POLITECNICO DI TORINO

DOCTORATE SCHOOL
Ph.D. in Metrology: Measuring science and Technique – XXVI doctoral cycle

PhD Thesis

Process Intensification Vs. Reliability

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February 2014

Annex I. Recursive operability analysis

Annex I.A. Recursive operability analysis of traditional plant

Legend

Description of code used: Node number - Variable analyzed - Deviation hypothesized

Variable used:	
Temperature	T
Flow rat	F
Concentration of VOCs	x(VOC)
Concentration of oxygen	x(O2)

Deviation	
High	H
Low	L
Fulfillment subordinated to another cause	+

Graphic symbols used	
Cause primary	*
OR gate	----------
AND Gate	&
Logical 2:3	2:3
TOP EVENT	

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
1	1	1-T-H	External deviation (T-H input gas)*	2-T-H					-	7
2	1	1-T-L	External deviation (T-L input gas)*	2-T-L					-	8
3	1	1-F-H	External deviation (F-H input gas)*	2-F-H					-	9
4	1	1-F-L	External deviation (F-L input gas)*	2-F-L					-	10
5	1	1-x(VOC)-H	External deviation (x(VOC)-H input gas)*	2-x(VOC)-H					-	14
6	1	1-x(VOC)-L	External deviation (x(VOC)-L input gas)*	2-x(VOC)-L					-	15
7	2	2-T-H	1-T-H	4-T-H					1	24
8	2	2-T-L	1-T-L	4-T-L					2	25
9	2	2-F-H	1-F-H	4-F-H					3	26
10	2	2-F-L	1-F-L ---------- Filter obstructed (b)	2-F-LL					4 12	11
11	2	2-F-LL	2-F-L	4-F-L					10	27
12	2	Filter obstructed (b)	0	2-F-L					13	10
13	2		Filter F01A clogged* & Filter F01B clogged*	Filter obstructed (b)	PdAH18403				- -	12
14	2	2-x(VOC)-H	1-x(VOC)-H	4-x(VOC)-H					5	28
15	2	2-x(VOC)-L	1-x(VOC)-L	4-x(VOC)-L					6	29

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
16	3	3-T-H	External deviation (T-H input oxygen)*	High temperature in the line of oxygen input			1		-	TE1
17	3	3-T-L	External deviation (T-L input oxygen)*	Low temperature in the line of oxygen input			2		-	TE2
18	3	3-F-H	External deviation (F-H input oxygen)* --- M.F. AE18415* --- M.F. AT18415* --- M.F. AIC18415* --- M.F. AV18415* --- M.F. FE18404* --- M.F. FT18404* --- M.F. FI18404*	3-F-HH					- - 0 0 - - - - -	19
19	3	3-F-HH	3-F-H	3-F-HHH	AAH18415				18	20
20	3	3-F-HHH	3-F-HH	4-x(O2)-H					19	31
21	3	3-F-L	External deviation (F-L input oxygen)* --- M.F. AE18415* --- M.F. AT18415* --- M.F. AIC18415* --- M.F. AV18415* --- M.F. FE18404* --- M.F. FT18404* --- M.F. FI18404*	3-F-LL					- - 0 0 0.15847348 0.15847348 0.15847348 0.15847348 0.15847348	22
22	3	3-F-LL	3-F-L	4-x(O2)-L					21	32
23	3	3-x(O2)-L	Absence of oxygen*	4-x(O2)-L					-	32

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
24	4	4-T-H	2-T-H	5-T-H					7	34
25	4	4-T-L	2-T-L	5-T-L					8	35
26	4	4-F-H	2-F-H	5-F-H					9	37
27	4	4-F-L	2-F-LL	5-F-L					11	38
28	4	4-x(VOC)-H	2-x(VOC)-H	5-x(VOC)-H					14	39
29	4	4-x(VOC)-L	2-x(VOC)-L	4-x(VOC)-LL					15	30
30	4	4-x(VOC)-LL	4-x(VOC)-L	5-x(VOC)-L					29	40
31	4	4-x(O2)-H	3-F-HHH	5-x(O2)-H					20	41
32	4	4-x(O2)-L	3-F-LL --- 3-x(O2)-L	4-x(O2)-LL					22 23	33
33	4	4-x(O2)-LL	4-x(O2)-L	5-x(O2)-L					32	42
34	5	5-T-H	4-T-H	6-T-H & 8-T-H+(2)					24	49 84
35	5	5-T-L	4-T-L --- Heat recovery H01 dirty*	5-T-LL					25 -	36
36	5	5-T-LL	5-T-L	6-T-L					35	52
37	5	5-F-H	4-F-H	6-F-H					26	54
38	5	5-F-L	4-F-L	6-F-L					27	55
39	5	5-x(VOC)-H	4-x(VOC)-H	6-x(VOC)-H					28	56
40	5	5-x(VOC)-L	4-x(VOC)-LL	6-x(VOC)-L					30	57
41	5	5-x(O2)-H	4-x(O2)-H	6-x(O2)-H					31	58
42	5	5-x(O2)-L	4-x(O2)-LL	6-x(O2)-L					33	59

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
43	6	Failure temperature measure in heater high	M.F. TE18408* 2:3 M.F. TE18409* 2:3 M.F. TE18410*	Heater break high					- - -	44
44	6	Heater break high	Failure temperature measure in heater high --- M.F. TE18406* --- M.F. TIC18406* --- M.F. E01*	Wrong temperature in heater high					43 - - -	45
45	6	Wrong temperature in heater high	Heater break high	6-T-H & 8-T-H+(1) & 8-T-H+(2)					44	50 83 84
46	6	Failure temperature measure in heater low	M.F. TE18408* 2:3 M.F. TE18409* 2:3 M.F. TE18410*	Heater break low					- - -	47
47	6	Heater break low	Failure temperature measure in heater low --- M.F. TE18406* --- M.F. TIC18406* --- M.F. E01*	Wrong temperature in heater low					46 - - -	48
48	6	Wrong temperature in heater low	Heater break low	6-T-L					47	52
49	6	6-T-H	5-T-H --- Wrong temperature in heater high	6-T-HH					34 45	51

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
51	6	6-T-HH	6-T-H	7-T-H					49.5	60
52	6	6-T-L	5-T-LL --- Wrong temperature in heater low	6-T-LL					36 48	53
53	6	6-T-LL	6-T-L	7-T-L					52	61
54	6	6-F-H	5-F-H	7-F-H					37	62
55	6	6-F-L	5-F-L	7-F-L					38	63
56	6	6-x(VOC)-H	5-x(VOC)-H	7-x(VOC)-H					39	64
57	6	6-x(VOC)-L	5-x(VOC)-L	7-x(VOC)-L					40	65
58	6	6-x(O2)-H	5-x(O2)-H	7-x(O2)-H					41	66
59	6	6-x(O2)-L	5-x(O2)-L	7-x(O2)-L					42	67
60	7	7-T-H	6-T-HH	8-T-H					51	68
61	7	7-T-L	6-T-LL	8-T-L					53	69
62	7	7-F-H	6-F-H	8-F-H					54	70
63	7	7-F-L	6-F-L	8-F-L					55	72
64	7	7-x(VOC)-H	6-x(VOC)-H	8-x(VOC)-H					56	74
65	7	7-x(VOC)-L	6-x(VOC)-L	8-x(VOC)-L					57	75
66	7	7-x(O2)-H	6-x(O2)-H	8-x(O2)-H					58	76
67	7	7-x(O2)-L	6-x(O2)-L	8-x(O2)-L					59	77
68	8	8-T-H	7-T-H	Reactor work correctly					60	78
69	8	8-T-L	7-T-L	8-T-LL					61	79
70	8	8-F-H	7-F-H	8-F-HH					62	71
71	8	8-F-HH	8-F-H	9-F-H & Reactor work correctly					70	94 78
72	8	8-F-L	7-F-L	8-F-LL					63	73
73	8	8-F-LL	8-F-L	9-F-L & Reactor work correctly & 8-T-H+(1)					72	95 78 83
74	8	8-x(VOC)-H	7-x(VOC)-H	Reactor work correctly & 8-T-H+(2)					64	78 84
75	8	8-x(VOC)-L	7-x(VOC)-L	Reactor work correctly					65	78
76	8	8-x(O2)-H	7-x(O2)-H	Reactor work correctly & 9-x(O2)-H					66	78 98

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
77	8	8-x(O2)-L	7-x(O2)-L	8-T-LL & 9-x(O2)-L					67	79 99
78	8	Reactor work correctly	8-T-H --- 8-F-HH --- 8-F-LL --- 8-x(VOC)-H --- 8-x(VOC)-L --- 8-x(O2)-H	System work correctly				It is not a TOP EVENT because it is not an undesirable event.	68 71 73 74 75 76	TE
79	8	8-T-LL	8-T-L --- 8-x(O2)-L	8-T-LLL					69 77	80
80	8	8-T-LLL	8-T-LL	Reactor is clod	TAL18405				79	81
81	8	Reactor is clod	8-T-LLL	8-T-LLLL					80	82
82	8	8-T-LLLL	Reactor is clod	9-x(VOC)-H & 9-T-L					81	96 93
83	8	8-T-H+(1)	8-F-LL & Wrong temperature in heater high	8-T-HH+					73 45	85
84	8	8-T-H+(2)	8-x(VOC)-H & Wrong temperature in heater high & 5-T-H	8-T-HH+					74 45 34	85
85	8	8-T-HH+	8-T-H+(1) --- 8-T-H+(2)	8-T-HH					83 84	86
86	8	8-T-HH	8-T-HH+	8-T-HHH	TAH18411				85	87
87	8	8-T-HHH	8-T-HH	8-T-HHHH		TSHH18411			86	88
88	8	8-T-HHHH	8-T-HHH	8-T-HHHHH & 9-T-H	TAAH18411				87	89 92
89	8	8-T-HHHHH	8-T-HHHH	8-T-HHHHHH	TAH18405				88	90
90	8	8-T-HHHHHH	8-T-HHHHH	Sintering of the catalyst	TAH18408/09/10		3		89	91

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
91	8	Sintering of the catalyst	8-T-HHHHHH	9-x(VOC)-H & 9-T-L					90	96 93
92	9	9-T-H	8-T-HHHH	10-T-H					88	100
93	9	9-T-L	8-T-LLLL ---------- Sintering of the catalyst	10-T-L					82 91	101
94	9	9-F-H	8-F-HH	10-F-H					71	102
95	9	9-F-L	8-F-LL	10-F-L					73	103
96	9	9-x(VOC)-H	8-T-LLLL ---------- Sintering of the catalyst	9-x(VOC)-HH					82 91	97
97	9	9-x(VOC)-HH	9-x(VOC)-H	10-x(VOC)-H	AAH18416				96	104
98	9	9-x(O2)-H	8-x(O2)-H	10-x(O2)-H					76	105
99	9	9-x(O2)-L	8-x(O2)-L	10-x(O2)-L					77	106
100	10	10-T-H	9-T-H	High temperature in output			4		92	TE4
101	10	10-T-L	9-T-L	Low temperature in output			5		93	TE5
102	10	10-F-H	9-F-H	High flow in output			6		94	TE6
103	10	10-F-L	9-F-L	Low flow in output			7		95	TE7
104	10	10-x(VOC)-H	9-x(VOC)-HH	High VOC concentration in output			8		97	TE8
105	10	10-x(O2)-H	9-x(O2)-H	High oxygen concentration in output			9		98	TE9
106	10	10-x(O2)-L	9-x(O2)-L	Low oxygen concentration in output			10		99	TE10

Annex I.B. Recursive operability analysis of intensified plant

Legend

Description of code used: Node number - Variable analyzed - Deviation hypothesized

Variable used:	
Temperature	T
Flow rat	F
Concentration of VOCs	x(VOC)
Concentration of oxygen	x(O2)

Deviation	
High	H
Low	L

Graphic symbols used	
Cause primary	*
OR gate	----------
AND Gate	&
TOP EVENT	

M.F. = Malfunction

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
1	1	1-T-H	External deviation (T - H input gas)*	2-T-H					-	8
2	1	1-T-L	External deviation (T - L input gas)*	2-T-L					-	9
3	1	1-F-H	External deviation (F - H input gas)*	2-F-H					-	10
4	1	1-F-L	External deviation (F - L input gas)*	2-F-L					-	11
5	1	1-x(VOC)-H	External deviation (x(VOC) - H input gas)*	1-x(VOC)-HH	AAH01				-	6
6	1	1-x(VOC)-HH	1-x(VOC)-H	2-x(VOC)-H					5	12
7	1	1-x(VOC)-L	External deviation (x(VOC) - L input gas)*	2-x(VOC)-L					-	13
8	2	2-T-H	1-T-H	3-T-H					1	14
9	2	2-T-L	1-T-L	3-T-L					2	16
10	2	2-F-H	1-F-H	3-F-H					3	17
11	2	2-F-L	1-F-L ---------- Fault blower B-01*	3-F-L					4 -	19
12	2	2-x(VOC)-H	1-x(VOC)-HH	3-x(VOC)-H					6	21
13	2	2-x(VOC)-L	1-x(VOC)-L	3-x(VOC)-L					7	22

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
14	3	3-T-H	2-T-H	3-T-HH	TAH03				8	15
15	3	3-T-HH	3-T-H	4-T-H					14	23
16	3	3-T-L	2-T-L	4-T-L					9	25
17	3	3-F-H	2-F-H --- M.F. FCV05* --- M.F. FIC05* --- M.F. FT05* --- M.F. FE05*	3-F-HH					10 - - - -	18
18	3	3-F-HH	3-F-H	4-F-H					17	26
19	3	3-F-L	2-F-L --- M.F. FCV05* --- M.F. FIC05* --- M.F. FT05* --- M.F. FE05*	3-F-LL					11 - - - -	20
20	3	3-F-LL	3-F-L	4-F-L					19	27
21	3	3-x(VOC)-H	2-x(VOC)-H	4-x(VOC)-H					12	31
22	3	3-x(VOC)-L	2-x(VOC)-L	4-x(VOC)-L					13	32
23	4	4-T-H	3-T-HH	4-T-HH					15	24
24	4	4-T-HH	4-T-H	6-T-H					23	40
25	4	4-T-L	3-T-L	6-T-L					16	41
26	4	4-F-H	3-F-HH	6-F-H					18	42
27	4	4-F-L	3-F-LL --- Filter F-01 clogged*	4-F-LL					20 -	28
28	4	4-F-LL	4-F-L	4-F-LLL	PDAH04				27	29
29	4	4-F-LLL	4-F-LL	4-F-LLLL	PAH22				28	30
30	4	4-F-LLLL	4-F-LLL	6-F-L					29	43
31	4	4-x(VOC)-H	3-x(VOC)-H	6-x(VOC)-H					21	44
32	4	4-x(VOC)-L	3-x(VOC)-L	6-x(VOC)-L					22	45

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
33	5	5-T-H	External deviation (T - H input oxygen)*	High temperature in the line of oxygen input			1		-	TE1
34	5	5-T-L	External deviation (T - L input oxygen)*	Low temperature in the line of oxygen input			2		-	TE2
35	5	5-F-H	External deviation (F - H input oxygen)* --- M.F. FE18* --- M.F. FT18* --- M.F. FIC18* --- M.F. FV18* --- M.F. AT18* --- M.F. AICA18* --- M.F. AE18*	5-F-HH					- - - - - - - -	36
36	5	5-F-HH	5-F-H	6-x(O2)-H					35	46
37	5	5-F-L	External deviation (F - L input oxygen)* --- M.F. FE18* --- M.F. FT18* --- M.F. FIC18* --- M.F. FV18* --- M.F. AT18* --- M.F. AICA18* --- M.F. AE18*	5-F-LL					- - - - - - - -	38
38	5	5-F-LL	5-F-L	6-x(O2)-L					37	47
39	5	5-x(O2)-L	Absence of oxygen*	6-x(O2)-L					-	47

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
40	6	6-T-H	4-T-HH	7-T-H					24	49
41	6	6-T-L	4-T-L	System work correctly				It is not a TOP EVENT because it is not an undesirable event.	25	TE
42	6	6-F-H	4-F-H	7-F-H					26	69
43	6	6-F-L	4-F-LLLL	7-F-L					30	70
44	6	6-x(VOC)-H	4-x(VOC)-H	7-x(VOC)-H					31	71
45	6	6-x(VOC)-L	4-x(VOC)-L	7-x(VOC)-L					32	73
46	6	6-x(O2)-H	5-F-HH	7-x(O2)-H					36	75
47	6	6-x(O2)-L	5-F-LL ---------- 5-x(O2)-L	6-x(O2)-LL					38 39	48
48	6	6-x(O2)-LL	6-x(O2)-L	7-x(O2)-L					47	76
49	7	7-T-H	6-T-H ---------- 7-x(VOC)-HH	7-T-HH					40 72	50
50	7	7-T-HH	7-T-H	7-T-HHH		TSH21			49	51
51	7	7-T-HHH	7-T-HH	7-T-HHHH		TSH10			50	52
52	7	7-T-HHHH	7-T-HHH	7-T-HHHHH	TAH11				51	53
53	7	7-T-HHHHH	7-T-HHHH	7-T-HHHHHH	TAH21				52	54
54	7	7-T-HHHHHH	7-T-HHHHH	7-T-HHHHHHH	TAH10				53	55
55	7	7-T-HHHHHHH	7-T-HHHHHH	7-T-HHHHHHHH		TSHH11			54	56
56	7	7-T-HHHHHHHH	7-T-HHHHHHH	7-T-HHHHHHHHH		TSHH10			55	57
57	7	7-T-HHHHHHHHH	7-T-HHHHHHHH	7-T-HHHHHHHHH	TAHH11				56	58
58	7	7-T-HHHHHHHHHH	7-T-HHHHHHHHH	7-T-HHHHHHHHHH	TAHH10				57	59
59	7	7-T-HHHHHHHHHH	7-T-HHHHHHHHHH	7-T-HHHHHHHHHH & Sintering of the catalyst			 3		58	60 61
60	7	7-T-HHHHHHHHHH	7-T-HHHHHHHHHH	8-T-H					59	78
61	7	Sintering of the catalyst	7-T-HHHHHHHHHH	8-x(VOC)-H					59	82

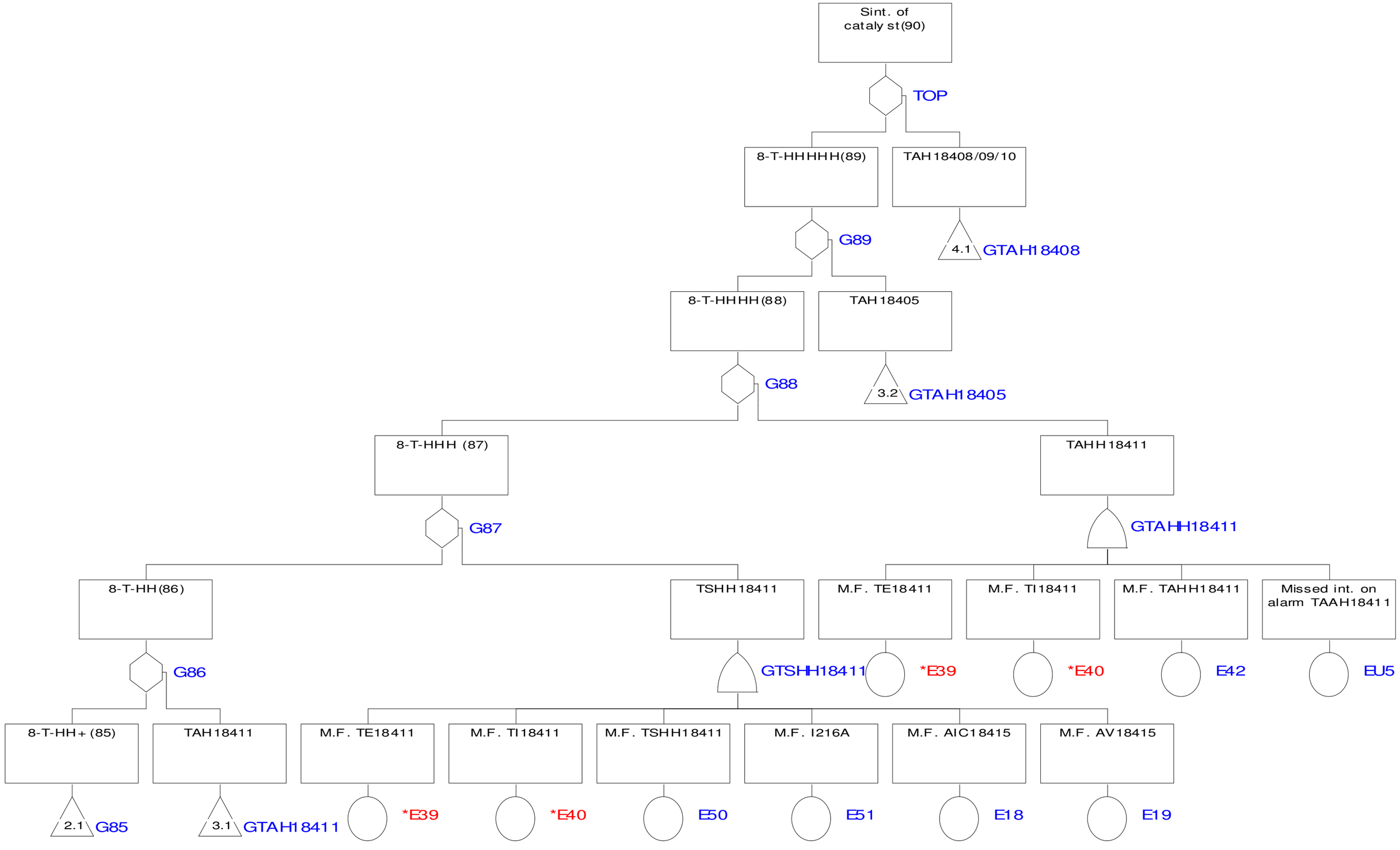
ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
62	7	7-T-L	7-x(VOC)-LL --- 7-x(O2)-LL --- M.F. XV12* --- M.F. XV13* --- M.F. XV14* --- M.F. XV15*	7-T-LL					74 77 - - - -	63
63	7	7-T-LL	7-T-L	7-T-LLL		TSL10			62	64
64	7	7-T-LLL	7-T-LL	7-T-LLLL	TAL10				63	65
65	7	7-T-LLLL	7-T-LLL	7-T-LLLLL	TALL10				64	66
66	7	7-T-LLLLL	7-T-LLLL	7-T-LLLLLL & Reactor is clod					65	68 67
67	7	Reactor is clod	7-T-LLLLL	8-x(VOC)-H					66	82
68	7	7-T-LLLLLL	7-T-LLLLL	8-T-L					66	79
69	7	7-F-H	6-F-H	8-F-H					42	80
70	7	7-F-L	6-F-L	8-F-L					43	81
71	7	7-x(VOC)-H	6-x(VOC)-H	7-x(VOC)-HH					44	72
72	7	7-x(VOC)-HH	7-x(VOC)-H	7-T-H					71	49
73	7	7-x(VOC)-L	6-x(VOC)-L	7-x(VOC)-LL					45	74
74	7	7-x(VOC)-LL	7-x(VOC)-L	7-T-L					73	62
75	7	7-x(O2)-H	6-x(O2)-H	8-x(O2)-H					46	85
76	7	7-x(O2)-L	6-x(O2)-LL	7-x(O2)-LL					48	77
77	7	7-x(O2)-LL	7-x(O2)-L	7-T-L & 8-x(O2)-L					76	62 86

