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Co-ordination of Directional Relay in Power System Doubly Fed Network

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Abstract: *Generation stations are considered extremely vital part of power system. Overcurrent voltage controlled relays are extensively used as backup protection of generators. Coordination between generator overcurrent voltage controlled relays and transmission line directional overcurrent relays represents a tedious task in power system protection as it depends heavily on network topology and system parameters. Mis-coordination is normally practiced in this situation. In thisLinknet algorithm technique use for finding the primary/backup pairs of relay and by properly Relay setting done are given proper coordination between the relay pairs.*

***Keywords*:** Doubly Fed Network, Relay Setting, LINKNET Algorithm.

I. INTRODUCTION

Relay is play the important role in protection scheme. Generally, overcurrent relay use in simple redial system but for the parallel and interconnected distribution system and sub-transmission system directional relay is using. Directional relay is work as a backup relay and for the primary protection distance relay (Instantaneous relay) use. The relay coordination is heart of the protection system. properly coordinated relay improves the stability and reliability of the system. For finding the primary/backup relay pairs LINKNET algorithm use. During some unbalancing condition if primary relay fails to protect then backup relay comes in the picture and improve the reliability of the system.

A. *Justification of Linknet structure*

For finding the primary/backup pairs of relay linknet algorithm is very useful. By finding the pairs we have the knowledge about whatis relay work as primary and what relay work as secondary. Linknet has advantages respect to the another method like that matrix method, Speartechnique, linear method. Linknet method is save number of the iteration, so, its require less computer memory.Linknet only concentrate on useful bus and other are ignoring.

B. *Plug Setting and T.M.S(Time Multiplier Setting)*

For setting of relay first set the pickup value either overcurrent relay or directional relay, pickup value of relay is more than to the normal current flow through network and less than to small fault current.

I_{normal} < Pickup value(I_p)<$I_{f\ small}$ (1)

Time multiplier setting is define as operating time of the relay, the plug setting of relay is 1.3/1/05 times of the time multiplier setting.

Plug setting value range of relay is between 50%, 75%,100%,125%,150%,175%, 200 % of the C.T primary current.

I. RELAY COORDINATION

Directional overcurrent relay(DOR) use for the protection of doubly fed network, the coordination between primary/backup relaydone by the operating time of the relay generally its done by the TDS (Time Dial Setting). The operating time of relay is defining as

$T=\frac{0.14\times TMS}{(PSM^{0.02}-1)}$ (2)

TMS= Time multiplier setting

PSM= Plug Setting multiplier

The operating time of relay is possible to minimum.

B. *Relay Setting*

The Time dial setting and plug setting are done in directional overcurrent relay, for the Instantaneous relay only TDS are done.

TDS i_{min} < TDS i <TDS i_{max} (3)

The pickup value is taken by (1) its defining the value of current limit for operating the relay.

C. *Relay coordination*

In power system the protection given by primary and backup relay, any fault occurs in network then primary relay give protection against then, if primary is fail then the backup relay protects the network. The reliability is improving by the proper coordination of relay. The coordination time interval (CTI) between primary and backup is predefined value and its depend on the relay type.

$$CTI = T_{backup} - T_{primary} \quad (4)$$

$T_{primary}$ = operating time of the primary rela

T_{backup} =operating time of the backup relay

CTI is 0.4s or 0.25s for the electromagnetic relay and 0.2s or 0.1s for the microprocessor relay.

II. LINKNET ALGORITHUM

Linknet is use for finding the primary/backup pairs of the relay. After finding the pairs of relay we can easily setting of relay to protect a network.

