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Optimal Relay Coordination Scheme Used for Interconnected Power System

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ABSTRACT
The main objective of protective relay coordination technique in an interconnected one or more power system of transmission and distribution processes is to provide system stability and line voltage stability, also provides voltage regulation. In the protection system in which protective relay are used to protect the transmission line, connected other electrical equipment and human injury. The protective relay operates when internal and external fault is occurred in power system. The relay which operates through over current and earth fault in accordance with setting value of relay plug setting multiplier (current setting) and time multiplier setting.

Keywords
Relay Coordination, Time Multiplier Setting, Voltage Regulation, Fault Calculation

1. INTRODUCTION
In an over current relay, there would be essentially a current coil. When normal current flows through this coil, the magnetic effect generated by the coil is not sufficient to move the moving element of the relay, as in this condition the restraining force is greater than deflecting force. But when the current through the coil increased, the magnetic effect increases, and after certain level of current, the deflecting force generated by the magnetic effect of the coil, crosses the restraining force, as a result, the moving element starts moving to change the contact position in the relay.

The present value of current in the relay coil is referred as pick up setting current. This relay is referred as instantaneous over current relay, as ideally, the relay operates as soon as the current in the coil gets higher than pick up setting current. There is no intentional time delay applied. But there is always an inherent time delay which cannot be avoided practically. Over current and earth relays are commonly used for protecting power system transmission and distribution connected transformer, switchgear, transmission line etc. over current and earth fault relay typical setting 0.05xin to 2.5xin step 0.01 adopted for protection against over current.

A relay is automatic device which senses an abnormal condition of electrical circuit and closes its contacts. These contacts in turns close and complete the circuit breaker trip coil circuit hence make the circuit breaker tripped for disconnecting the faulty portion of the electrical circuit from rest of the healthy circuit. Power system connected many switchgear and relay so today required batter coordination or operation time according CT ration, connected load and one or more switchgear operation or trip time according relay setting current and time multiplier setting parameter through calculation of maximum fault current of substation and coordinate multiple relay to correct operation in abnormal or faulty condition.

Here relay isolate the faulty section according relay setting only faulty section isolate in power system and other healthy system run smoothly. Power system one or more relays connected so coordination of relay must be required otherwise unwanted tripping comes in healthy system. So my object better study relay setting or coordination using mate lab simulation program and calculation of maximum fault current of supply system single line diagram of double bus connected supply system.

2. OVER CURRENT RELAY CHARACTERISTIC
The worldwide demand for electricity continues to grow even as energy conservation measures and advances in power conversion efficiency reduce the consumption of individual loads. To feed the energy appetite of the world, renewable energy technologies are becoming feasible and offer alternative generation options that enable consideration of the impact on the environment and other social and economic factors. The over current characteristic of relay according using of curve IDMT or DT various type of characteristic normal inverse, very inverse, extremely inverse, standard inverse 3 s, standard inverse 1.3 s according to IEC or ANSI time current characteristics 50 INST/DTL and 51 IDMTL/DTL elements provide over current protection, each with independent settings for pickup current, time-multiplier (51) and time-delays.

The minimization of the total operating time of a protective relay system under different fault zones is taken as the objective of the optimal coordination problem of protective relays. Specific to directional overcurrent relays, the optimal coordination problem determines two parameters, that is, the pickup current setting and the time setting multiplier. User can select IEC or ANSI time current characteristics. The relay characteristic between time multiplier and fault current level or multiple of percentage of fault current shown in characteristic relay coordination shown in table know data ct ratio , full load current capacity of in table know data

ct ratio , full load current capacity of Substation transformer depend all relay setting on it.