ID	Node	Deviation	Cause	Consequences	Alarm	Protective device	TE	Notes	Previous line	Following line
78	8	8-T-H	7-T-HHHHHHHHHHHH	High temperature in output			4		60	TE4
79	8	8-T-L	7-T-LLLLLL	Low temperature in output			5		68	TE5
80	8	8-F-H	7-F-H	High flow in output			6		69	TE6
81	8	8-F-L	7-F-L	Low flow in output			7		70	TE7
82	8	8-x(VOC)-H	Reactor is clod ---------- Sintering of the catalyst	8-x(VOC)-HH					67 61	83
83	8	8-x(VOC)-HH	8-x(VOC)-H	8-x(VOC)-HHH	AIA19				82	84
84	8	8-x(VOC)-HHH	8-x(VOC)-HH	High VOC concentration in output			8		83	TE8
85	8	8-x(O2)-H	7-x(O2)-H	High oxygen concentration in output	AICA18		9		75	TE9
86	8	8-x(O2)-L	7-x(O2)-LL	Low oxygen concentration in output			10		77	TE10

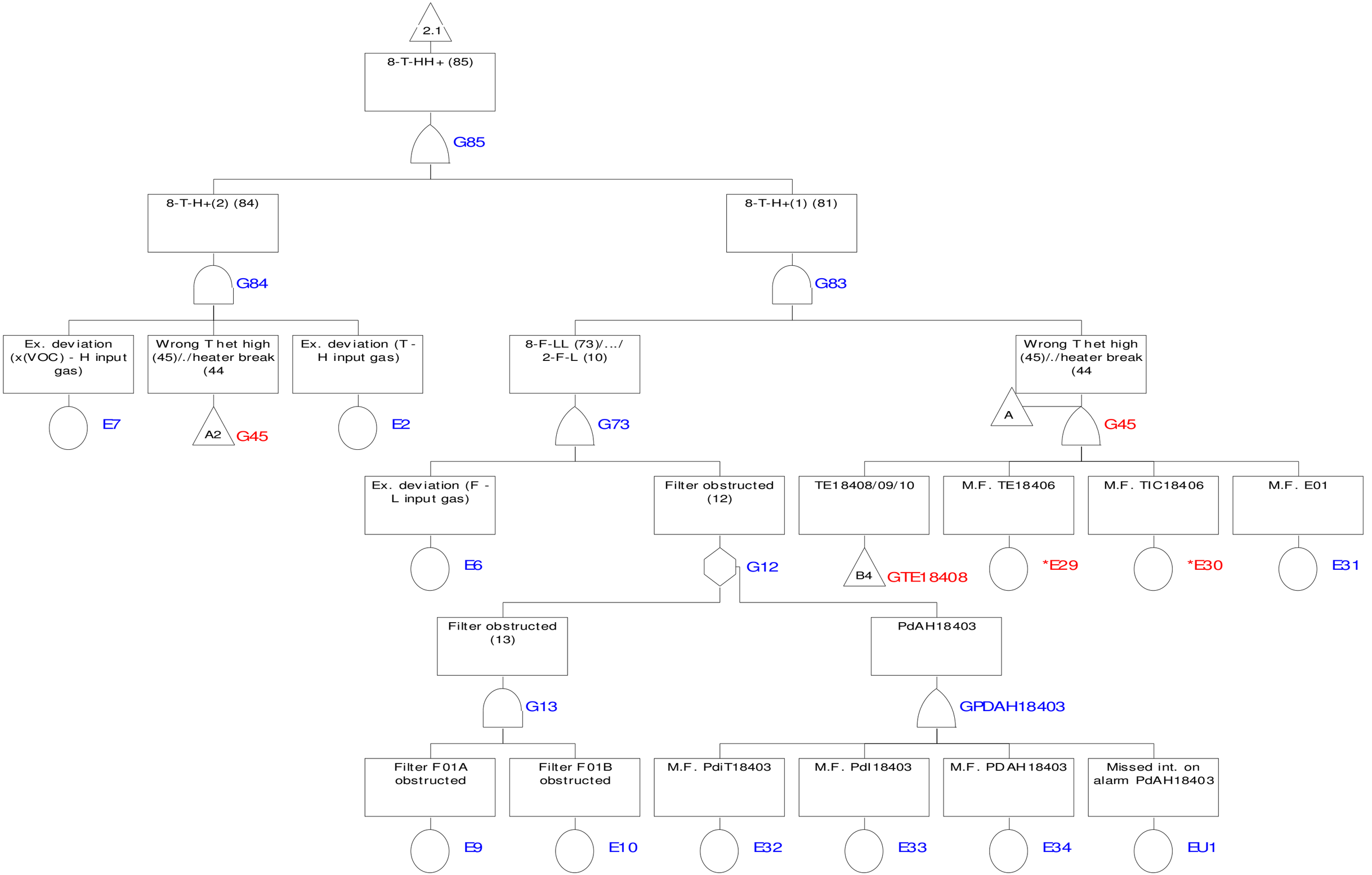
Annex II. Fault tree

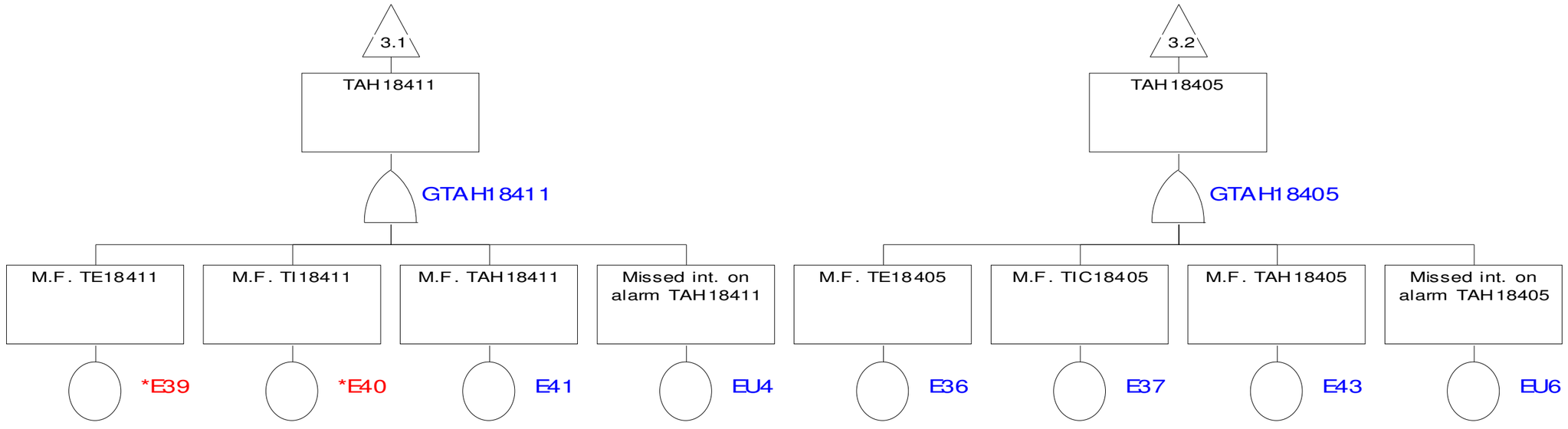
Annex II.A. Fault tree of traditional plant

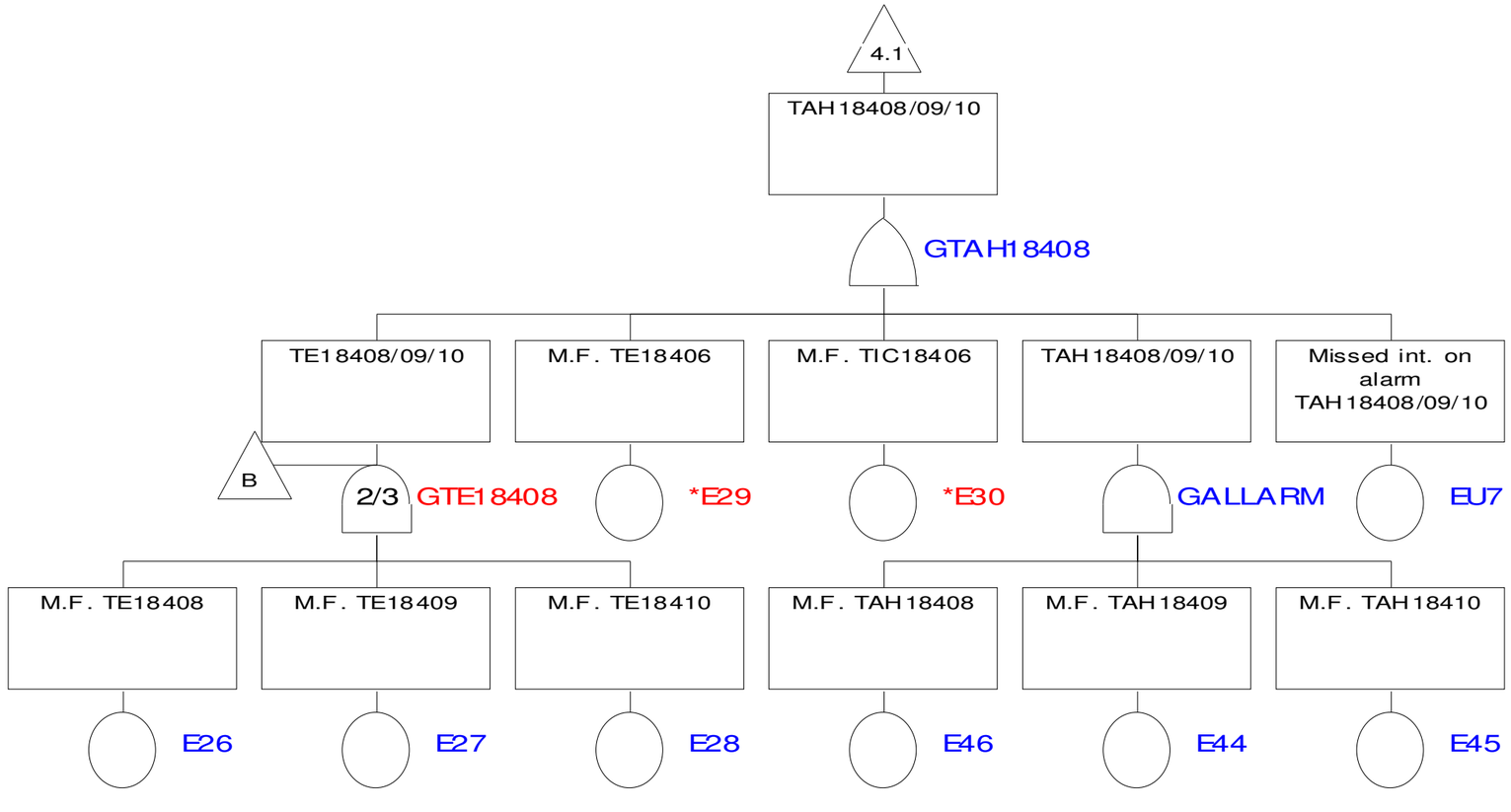
Annex II.A.1.Sintered catalyst



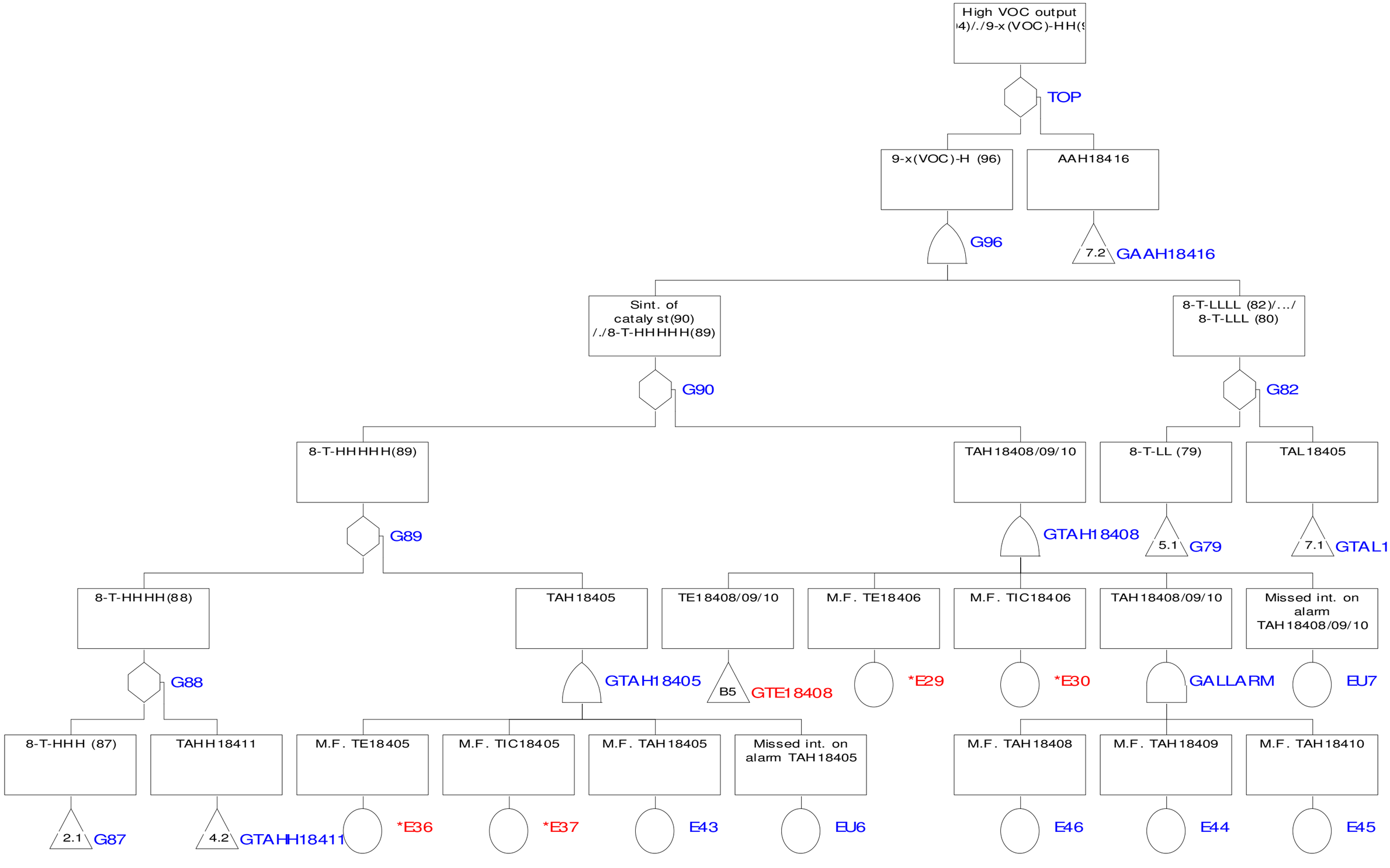
Traditional Catalyst sintered


2.1
8-T-HH+ (85)
G85
8-T-H+(2) (84)
G84
8-T-H+(1) (81)
G83
Ex. deviation (x(VOC) - H input gas)
E7
Wrong T het high (45)/./heater break (44
A2
G45
Ex. deviation (T - H input gas)
E2
8-F-LL (73)/.../ 2-F-L (10)
G73
Wrong T het high (45)/./heater break (44
A
G45
Ex. deviation (F - L input gas)
E6
Filter obstructed (12)
G12
TE18408/09/10
B4
GTE18408
M.F. TE18406
*E29
M.F. TIC18406
*E30
M.F. E01
E31
Filter obstructed (13)
G13
PdAH18403
GPDAH18403
Filter F01A obstructed
E9
Filter F01B obstructed
E10
M.F. PdiT18403
E32
M.F. PdI18403
E33
M.F. PDAH18403
E34
Missed int. on alarm PdAH18403
EU1

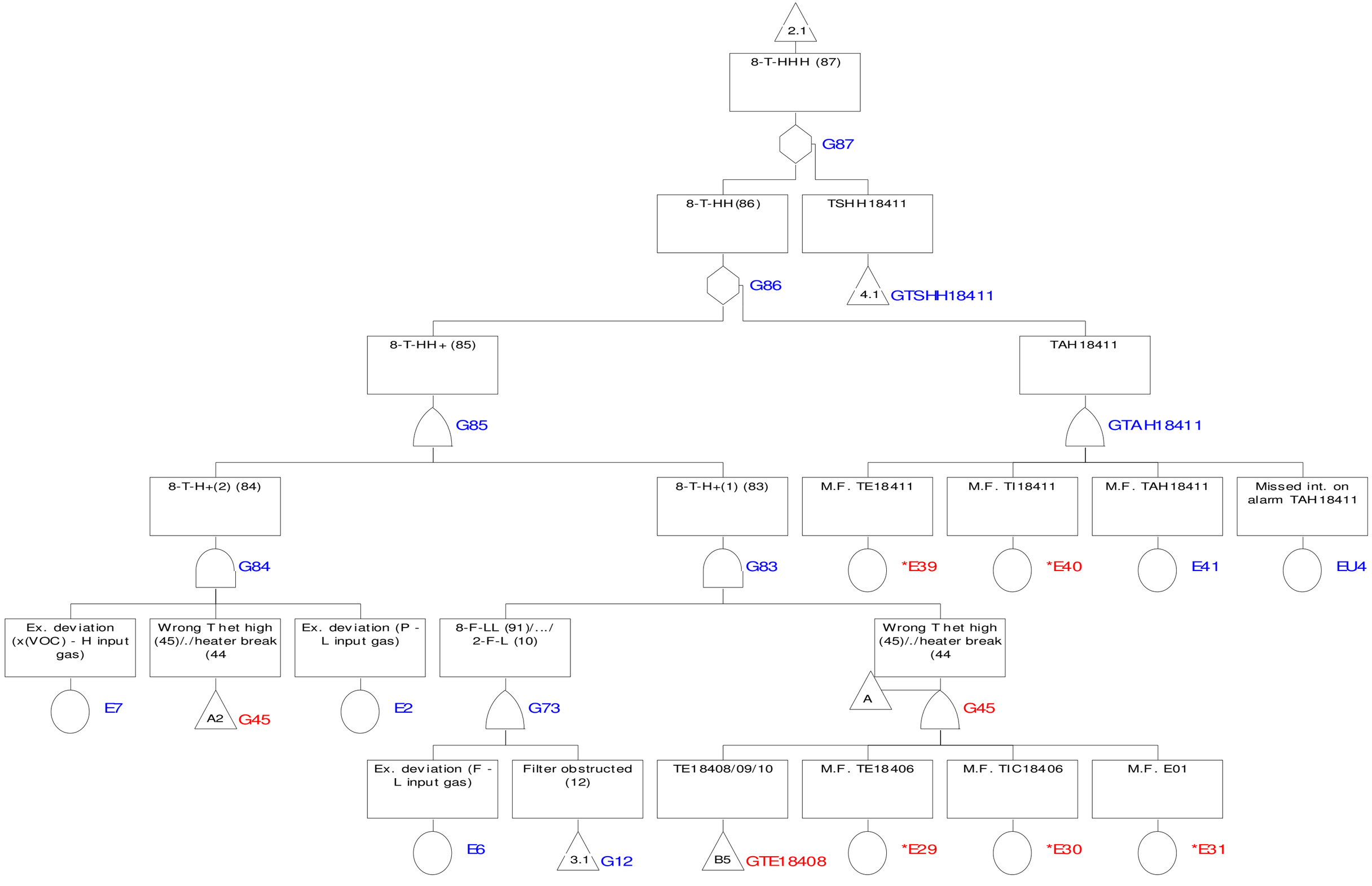

3.1
TAH18411
GTAH18411
M.F. TE18411
M.F. TI18411
M.F. TAH18411
Missed int. on alarm TAH18411
*E39
*E40
E41
EU4
3.2
TAH18405
GTAH18405
M.F. TE18405
M.F. TIC18405
M.F. TAH18405
Missed int. on alarm TAH18405
E36
E37
E43
EU6