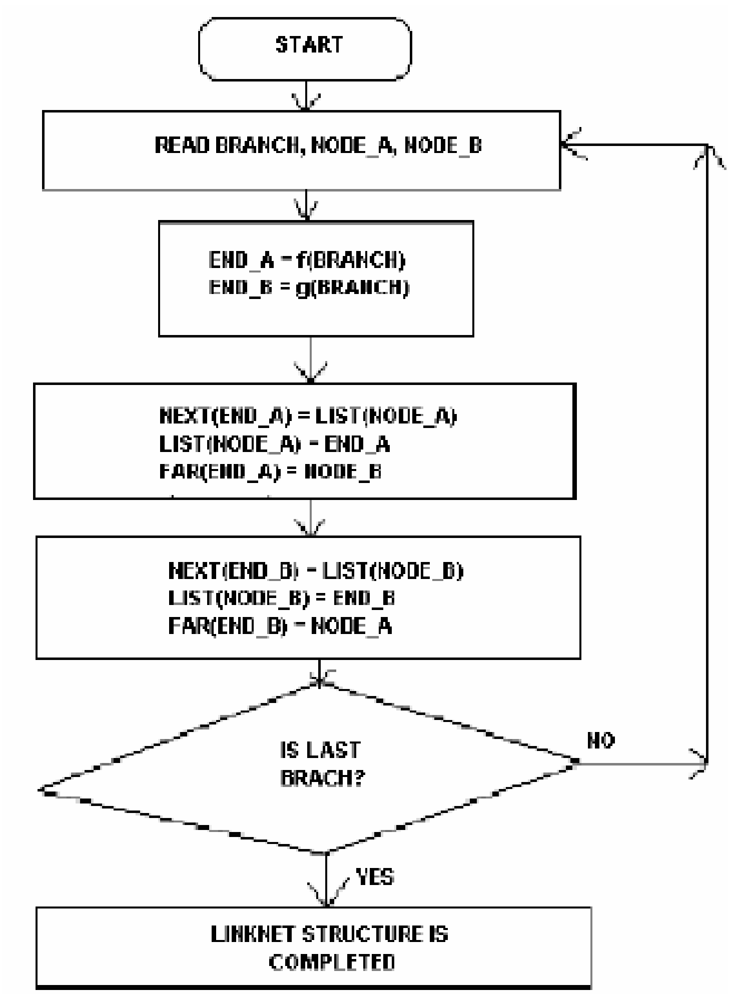
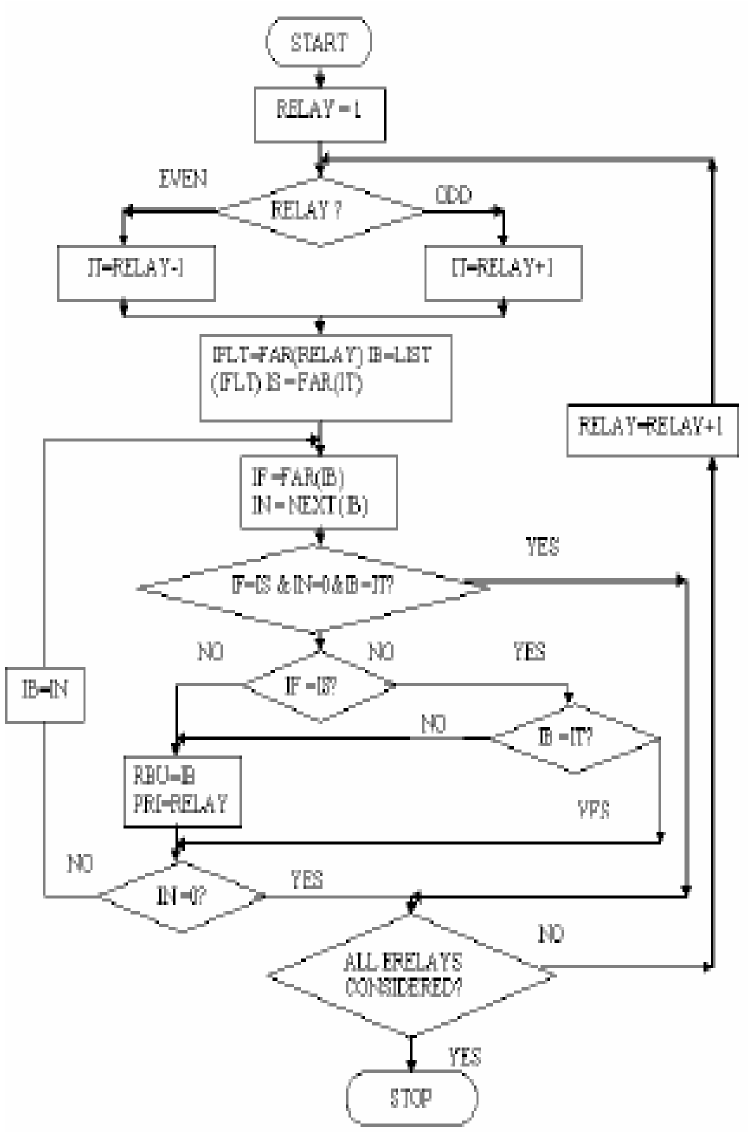


