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(Risk Spectrum, Windchill, Cris,
(GraphMaker, 2, RastrWin, 3 .)

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2003611099 [16]. ∴ , 12 2003. -

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2003611100 [17]. - ∴ , 12 2003. -

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2001, (2001 , . . .) [18] //
[10]. -

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2 XIII " - " -

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3 " " , . . . 5-8 2010 . -

4 " " , . . . 12-13 2010 . -

5 XVI " (- 2011), . . . 2011 . -

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6 " " , . . . 3-6 2013 . -

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[10, 15] [1-9, 11, 12, 13, 14]. -

[1,3,7,10] [1-7]. -

[17]; [2,4,12,14] " " ; [8,9] -

; [5,6,11,13,15]

" " " 2001", ; [15]

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Risk Spectrum SAPHIRE-7 Windchill FTA RISK,CRISS-4.0	-	-	-	-	-	-	+	-	+	-	-	-	-	-
Windchill RBD	-	-	+	-	-	-	+	-	-	+	-	-	-	-
2001	+	+	+	+	-	-	+	+	+	+	-	-	-	-
GraphMaker, ProjectManager 2,	-	-	-	-	+	-	+	-	+	+	+	+	+	±
RastrWin, 3	-	-	-	-	-	+	+	-	-	+	+	+	+	-
	+	+	+	+	±	±	+	+	+	+	±	+	+	+

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($r \in \langle X, R \rangle$, $X -$, $R \subseteq X^2 -$, $X \cap X_> \cup X_< \cup X^V$, $X_> \cap \{x_>^k, k \in I, \dots, K\} -$); $X_< \cap \{x_<^l, l \in I, \dots, L\} -$); $X^V \cap \{x_j, j \in I, \dots, N\} -$); $r \in R^I$. (R) .

$S \cap \{S_j(\langle x_>^k, x_<^l \rangle)\}, k=1, \dots, K; l=1, \dots, L; j=1, \dots, S_{kl} - X_-, X_+$.

$$\dagger_j(S_j(\langle x_>^k, x_<^l \rangle)) \cap \underset{\langle x_>, x_< \rangle \in S_j(\langle x_>^k, x_<^l \rangle)}{\ddot{y}} f(\langle x_>, x_< \rangle) \mid T$$

$S_{j0}(\langle x_>^{k0}, x_<^{l0} \rangle) \in \underset{S}{\text{Argmin}} \dagger_j(S_j(\langle x_>^k, x_<^l \rangle))$ $S_{j1}(\langle x_>^{k1}, x_<^{l1} \rangle) \in \underset{S}{\text{Argmax}} \dagger_j(S_j(\langle x_>^k, x_<^l \rangle))$.

$$\langle x_m, x_n \rangle \quad \langle m, n \rangle \quad r_{mn} \cap f(\langle x_m, x_n \rangle)$$

$$\dagger_j(S_j(\langle x_>^k, x_<^l \rangle)) \cap \underset{\langle x_m, x_n \rangle \in S_j(\langle x_>^k, x_<^l \rangle)}{\ddot{y}} f(\langle x_m, x_n \rangle) \cap \underset{\langle m, n \rangle \in S_j(\langle k, l \rangle)}{\ddot{y}} r_{mn}$$

$p_{mn} \cap P(\langle x_m, x_n \rangle)$.

$$S \cap \{S_j | S_j(\langle x^k, x^l \rangle) \in \underset{S}{\text{Argmax}} P(S_j(\langle x^k, x^l \rangle))\}$$

