



Институт энергетики,
информационных технологий
и управляющих систем

Релейная защита и автоматика систем электрообеспечения

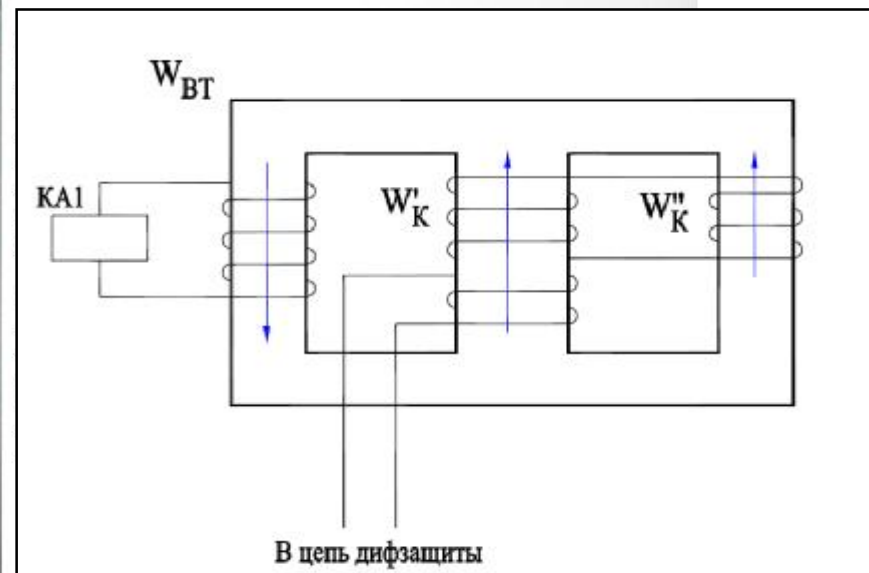
Практическое занятие № ____ . Теоретическая часть

Методика расчета уставок дифференциальной защиты трансформаторов на реле типа РНТ-565 и ДЗТ-11