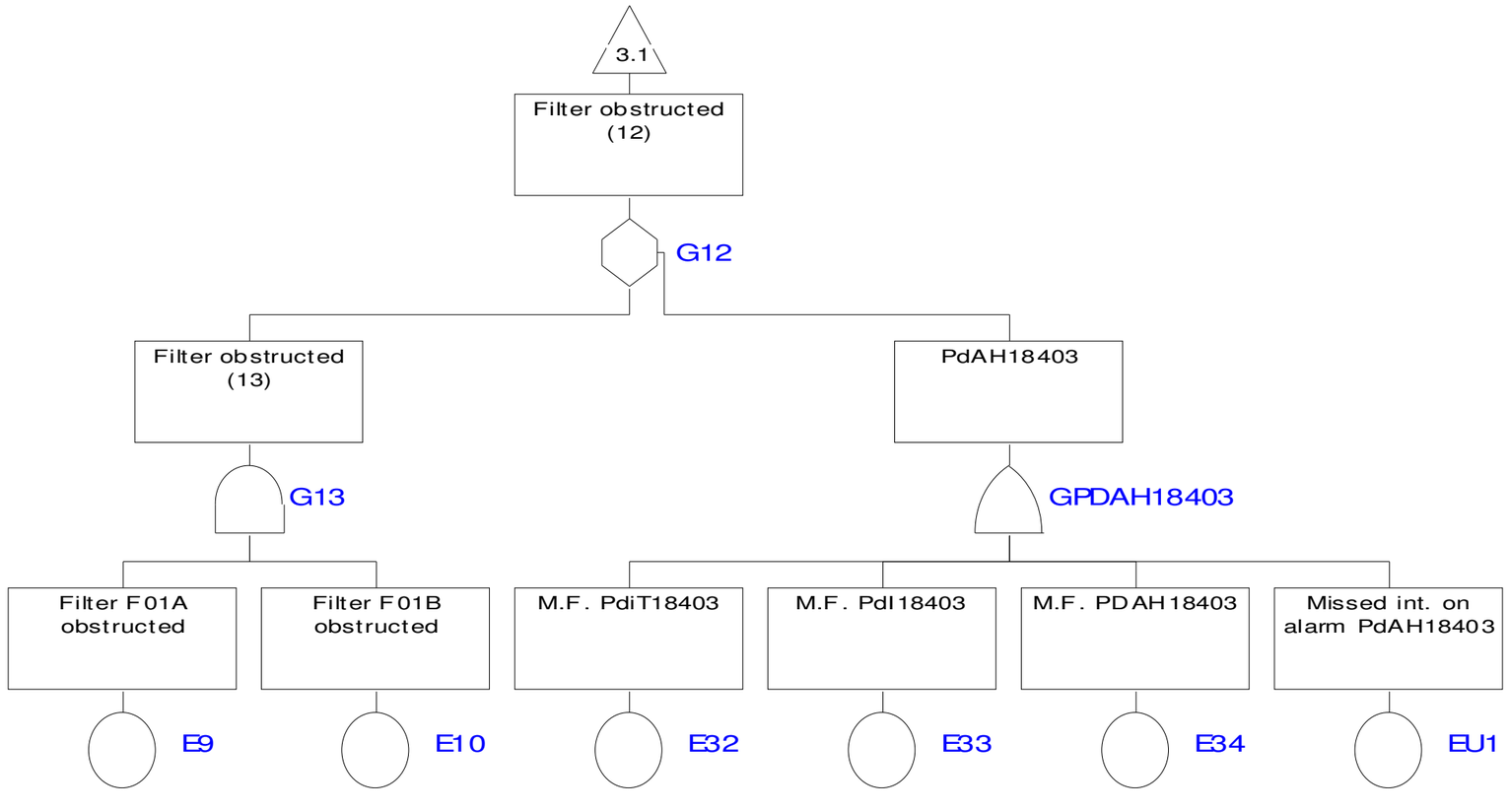

4.1
TAH18408/09/10
GTAH18408
TE18408/09/10
M.F. TE18406
M.F. TIC18406
TAH18408/09/10
Missed int. on alarm TAH18408/09/10
B
2/3
GTE18408
*E29
*E30
GALLARM
EU7
M.F. TE18408
M.F. TE18409
M.F. TE18410
M.F. TAH18408
M.F. TAH18409
M.F. TAH18410
E26
E27
E28
E46
E44
E45

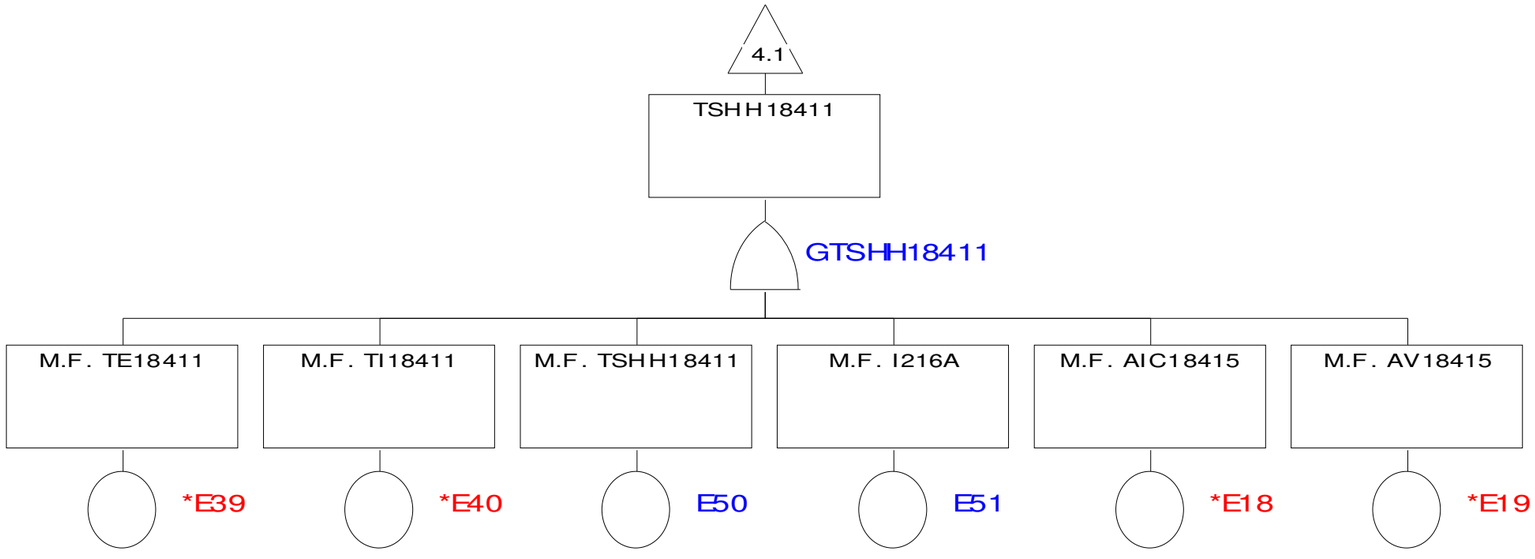
Annex II.A.2. Discharge of excess of VOCs

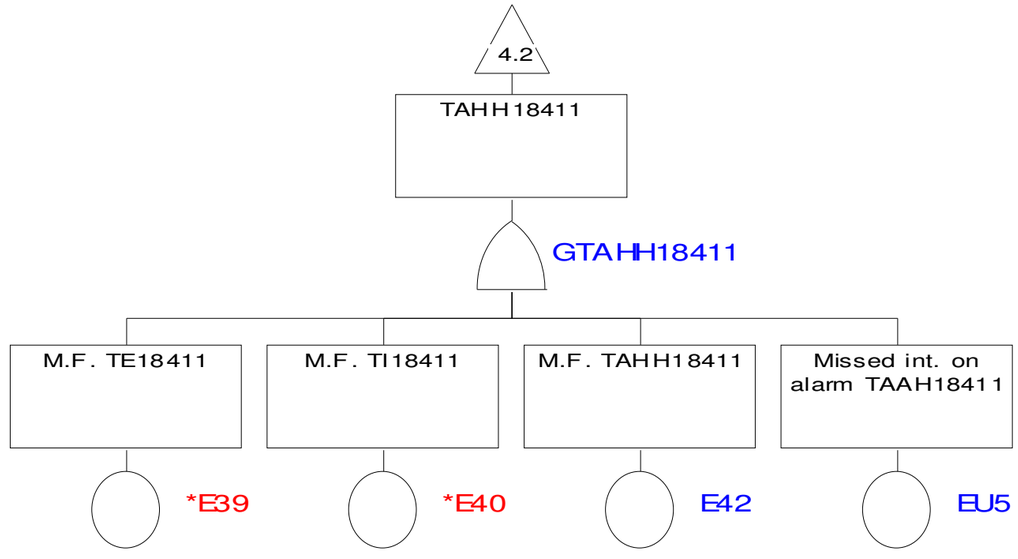


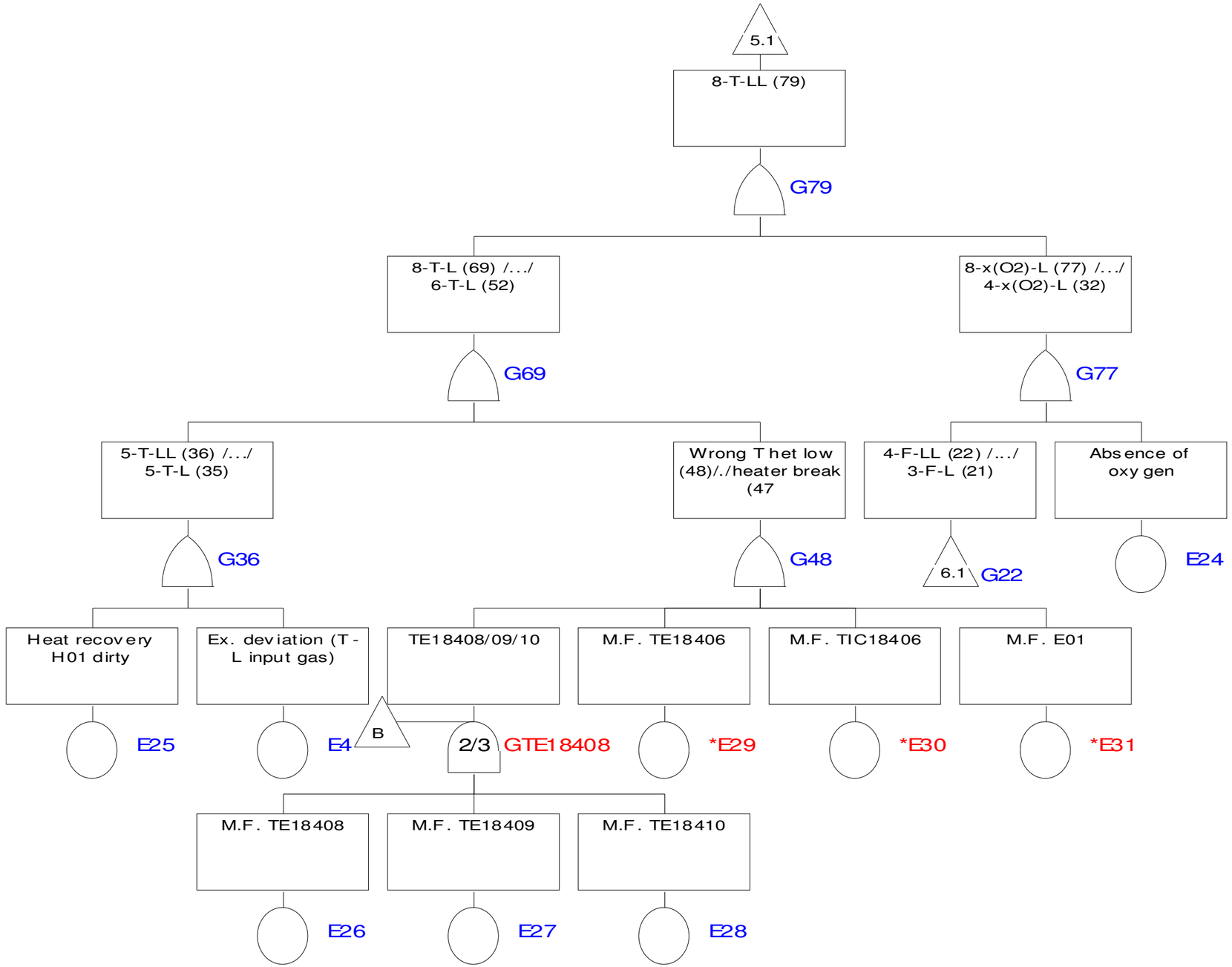
Traditional Discharge excess of VOCs

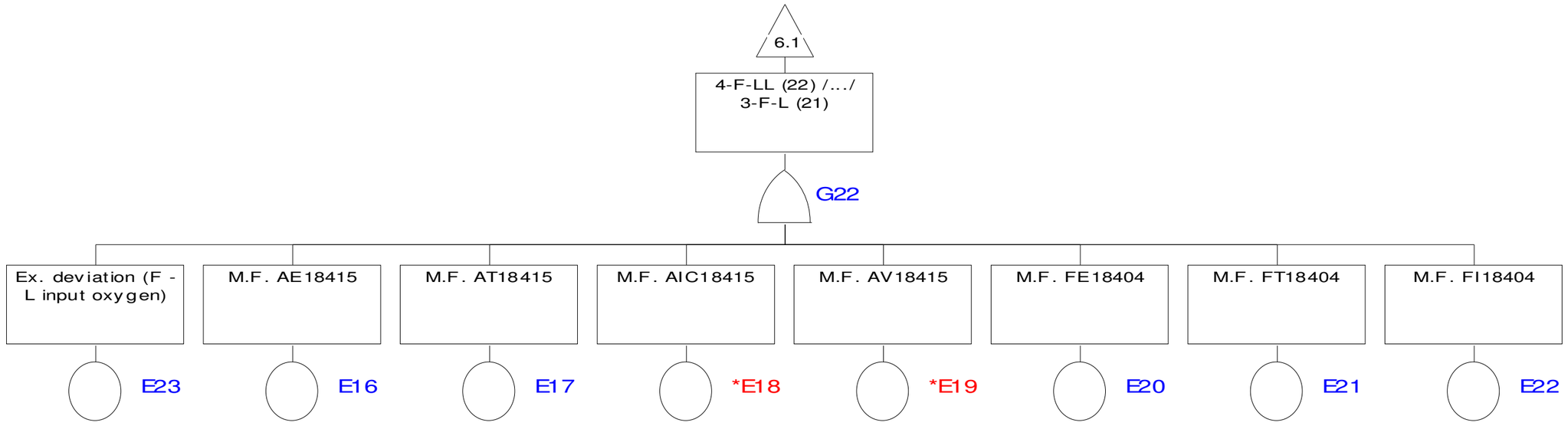

2.1
8-T-HHH (87)
G87
8-T-HH (86)
TSHH18411
G86
4.1
GTSHH18411
8-T-HH+ (85)
TAH18411
G85
GTAH18411
8-T-H+(2) (84)
8-T-H+(1) (83)
M.F. TE18411
M.F. TI18411
M.F. TAH18411
Missed int. on alarm TAH18411
G84
G83
*E39
*E40
E41
EU4
Ex. deviation (x(VOC) - H input gas)
Wrong T het high (45)/./heater break (44
Ex. deviation (P - L input gas)
8-F-LL (91)/.../ 2-F-L (10)
Wrong T het high (45)/./heater break (44
E7
A2
G45
E2
G73
A
G45
Ex. deviation (F - L input gas)
Filter obstructed (12)
TE18408/09/10
M.F. TE18406
M.F. TIC18406
M.F. E01
E6
3.1
G12
B5
GTE18408
*E29
*E30
*E31

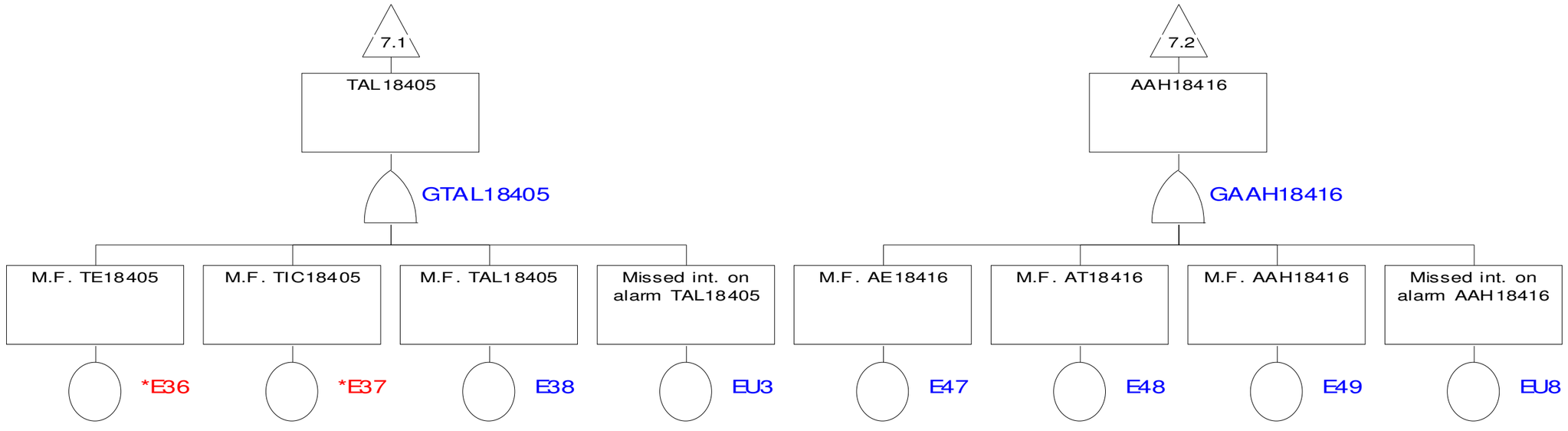

3.1
Filter obstructed (12)
G12
Filter obstructed (13)
PdAH18403
G13
GPDAH18403
Filter F01A obstructed
Filter F01B obstructed
M.F. PdiT18403
M.F. PdI18403
M.F. PDAH18403
Missed int. on alarm PdAH18403
E9
E10
E32
E33
E34
EU1


4.1
TSHH18411
GTSHH18411
M.F. TE18411
M.F. TI18411
M.F. TSHH18411
M.F. I216A
M.F. AIC18415
M.F. AV18415
*E39
*E40
E50
E51
*E18
*E19


4.2
TAHH18411
GTAHH18411
M.F. TE18411
M.F. TI18411
M.F. TAHH18411
Missed int. on alarm TAAH18411
*E39
*E40
E42
EU5


5.1
8-T-LL (79)
G79
8-T-L (69) /.../
6-T-L (52)
8-x(O2)-L (77) /.../
4-x(O2)-L (32)
G69
G77
5-T-LL (36) /.../
5-T-L (35)
Wrong T het low
(48)/./heater break
(47
4-F-LL (22) /.../
3-F-L (21)
Abs ence of
oxy gen
G36
G48
6.1
G22
E24
Heat recovery
H01 dirty
Ex. deviation (T -
L input gas)
TE18408/09/10
M.F. TE18406
M.F. TIC18406
M.F. E01
E25
E4
B
2/3
GTE18408
*E29
*E30
*E31
M.F. TE18408
M.F. TE18409
M.F. TE18410
E26
E27
E28


6.1
4-F-LL (22) /.../
3-F-L (21)
G22
Ex. deviation (F - L input oxygen)
M.F. AE18415
M.F. AT18415
M.F. AIC18415
M.F. AV18415
M.F. FE18404
M.F. FT18404
M.F. FI18404
E23
E16
E17
*E18
*E19
E20
E21
E22


7.1
TAL18405
GTAL18405
M.F. TE18405
M.F. TIC18405
M.F. TAL18405
Missed int. on alarm TAL18405
*E36
*E37
E38
EU3
7.2
AAH18416
GAAH18416
M.F. AE18416
M.F. AT18416
M.F. AAH18416
Missed int. on alarm AAH18416
E47
E48
E49
EU8

Annex II.B. Fault tree of traditional plant before phenomenological model

Annex II.B.1. Sintered catalyst

Sint. of cataly st(90) /./8-T-HHHH(88)

TOP

8-T-HHH (87)

TAHH18411

G87

GTAHH18411

8-T-HH(86)

TSHH18411

M.F. TE18411

M.F. TI18411

M.F. TAHH18411

Missed int. on alarm TAAH18411

G86

4.1 GTSHH18411

*E39

*E40

E42

EU5

8-T-HH+ (85)

TAH18411

G85

GTAH18411

8-T-H+(2) (84)

8-T-H+(1) (83)

M.F. TE18411

M.F. TI18411

M.F. TAH18411

Missed int. on alarm TAH18411

G84

G83

*E39

*E40

E41

EU4

Ex. deviation (x(VOC) - H input gas)

