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Directional over Current Coordination Techniques for Cascaded network Using Matlab - Linknet Structure

Sameer S. Patel[1], [s] Miss. Priyanka Rani[2]

[1] *Student, Electrical Dept, Rajasthan Institute of Engineering And Technology, Jaipur*
[2] *Asst. professors, Electrical Dept, Rajasthan Institute of Engineering And Technology, Jaipur*

Abstract —: In interconnected power system stability of entire system is concern of the principal importance for coordination. So many techniques are developed in field of relay coordination in a power system. With interconnection a large number of protective relays are required depend on protection system. These relays are needed to be coordinated to give their optimal load flow and protection level. This work out regarding load flow analysis, fault level computations along with listing the primary & back up pair is going to be really monotonous. This work out can be quite difficult simply because we have to make collection of contingencies along with relay setting , which are to be decide using the worst circumstance. This paper represents different methodologies used to treat the problem of optimization of relay coordination of direction relay in cascaded interconnected power system. Attempts have been produced to cover all the methods used for over current relay coordination. Conventional techniques and new approaches like Genetic algorithm (GA) and Artificial intelligence (AI) are described briefly. Also MATLAB software based approach is explained by a case study and the results are also provided, so that the reader can easily understand DCOR relay coordination.

Keywords: directional Over current coordination, Different network topologies,8-bus parallel network, genetic algorithm (GA),Link-net structure – MATLAB.

I. INTRODUCTION

In economically immerging countries like India demand of electrical power is increasing drastically. This increase in electrical energy has also resulted in increased complexity of the power system. Due to this designing challenges have also increased. So it has been one of the mandatory functions for power system to reach all the load points with equal reliability and efficiency. With increased requirements of power, higher and higher system voltages are used to deliver bulk power at high efficiency. Due to these increased system voltages, abnormal conditions like over voltage, over load, under frequency, etc. faults occur frequently [4]. These faults are more likely to damage equipment's connected hence results in interruption of supply. The faulted components must be identified and isolated to guarantee the energy supply to the largest number of consumers as possible. To protect transmission line and equipment's in case of any faulty condition, two types of protective schemes, primary protection and back protection are used. This protective systems check, analyzes and performs quick switching operation, so that the system remains stable. To insure stability of the protective scheme, the back-up protection scheme shouldn't come into action unless the primary protection scheme (main) fails to take the appropriate action. In other words, it should operate after a certain time delay known as Protection Coordination Time Interval (PCTI) [8], giving the Chance for the primary protection to operate. The prime function of any protective scheme is covered under the requirement of reliability, selectivity, sensitivity and operating speed. It's all are cover in a link net algorithm program to run in a mat lab to focus on a relay coordination in 8-bus cascaded network.

II. PERCEPTION AND NARRATION

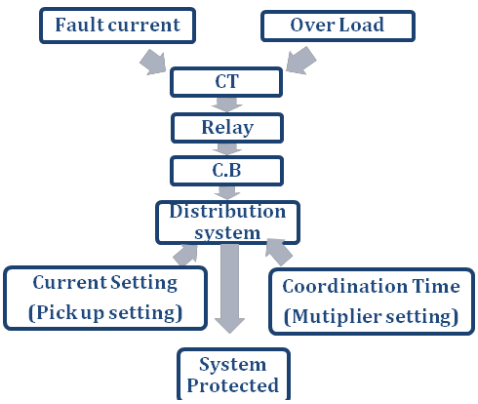

Fig: 1: Process Frame work for DCORs.

Power system protections are mainly distributed in protective zones and Each zone is accountable for avoidance and protections operate in separate zone of responsibility as quickly as possible from the system when fault occur in the system . Directional over Current Relays (DOCRs) are generally used for protection of interconnected power system and distribution system. With respect to location of fault, the relays may work as primary and back up protection. That means, the relay should work as primary protection for all the faults of its own zone and should work as back up protection for fault outside its zone of protection [4].