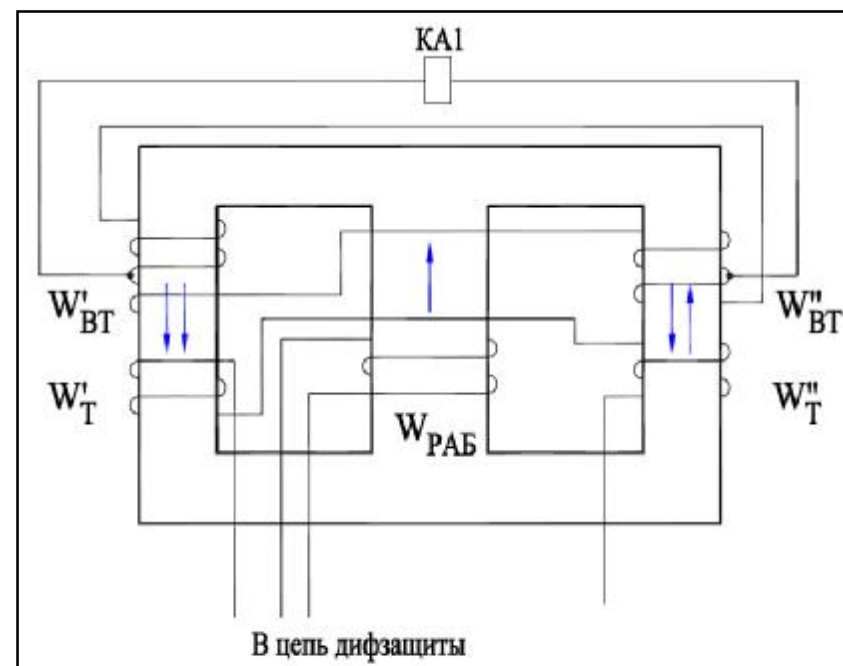
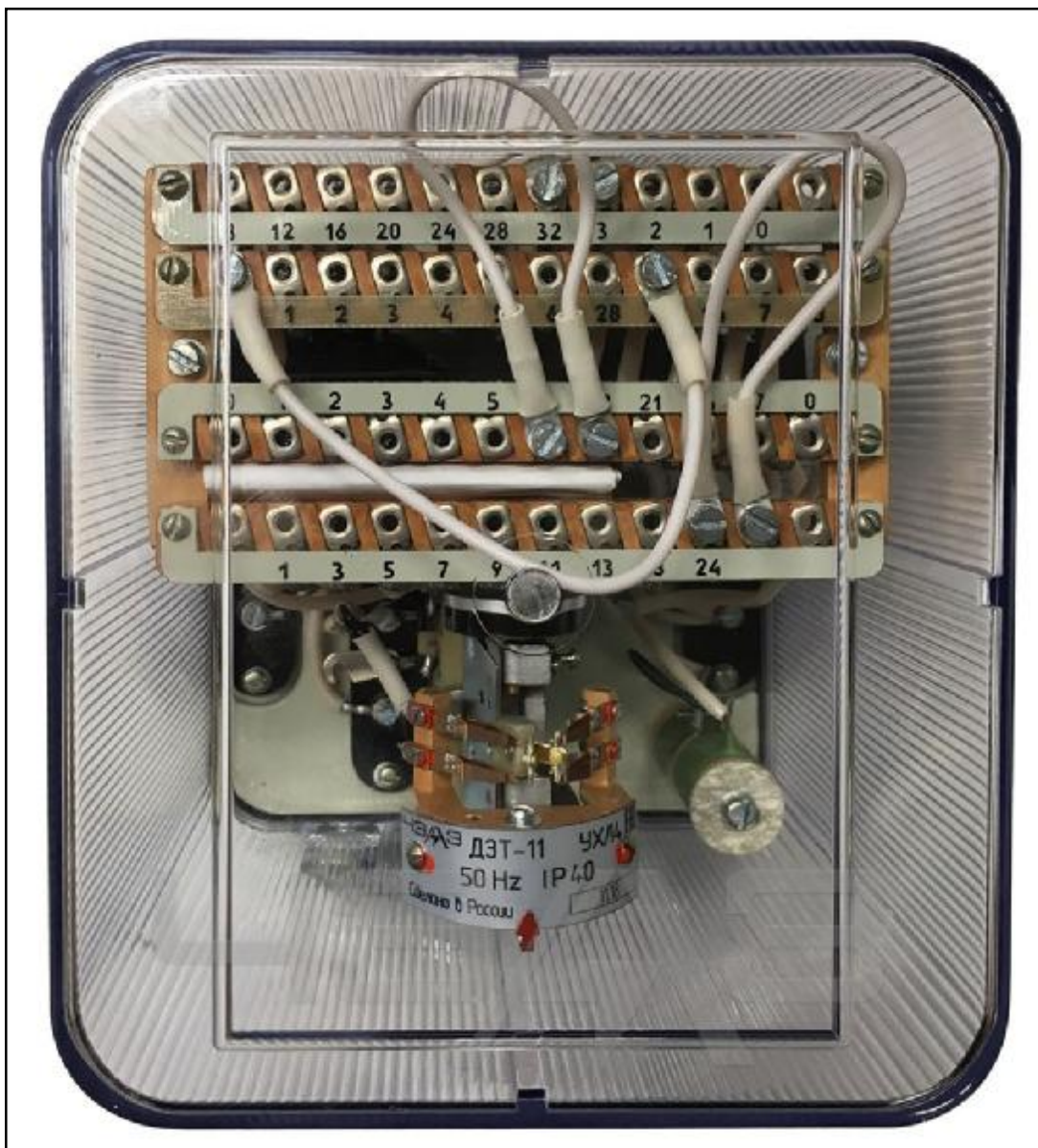
Материалы из: **КОПЬЕВ В.Н.** Релейная защита. Проектирование:
Учебное пособие. Томск: Изд. ТПУ, 2012. - 100с



Внешний вид РНТ-565



Внешний вид ДЗТ-11



$$(2.87 - 12.5) \text{ }.$$

$$(1.45 - 12.5) \text{ }.$$

-565

:

1. -

,

.

,-

« — » « — -

»,

,

-

—

.

-

’ 5 .

2. ,

:

2.1

:

$$I \geq k I \tag{17}$$

$k = 1,3$ - ,

;

$$I = I' + I''$$

,

I' - ,

$$I' = k_A k f_i I \tag{18}$$

$k_A = 1$ - ,

..;

$k = 0,5 - 1$ - ;

$f_i = 0,1$ -

;

I - -

($t = 0$) ,

$$I'' = (\Delta U_1 k_{-1} + \Delta U_1 k_{-2}) I \quad ,$$

$$\Delta U_1, \Delta U_1 - \quad , \quad ; \quad -$$

$$k_{-1}, k_{-2} - \quad ; \quad ;$$

2.2.

$$I \geq k I \quad , \quad (21)$$

$$k = 1 - 1,3 - \quad ;$$

$$I - \quad .$$

2.1 2.2

3.