$$S \cap \{S_j | P(S_j(\langle x^k, x^l \rangle)) \geq P_j\}, \quad P_j = 1,$$

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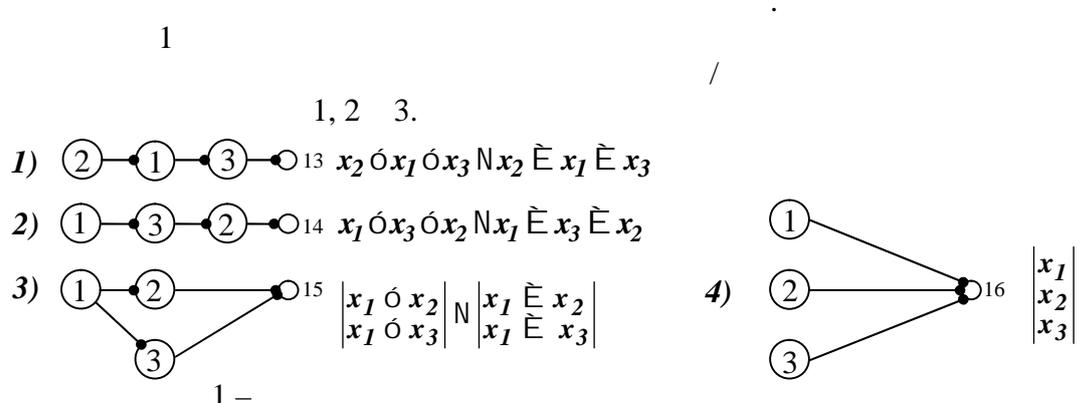
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$$y_{13} \cap y_{14} \cap y_{15} \cap y_{16} \cap x_1 \acute{o} x_2 \acute{o} x_3,$$

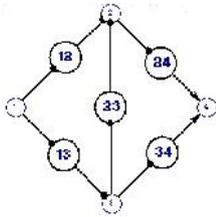
$$i \rightarrow j, \quad (i \rightarrow j),$$

$$x_i \circ x_j \wedge x_i \in x_j;$$

$$\left| \begin{matrix} x_i \\ x_j \end{matrix} \right|.$$

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- 1) $y_1 \wedge true$
- 2) $y_2 \wedge y_{12} \circ y_{23}$
- 3) $y_3 \wedge y_{13}$
- 4) $y_4 \wedge y_{24} \circ y_{34}$
- 5) $y_{12} \wedge x_{12} \circ y_1$
- 6) $y_{13} \wedge x_{13} \circ y_1$
- 7) $y_{23} \wedge x_{23} \circ y_3$
- 8) $y_{24} \wedge x_{24} \circ y_2$
- 9) $y_{34} \wedge x_{34} \circ y_3$

$$Yc \wedge y_4$$

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y_4 .

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$$Yc \wedge \left| \begin{matrix} x_{13} \circ x_{23} \circ x_{24} \\ x_{12} \circ x_{24} \end{matrix} \right| \circ x_{13} \circ x_{34} \wedge \left| \begin{matrix} x_{13} \in x_{23} \in x_{24} \\ x_{12} \in x_{24} \end{matrix} \right| \circ x_{13} \in x_{34} \quad (1)$$

$$Yk \wedge x_{24} \circ x_{23} \circ x_{13} \circ x_{12} \circ x_{34} \circ x_{13} \quad (2)$$

$Yc (1)$

(. 1)

$Yk (2)$

Номер шага	Столбец 1						Столбец 2			
	1	2	3	4	5	6	7	8	9	10
Номер этапа СГМ	1	2	3,4	5,2,3,4,5, 2,3,4,5	2,3,4,5, 2,3,4,5	2, 6	2, 3, 4, 5, 2, 6, 7	8	5, 2, 3, 4, 5, 2, 3, 4, 5 2, 3, 4, 5	2, 6, 7, 8, 1, 9
ЛКФ: $V_c = Y_4$	4	4	4	4	4	4	4	4	4	4
			$y_{24} \vee y_{34}$	$x_{24} \vee y_{34}$	$x_{24} \vee y_{34}$	$x_{24} \vee y_{34}$	$x_{24} \vee y_{34}$	y_{34}	x_{34}	x_{34}
			x_2	x_2	x_2	x_2	x_2	x_3	x_3	x_3
			$x_{12} \vee x_{23}$	$x_{12} \vee x_{23}$	$x_{12} \vee x_{23}$	$x_{12} \vee x_{23}$	$x_{12} \vee x_{23}$	x_{13}	x_{13}	x_{13}
			x_3	x_3	x_3	x_3	x_3	x_1	x_1	x_1
			x_{13}	x_{13}	x_{13}	x_{13}	x_{13}	x_{13}	x_{13}	x_{13}
			x_1	x_1	x_1	x_1	x_1	x_1	x_1	x_1
										$x_{13} \rightarrow x_{34}$
										$x_{13} \rightarrow x_{23}$
										$x_{13} \rightarrow x_{23} \rightarrow x_{24}$
										$x_{12} \rightarrow 24$
Y_c			Сетевые конъюнкции				$x_{13} \rightarrow x_{23} \rightarrow x_{24}$ $x_{12} \rightarrow 24$			$x_{13} \rightarrow x_{34}$
Y_k			Комбинаторные конъюнкции				$x_{24} \wedge x_{23} \wedge x_{13} \wedge x_{12}$			$x_{34} \wedge x_{13}$