Wrong T het high high

6-T-HH

8-F-LL (73)/.../ 2-F-L (10)

Wrong T het high high

E7

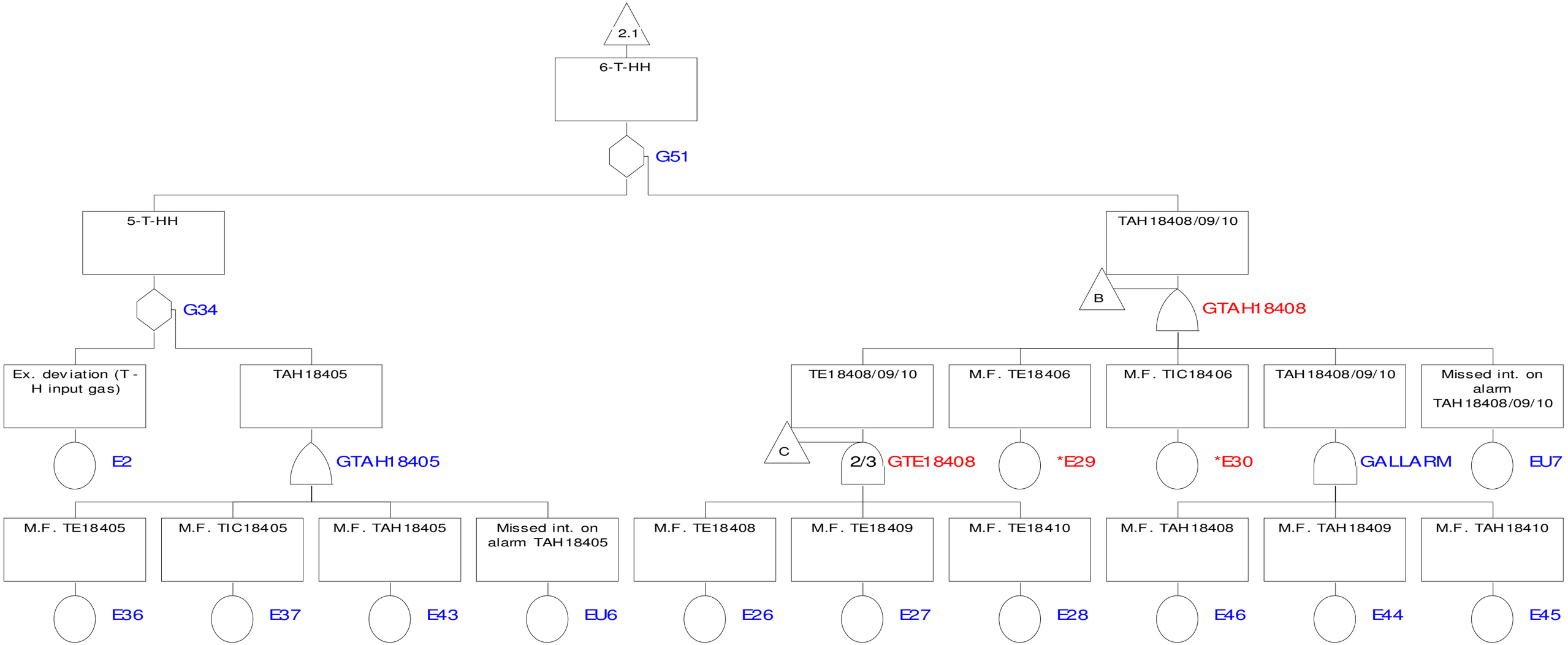
A1 G45

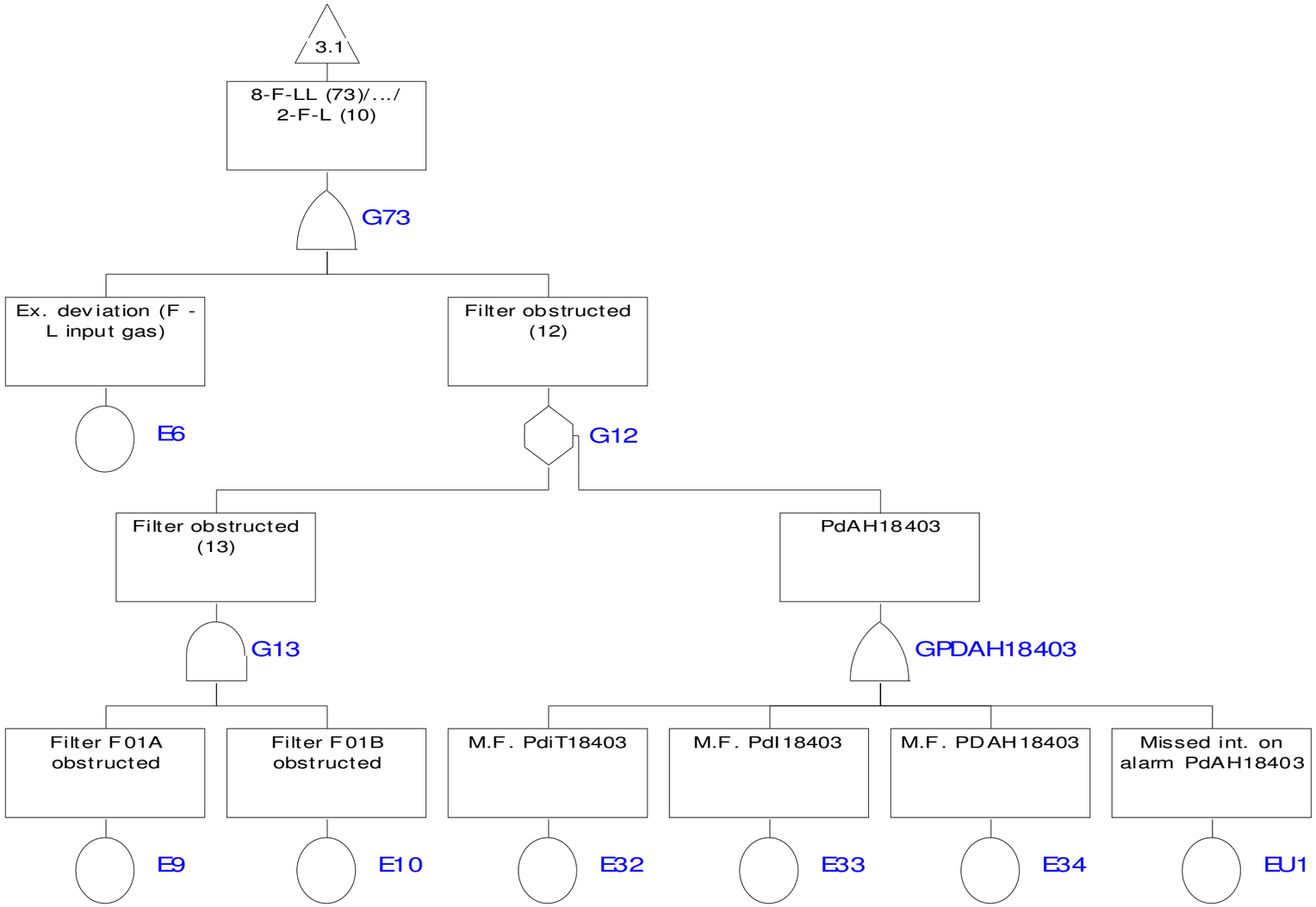
2.1 G51

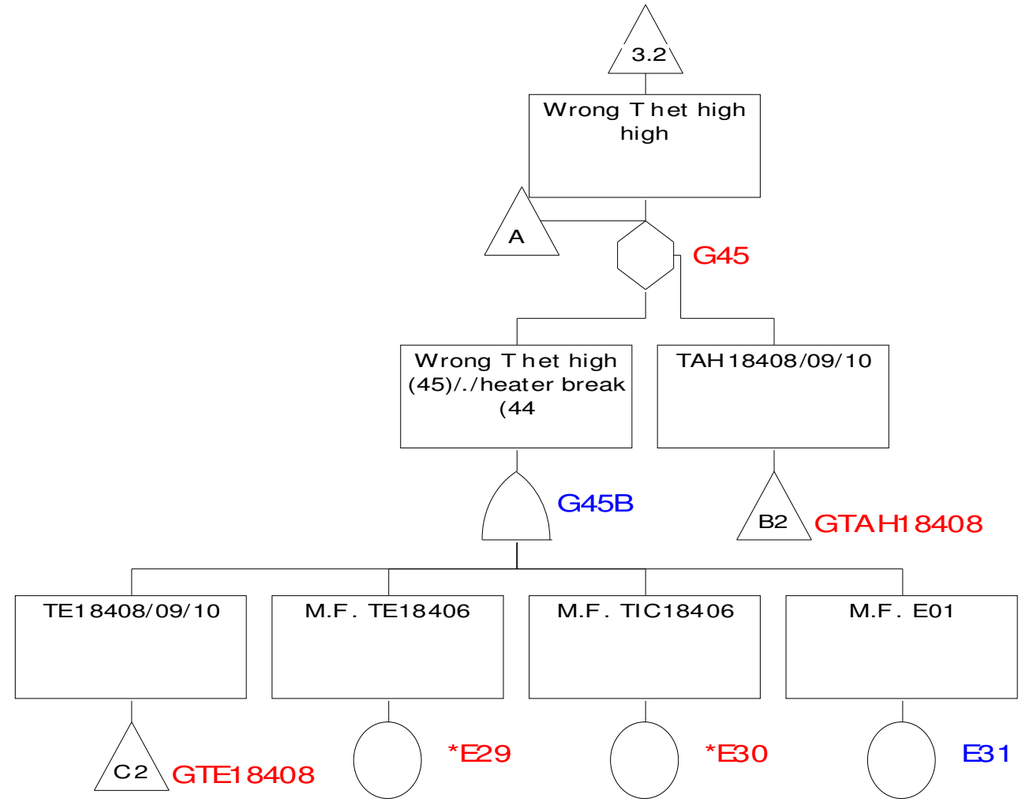
3.1 G73

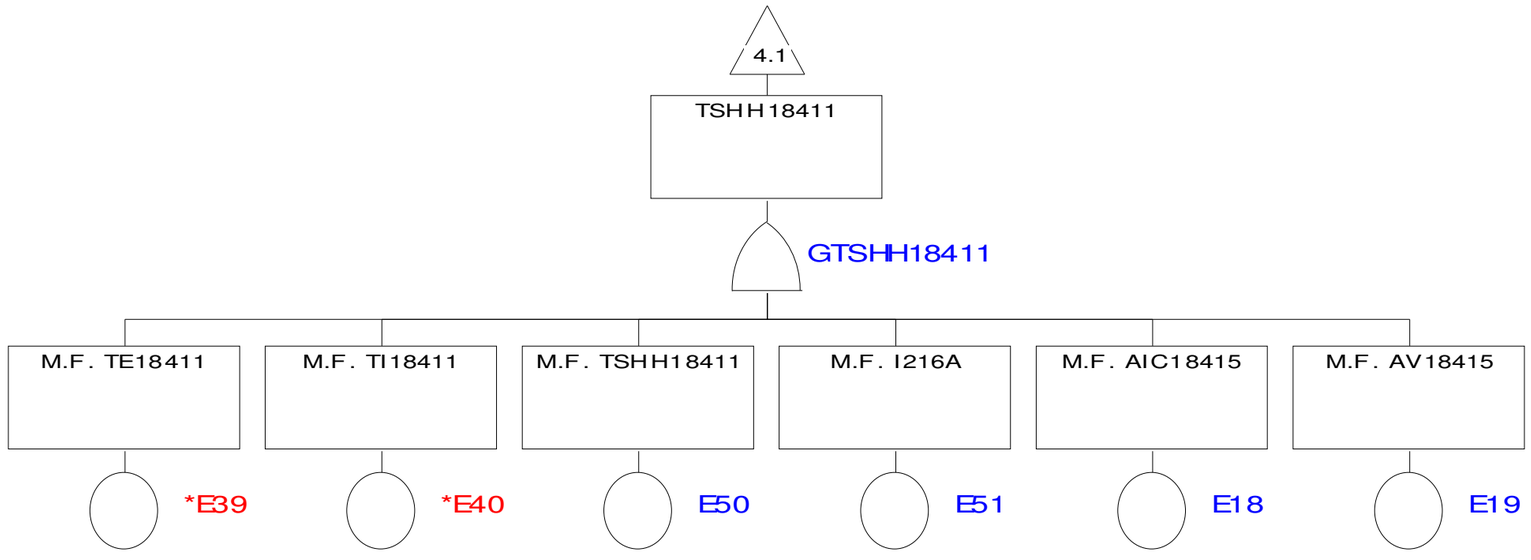
3.2 G45

Traditional Catalyst sintered before phenomenological model

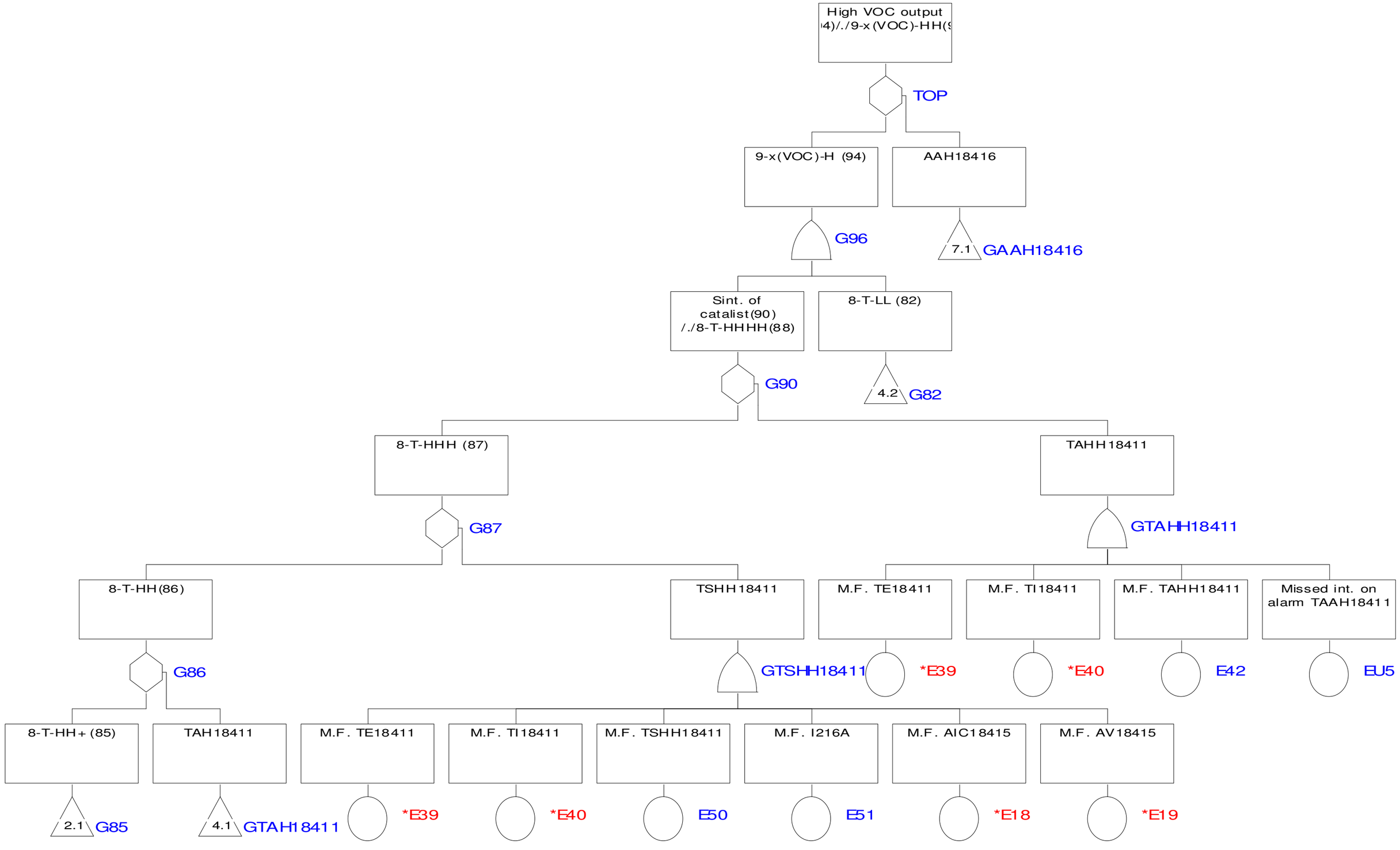

2.1
6-T-HH
G51
5-T-HH
G34
Ex. deviation (T-H input gas)
E2
TAH18405
GTAH18405
M.F. TE18405
E36
M.F. TIC18405
E37
M.F. TAH18405
E43
Missed int. on alarm TAH18405
EU6
TAH18408/09/10
B
GTAH18408
TE18408/09/10
C
2/3 GTE18408
M.F. TE18408
E26
M.F. TE18409
E27
M.F. TE18410
E28
M.F. TE18406
*E29
M.F. TIC18406
*E30
TAH18408/09/10
GALLARM
M.F. TAH18408
E46
M.F. TAH18409
E44
Missed int. on alarm TAH18408/09/10
EU7
M.F. TAH18410
E45


3.1
8-F-LL (73)/.../
2-F-L (10)
G73
Ex. deviation (F -
L input gas)
Filter obstructed
(12)
E6
G12
Filter obstructed
(13)
PdAH18403
G13
GPDAH18403
Filter F01A
obstructed
Filter F01B
obstructed
M.F. PdiT18403
M.F. PdI18403
M.F. PDAH18403
Missed int. on
alarm PdAH18403
E9
E10
E32
E33
E34
EU1

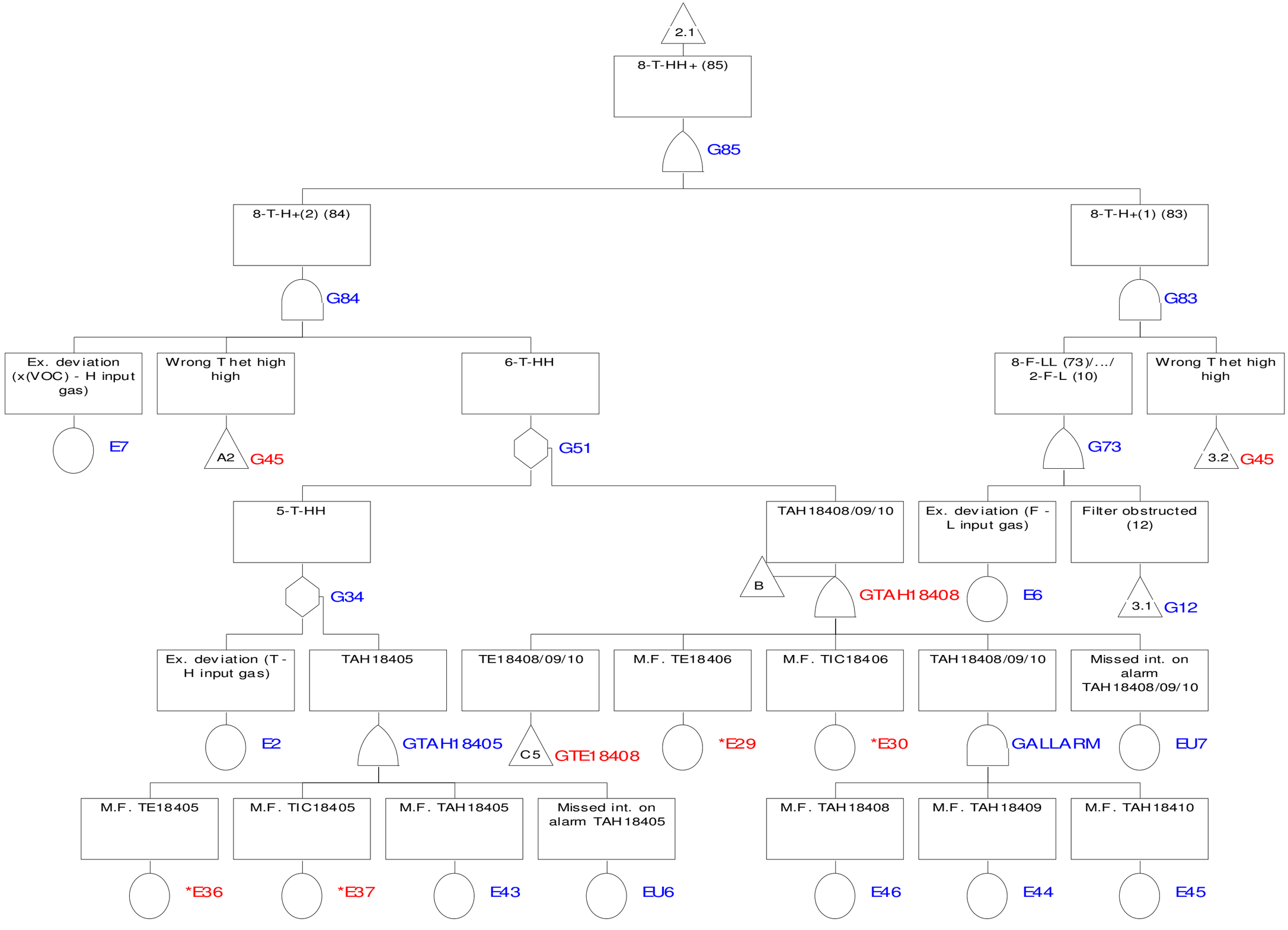

3.2
Wrong T het high
high
A
G45
Wrong T het high
(45)/./heater break
(44
TAH18408/09/10
G45B
B2
GTAH18408
TE18408/09/10
M.F. TE18406
M.F. TIC18406
M.F. E01
C2
GTE18408
*E29
*E30
E31