-560

-11.

$$k = \frac{I_{K MIN}^{(m)} k_N^{(m)}}{I k_N^{(3)}} \quad , \quad (22)$$

$$I_{K MIN}^{(m)} - \quad . \quad . \quad ; m = 2 - \quad . \quad . \quad ; m = 1 - \quad m (m = 3 -$$

$$I - \quad ;$$

$$k_N^{(3)} - \quad , \quad m ,$$

$$N \quad ,$$

N ...			$\frac{k^{(m)}_N}{k^{(3)}_N}$
1			1
2			$\frac{2}{\sqrt{3}}\left(\frac{1}{\sqrt{3}}\right)$ 1
3			$\frac{1}{\sqrt{3}}$

:

- , - ;
- , -
.
.
.
(23) -

$$= \frac{F}{I}, \tag{23}$$

$F = 100$ - -565
-566;
 I - .

,
.
4. (24) (25) -
:

$$I_1 = \frac{I}{I_1} \quad (24)$$

$$I_2 = \frac{I}{I_2}, \quad (25)$$

$$\begin{aligned} I &= \dots; \\ I_1, I_2 &= \dots; \\ I_1, I_2 &= \dots \end{aligned}$$

$$5. \quad I_1, I_2 = \dots$$

$$I''',$$

$$I''' = \left(\frac{I_1}{I_1} k_1 \pm \frac{I_2}{I_2} k_2 \right) I \quad (26)$$

$$I_1, I_2 = \dots$$

$$\begin{aligned} &\ll + \gg \quad \ll - \gg \\ &\quad \vdots \\ &\ll + \gg, \quad - \quad \ll - \gg. \end{aligned}$$

$$I = I' + I'' + I''' \quad (27)$$

$$6. \quad I'' \quad I',$$

$$7. \quad I' \quad I,$$

$$5\%, \quad I'$$

$$-7 \quad I''$$

$$8. \quad \dots$$

(23) ,

-565

110/11

16 ,

Е 10 %.

()

.12.

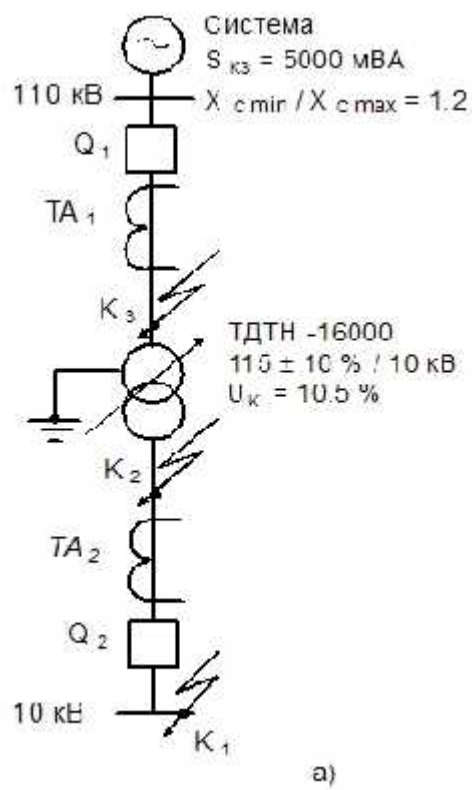
1.

110)

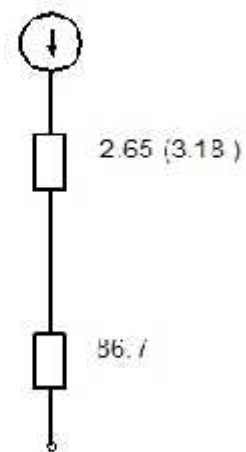
$\sqrt{3}I$,

5 .

.4.



а)



б)

.12

(
 115 ;
)

		110	10
,	$I = \frac{S}{\sqrt{3}I}$	$\frac{16000}{\sqrt{3} \cdot 110} = 84$	$\frac{16000}{\sqrt{3}11} = 840$
	n	200/5	1500/5
,	$I = \frac{I \cdot k}{n}$	$\frac{84\sqrt{3}}{200/5} = 3,64$	$\frac{840}{1500/5} = 2,8$

2.

,
 · · · · I ·

$$I_{kmax} = 743 \text{ .}$$

3.

:

-

(17)

-

 I''

$$I = 1,3(1 \cdot 1 \cdot 0,1 + 0,1)743 = 1,3 \cdot 148,6 = 193 \text{ .}$$

-

$$I = 1,3 \cdot 84 = 109,2 \text{ .}$$

,

-

$$I = 193 \text{ .}$$

4.

.

· ·

$$I_{kmin}^{(2)} = \frac{115000}{\sqrt{3}(3,18 + 86,7)} \cdot \frac{\sqrt{3}}{2} = 639,7 A .$$

(22)

$$k_{min} = \frac{640 \cdot 1}{193} = 3,3 .$$

5.