Fig .1 LinknetAlgorithm [1]

For any relay, the bus towards which the relay under consideration is operative can be known by the vector LIST (BUS). The next over current directional relay which will come in picture is known by NEXT (RELAY) and the elements of the vector FAR(RELAY) points to the bus on which the relay under consideration is located. After finding this value of NEXT, LIST, FAR go for the another algorithm for finding the pairs of relay [1].



(Fig 2 Primary /Backup Algorithm) [1]

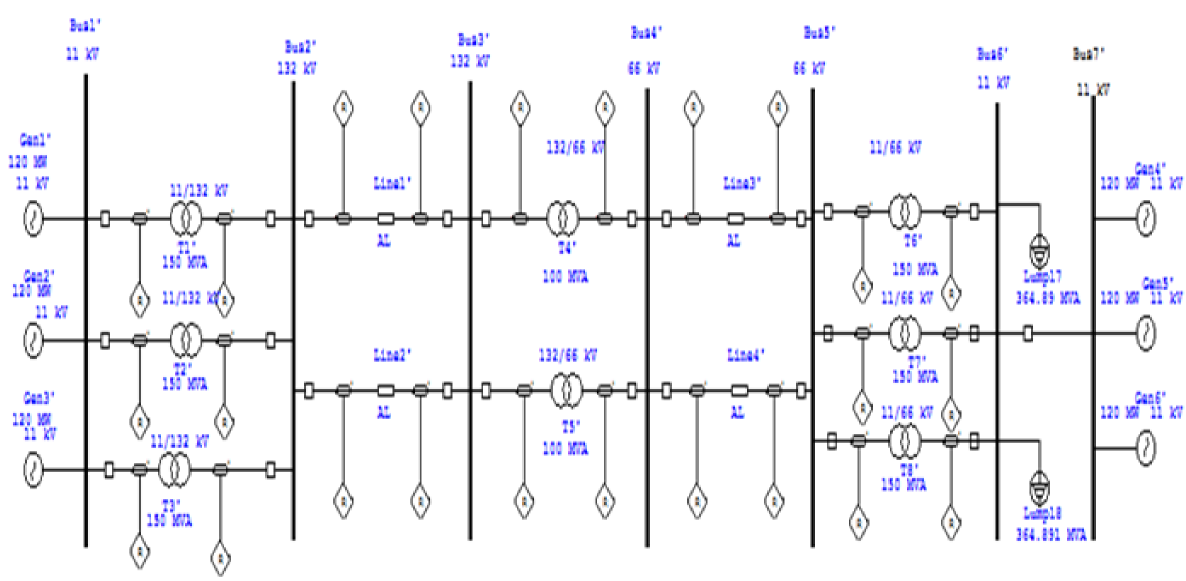
IV NETWORK

I) Study the Load Flow analysis done by Newton Raphson method for determine the line current, rated power flow through the network by using ETAP software.
II) Analysis of short-circuit study for finding the fault current in the network.
III) Generate the Primary/Backup pairs of network using the algorithm.

TABLE I. Primary/backup relay pairs **.2**

1	Relay Number	Backu1p
Branch Number	2	Relay2

2	3	2
	4	1
3	5	4,2
	6	3,1
4	7	7,6,4,2
	8	6,4,2
5	9	8
	10	6,4,2
6	11	11
	12	10,8
7	13	12
	14	11,10,8
8	15	15
	16	14,12
9	17	16
	18	15,14,12
10	19	19
	20	18,16
11	21	20
	22	19,18,16
12	23	22,20
	24	21,19,18,16



V CIRCUIT BREAKER SIZING

The rated normal current is defining as the current flow through the circuit breaker under normal condition or no faulty condition.The Braking current of the circuit breaker is defining as the fault current flow through the barker under LLL-g occur.The Making current of the circuit breaker is defining as the 2.5 times more than to the short circuit current flow through.

