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Relay Protection – An Analysis

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Abstract - *This paper presents the design and operation of the protection of long EHV/UHV transmission line using microcontroller-based distance relay. The characteristic of a distance relay is realized by comparing voltage and current ratio at the relay location.*

The magnitude relation of voltage (V) to current (I) provides the electrical phenomenon of the road section between the relay location and therefore the fault purpose. The signal will be taken from the transmission line and it will be converted to digital signal then goes to the microcontroller which has to estimate the apparent impedance of the protected line, the calculated impedance is compared to the replica set impedance inside the relay to decide a trip command.

The decisions are going to be created in keeping with this signal whether or not there's a fault or not. The algorithms used for the calculation of line parameters are supported the answer of the cos and trigonometric function rework representing the line model.

A generalized mathematical expression for the operating conditions of mho relays has been derived. Any desired siemens or offset siemens relay characteristics will be completed by dynamical the constants solely. A program has been developed to obtain the mho and offset mho characteristic on the R-X diagram.

The relay has been designed and with success checked statically within the laboratory with a test signal.

1. INTRODUCTION

The exaggerated growth of installation each in size and quality has caused the requirement for quick and reliable relays to safeguard major instrumentation and to keep up system stability. The main options that have inspired the planning and development of Microcontroller based mostly protecting relays square measure their economy, compactness, responsibility, flexibility and improved performance over typical relays.

A number of desired relaying characteristics, such as over current, directional, impedance, reactance, mho quadrilateral elliptical, etc. can be obtained using the same interface.

Different programs square measure wont to acquire completely different relaying characteristics exploitation constant interfacing electronic equipment.

This paper presents micro controller based mho relays for protection of extra high voltage long transmission lines. An interface using operational; amplifiers sample and hold, analog multiplexer, analog to digital converter (ADC), voltage comparator and passive circuit elements has been designed and fabricated.

To realize conductance unit characteristics the resistance and electrical phenomenon at the relay location square measure measured by micro-controller.

Distance protection relay is that the name given to the protection, whose action depends on the space of the feeding purpose to the fault. The time of operation of such protection could be a operate of the magnitude relation of voltage and current, i.e., impedance. This electrical phenomenon between the relay and also the fault depends on the electrical distance between them.

Distance protection relay principle differs from alternative styles of protection as a result of their performance doesn't rely on the magnitude of the present or voltage within the protecting circuit however

it depends on the ratio of these two quantities.

It is a double causative amount relay with one in all their coil is energized by voltage and also the alternative coil is energized by the present.

The current component produces a positive or pick-up force whereas the voltages component has caused a negative and reset force.

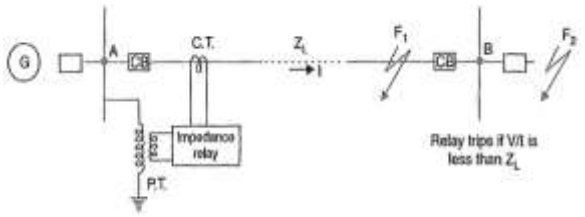

Fig.1. Transmission Line with Distance Protection Relay

2. WORKING OF DISTANCE RELAY

The working principle of distance relay is very simple. There is one voltage element from potential transformer and a current element fed from current transformer of the system.

The deflecting force is created by secondary current of CT and restoring force is created by voltage of potential electrical device.

3. OPERATING CHARACTERISTIC OF MHO RELAY

The operational characteristic of the conductance unit relay is shown within the figure below. The diameter of the circle is much freelance of V and that i, except at a awfully low magnitude of the voltage and current once the spring impact is taken into account, which causes the diameter to decrease. The diameter of the circle is expressed by the equation as ZR= K1 / K2 = ohmic setting of the relay.

The relay operates once the ohmic resistance seen by the relay at intervals the circle. The operative characteristic showed that circle passes through the origin, which makes the relay naturally directional.

The relay owing to its naturally directional characteristic needs just one combine of contacts that makes it quick tripping for fault clearance and reduces the VA burdens on the current transformer.

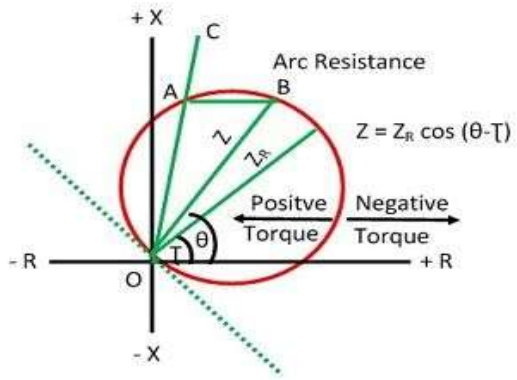

Fig.2 Operating Characteristic of MHO Relay

The electric resistance angle of the protected line is often 60º and 70º that is shown by line OC within the figure.

The arc resistance R is diagrammatic by the length AB, that is horizontal to OC from the extremity of the chord Z.

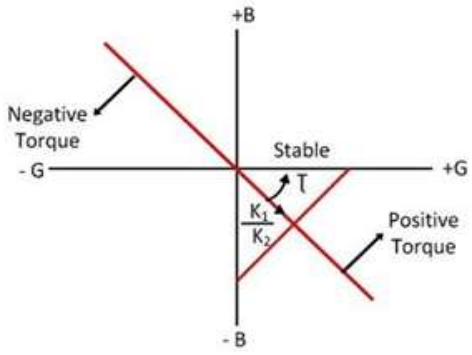

Fig.3 Characteristic of MHO Relay On Admittance Diagram

By creating the τ capable, or very little less insulant than Θ, the circle is created to suit round the faulty space so the relay is insensitive to power swings and thus notably applicable to the protection of long or heavily loaded lines.