I''' .

. 5.

5

1	,	$I = \frac{k \cdot I}{n_{TT110}}$	$\frac{\sqrt{3} \cdot 193}{200/5} = 8,35$
2	() -	$= \frac{F}{I}$	$\frac{100}{8,35} = 11,97$
3	,		11
4	- ,	$I = \frac{F}{I}$	$\frac{100}{11} = 9,1$
5	() ,	$I = \frac{I}{I_1}$	$11 \frac{3,64}{2,8} = 14,3$
6	- ,	I	14
7	I''' , A	$I''' = \left \frac{I}{I} - \frac{I}{I} \right \times$ $\times I$	$\frac{14,3 - 14}{14,3} \cdot 743 = 15$
8	I_c , -	$I = k (I' + I'' + I''')$	$193 + 1,3 \cdot 15 = 212$
9	,	$I' = \frac{k \cdot I}{n_{TT110}}$	$\frac{\sqrt{3} \cdot 212}{200/5} = 9,2$
10	(110) (10), -	I	$\frac{11}{14}$

6. . . . K_2

$$k_{min} = \frac{640 \cdot 1}{212} = 3$$

3.2.3 11 -

$$-11/2, \quad \begin{matrix} -11 \\ -11/3, \end{matrix} \quad -11/4. \quad : \quad -11, \\ -11$$

$$\begin{matrix} -11 \\ -11/3 \end{matrix} \quad -11/2 \quad -11/4$$

$$\begin{matrix} -11 \\ -11 \end{matrix} \quad .13. \quad .14. \quad -11$$

1. -

2. -

- -

- -

-

5.

$$\check{S} \geq k \frac{I}{I \cdot \text{tg}} \quad (28)$$

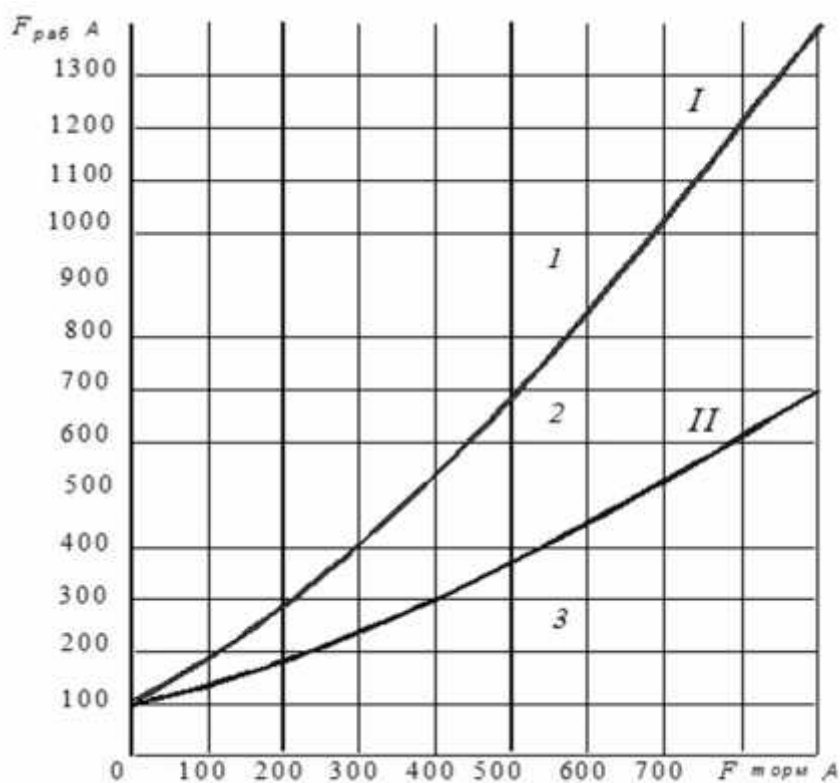
$$I \quad I \quad (17)$$

$$k = 1,5$$

$$\text{tg}$$

$$F = k I \geq 200$$

$$\text{tg} = 0,75.$$



.14

-11/4: 1 –

; 2-

; 3 –

; I –

; II -

	<p> $F < 200$ </p>	-
	<p> F </p>	-
6.	<p> $k = I / I_{CP}$ </p>	-
	<p> $2.$ </p>	-
	<p> 1.5 </p>	-
	<p> 80 </p>	-
	<p> $;$ </p>	-
	<p> $;$ </p>	-
	<p> $;$ </p>	-
7.	<p> $k = \frac{F}{F}$ </p>	-
	<p> F </p>	-
	<p> F </p>	-
	<p> $F = \sum I$ </p>	-
	<p> I </p>	-
	<p> $;$ </p>	-
	<p> $;$ </p>	-