4.1
TSHH18411
GTSHH18411
M.F. TE18411
M.F. TI18411
M.F. TSHH18411
M.F. I216A
M.F. AIC18415
M.F. AV18415
*E39
*E40
E50
E51
E18
E19

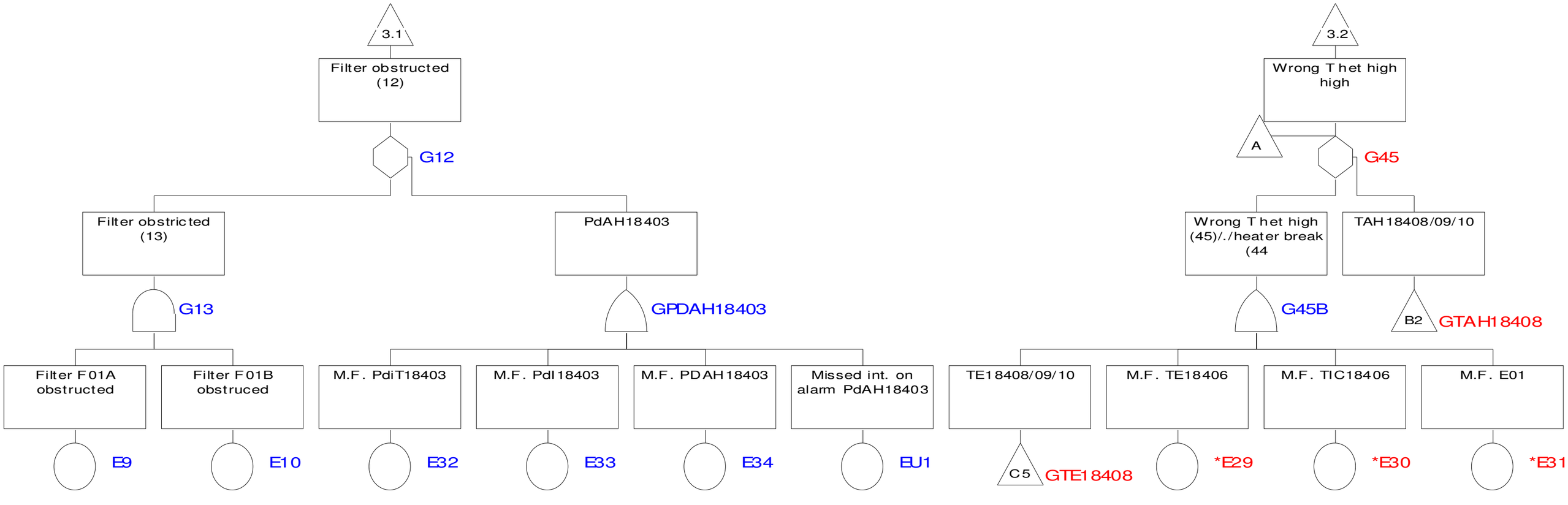
Annex II.B.2. Discharge of excess of VOCs

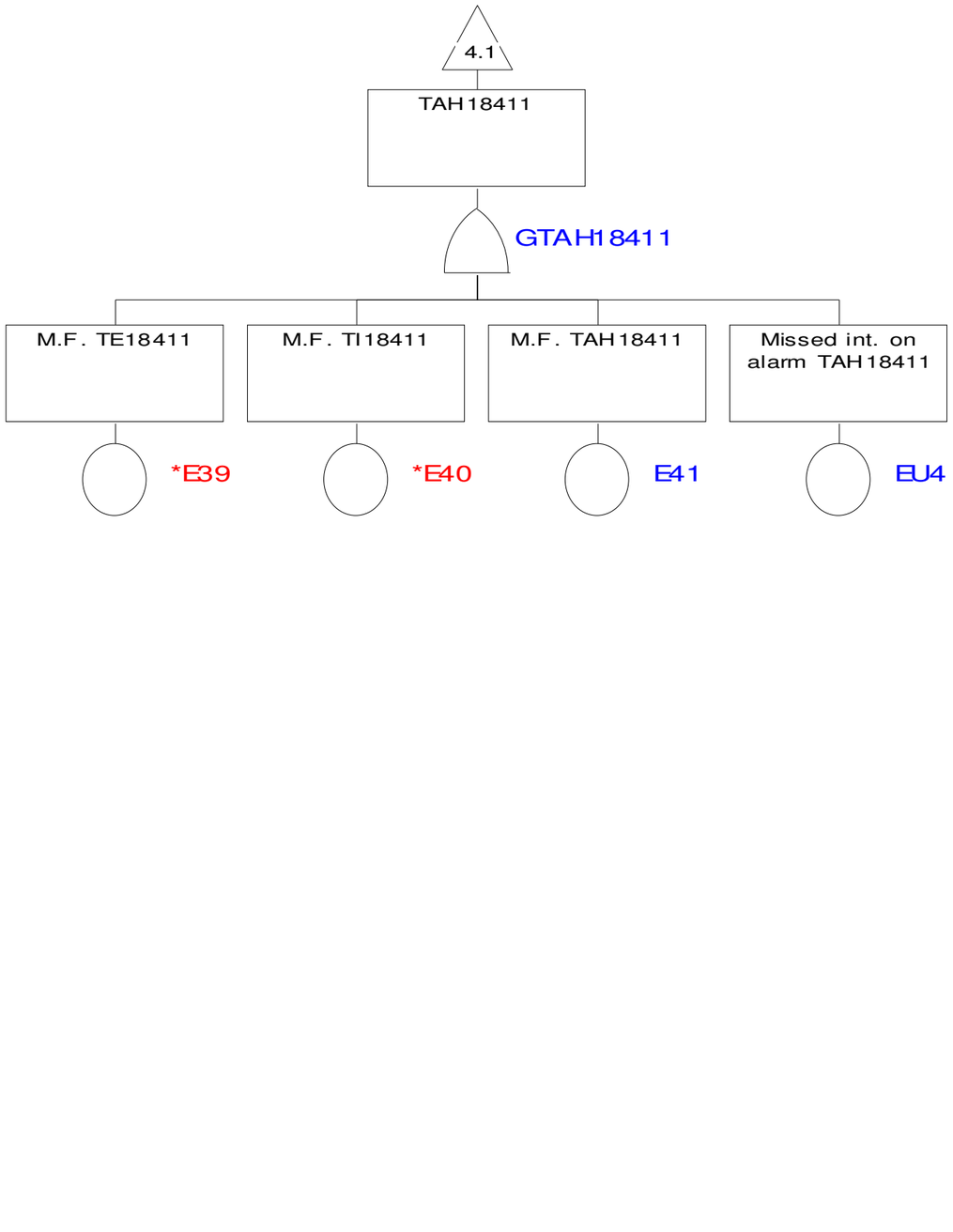


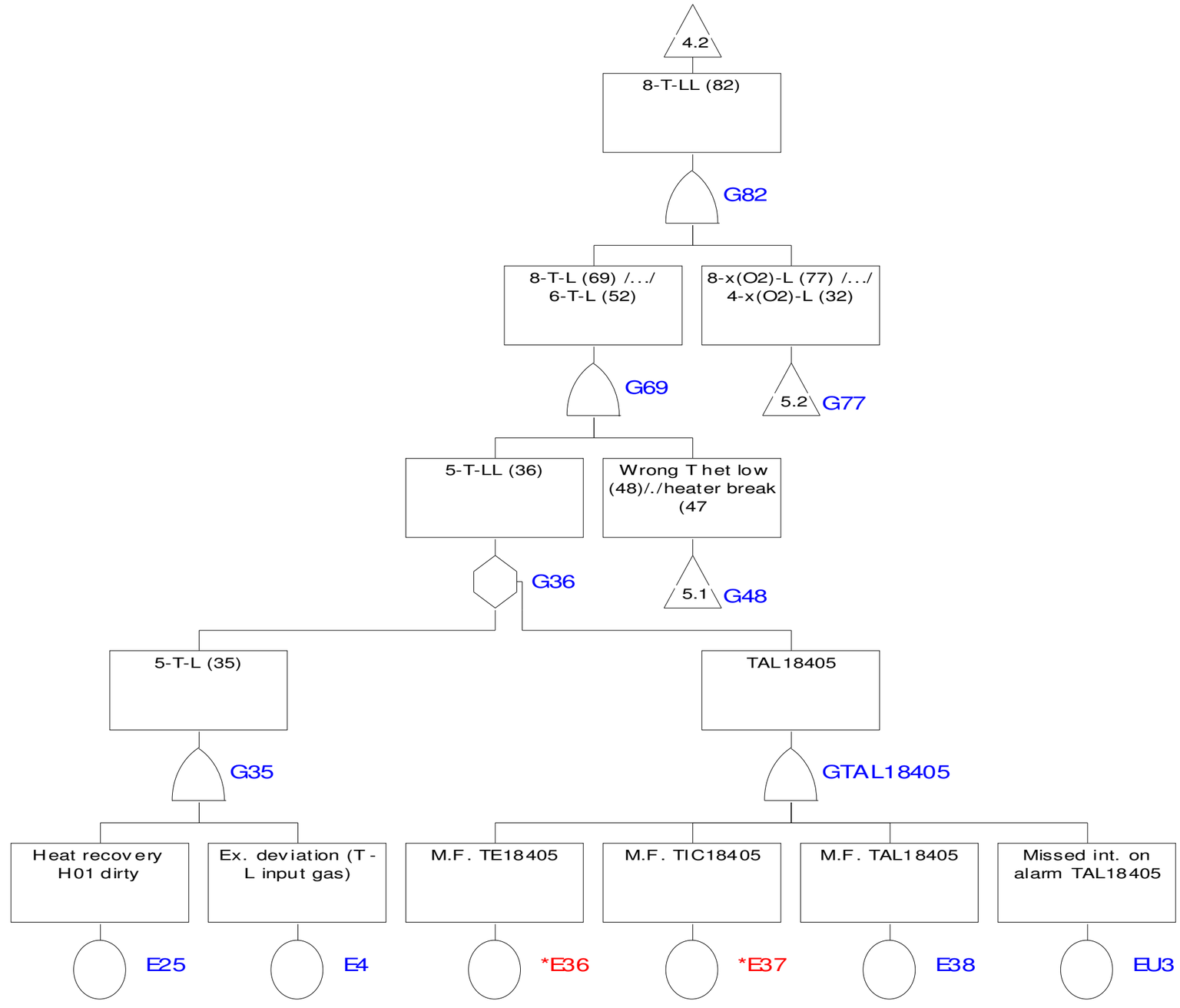
Traditional Discharge excess of VOCs before phenomenological model

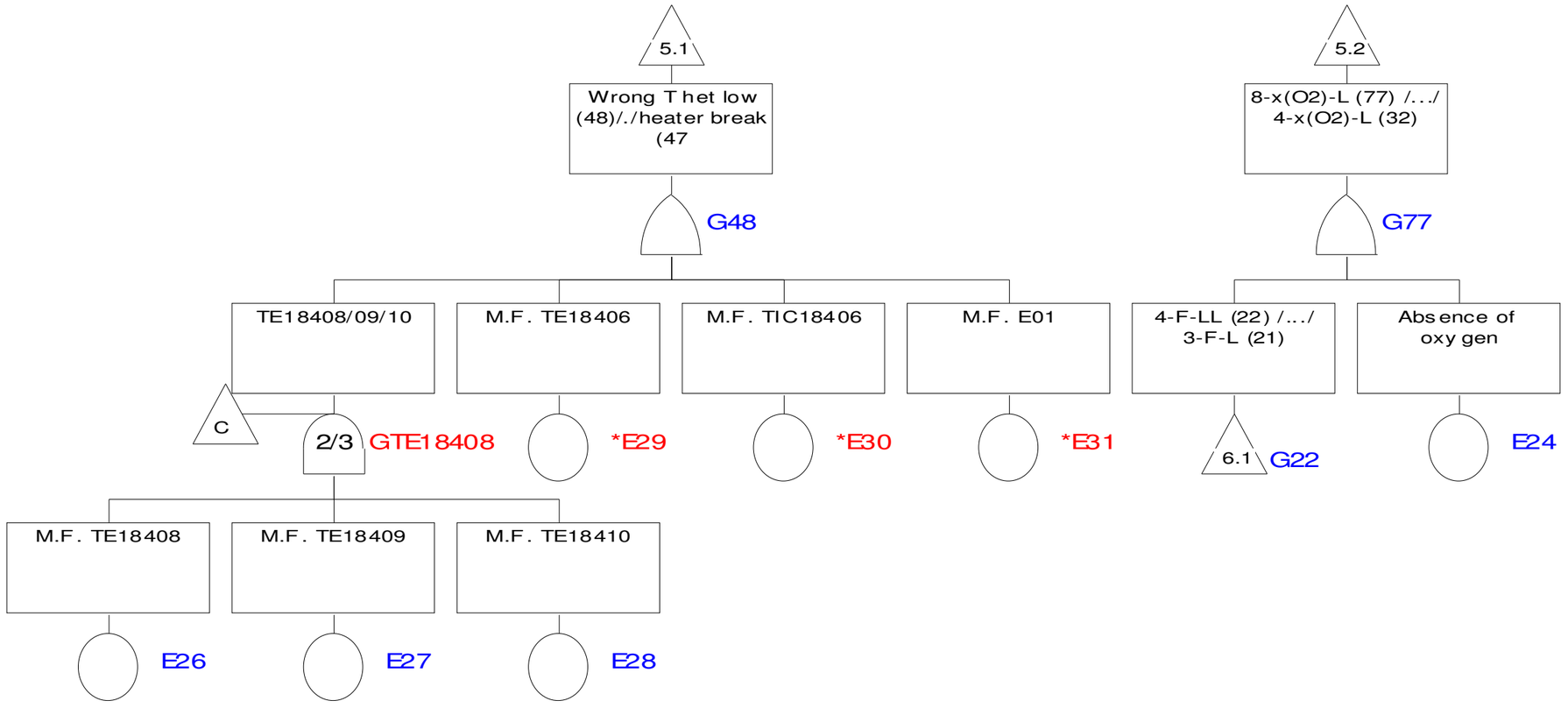


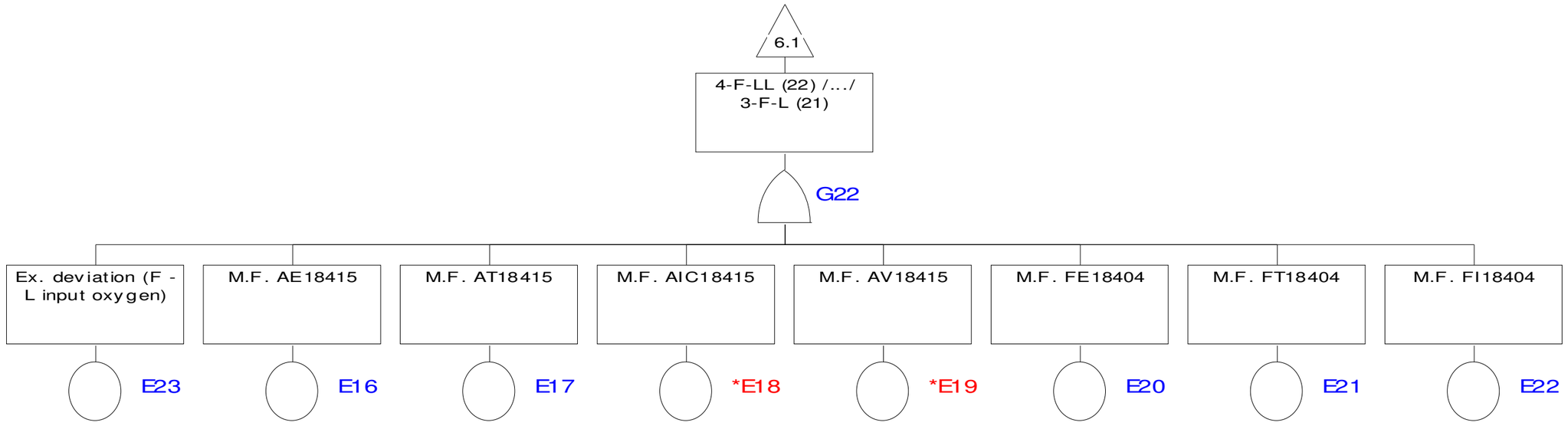
Traditional Discharge excess of VOCs before phenomenological model

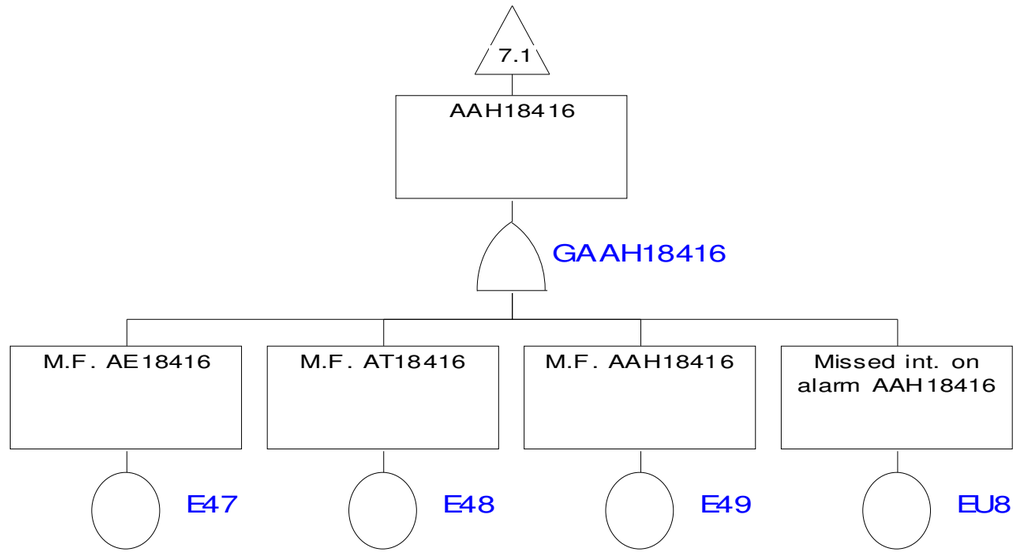

3.1
Filter obstructed (12)
G12
Filter obstricted (13)
PdAH18403
G13
GPDAH18403
Filter F01A obstructed
Filter F01B obstruced
M.F. PdiT18403
M.F. PdI18403
M.F. PDAH18403
Missed int. on alarm PdAH18403
E9
E10
E32
E33
E34
EU1
3.2
Wrong T het high high
A
G45
Wrong T het high (45)/./heater break (44
TAH18408/09/10
G45B
B2
GTAH18408
TE18408/09/10
M.F. TE18406
M.F. TIC18406
M.F. E01
C5
GTE18408
*E29
*E30
*E31


4.1
TAH18411
GTAH18411
M.F. TE18411
M.F. TI18411
M.F. TAH18411
Missed int. on alarm TAH18411
*E39
*E40
E41
EU4


4.2
8-T-LL (82)
G82
8-T-L (69) /.../ 6-T-L (52)
8-x(O2)-L (77) /.../ 4-x(O2)-L (32)
G69
5.2
G77
5-T-LL (36)
Wrong T het low (48)/./heater break (47
G36
5.1
G48
5-T-L (35)
TAL18405
G35
GTAL18405
Heat recovery H01 dirty
Ex. deviation (T-L input gas)
M.F. TE18405
M.F. TIC18405
M.F. TAL18405
Missed int. on alarm TAL18405
E25
E4
*E36
*E37
E38
EU3