For a given relay the τ is constant, and therefore the admittance phasor Y can lie on the line. The characteristic of S relays on the admittance diagram is, therefore, a line and is shown within the figure above.

Mho relay is appropriate for EHV/UHV heavily loaded transmission lines as its threshold characteristic in Z-plane may be a circle passing through the origin, and its diameter is zirconium. due to this, the edge characteristic is kind of compact enclosure faulty space succinctly and thus, there's lesser probability to work throughout power swing and conjointly it's directional.

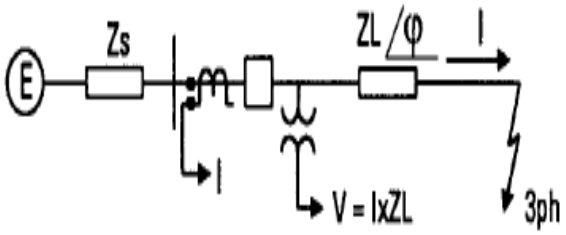

Fig .4 Distance Protection Relay at 3 Phase fault

4. Definite Distance Relay

This is merely a range of beam relay. Here one beam is placed horizontally and supported by depend on the center. One finish of the beam is force downward by the magnetic attraction of voltage coil, fed from potential electrical device hooked up to the road. alternative finish of the beam is force downward by the magnetic attraction of current coil fed from current electrical device connected serial with line. thanks to torsion made by these 2 downward forces, the beam stays at associate equilibrium position. The torsion thanks to voltage coil, is restraining torsion and torsion thanks to current coil, is deflecting torsion.

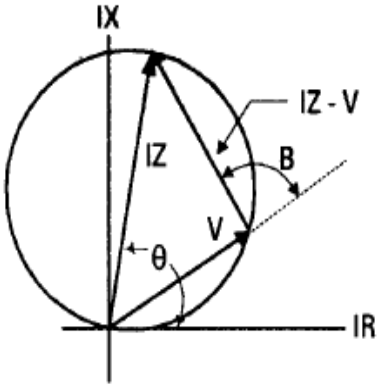

Fig.5 Operation Zone

Under traditional operative condition restraining torsion is bigger than deflecting torsion. Hence contacts of this distance relay remain open. When any fault happens within the feeder, below protected zone, voltage of feeder decreases and at constant time current will increase.

The ratio of voltage to current i.e. impedance falls below the pre-determined value.

In this state of affairs, current coil pulls the beam a lot of powerfully than voltage coil, thence beam tilts to shut the relay contacts and consequently the breaker related to this impedance relay will trip.

5. Time Distance Impedance Relay

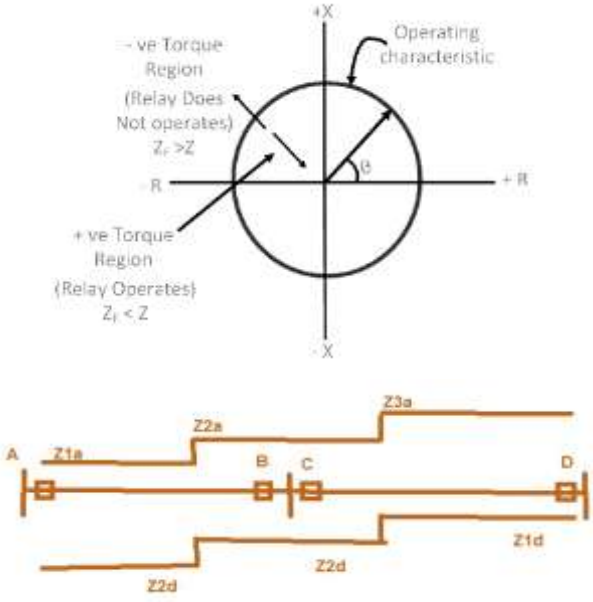

Fig.6 Four Quadrant Operation Zone

This delay mechanically adjusts its in operation time in line with the space of the relay from the fault purpose. This delay mechanically adjusts its in operation time in line with the space of the relay from the fault purpose. The time distance ohmic resistance relay won't solely be operated relying upon voltage to current magnitude relation, its in operation time additionally depends upon the worth of this magnitude relation.

The relay chiefly consists of a current driven part like double winding sort induction over current relay. The spindle carrying the disc of this part is connected by means that of a spring coupling to a second spindle that arries the bridging piece of the relay contacts. The bridge is generally control within the open position by AN coil control against the pole face of AN magnet excited by the voltage of the circuit to be protected.

$$Operating\ time\ T \propto \frac{Voltage}{Current} \propto Impedance \propto Distance\ along\ transmission\ line$$

6. CONCLUSIONS

Distance protection relay is wide unfold used for the protection of high-voltage AC conductor and distribution lines. They need replaced the over current protection due to the subsequent reasons.

- It provides quicker protection as compared to over current relay.
- It includes a permanent setting while not the necessity for readjustments.
- Direct protection relay has less impact of AN quantity of generation and fault levels.

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