F

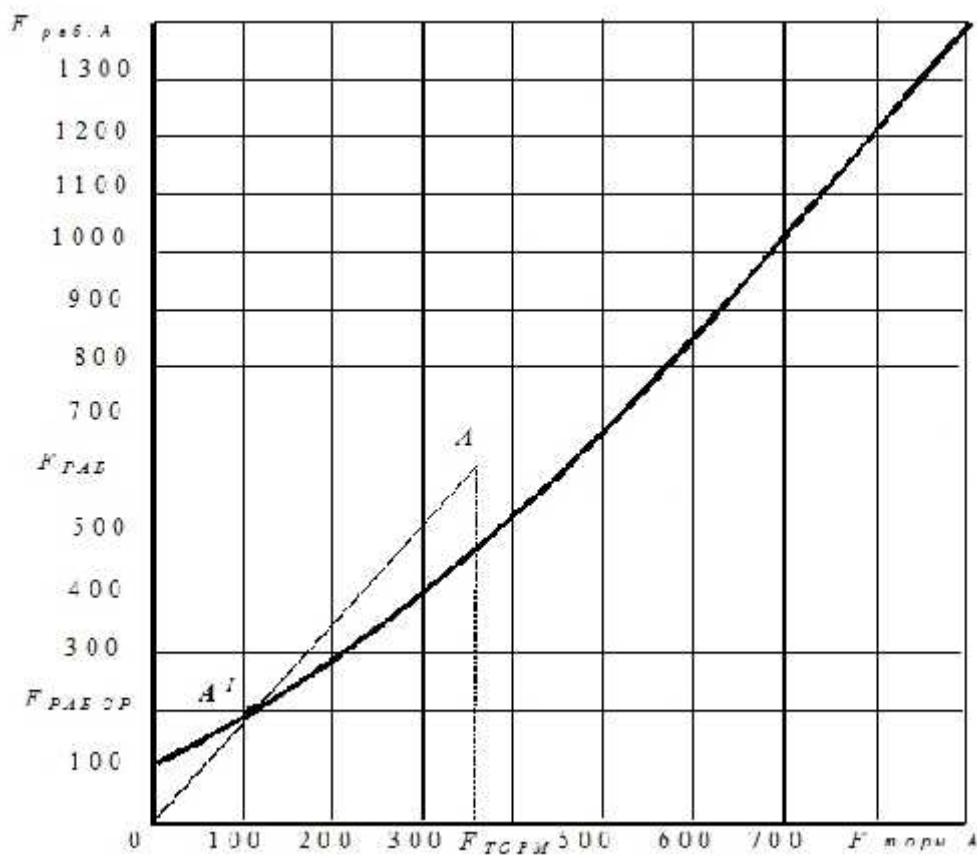
,
15:

$$F = I \quad (31)$$

F, F

(30) (31);

I
 F



15

1.5

38.5/11 .

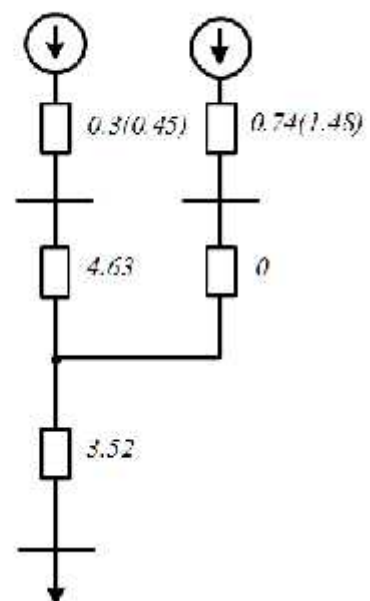
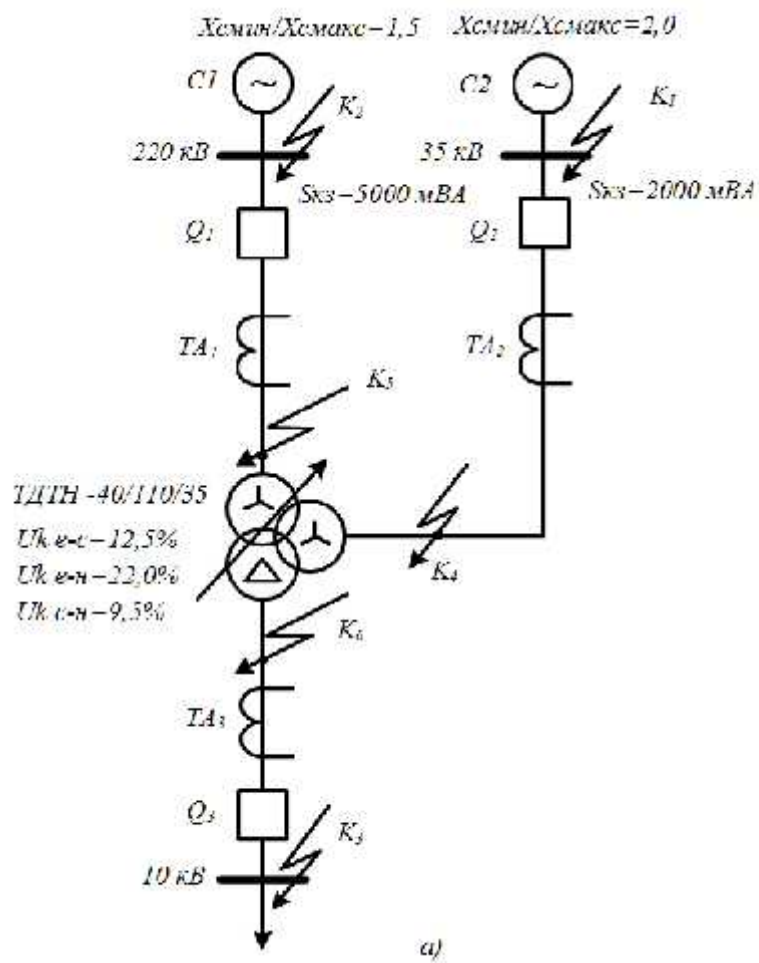
Е 12 %

