ESTIMATION OF CURENT`S FLOW, LOSS OF POWER AND VOLTAGE FALL DOWN IN DISTRIBUTIVE NETWORKS BY USING PDM $KM_{p,q}$ PROGRAM

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ABSTRACT

These instructions give the author basic guidelines to prepare Summary: Accomplishments in technical science attained in all areas of science and technique are increasing the role of computer technique as a science of technical progress. It is not possible to create and use modern technical programmes without its further development.

Author's basic intention is to present system which will help easier resolution of practical problems. Knowing that there are researches for appropriate adoptable programs steel ongoing, we have tried to animate auditorium to control wider areas of electrical engineering, in regard to have their knowledge increased and directed toward computer's technique and programming. Estimation flow current, loss of power and voltage fall down are showing us the usage of PDM $KM_{p,q}$ *applicative program in electrical engineering.*

PAPER OBJECTIVES

Determination of power parameters (**P**, **Q**, **S**) in distributive network.
Voltage divergence in important points of medium voltage distributive network.
Analysis of power loss (**ΔP** i **ΔQ**) in lines.
Analysis of distributive network u certain periods of time (one month, one year).

PAPER CONTENTS

Network parameters and operations regime parameters in given configuration distinguish the distribution of powers, and by doing so can have the influence on the selection of optimal conditions of network operations. With the assistance of adapted programme **PDM** $\mathbf{KM_{p,q}}$, the values of the powers have been determined in the important parts of real configuration.

For distributive electric network, due to the extremely high overloads, the voltage divergences are very distinct, which has high influence on power supply quality. This paper represents researches of these influences, with the application of certain programme packages, and points out the possibility of correction of voltage conditions.

In conditions of distinct overloads at distribution of active and reactive powers, the losses in lines in this distributive network have been expressed. Tables given in the paper contain the values of these losses and the possibility of their reduction.

ESTIMATION OF DISTRIBUTIVE NETWORK PARAMETERS

According to input data of index branch that is placed in the first column and indexes node given in the second column, it is possible to draw a graph of distributive line (figure 1).

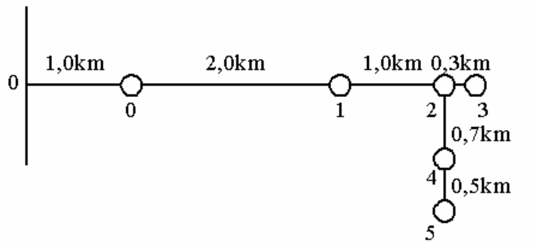

Figure 1

While opening a new file, in the first line we enter title PS 35/10 kV.
The second line consist the title of 10 kV radial line.
1-ordinal number of radial line [kV].
6-total number of branches.
10,5-voltage at the beginning of radial line [kV].
The third line consists the following parameters:
2082840-measured monthly active energy [kWh].
411720-measured monthly reactived energy [kVAr].
720-number of working hours.
The fourth column is consisted of estimated values of active and reactive power in all nodes (in the given sample of 6 nodes) [kW,kVAr].
The fifth column is placed code that denotes the branch type. All these data in the tables have been taken from data base.
All entered data have to be separated by comma, as it is shown in input file.
The sixth column refers to branch length expressed in km.
The seventh column denotes the names of nodes (ex. MBTS Jugopetrol).
The eighth column presents the types of consumers.
Consumers' loads have been shown through their static characteristics:

$$P_i = P_{ni}\left(\frac{U_i}{U_n}\right)^{k_{pi}},$$

$$Q_i = Q_{ni}\left(\frac{U_i}{U_n}\right)^{k_{qi}},$$

where:
k_{pi}, k_{qi}-can have values 0,1,2.
0-constant power consumer.
1-constant current consumer.
2-constant impedance consumer.

NOTES:

Approved voltage fall down in 10 kV cannot exceed 5%, and the currents' load in branches cannot exceed the values of approved currents given in data base.
If the current in branch is bigger from approved one, then in the results of estimation in the column the critical value should be $I_0 > I_{doz}$.
If the total percentage voltage fall down at the end of certain branch exceeds 5%, the critical value for that branch is voltage; if the voltage fall down exceeds 10% then the voltage in that branch is supercritical.

SAMPLE OF INPUT

P S 35/10 G A Z I V O D E							
z u p c e, 1, 6, 10.5							
2082840, 411720, 720							
0,	0,	1120,	232,	4,	1.0 ,	MBTS Jugopetrol,	2
1,	0,	456,	222,	4,	2.0 ,	BTSD Jasenovik,	1
2,	1,	456,	256,	4,	1.0 ,	BTS Z.Potok,	0
3,	2,	66,	100,	4,	0.3 ,	MBTS Posta,	2
4,	2,	654,	50,	4,	0.7 ,	KTS Zadruga,	2
5,	4,	131,	50,	4,	0.5 ,	BTS Z.Potok,	2