Over the last few decades, various methods have been developed to proper relay setting. Traditional approaches were not suitable for large power systems as they suffered delays in convergence rate due to a large number of iterations needed to reach an optimal relay setting. Than new approaches invented that concerned graphical techniques and control functional dependency of relay settings, which determine break point of system. Than even more advanced techniques were adopted such as artificial intelligence (AI) and Genetic Algorithm (GA). Latest trends are to achieve optimal relay setting point by high speed computers and software based techniques. These techniques are very successful in solving wide range of optimization problems.

III. DIFFERENT METHODOLOGIES

A. Conventional Methods :-

1) Trial and Error

This method was one of the first method adopted for solving relay setting problems .This method was iterative method required large time for calculation and result validation. With increase in system size, this method become more and more complex and suffered slow convergence time. This made in non-suitable for large power system networks.

2) Topological analytical method

Topological methods which include functional and graph theory are used to determine break points. In the functional method, the constraints on the relay settings are formulated by a set of functional dependencies. Other topological analysis which is linear graph theory has been extended to analyze all simple loops of the network in both directions considering the minimum set of breakpoints and so as the primary and backup relay pairs. The solution found using this method is the best of option settings considered but not optimal in any strict sense. Meaning that, the TSM or time dial settings (TDS) of the relays are high. Furthermore, due to the complexity of the system, topological analysis are time consuming and not optimal

B. Optimization

Optimization technique in general is more beneficial over conventional approach as in these techniques we need not to arrange all the relays before considering for Relay coordination. This feature eliminates the need to find the minimum set of break points. This technique became very popular along researchers .This technique basically defines process of coordination as Linear programming (LP) problem. This reduces time taken for relay to operate on faults. Only constraints here are relay characteristics and relay setting limit.

In optimization, non-linear approach was also used by few researchers. The approach commonly known as mixed integer non-linear programming (MINLP) and is solved by using General Algebraic Modeling System (GAMS) software However , the discrete pick up current Ips was simulated by binary variables , which was time consuming and more complex. Due to more complexity in non-linear technique, the optimization was done through linear method only. The only disadvantage of this system was, the pickup current Ip was assumed to be known and time taken for every relay to operate is considered as linear multiplier of TDS[9].

C. Artificial neural network

Artificial neural network (ANN) is an artificial intelligence (AI) based optimization technique. During last few decades, various researches is being done on utilization of Artificial Neural Network for various purpose such as memory simulation and logical reasoning. Since D. N. Vishwakarma proposed DCORs using ANN, various methods of AI have been developed and their application on the power system protection gave encouraging results. Some of the ANN methods like fuzzy logic and expert system (adaptive system) overcome the traditional methods as it follows parallel distributed architecture for data processing and quicker operating speed. With AI techniques, if linear programming (LP) is used, the results will represent only TMS (Time Multiplier Setting) for given value of I , but to find out optimal TSM of relays , nonlinear programming method is used. A new method for modeling over current relay characteristics curves based on a combined adaptive network and fuzzy inference system (ANFIS) , over current relay modeling was done using ANFIS for two types of over current relays (RSA20 and CRP9) with different types to bring out the optimal design.

D. Genetic Algorithm (GA) & Hybrid GA.

Genetic algorithms can be defined as the automated search and Optimization- algorithm based on the techniques of natural genetics and natural selection. For optimal coordination of over current relay and to Overcome Wrong coordination problem by minimizing the operation time of relays, the concept of genetic algorithm was introduced in mid 60s. In GA decision variables are encoded into binary string as a set of genes corresponding to chromosomes In Biological systems. A group of the chromosomes are called a population. The GA is essentially a method to generate a new population or generation from a given population. Members of each generation are ranked according to a specific criterion called fitness, which is derived from the objective function and constraints of optimization problem.

