FD (fault detector) and MU (measuring unit), and tripping takes place any intentional time delay.[3]

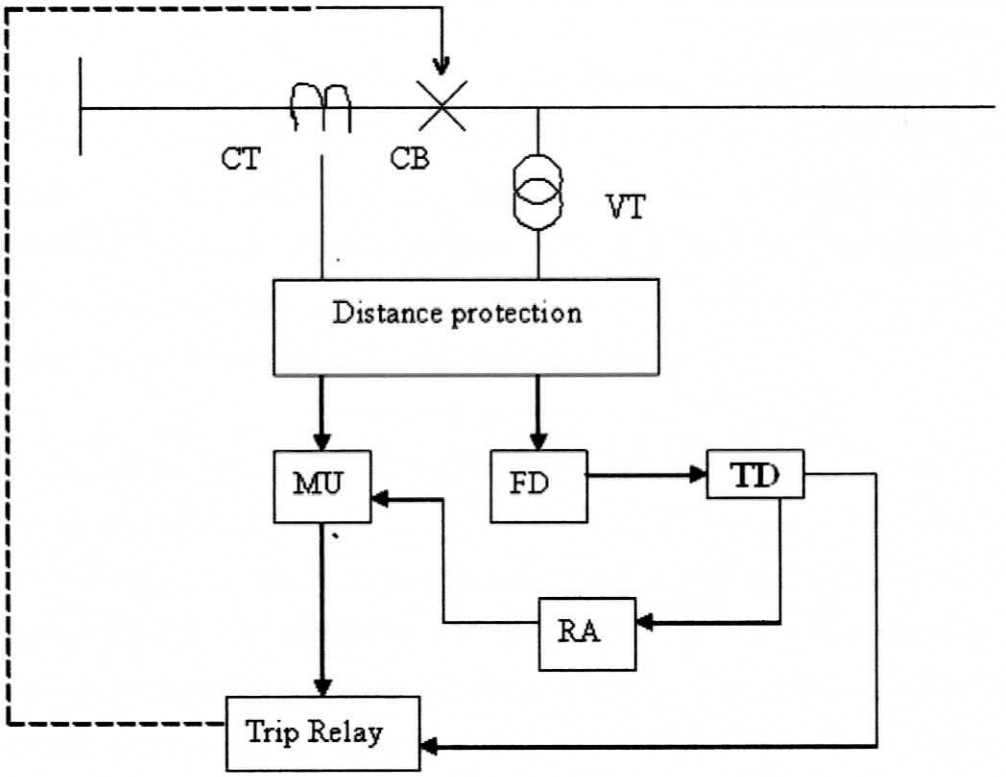

Figure 2.4: Simplified tripping arrangement of a typical distance protection scheme

A fault beyond zone 1 but inside zone 2 result initially in operation of FD (fault detector) only, which triggers the time delay unit TD (time delay). After a delay of 0.25 to 0.4 sec, the reach of MU (measuring unit) is extended to its zone 2 values to embrace the fault location and give zone 2 tripping. A fault beyond zone 2 but inside zone 3 gives rise to a trip signal after a further delay. The fault detector may thus serve as a starting unit and a zone 3 control units.

The directional requirements of the distance protection in order to fulfill the above should be such that, zone 1 and zone 2 characteristic should be such that high stability against tripping for all faults locations that are behind the relay location.

The zone 3 characteristic can have a certain amount of reverse reach to provide a back up for close in reverse faults such as before faults.

2.5 The inputs to the relay during different fault condition.

In a distance relay, the fault location is determined by measurement of the impedance of the faulted conductors between the relaying location and the fault. In the absence of fault resistance, this impedance is directly proportional to the corresponding "distance", from relay location to fault location. This measurement duty is usually performed by six relay element, three being used for phase fault measurement and another three for earth fault measurements.

The measuring element are presented with appropriate current signal (Ir) and voltage signals (Vr) and the impedance "presented to" or "seen by" a relay element is given by the ratio Vr / Ir = Zr. An important aspect of designing a distance protection scheme is to select correct values of Vr and Ir, so that the impedance presented to a measuring element during a fault condition is the positive phase sequence (pps) impedance from the relay location up to the fault location. This measured impedance is influenced by a number of power system parameters and also by the fault type, so that all the six measuring element will not monitor the same impedance.

2.5.1 Phase fault measuring element.

The three measuring element provided for phase fault protection are denoted (AB), (BC) and (CA). These relays are expected to respond correctly to three-phase, phase to phase and double phase to earth short circuits. The system shown in figure 2.5.1.