DATA BASE

code	section [mm^2]	r [Ω/km]	x [Ω/km]	I_{doz} [A]	Type of conductor (s-single lead)
1	16	2.060	0.390	90	Al/Feoverground
2	25	1.380	0.378	125	Al/Feoverground
3	35	0.850	0.367	145	Al/Feoverground
4	50	0.650	0.355	170	Al/Feoverground
5	70	0.460	0.350	290	Al/Feoverground
6	95	0.330	0.345	350	Al/Feoverground
7	120	0.270	0.335	410	Al/Feoverground
8	150	0.210	0.330	470	Al/Feoverground
9	185	0.170	0.330	535	Al/Feoverground
10	240	0.135	0.330	645	Al/Feoverground
11	16	1.200	0.390	125	Cuoverground
12	25	0.740	0.378	160	Cuoverground
13	35	0.540	0.367	200	Cuoverground
14	50	0.390	0.355	250	Cuoverground
15	70	0.280	0.350	310	Cuoverground
16	95	0.200	0.345	380	Cuoverground
17	120	0.158	0.335	440	Cuoverground
18	150	0.123	0.330	510	Cuoverground
19	185	0.103	0.330	510	Cuoverground
20	240	0.077	0.330	700	Cuoverground
21	16	1.960	0.132	69	AlcablePVC
22	25	1.260	0.123	89	AlcablePVC
23	35	0.897	0.117	110	AlcablePVC
24	50	0.628	0.112	130	AlcablePVC
25	70	0.449	0.102	165	AlcablePVC
26	95	0.331	0.098	195	AlcablePVC
27	120	0.261	0.096	225	AlcablePVC
28	150	0.209	0.093	255	AlcablePVC
29	185	0.170	0.090	285	AlcablePVC
30	240	0.131	0.088	325	AlcablePVC
31	16	1.159	0.132	85	CucablePVC
32	25	0.741	0.123	110	CucablePVC
33	35	0.530	0.117	135	CucablePVC
34	50	0.371	0.112	165	CucablePVC
35	70	0.265	0.102	200	CucablePVC
36	95	0.195	0.098	240	CucablePVC
37	120	0.154	0.096	280	CucablePVC
38	150	0.124	0.093	320	CucablePVC
39	185	0.100	0.090	360	CucablePVC
40	240	0.077	0.088	420	CucablePVC
41	35	0.897	0.140	140	AlcableXHPs
42	50	0.628	0.133	157	AlcableXHPs
43	70	0.449	0.126	205	AlcableXHPs
44	95	0.331	0.122	246	AlcableXHPs
45	120	0.261	0.118	279	AlcableXHPs
46	150	0.209	0.110	312	AlcableXHPs
47	25	0.741	0.146	154	CucableXHPs
48	35	0.530	0.140	181	CucableXHPs
49	50	0.371	0.133	214	CucableXHPs
50	70	0.265	0.126	260	CucableXHPs
51	95	0.195	0.122	312	CucableXHPs
52	120	0.154	0.118	358	CucableXHPs
53	150	0.124	0.110	400	CucableXHPs
54	25	1.260	0.123	106	AlcableXHPT
55	35	0.897	0.117	129	AlcableXHPT
56	50	0.628	0.112	152	AlcableXHPT
57	70	0.449	0.102	189	AlcableXHPT
58	95	0.331	0.098	225	AlcableXHPT
59	120	0.261	0.096	258	AlcableXHPT
60	150	0.209	0.093	290	AlcableXHPT
61	25	0.741	0.123	138	CucableXHPT
62	35	0.530	0.117	166	CucableXHPT
63	50	0.371	0.112	198	CucableXHPT
64	70	0.265	0.102	244	CucableXHPT
65	95	0.195	0.098	290	CucableXHPT
66	120	0.154	0.096	331	CucableXHPT
67	150	0.124	0.093	368	CucableXHPT
68	35	0.897	0.140	140	ALovergroundXHE48/0-A
69	50	0.628	0.133	179	ALovergroundXHE48/0-A
70	70	0.449	0.126	220	ALovergroundXHE48/0-A
71	95	0.331	0.122	267	ALovergroundXHE48/0-A

ESTIMATION RESULTS 10 KV SITE ZUPCE, PS 35/10 GAZIVODE

Date: 28th of February .06 8:39:36 AM

The chosen type of input file: PDMpq
Input file: C:\Documents and Settings\Nebojsa\Desktop\sample_of_input_PDMpg.txt
Control file: C:\Documents and Settings\Nebojsa\Desktop\Proba.txt

Number of iteration: 5
Un0: 10.5 kV.
Un: 10 kV.
Accuracy: 1E-07
Wa: 2082840 kWh.
Wr: 411720 kVArh.
Pmax: 3100 kW.