Е 2×2.5 % .

220 35 .

()

. 16.



.16

38.5 ,

1.

5 .

. 6.

6

		220	35	10
-	$I = \frac{S}{\sqrt{3}U}$	$\frac{40000}{\sqrt{3} \cdot 230} = 100$	$\frac{40000}{\sqrt{3} \cdot 38,5} = 600$	$\frac{40000}{\sqrt{3} \cdot 11} = 2100$
-				
-	n_{TT}	300/5	2000 / 5	3000 / 5
-	$I = \frac{k I}{n}$	$\frac{\sqrt{3} \cdot 100}{300/5} = 2,89$	$\frac{\sqrt{3} \cdot 600}{2000/5} = 2,6$	$\frac{2100}{3000/5} = 3,5$

2.

· , -
 , · , -
 , · , -
 , ·

.17.

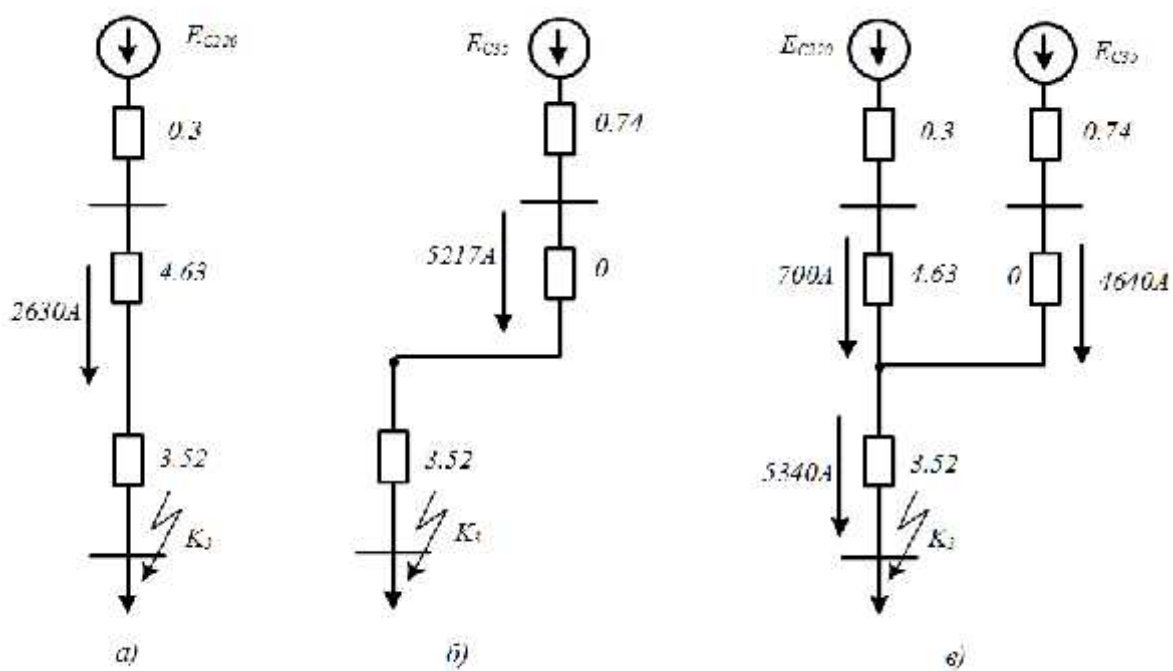
· ,
 I , I -

$$I = (k k f_I + U_{220}) I = (1 \cdot 1 \cdot 0,1 + 0,12) 2630 = 579 A.$$

$$I \geq k I = 1,5 \cdot 579 = 868 .$$

$$I = (k k f_I + U_{35}) I = (1 \cdot 1 \cdot 0,1 + 0,05) \cdot 5217 = 783 A.$$

$$I \geq k I = 1,5 \cdot 783 = 1175 \text{ .}$$



.17

)

35 ;)
220 ;)

220

10

10

10

$$I_{\geq k} I = 1,5 \cdot 600 = 900 \text{ .}$$

35 .