The smaller the objective function, the better the coordination of the protective relays. In the case of the optimal solution, the total operating time of the protective relays in the protection system studied is minimized under all specified faults. In this way, faults can be cleared quickly if they are included in the specified kinds of faults. Relay setting according load, ct ration and transformer full load HV LV current of percentage and time multiplier setting configure in relay operating time depend on fault level 7 or 8 times operating time calculate through relay characteristic used IEC or ANSI where a and k are constant for time calculation of relay operate on time on fault condition or over loading.
The relay coordination problem is to determine the sequence of relay operations for each possible fault location so that faulted section is isolated to provide sufficient coordination margins without excessive time delay.
Any relay operation depend on ct ration and percentage current and time multiplier setting set by human interfacing by hand or pc set option available on numerical or digital relay mostly available wide range of setting in numerical protective relay in past electromagnetic setting range 50 % to 200 % in step 25 % setting value adopted is respect of ct ratio. some time fault in power system outside of protective relay or supply side so this type fault dictated by using directional over current and earth fault relay protection due to sudden low voltage or more current draw by the load because this condition are supply side any heavy fault

Multiple Characteristics

Relay is suitable for various inverse characteristics and also for definite time lag characteristic, any one of them selectable at site independently for phase and earth fault.

Standard Inverse characteristic - SI 3 theoretical operating time is 3 seconds at 10 time's current setting at time multiplier setting (TMS) 1.000. Theoretical operating time of the

Standard Inverse characteristics –SI 1 is 1.3 seconds at 10 times current setting at TMS 1.000.

Very Inverse characteristic - VI curve is suited to networks where there is a significant reduction in fault current as the distance from the source increases. The operating time is shorter for large fault currents and increases at a greater rate as the fault current decreases. This permits the use of the same time multiplier setting for several relays in series.

Table 1

Sr. no.		CT ratio	I % set	TMS sec	7 time fault current op time s
1	132kv Incomer	150/1 A	120 %	0.50	1.76 s
2	132kv Bus - Coupler	150/1 A	100 %	0.40	1.28 s
3	132kv Xmer	150/1 A	100 %	0.35	1.12 s
4	33kv L.V. side	600/1 A	100 %	0.25	0.80
5	33kv Outgoing	200/1 A	85 %	0.15	0.44 s
6	33kv Outgoing	400/1 A	45 %	0.15	0.34
7	33kv Outgoing	250/1 A	70 %	0.15	0.41 s

Extremely Inverse characteristic - EI is very much useful to grade the relay with the fuse and applications where short duration transient over currents occurs. E.g. motor starting or reacceleration.

Long time Inverse characteristic - LTI is generally used for Standby Fault protection for Neutral / Ground Earthing Resistor. The same characteristics can be used to guard against overheating / over loading protection, when it matches with thermal characteristics of the motor, generator, and transformer or capacitor banks. Definite Time Lag characteristic - DTL is used for grading the system where source impedance determines fault current level and the fault current does not vary to a considerable amount down the length of the line relay operating time.

III.TTHEORETICAL AND PRACTICAL VALUE OF RELAY

Table 1 shows theoretical value of each characteristic with time multiplier set to1.000. Record the actual results in Table 2 and check that the measured times are within ±5% or ± 30 m.secs.of theoretical value.

Table 2

Curve	2xIs	5xIs	10xIs	20xIs
SI 3	10.03	4.28	2.97	2.27
SI 1	4.39	1.87	1.3	1.0
EI	26.67	3.33	0.81	0.20
VI	13.50	3.38	1.50	0.71
LTI	120.00	30.0	13.33	6.32
DTL	*	*	*	*