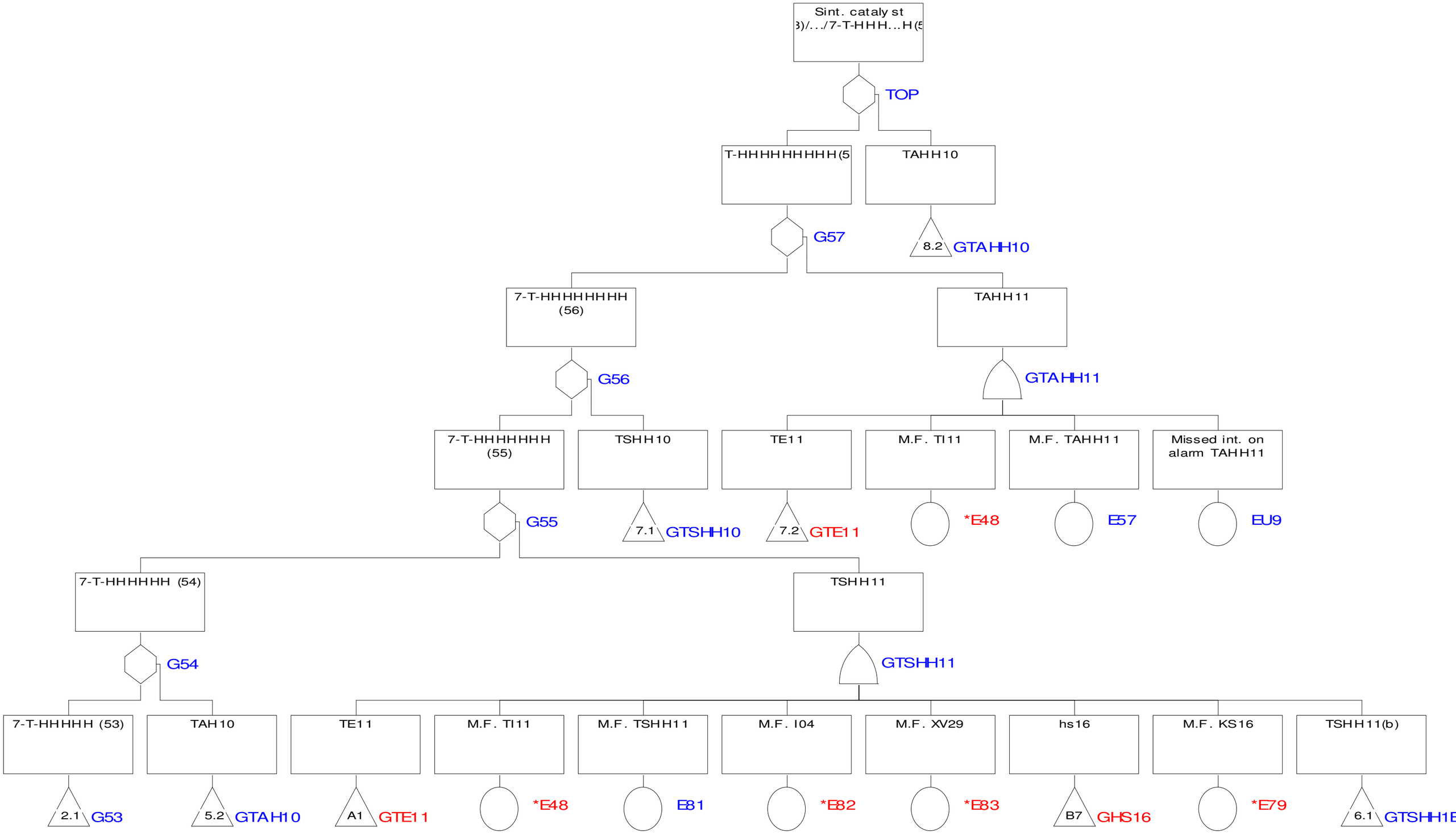

5.1
Wrong T het low (48)/./heater break (47
G48
TE18408/09/10
M.F. TE18406
M.F. TIC18406
M.F. E01
C
2/3
GTE18408
*E29
*E30
*E31
M.F. TE18408
M.F. TE18409
M.F. TE18410
E26
E27
E28
5.2
8-x(O2)-L (77) /.../ 4-x(O2)-L (32)
G77
4-F-LL (22) /.../ 3-F-L (21)
Absence of oxygen
6.1
G22
E24


6.1
4-F-LL (22) /.../
3-F-L (21)
G22
Ex. deviation (F - L input oxygen)
M.F. AE18415
M.F. AT18415
M.F. AIC18415
M.F. AV18415
M.F. FE18404
M.F. FT18404
M.F. FI18404
E23
E16
E17
*E18
*E19
E20
E21
E22

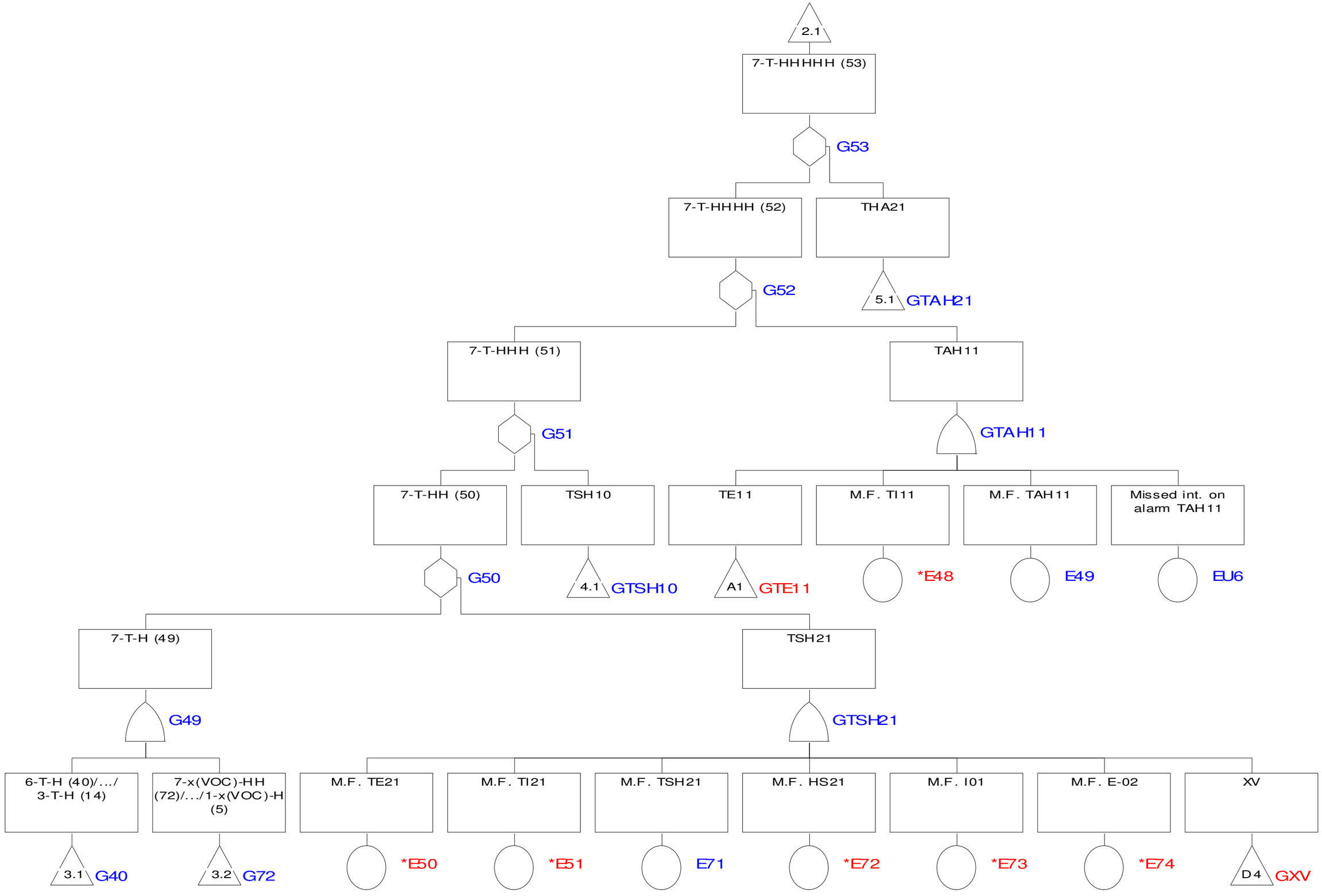

7.1
AAH18416
GAAH18416
M.F. AE18416
M.F. AT18416
M.F. AAH18416
Missed int. on alarm AAH18416
E47
E48
E49
EU8

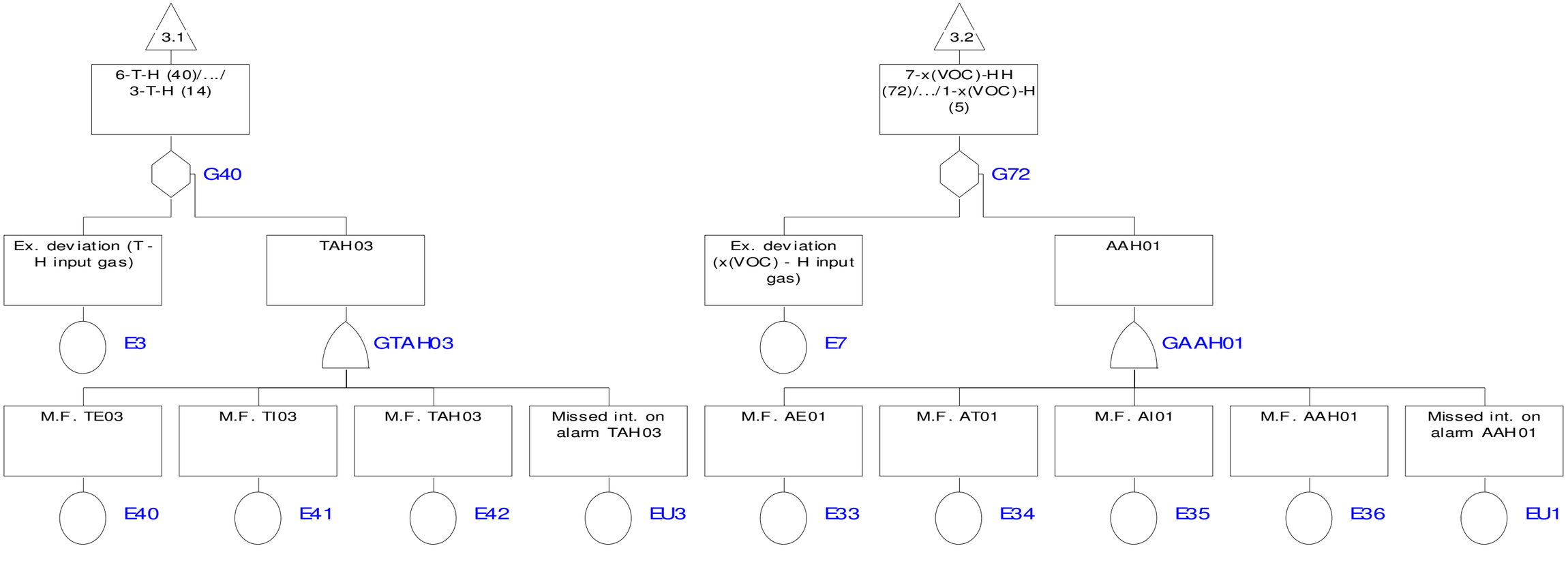
Annex II.C. Fault tree of intensified plant

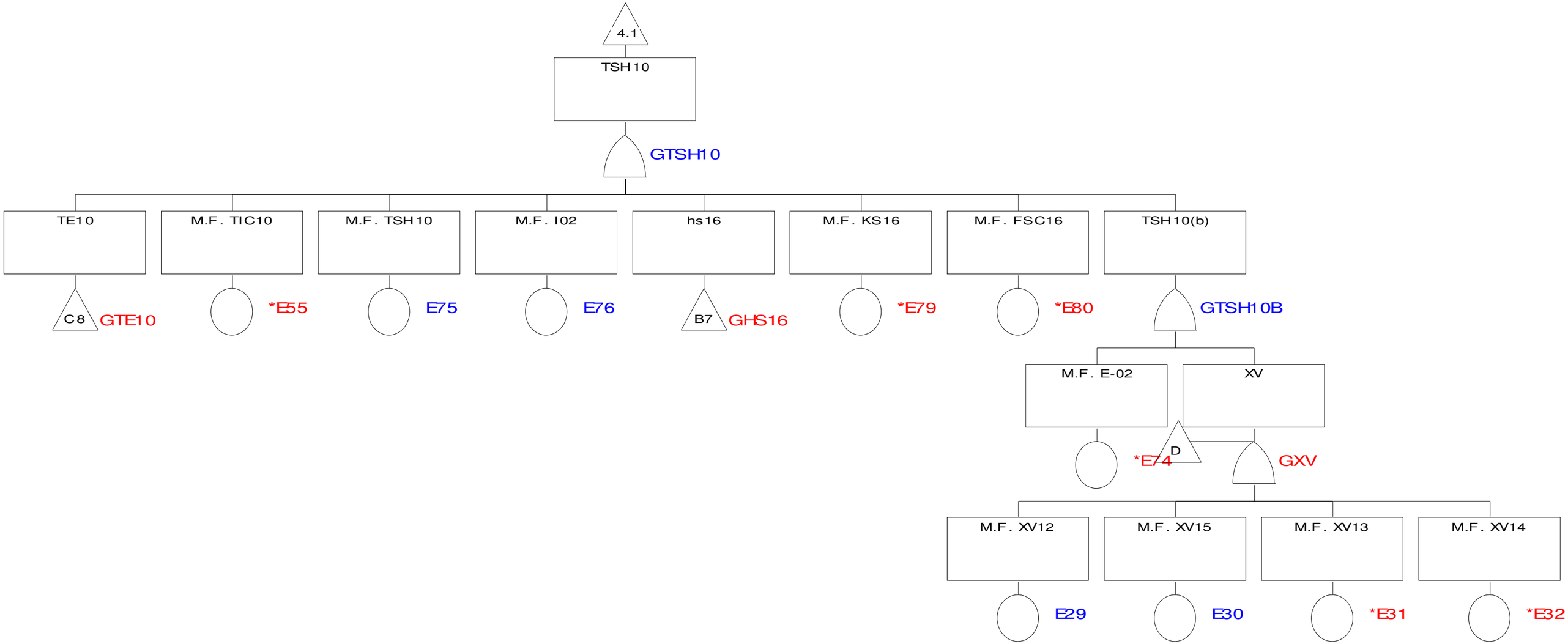
Annex II.C.1.Sintered catalyst

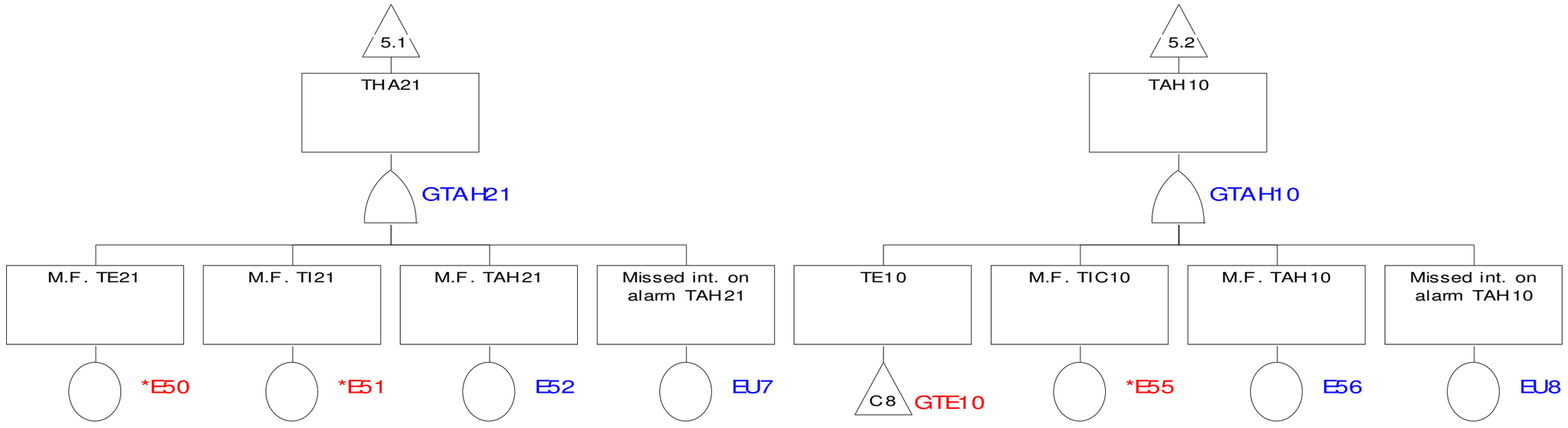


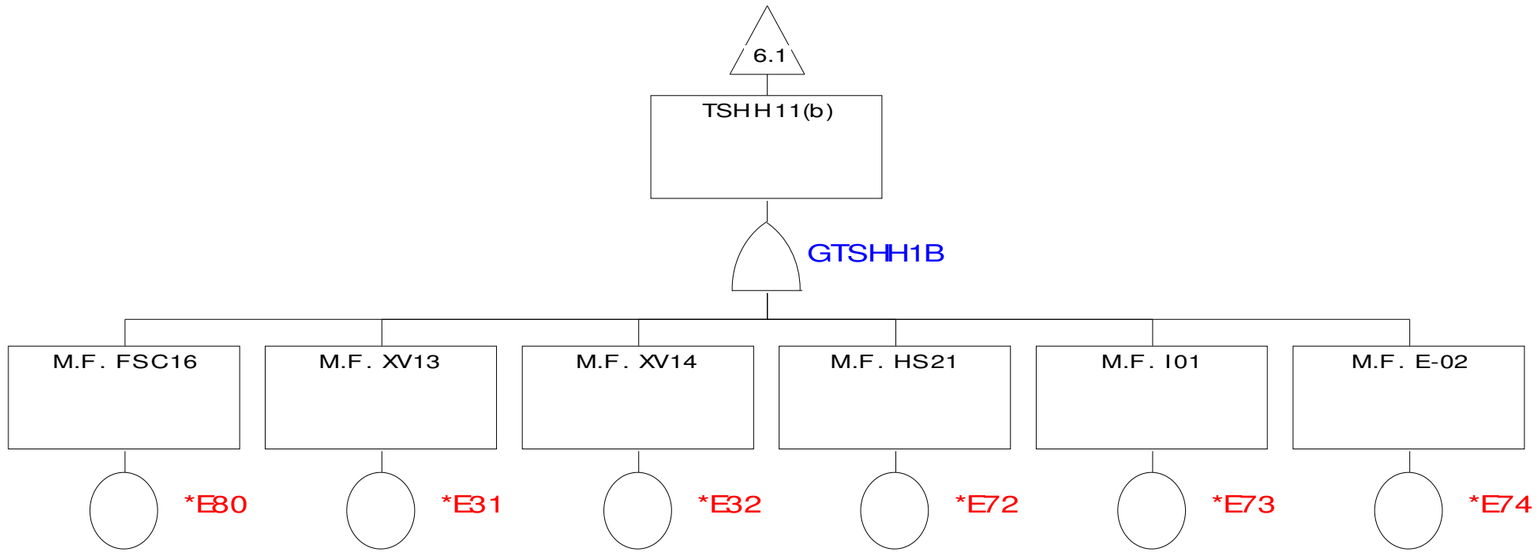
Intensified Catalyst sintered

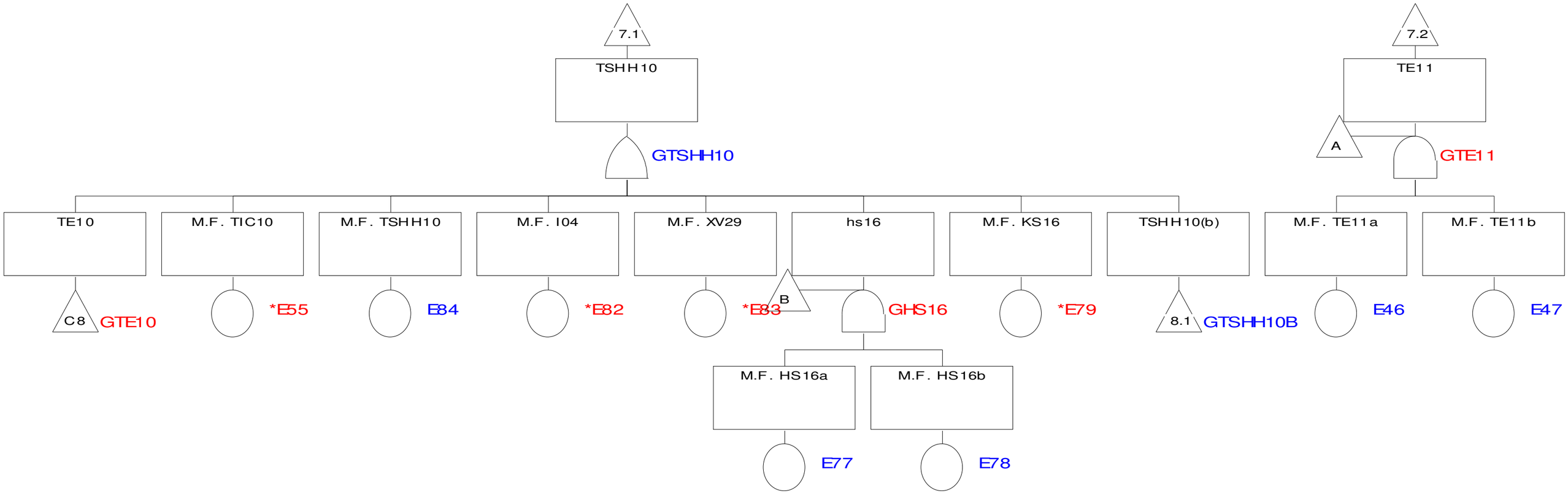

2.1
7-T-HHHHH (53)
G53
7-T-HHHH (52)
THA21
G52
5.1
GTAH21
7-T-HHH (51)
TAH11
G51
GTAH11
7-T-HH (50)
TSH10
TE11
M.F. TI11
M.F. TAH11
Missed int. on alarm TAH11
G50
4.1
GTSH10
A1
GTE11
*E48
E49
EU6
7-T-H (49)
TSH21
G49
GTSH21
6-T-H (40)/.../ 3-T-H (14)
7-x(VOC)-HH (72)/.../1-x(VOC)-H (5)
M.F. TE21
M.F. TI21
M.F. TSH21
M.F. HS21
M.F. I01
M.F. E-02
XV
3.1
G40
3.2
G72
*E50
*E51
E71
*E72
*E73
*E74
D4
GXV