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j	$\&j(x''i)$	W_j	j	$\&j(x''i)$	W_j
1	2	3	4	5	6
1	$x''_{13} \wedge x''_{12} \wedge x''_{15}$	900	10	$x''_{57} \wedge x''_{26} \wedge x''_{24} \wedge x''_{13}$	850
2	$x''_{36} \wedge x''_{12} \wedge x''_{15}$	850	11	$x''_{36} \vee x''_{57} \vee x''_{26} \vee x''_{24}$	800
3	$x''_{67} \wedge x''_{26} \wedge x''_{12} \wedge x''_{15}$	1050	12	$x''_{67} \vee x''_{57} \vee x''_{24}$	800
4	$x''_{57} \wedge x''_{25} \wedge x''_{13} \wedge x''_{12}$	1400	13	$x''_{47} \wedge x''_{26} \wedge x''_{25} \wedge x''_{13} \wedge x''_{15}$	1000
5	$x''_{36} \wedge x''_{57} \wedge x''_{25} \wedge x''_{12}$	1350	14	$x''_{36} \wedge x''_{47} \wedge x''_{26} \wedge x''_{25} \wedge x''_{15}$	950
6	$x''_{67} \wedge x''_{57} \wedge x''_{26} \wedge x''_{25} \wedge x''_{12}$	1550	15	$x''_{67} \wedge x''_{47} \wedge x''_{25} \wedge x''_{15}$	950
7	$x''_{26} \wedge x''_{25} \wedge x''_{24} \wedge x''_{13} \wedge x''_{15}$	950	16	$x''_{57} \wedge x''_{47} \wedge x''_{26} \wedge x''_{13}$	900
8	$x''_{36} \wedge x''_{26} \wedge x''_{25} \wedge x''_{24} \wedge x''_{15}$	900	17	$x''_{36} \wedge x''_{57} \wedge x''_{47} \wedge x''_{26}$	850
9	$x''_{67} \wedge x''_{25} \wedge x''_{24} \wedge x''_{15}$	900	18	$x''_{67} \wedge x''_{57} \wedge x''_{47}$	850

11 12), (5), 3, (j =

$$W_{max} = W_{11} = W_{12} = 800 \quad (6)$$

(6)

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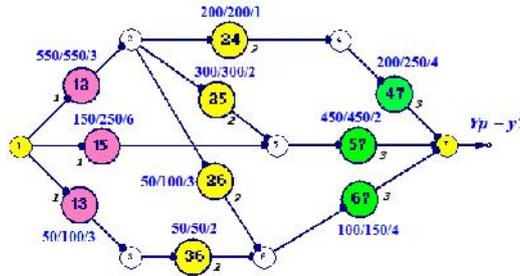
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2) :

- $wn_i -$ () ;

- $w_i -$ () ;

- $s_i -$ (, . . .) .

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$w_i -$ / $wn_i -$ / $s_i -$.