$$I = 900 \text{ .}$$

3.

10 (

)

220 35 .

.7.

..			
1	- - ,	$I_C = \frac{k I \frac{U_{35}}{U_{XX10}}}{n_{10}}$	$900 \frac{38,5}{11} = \frac{3000}{5} = 5,25$
2	- - () ,	$= \frac{F}{I}$	$\frac{100}{5,25} = 19,05$
3	- - ,		19
4	, ,	$I = \frac{F}{I}$	$\frac{100}{19} = 5,26$
5	- - () , 220	$I = \frac{I}{I_1}$	$19 \frac{3,5}{2,89} = 23,01$
6	- - 220 ,	I	23
7	- - () , 35	$I = \frac{I}{I_1}$	$19 \frac{3,5}{2,6} = 25,6$
8	- 35 ,	S	26

(28),
10 , . 17, .

$$\geq k \frac{I}{I \cdot \lg}$$

$$I = I' + I'' + I'''$$

$$I' = 1 \cdot 1 \cdot 0,1 \cdot (700 + 4640) = 534 \text{ A};$$

$$I'' = 0,12 \cdot 700 + 0,05 \cdot 4640 = 316 \text{ A};$$

$$I''' = \frac{|25,6 - 25|}{25,6} \cdot 4640 = 73 \text{ A};$$

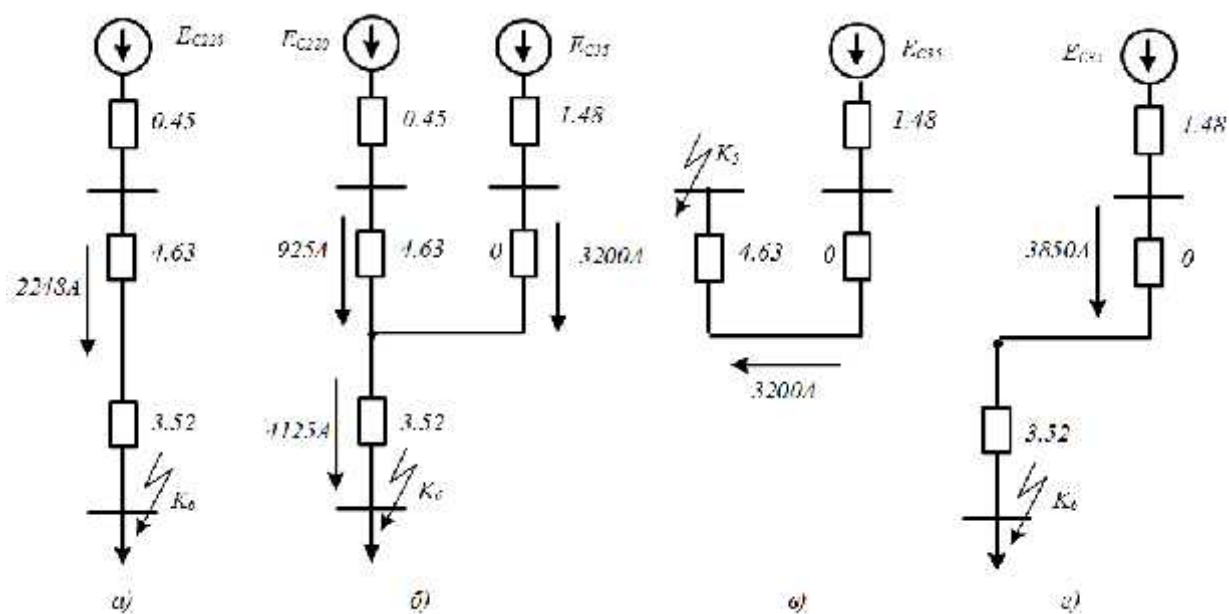
$$I = 534 + 316 + 73 = 923 \text{ A};$$

$$= \frac{1,5 \cdot 923 \cdot 25,6}{4640 \cdot 0,75} = 10,2.$$

$$= 11.$$

4.