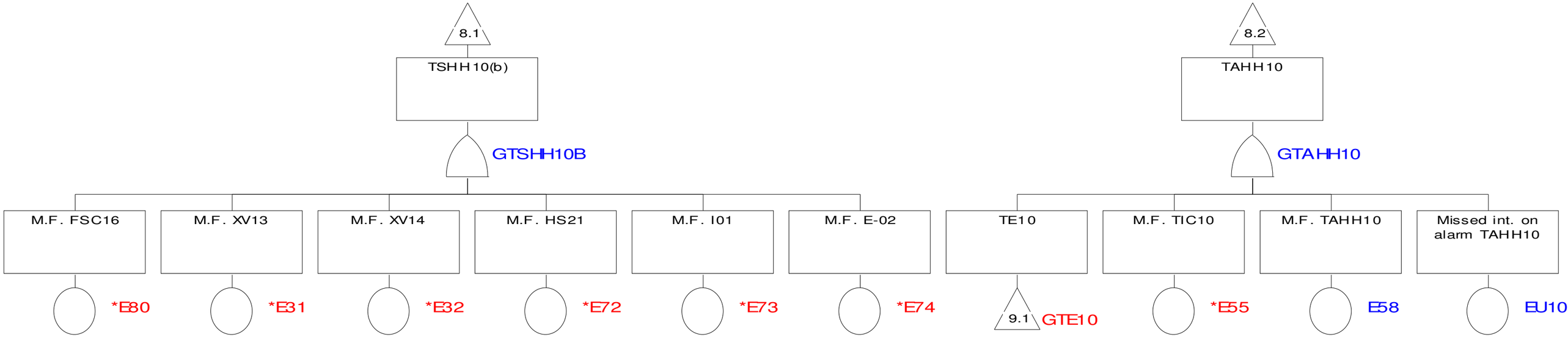

3.1
6-T-H (40)/.../
3-T-H (14)
G40
Ex. deviation (T-
H input gas)
TAH03
E3
GTAH03
M.F. TE03
M.F. TI03
M.F. TAH03
Missed int. on
alarm TAH03
E40
E41
E42
EU3
3.2
7-x(VOC)-HH
(72)/.../1-x(VOC)-H
(5)
G72
Ex. deviation
(x(VOC) - H input
gas)
AAH01
E7
GAAH01
M.F. AE01
M.F. AT01
M.F. AI01
M.F. AAH01
Missed int. on
alarm AAH01
E33
E34
E35
E36
EU1

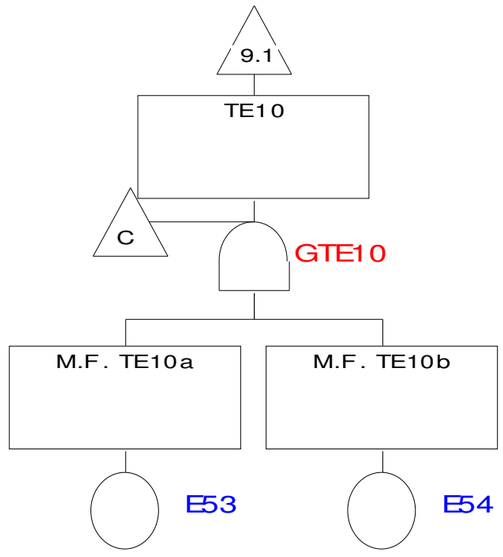

4.1
TSH10
GTSH10
TE10
M.F. TIC10
M.F. TSH10
M.F. I02
hs16
M.F. KS16
M.F. FSC16
TSH10(b)
C8
GTE10
*E55
E75
E76
B7
GHS16
*E79
*E80
GTSH10B
M.F. E-02
XV
D
*E74
GXV
M.F. XV12
M.F. XV15
M.F. XV13
M.F. XV14
E29
E30
*E31
*E32


5.1
THA21
GTAH21
M.F. TE21
M.F. TI21
M.F. TAH21
Missed int. on alarm TAH21
*E50
*E51
E52
EU7
5.2
TAH10
GTAH10
TE10
M.F. TIC10
M.F. TAH10
Missed int. on alarm TAH10
C8
GTE10
*E55
E56
EU8

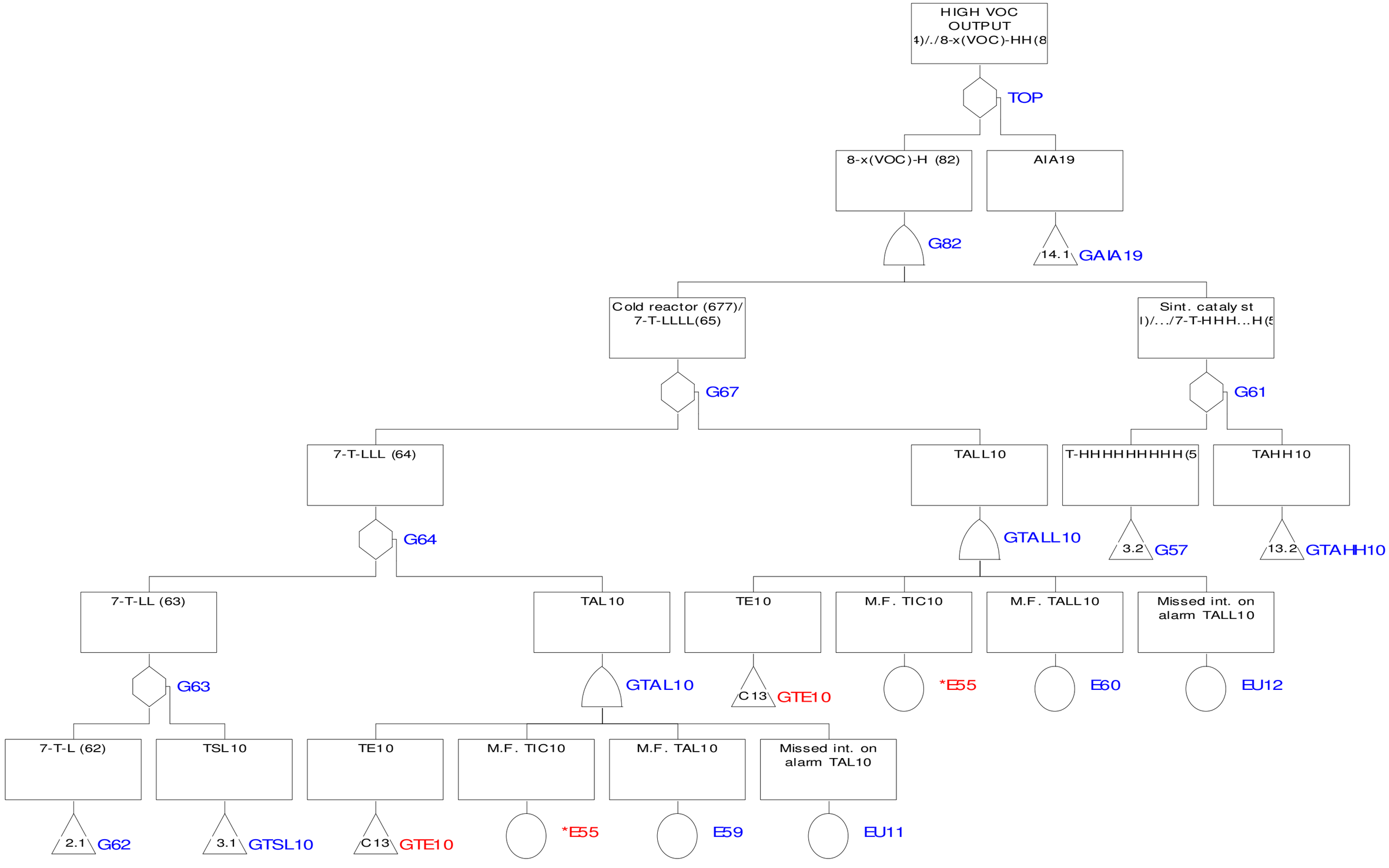

6.1
TSHH11(b)
GTSHH1B
M.F. FSC16
M.F. XV13
M.F. XV14
M.F. HS21
M.F. I01
M.F. E-02
*E80
*E31
*E32
*E72
*E73
*E74

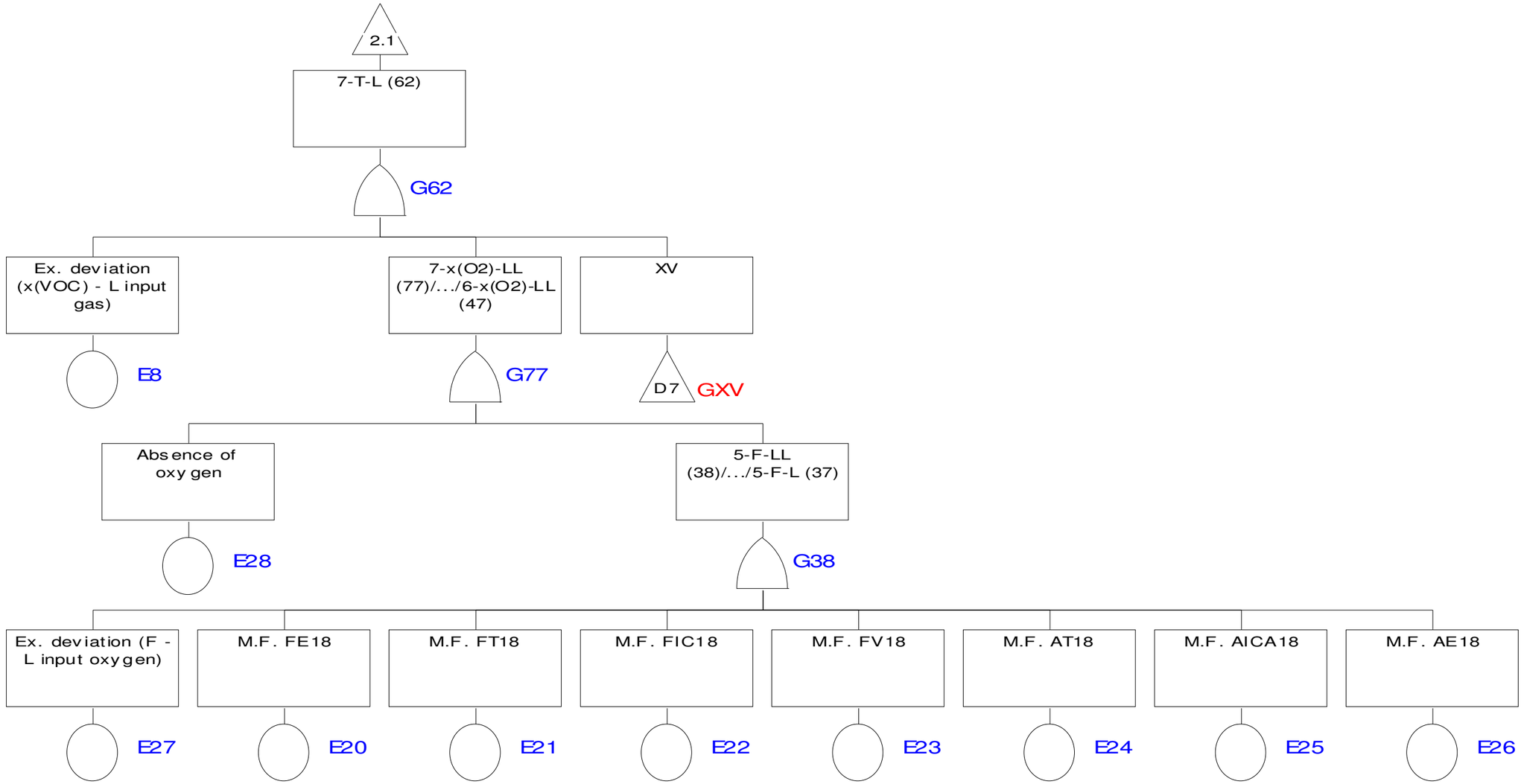

7.1
TSHH10
GTSHH10
TE10
M.F. TIC10
M.F. TSHH10
M.F. I04
M.F. XV29
hs16
M.F. KS16
TSHH10(b)
C8
GTE10
*E55
E84
*E82
*E83
B
GHS16
*E79
8.1
GTSHH10B
M.F. HS16a
M.F. HS16b
E77
E78
7.2
TE11
A
GTE11
M.F. TE11a
M.F. TE11b
E46
E47

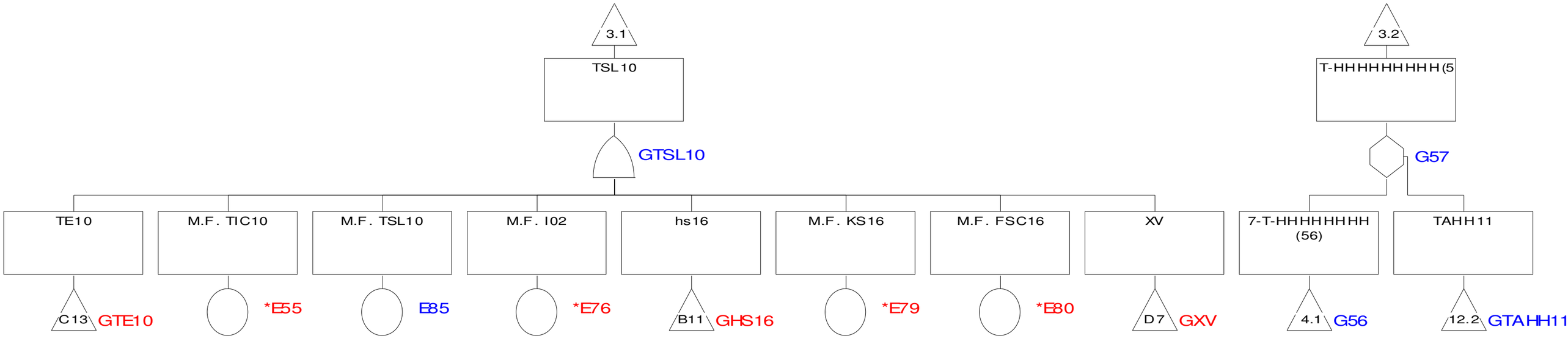

8.1
TSHH10(b)
GTSHH10B
M.F. FSC16
M.F. XV13
M.F. XV14
M.F. HS21
M.F. I01
M.F. E-02
*E80
*E31
*E32
*E72
*E73
*E74
8.2
TAHH10
GTAHH10
TE10
M.F. TIC10
M.F. TAHH10
Missed int. on alarm TAHH10
9.1
GTE10
*E55
E58
EU10

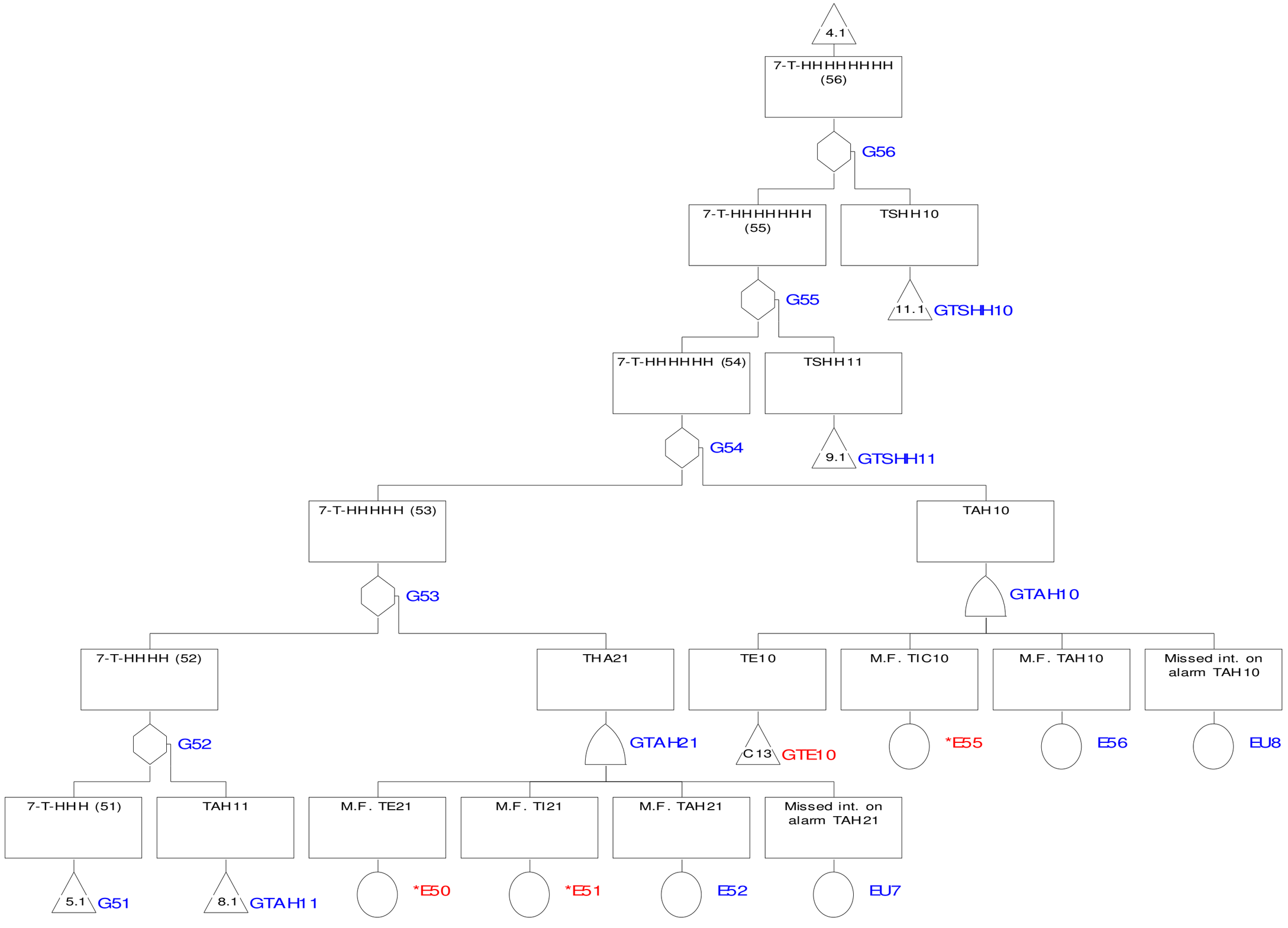

9.1
TE10
C
GTE10
M.F. TE10a
M.F. TE10b
E53
E54

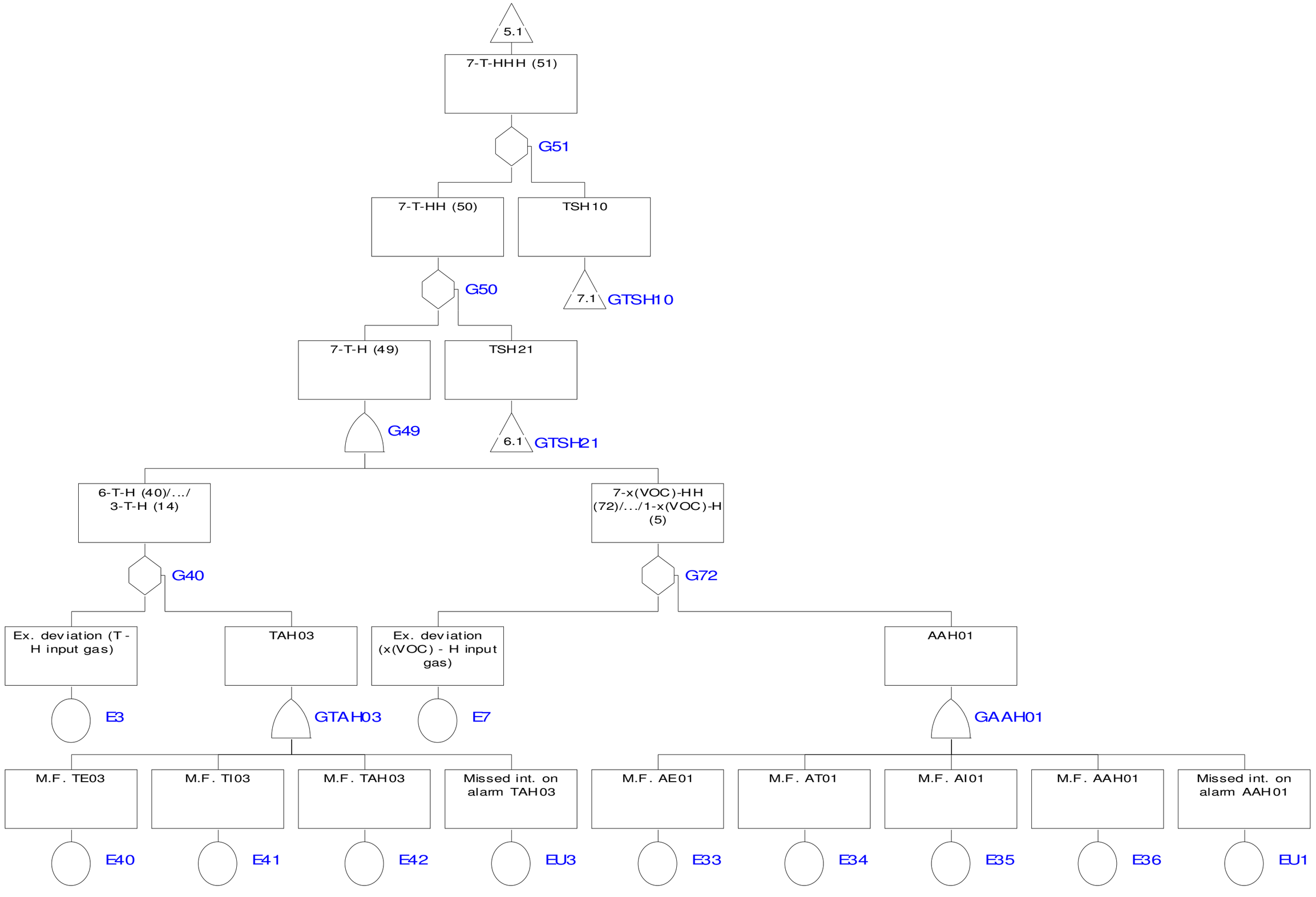
Annex II.C.2. Discharge of excess of VOCs