3) ()

$$(7) \quad Lk \in Yc$$

6.

$$\begin{array}{llll}
 L_1 \ N \ x_{12} \ \bar{E} \ x_{24} \ \bar{E} \ x_{47} & W_{r_1} \ N \ 200 / W_{n_1} \ N \ 200 \ (R_{-}W_1 \ N \ 0) & S_1 \ N \ 8 \\
 L_2 \ N \ x_{12} \ \bar{E} \ x_{25} \ \bar{E} \ x_{57} & W_{r_2} \ N \ 300 / W_{n_2} \ N \ 300 \ (R_{-}W_2 \ N \ 0) & S_2 \ N \ 7 \\
 L_3 \ N \ x_{15} \ \bar{E} \ x_{57} & W_{r_3} \ N \ 150 / W_{n_3} \ N \ 250 \ (R_{-}W_3 \ N \ 100) & S_3 \ N \ 8 \\
 L_4 \ N \ x_{13} \ \bar{E} \ x_{36} \ \bar{E} \ x_{67} & W_{r_4} \ N \ 50 / W_{n_4} \ N \ 50 \ (R_{-}W_4 \ N \ 0) & S_4 \ N \ 9 \\
 L_5 \ N \ x_{12} \ \bar{E} \ x_{26} \ \bar{E} \ x_{67} & W_{r_5} \ N \ 50 / W_{n_5} \ N \ 100 \ (R_{-}W_5 \ N \ 50) & S_5 \ N \ 10
 \end{array} \tag{7}$$

4) , $L_k \in Y_c$ -

$$\begin{array}{l}
 : \\
 - \\
 : \\
 W_{r_k} \ N \ \min(w_i), i \in L_k, k \ N \ 1, 2, \dots, K ; \tag{8}
 \end{array}$$

$$\begin{array}{l}
 - \\
 : \\
 W_{n_k} \ N \ \min(w_{n_i}), i \in L_k, k \ N \ 1, 2, \dots, K ; \tag{9}
 \end{array}$$

$$\begin{array}{l}
 - \\
 : \\
 R_{-}W_k \ N \ W_{n_k} > W_{r_k}, k \ N \ 1, 2, \dots, K ; \tag{10}
 \end{array}$$

$$\begin{array}{l}
 - \\
 (\quad , \quad) : \\
 S_k \ N \ \sum_{i \in L_k} s_i, k \ N \ 1, 2, \dots, K . \tag{11}
 \end{array}$$

(7) (8)-(11) -

(. 6).

5) $L_k \in Y_c$

$$\begin{array}{l}
 : \\
 - \\
 W_{-}x_i \ N \ \sum_{K / x_i \in L_k} W_{r_k}, i \ N \ 1, 2, \dots, H , \tag{12}
 \end{array}$$

$$\begin{array}{l}
 - \\
 R_{-}x_i \ N \ w_{n_i} > w_i, i \ N \ 1, 2, \dots, H ; \tag{13}
 \end{array}$$

$$\begin{array}{l}
 - \\
 SWr \ N \ \sum_{k \ N \ 1}^K W_{r_k} ; \tag{14}
 \end{array}$$

$$\begin{array}{l}
 - \\
 R_{-}SW \ N \ \sum_{k \ N \ 1}^K W_{n_k} > SWr . \tag{15}
 \end{array}$$