, , 10 , 35 - , 18, .



.18

$$I_1 = \frac{2248 \frac{38,5}{230} \sqrt{3}}{300/5} = 10,9 \text{ A}.$$

$$k = \frac{10,9 \cdot 23}{100} = 2,5.$$

5.

:

)

..

$$\frac{10}{220} \cdot 35 = 1,59 \text{ , } 18, \text{ .}$$

,

$$220$$

$$I_1 = \frac{925 \frac{38,5}{230} \sqrt{3}}{300/5} = 4,47 A.$$

,

$$35$$

$$I_1 = \frac{3200 \sqrt{3}}{2000/5} = 13,86 A.$$

$$F = I_1 + I_2 = 4,47 \cdot 23 + 13,86 \cdot 26 = 463 \text{ .}$$

$$F = 13,86 \cdot 11 = 153 \text{ .}$$

$$F = 145 \text{ ,}$$

, .19.

$$k = \frac{463}{153} = 3 > 2.$$

)

..

$$220$$

$$35$$

, .18, .

,

$$35$$

$$I_2 = \frac{3640 \sqrt{3}}{2000/5} = 15,8 A.$$

$$F = I_2 = 15,8 \cdot 26 = 411 \text{ .}$$

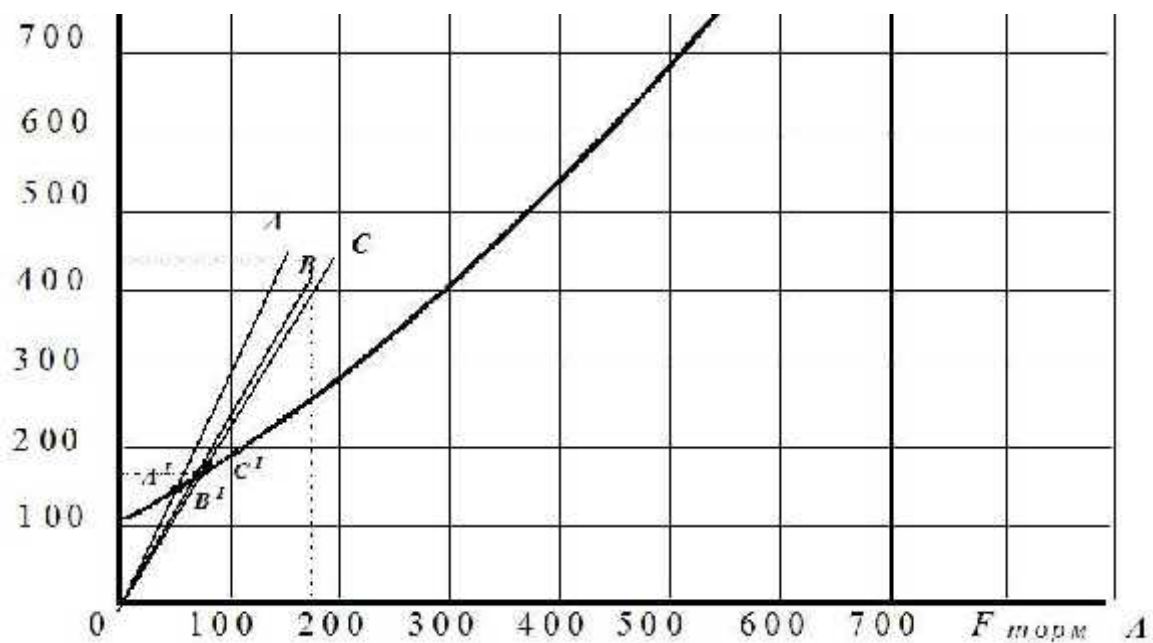
$$F = 15,8 \cdot 11 = 174 \text{ .}$$

$$F = 170 \text{ ,}$$

B

, .19.

$$k = \frac{411}{170} = 2,4 > 2.$$



.19

) ... 10

220 -
35 , .18, .

, -
35 .

$$I_2 = \frac{3850\sqrt{3}}{2000/5} = 16,7 \text{ A};$$

$$F_2 = I_2 \cdot 26 = 16,7 \cdot 26 = 434 \text{ ;}$$

$$F_1 = 16,7 \cdot 11 = 183 \text{ .}$$

$$F_3 = 176 \text{ ;} \quad -$$

C -

, .19.

$$k = \frac{434}{176} = 2,5 > 2.$$

,

.