IV. SOFTWARE BASED APPROACH

4.1 MATLAB – Link-net structure

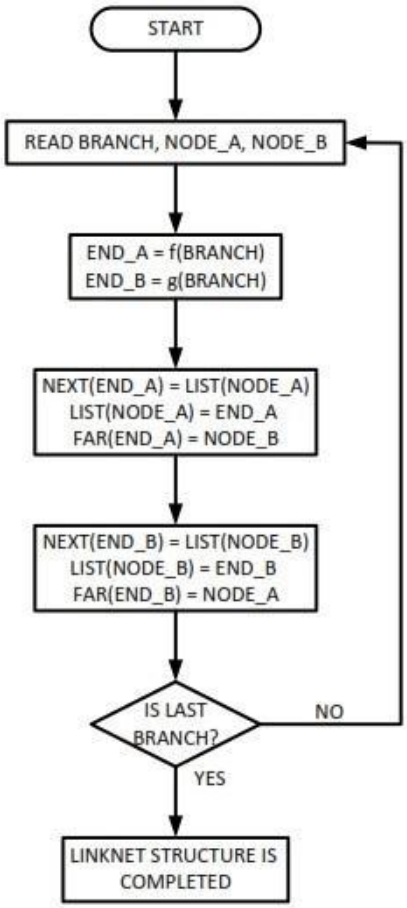

Fig. 2: Algorithm to Find Out Link-Net Structure.

Following are the different variables used to locate relay positions are,

IT = Relay at the other end
IFLT= Bus number near which the relay under consideration is located
IB = Directional relay looking towards IFLT bus
IS = Bus on which opposite end relay is placed
IF = Bus near which backup relay is placed
IN = Next directional relay incident at bus IFLT bus

4.2 Program For Link net Structure

For branch 1,
Node A =1 Node B = 2
End A = (2* branch)-1 = 1
End B = 2*branch =2
As branch 1 is initial branch Next (End A
) = Next (1) = 0
Similarly Next (End B
) = Next (2) = 0
Far
(End A
) =Far (1
) = Node B =2
Far
(End B
) =Far
(2) = Node A
For branch 2,
Node A =1 Node B = 2
End A = (2* branch)-1 = 3 End B = 2*branch =4
Next (End A
) = Next (3) = 1 Next (End B
) = Next (4) = 2
Far
(End A
) =Far (1
) = Node B =2 Far (End B
) =Far (2) = Node A

V. RESULT ANALYSIS

In this paper the BUS network is considered. By using primary/back up relays pairs are determined.

- **Simulation results Input :**

No of branch=6
Enter Node A of branch 1 =1
Enter Node B of branch 1 =2
Enter Node A of branch 2 =1
Enter Node B of branch 2 =2
Enter Node A of branch 3 =1
Enter Node B of branch 3 =3
Enter Node A of branch 4 =2
Enter Node B of branch 4 =4
Enter Node A of branch 5 =3
Enter Node B of branch 5 =5
Enter Node A of branch 6 =3
Enter Node B of branch 6 =5

- **Output ::**

LINKNET STRUCTURE FOR GIVEN NETWORK

Branch	Node	End	Next	List	Far
1	1	1	0	1	2
1	2	2	0	2	1
2	1	3	1	3	2
2	2	4	2	4	1

3	1	5	3	5	3
3	3	6	0	6	1
4	2	7	4	7	4
4	4	8	0	8	2
5	3	9	6	9	5
5	5	10	0	10	3
6	3	11	9	11	5
6	5	12	10	12	3

VI. CONCLUSION

This paper present of the practical work of software of ETAP and Various methods and techniques are proposed and implementation of them on interconnected system is studied. . The latest software based approaches are most suitable for very large size of systems. At the end, latest trends on system coordination are presented through a Simulation data in MATLAB. The results obtained on a bus system are found to be very decisive.

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BIOGRAPHIES

Sameer Patel Doing M.Tech In Electrical Engineering (Power System) At Rajasthan Institute Of Engineering And Technology, Jaipur And Also Completed Diploma & B.Tech In Electrical Engineering.

Miss. Priyanka Rani Worked As Asst. Professor In electrical department At Rajasthan Institute Of Engineering And Technology, Jaipur And Also Completed M.Tech & B.Tech In Electrical Engineering.