(12)-(15),

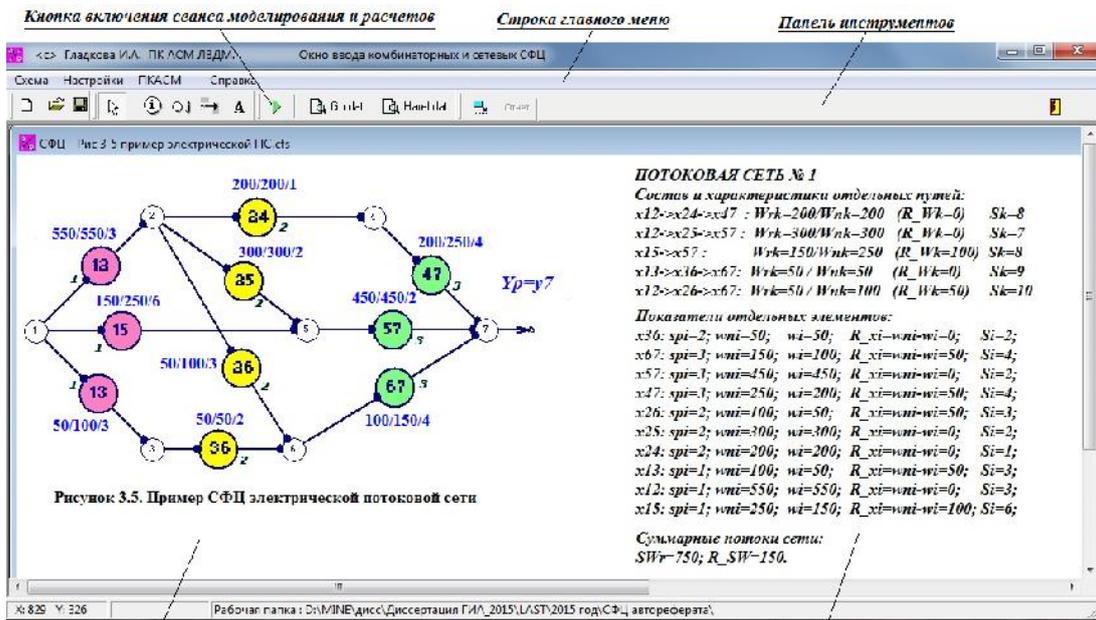
$$\begin{array}{llll}
 x_{36} : w_i \ N \ 50; & R_{-}x_i \ N \ 0; & x_{25} : w_i \ N \ 300; & R_{-}x_i \ N \ 0; \\
 x_{67} : w_i \ N \ 100; & R_{-}x_i \ N \ 50; & x_{24} : w_i \ N \ 200; & R_{-}x_i \ N \ 0; \\
 x_{57} : w_i \ N \ 450; & R_{-}x_i \ N \ 0; & x_{13} : w_i \ N \ 50; & R_{-}x_i \ N \ 50; \\
 x_{47} : w_i \ N \ 200; & R_{-}x_i \ N \ 50; & x_{12} : w_i \ N \ 550; & R_{-}x_i \ N \ 0; \\
 x_{26} : w_i \ N \ 50; & R_{-}x_i \ N \ 50; & x_{15} : w_i \ N \ 150; & R_{-}x_i \ N \ 100;
 \end{array} \tag{16}$$

$$\begin{array}{l}
 SWr \ N \ 750; \\
 R_{-}SW \ N \ 150.
 \end{array}$$

III

Windows-
 Borland Delphi Professional, Version 7.0;
 2001" [16].

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Рабочее поле графического ввода СФЦ

Запись результатов моделирования и расчетов

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"Harel.dat".

Номер вершины	Вероятность отключения	Средняя рабочая до отказа	Средняя восстановительная	Приоритет вмешательства	Сод. заявки	Время работы	Кратность заявки	Параметр RES	Параметр M11	Параметр G11	Параметр M12	Параметр G12	Описание оборудования, кодной единицы элемента
5	0.97	С	-1	0	1	0	1	1	100	6	250	Генерация 2	
2	0.967	С	-1	0	1	0	1	1	500	3	550	Генерация 1	
3	0.987	С	-1	0	1	0	1	1	50	3	100	Генерация 3	
24	0.997	Г	-1	0	1	1	2	200	1	200	Линия передачи 1		
25	0.997	Г	-1	0	1	1	2	300	2	300	Линия передачи 2		
26	0.997	Г	-1	0	1	1	2	50	3	100	Линия передачи 3		
47	0.957	С	-1	0	1	0	1	3	250	4	250	Потребитель 1	
57	0.947	С	-1	0	1	0	1	3	450	2	450	Потребитель 2	
67	0.987	Л	-1	0	1	1	3	150	1	150	Потребитель 3		
36	0.97	Л	-1	0	1	1	2	50	2	50	Линия передачи 4		

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2013 (ISBN 978-5-902241-22-5). :
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. 14.03.03 ; . 12.05.03.

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