TABLE 1.

site node		p branches	q branches	R branches	X branches
0	0	2986.3640578189	948.765315422176	0.65	0.355
1	0	1756.55659995497	681.336789003732	1.3	0.71
2	1	1287.92631615379	452.960701572017	0.65	0.355
3	2	64.7336923527	98.0813520495455	0.195	0.1065
4	2	764.390905030956	97.3673218737919	0.455	0.2485
5	4	127.441147997147	48.6416595408957	0.325	0.1775

TABLE 2.-THE VALUES OF VOLTAGES, CURRENTS AND APPROVED CURRENTS

node	node voltage	branch current	permited current
0	10.2805231682655	175.973512066599	170
1	10.0062184379765	108.709096399051	170
2	9.90593204009594	79.5716836293886	170
3	9.90360298323522	6.85092667703495	170
4	9.8683040217328	45.082437150158	170
5	9.86323066149177	7.98475075058097	170

TABLE 3.-VALUES FOR VOLTAGE FALL DOWN IN BRANCHES, % VOLTAGE FALL DOWN, % VOLTAGE FALL DOWN TO ALL NOTES

	volt. fall down in branches	% volt. fall down	% volt. fall down to nodes
0	0.219476831734507	2.09025554032864	2.09025554032864
1	0.274304730289034	2.66819816267496	4.7584537030036
2	0.100286397880517	1.00224074161624	5.76069444461985
3	0.00232905686072371	0.023511738736915	5.78420618335676
4	0.0376280183631419	0.37985338694871	6.14054783156856
5	0.00507336024103289	0.051410660128223	6.19195849169678

TABLE 4.-VALUES FOR % POWER LOSS IN BRANCHES

	% power lossin branches
0	1.98194923531014
1	2.55673695686203
2	0.949548491538805
3	0.0423974714652168
4	0.361625084226803
5	0.0487535094356161

TABLE 5.-CRITICAL CURRENTS

branch	current	Idoz/Io	
0	175.973512066599	0.966054481743035	critical current,Io>Idoz
1	108.709096399051	1.56380657765714	not critical current
2	79.5716836293886	2.13643839423819	not critical current
3	6.85092667703495	24.8141613556978	not critical current
4	45.082437150158	3.77086978314357	not critical current
5	7.98475075058097	21.2905831766422	not critical current

TABLE 6.-CRITICAL VOLTAGES

node 0	10.2805231682655	Not critical voltage, u%<5%
node 1	10.0062184379765	Not critical voltage, u%<5%
node 2	9.90593204009594	Critical voltage, 5%<u%<10%
node 3	9.90360298323522	Critical voltage, 5%<u%<10%
node 4	9.8683040217328	Critical voltage, 5%<u%<10%
node 5	9.86323066149177	Critical voltage, 5%<u%<10%

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//

ESTIMATION RESULTS 10 KV SITE ZUPCE, PS 35/10 GAZIVODE

i	c (i)	U (kV)	Pp (kW)	Qp (kVAr)	R (om)	X (om)	DP (kW)
0	0	10.28	1183.72	245.20	0.65	0.36	60.39
1	0	10.01	456.28	222.14	1.30	0.71	46.09
2	1	9.91	456.00	256.00	0.65	0.36	12.35
3	2	9.90	64.73	98.08	0.20	0.11	0.03
4	2	9.87	636.89	48.69	0.46	0.25	2.77
5	4	9.86	127.44	48.64	0.33	0.18	0.06

continuation

i	DQ (kVAr)	Io (A)	Idoz (A)	Io/Idoz	Critical value
0	30.16	175.97	170.00	1.04	u%<5% Io>Idoz
1	22.23	108.71	170.00	0.64	u%<5%
2	6.24	79.57	170.00	0.47	5%<u%<10%
3	0.01	6.85	170.00	0.04	5%<u%<10%
4	1.50	45.08	170.00	0.27	5%<u%<10%
5	0.03	7.98	170.00	0.05	5%<u%<10%

VOLTAGE OF POWER SYSTEM=10.5 kV.
TOTAL LOSSES OF ACTIVE POWER=121.684527984276 kW.
TOTAL LOSSES OF REACTIVE POWER =60.1716171342613 kVAr.

RESULTS AND DISCUSSION

In this paper the following estimation results have been obtained: voltage, current, approved current, % value for voltage fall down in all branches, % voltage fall down to all nodes, values for % power loss in branches, critical currents and critical voltages, total losses of active power, total losses of reactive power.
The complete estimation has been performed on the Power station 35/10 kV, for chosen 10KV extract. The above obtained results for radial distributive line that may have up to 100 branches (nodes) can be calculated by changing the input data.

EXTRACT

The complete material presented in this paper can be completely applied to any Power stations 35/10 KV. This paper can be, both expertly and educationally, recommended to Polytechnic school and faculty students, as well as the wider circle of electrical engineers. Engineers in planning bureaus can also use this paper, due to the fact the authors have used their own knowledge from this field obtained in theory and practice.
In order to have this applicable programme PDM $KM_{p,q}$ to operate, it is necessary to install programme Microsoft.Net.Framework 1.1 in Windows surroundings, which can be obtained on www.microsoft.com.

REFERENCES

For a Conference citation:

[1] D. Stojanovic, P. Grkovic, D. Savovic, 1996, "PDM", *Electronic faculty Nis,* Serbia.

For a book citation:

[2] D. Shirmo Hammadi, H. W. Hong, A. Semlyen, G. X. Luo, May 1998, " A Compensation-Based Power Flow Method for Weakly Meshed Distribution and Transmission Networks".

[3] Microsoft Visual Studio.Net 2003 (environment for C#)-programming language wherein is written program is PDM.