VI PLUG SETTING OF RELAY

The plug setting decides the current required for the relay to pick up. The name plug setting comes from the Electromagnetic over-current relay. In these relays, we have shorting plug inplug-setting bridge, so as to change the number of turns of the operatingcoil to get a particular pick-up value. The same terminology used in the modern relays.

TABLE II. Plug Setting of Relay

Relay No	Plug Setting	% P.S	Current
1	92.85	100	10000A
2	87.48	100	750 A
3	92.85	100	10000 A
4	87.48	100	750 A
5	92.85	100	10000 A
6	87.48	100	750 A
7	123.8	125	500 A
8	10.31	50	750 A
9	123.8	125	500 A
10	10.31	50	750 A
11	92.85	100	500 A
12	92.85	100	1000 A
13	92.85	100	500 A
14	92.85	100	1000 A
15	20.63	50	1500 A
16	123.8	125	1000 A
17	20.63	50	1500 A
18	123.8	125	1000 A
19	86.5	100	1500 A
20	92.85	100	10000 A
21	86.5	100	1500 A
22	92.85	100	10000 A
23	86.5	100	1500 A
24	92.85	100	10000 A

VII PSM& TOPCALCULATION

In PSM calculation using the formula give the operating time of the relay. If LLL-G fault occur in the system, then both relay sense the fault current the primary relay operating first after the 0.4 s the backup relay will operate.

PSM of relay $=\frac{\text{Fault current at Bus}}{\text{C.T Ratio} \times \text{PS of relay}}$(5)

After PSM calculation the time of operation calculate for both relay.

T.O.P $=\frac{3}{\log(PSM)} \times TMS$(6)

Table III. P.S.M & T.O. P of relay

	PSM	T.O.P	Backup Relay	
R1	0.044	0.221 s	R1'	0.471 s
R2	6.74	0.362 s	R3 R8	0.612 s
R3	0.044	0.221 s	R3'	0.471 s
R4	6.74	0.362 s	R5 R10	0.612 s
R5	0.044	0.221 s	R4 R2	0.471 s
R6	6.74	0.362 s	R3 R10	0.612 s
R7	0.0402	0.214 s	R10 R1	0.464 s
R8	0.101	0.301 s	R9 R12	0.551 s
R9	0.0402	0.214 s	R8 R3	0.464 s
R10	0.101	0.301 s	R7 R14	0.551 s
R11	0.0498	0.229 s	R14 R7	0.479 s
R12	0.016	0.167 s	R16R13	0.417 s
R13	0.0498	0.229 s	R12 R9	0.479 s
R14	0.016	0.167 s	R11R18	0.417 s
R15	0.0135	0.15 s	R18R11	0.409 s
R16	0.02	0.176 s	R20R17	0.426 s
R17	0.0135	0.15 s	R16R13	0.409 s
R18	0.02	0.176 s	R15R22	0.426 s
R19	6.48	0.36 s	R15R24	0.61 s
R20	0.044	0.221 s	R18R16	0.471 s
R21	6.48	0.36 s	R24R17	0.61 s
R22	0.044	0.221 s	R19, R18 R16	0.471 s
R23	6.48	0.36 s	R22R17	0.61 s
R24	0.044	0.221 s	R21, R19 R18,R16	0.471 s

VIII CONCLUSION

This paper represents a coordination of directional relay in doubly fed power system network. Method for identifying the primary back uprelay pairs and coordination of directional over current relays in the cascaded parallel feeders is presented in LINKNET structure consumes least memory location in the computer and fully describes the power system network containing any number of buses and lines without the need of graphical representation of the network. The search for the worst line configuration optimizes the number of iterations and gives the best setting of the relays. The operating time of backup relay is two times more then to the primary relay. The results are found to be encouraging.

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