Actual value of Substation – 132/33kv 30 MVA Transformer

Current HV side – 131 A LV side – 524 A over current setting

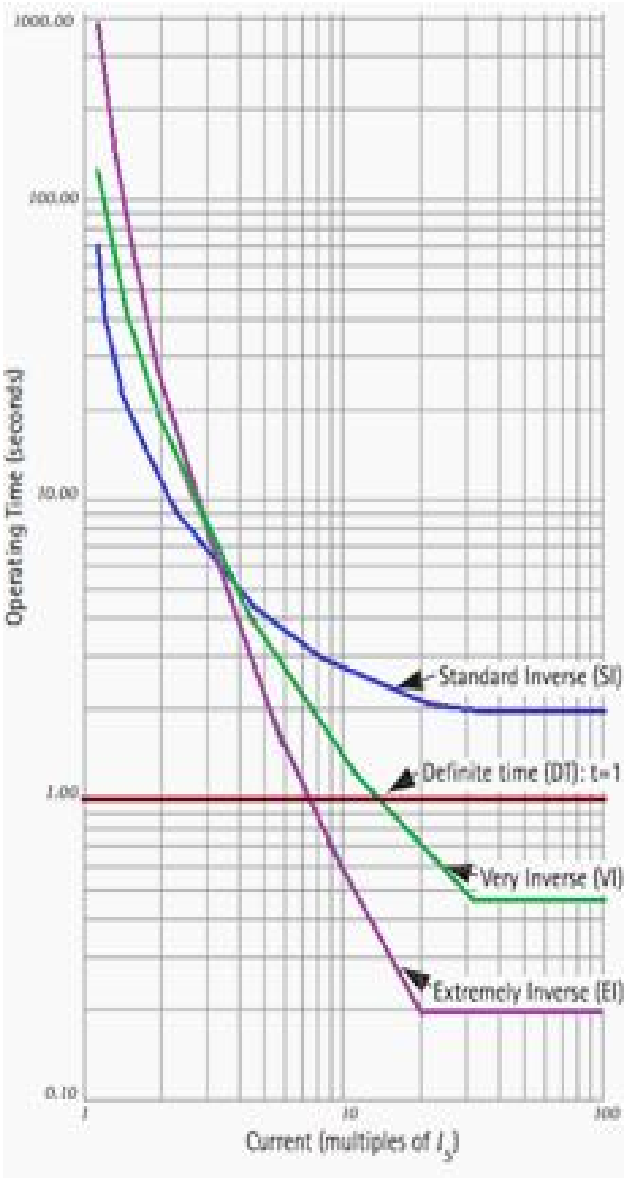
the two table theoretically and practical value of relay operation or trip time in second show first data of produce by relay manufacture and second data actual on field operating relay seven relay coordination according load and ct ration in table no 2 data of 132/33kv substation at different ration of ct relay setting of percentage of current at respect of ct ration and time multiplier set through calculation of fault current analysis of transmission ,switchgear , transformer , and other connected equipment .
In this case, the current direction through each protective relay does not change when a fault takes place on a bus; the only change is the fault current amount. The mathematical model presented in this work can solve this situation.

2. MATHEMATICAL EXPRESSION OF RELAY

There are many mathematical models for the over current
Relays In this study, the mathematical model of over current or earth fault Relays is considered to be the standard inverse 3s characteristic for calculation of operation time or trip time of relay know our data percentage of current setting and time multiplier setting so we are calculate the operating time of relay

$T = K \times TMS / (I sc / I 0) ^a - 1$

Where
I 0 is relay current setting; I sc is short-circuit current Setting of the relay. TMS varies from 0.05 to 1.
From the IEC curves, for standard inverse type relays, the parameters are assumed to be a = 0.14, and k = 0.02.



Over current relay characteristic between current and time

IEC / UK Curve TMS = 1
IEC standard inverse t = TMS x 0.14 / (I/Is) ^ 0.02 -1)
IEC very inverse t = TMS x 13.5 / (I/Is) -1)
IEC extremely inverse t = TMS x 80 / (I/Is) ^2 -1)
UK long time inverse t = TMS x 120 / (I/Is) -1)

IEC / US Curve DT = 7

IEEE moderately inverse

t = TD/7 x (0.0515/ (I/ Is) ^0.022-1) + 0.114

IEEE very inverse

t = TD/7 x (19.16 / (I/ Is) ^2-1) + 0.491

IEEE extremely inverse

t = TD/7 x (28..2 / (I/ Is) ^2-1) + 0.1217

US CO8 inverse

t = TD/7 x (5.95 / (I/ Is) ^2-1) + 0.18

3. CONCLUSION

Distributed generations can bring many benefits in economic, technological, and environmental aspects but, at the same time, result in many challenges, of which one of the most important is the coordination of protective relays. When Relay Coordination Scheme are connected in a distribution system, both the direction and the distribution of the power flow and fault current in the distribution system could change significantly, such that the traditional protection scheme can no longer work properly. Hence, there is a demand for new protection schemes.

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