



انجمن مهندسين برق و الكترونيك ايران
شاخه ي تهران

the 1st Power System Protection & Control conference
اولين كنفرانس تخصصي حفاظت و كنترل سيستمهاي قدرت
۲۹ و ۳۰ آذر ۸۵



دانشگاه صنعتي اميركبير
قطب علمي قدرت

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(Ip)

(TDS)

¹ Time Dial Setting



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$$J = \sum_{i=1}^n T_{ii} \quad ()$$

i T_{ii}

¹ Pick-up Current Setting (Ip)
² Mixed Integer Linear Programming



$$TDS_{i \min} \leq TDS_i \leq TDS_{i \max} \quad (1)$$

$$I_{Pi \min} \leq I_{Pi} \leq I_{Pi \max} \quad (2)$$

$$T = f(TDS, I_p, I) \quad (3)$$

$$T = \frac{k_1 TDS}{\left(\frac{I}{I_p}\right)^{k_2} + k_3} \quad (4)$$

k_3, k_2, k_1

$$k_1 = 0.14, \quad :$$

$$k_2 = 0.02, k_3 = -1$$

TDS Ip

TDS

$$T_{ji} - T_{ii} \geq CTI \quad (5)$$

T_{ji}

CTI

CTI

¹ Far bus

² Coordination Time Interval



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2n

(TDS , Ip)

$$F = \frac{A}{\sum_i T_{ii} + \sum_j Pen_j} \quad ()$$

$$A = \sum_i T_{ii} + \sum_j Pen_j$$

¹ Grey Code



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Extreme nodes	Sn(MVA)	Vp(kV)	Vs(kV)	X(%)	
7	1	150	10	150	4
8	6	150	10	150	4

()

Node	Sn(MVA)	Vn(kV)	Xsub(%)
7	150	10	15
8	150	10	15

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Node	P(MW)	Q(MVar)
2	40	20
3	60	40
4	70	40
5	70	50

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()

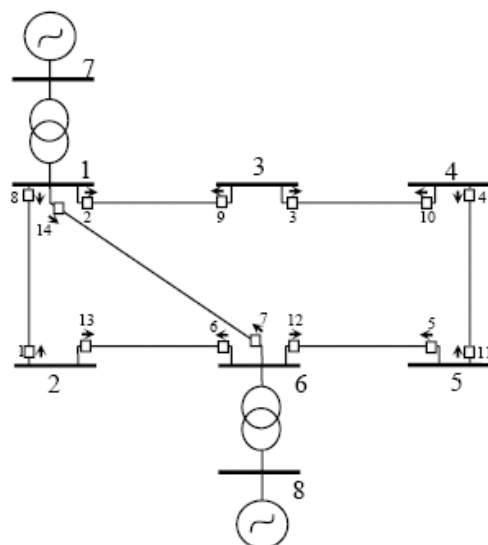
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Pair no.	Primary relay	Backup relay	Pair no.	Primary relay	Backup relay
1	1	6	11	14	9
2	7	13	12	8	9
3	12	13	13	5	4
4	2	7	14	9	10
5	8	7	15	4	3
6	6	14	16	3	2
7	12	14	17	10	11
8	13	8	18	2	1
9	6	5	19	14	1
10	7	5	20	11	12

Extreme nodes	R(Ω /km)	X(Ω /km)	L(km)	
1	2	0.0040	0.0500	100
1	3	0.0057	0.0714	70
3	4	0.0050	0.0563	80
4	5	0.0050	0.0450	100
5	6	0.0045	0.0409	110
2	6	0.0044	0.0500	90
1	6	0.0050	0.0500	100



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/ TDS

()

/ (TDS, Ip)

MATLAB

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Relay No.	CT Ratio	Pick up Tap (case 1)	TDS (case 1)	Pick up Tap (case 2)	TDS (case 2)
1	240	1.705	0.1000	2	0.1000
2	240	2.393	0.2306	2.5	0.2500
3	160	2.498	0.1855	2.5	0.2071
4	240	1.961	0.1000	1.75	0.1214
5	240	0.786	0.1000	1	0.1000
6	240	2.496	0.1451	2.25	0.1643
7	160	2.5	0.1978	2.5	0.2286
8	240	2.480	0.1417	2.5	0.1429
9	160	1.174	0.1000	1.25	0.1000
10	240	2.043	0.1000	2.25	0.1000
11	240	2.491	0.1466	2.25	0.1643
12	240	2.480	0.2238	2.25	0.2500
13	240	1.694	0.1000	1.75	0.1000
14	160	1.666	0.1960	2.5	0.2071

Relay No.	CT Ratio	Pick up Tap (case 1)	TDS (case 1)	Pick up Tap (case 2)	TDS (case 2)
1	240	0.5	0.3018	1.7026	0.1
2	240	2.0	0.2774	2.5	0.2245
3	160	1.5	0.2614	2.5	0.1852
4	240	1.5	0.1345	1.9586	0.1
5	240	1.0	0.1	0.7865	0.1
6	240	2.0	0.2424	1.5466	0.1913
7	160	1.5	0.2924	2.5	0.1964
8	240	1.5	0.2806	1.6685	0.1807
9	160	1.5	0.1	1.1792	0.1
10	240	1.5	0.1378	2.0525	0.1
11	240	1.0	0.2666	2.5	0.1465
12	240	2.0	0.2839	2.3839	0.2291
13	240	0.5	0.3069	1.7017	0.1
14	160	1.5	0.2992	2.5	0.1962

¹ Non-convex



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