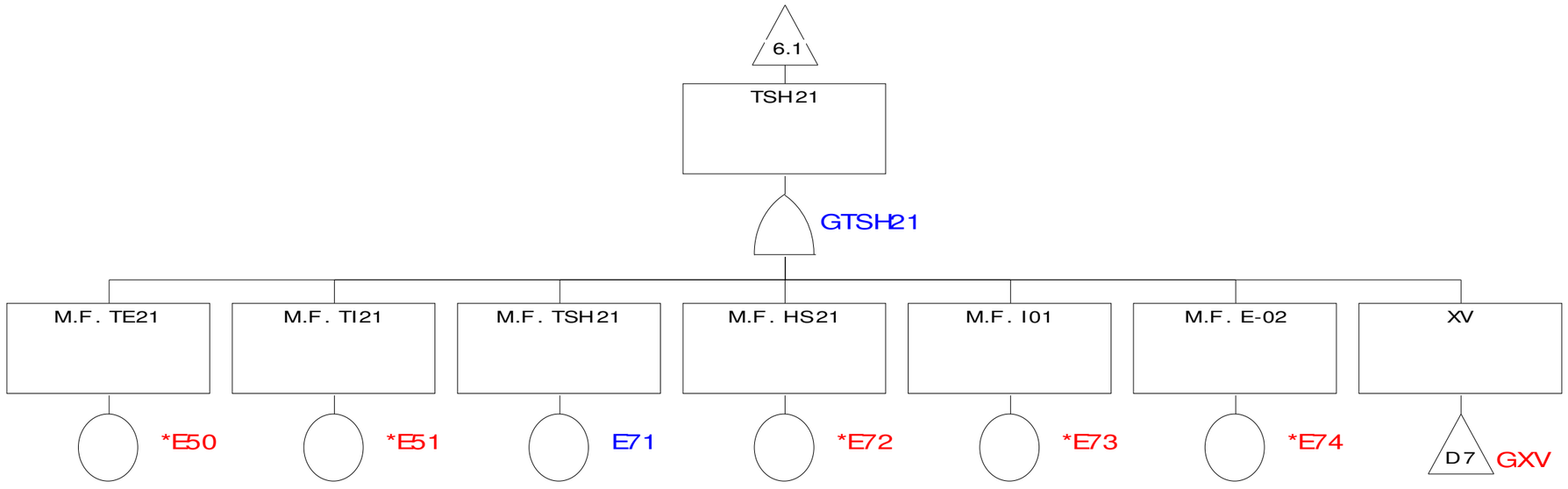

HIGH VOC
OUTPUT
4)/./8-x(VOC)-HH(8
TOP
8-x(VOC)-H (82)
AIA19
G82
14.1
GAIA19
Cold reactor (677)/
7-T-LLLL(65)
Sint. catalyst
I)/.../7-T-HHH...H(5
G67
G61
7-T-LLL (64)
TALL10
T-HHHHHHHHH(5
TAHH10
G64
GTALL10
3.2
G57
13.2
GTAHH10
7-T-LL (63)
TAL10
TE10
M.F. TIC10
M.F. TALL10
Missed int. on
alarm TALL10
G63
GTAL10
C13
GTE10
*E55
E60
EU12
7-T-L (62)
TSL10
TE10
M.F. TIC10
M.F. TAL10
Missed int. on
alarm TAL10
2.1
G62
3.1
GTSL10
C13
GTE10
*E55
E59
EU11

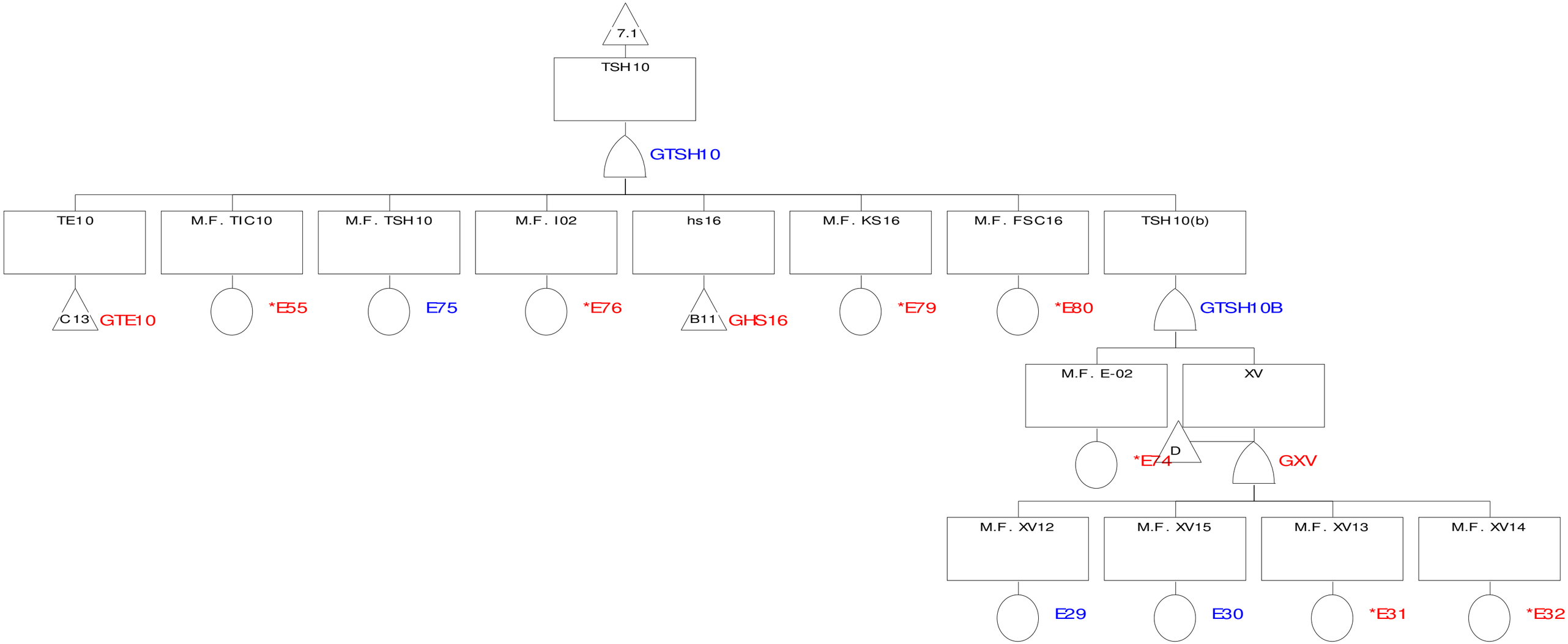

2.1
7-T-L (62)
G62
Ex. deviation (x(VOC) - L input gas)
E8
7-x(O2)-LL (77)/.../6-x(O2)-LL (47)
G77
XV
D7
GXV
Absence of oxygen
E28
5-F-LL (38)/.../5-F-L (37)
G38
Ex. deviation (F - L input oxygen)
E27
M.F. FE18
E20
M.F. FT18
E21
M.F. FIC18
E22
M.F. FV18
E23
M.F. AT18
E24
M.F. AICA18
E25
M.F. AE18
E26

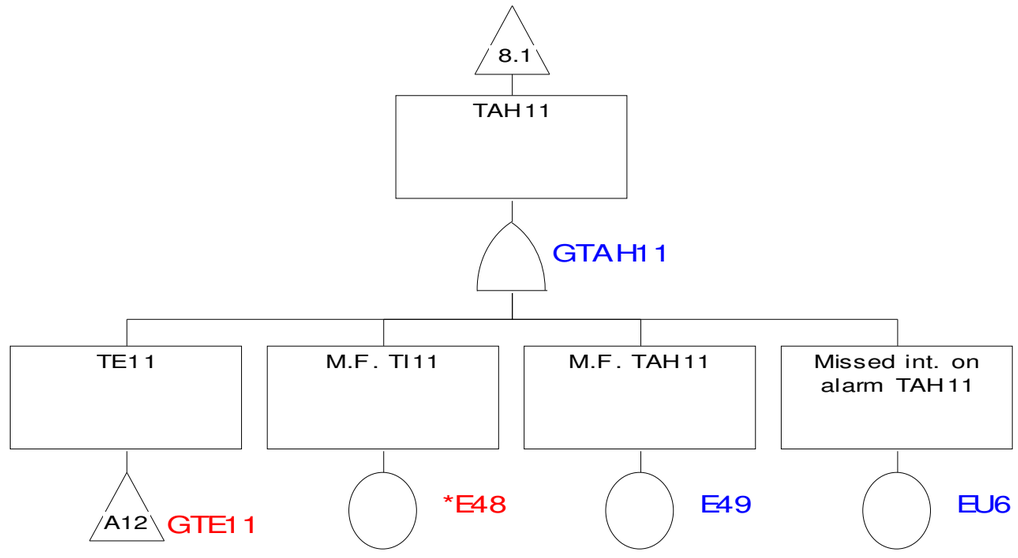

3.1
TSL10
GTSL10
TE10
M.F. TIC10
M.F. TSL10
M.F. I02
hs16
M.F. KS16
M.F. FSC16
XV
C13
GTE10
*E55
E85
*E76
B11
GHS16
*E79
*E80
D7
GXV
3.2
T-HHHHHHHHH(5
G57
7-T-HHHHHHHH
(56)
TAHH11
4.1
G56
12.2
GTAHH11

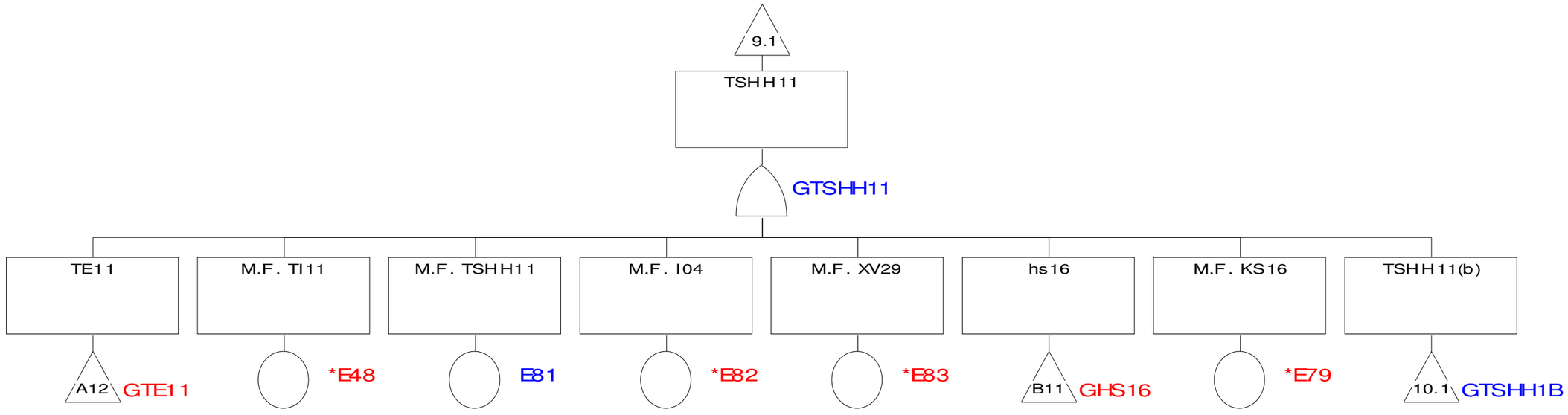

4.1
7-T-HHHHHHHH (56)
G56
7-T-HHHHHHH (55)
TSHH10
G55
11.1
GTSHH10
7-T-HHHHHH (54)
TSHH11
G54
9.1
GTSHH11
7-T-HHHHH (53)
TAH10
G53
GTAH10
7-T-HHHH (52)
THA21
TE10
M.F. TIC10
M.F. TAH10
Missed int. on alarm TAH10
G52
GTAH21
C13
GTE10
*E55
E56
EU8
7-T-HHH (51)
TAH11
M.F. TE21
M.F. TI21
M.F. TAH21
Missed int. on alarm TAH21
5.1
G51
8.1
GTAH11
*E50
*E51
E52
EU7

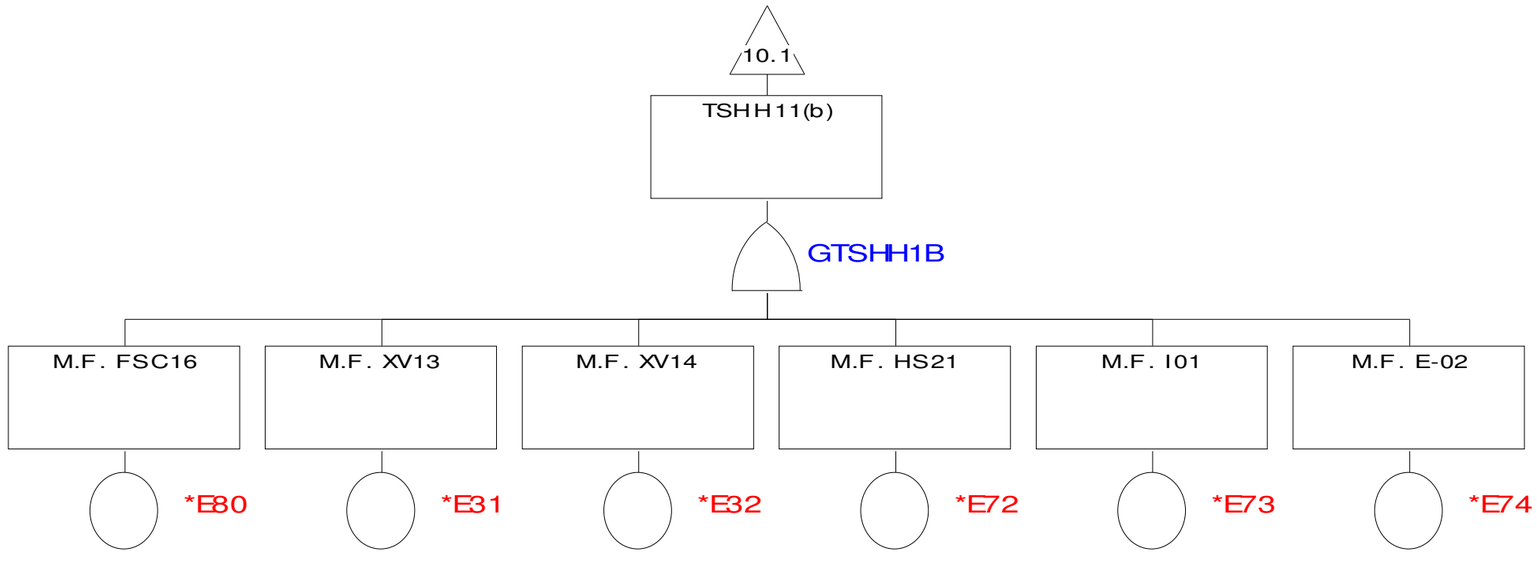

5.1
7-T-HHH (51)
G51
7-T-HH (50)
TSH10
G50
7.1
GTSH10
7-T-H (49)
TSH21
G49
6.1
GTSH21
6-T-H (40)/.../
3-T-H (14)
7-x(VOC)-HH
(72)/.../1-x(VOC)-H
(5)
G40
G72
Ex. deviation (T-
H input gas)
TAH03
Ex. deviation
(x(VOC) - H input
gas)
AAH01
E3
GTAH03
E7
GAAH01
M.F. TE03
M.F. TI03
M.F. TAH03
Missed int. on
alarm TAH03
M.F. AE01
M.F. AT01
M.F. AI01
M.F. AAH01
Missed int. on
alarm AAH01
E40
E41
E42
EU3
E33
E34
E35
E36
EU1

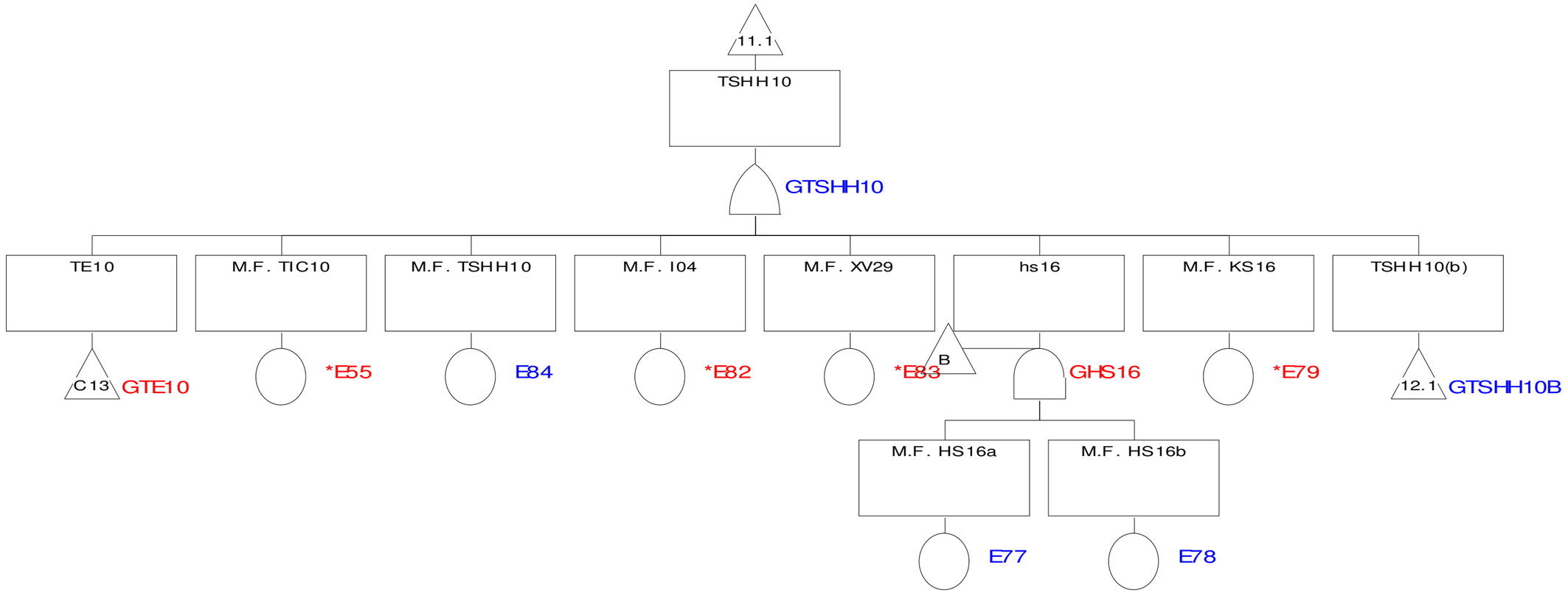

6.1
TSH21
GTSH21
M.F. TE21
M.F. TI21
M.F. TSH21
M.F. HS21
M.F. I01
M.F. E-02
XV
*E50
*E51
E71
*E72
*E73
*E74
D7
GXV

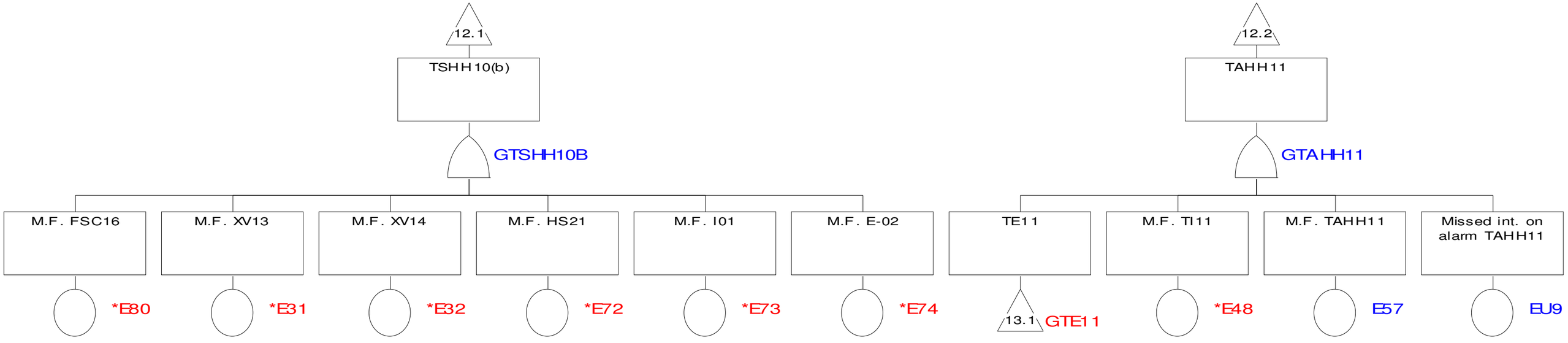

7.1
TSH10
GTSH10
TE10
M.F. TIC10
M.F. TSH10
M.F. I02
hs16
M.F. KS16
M.F. FSC16
TSH10(b)
C13
GTE10
*E55
E75
*E76
B11
GHS16
*E79
*E80
GTSH10B
M.F. E-02
XV
D
*E74
GXV
M.F. XV12
M.F. XV15
M.F. XV13
M.F. XV14
E29
E30
*E31
*E32

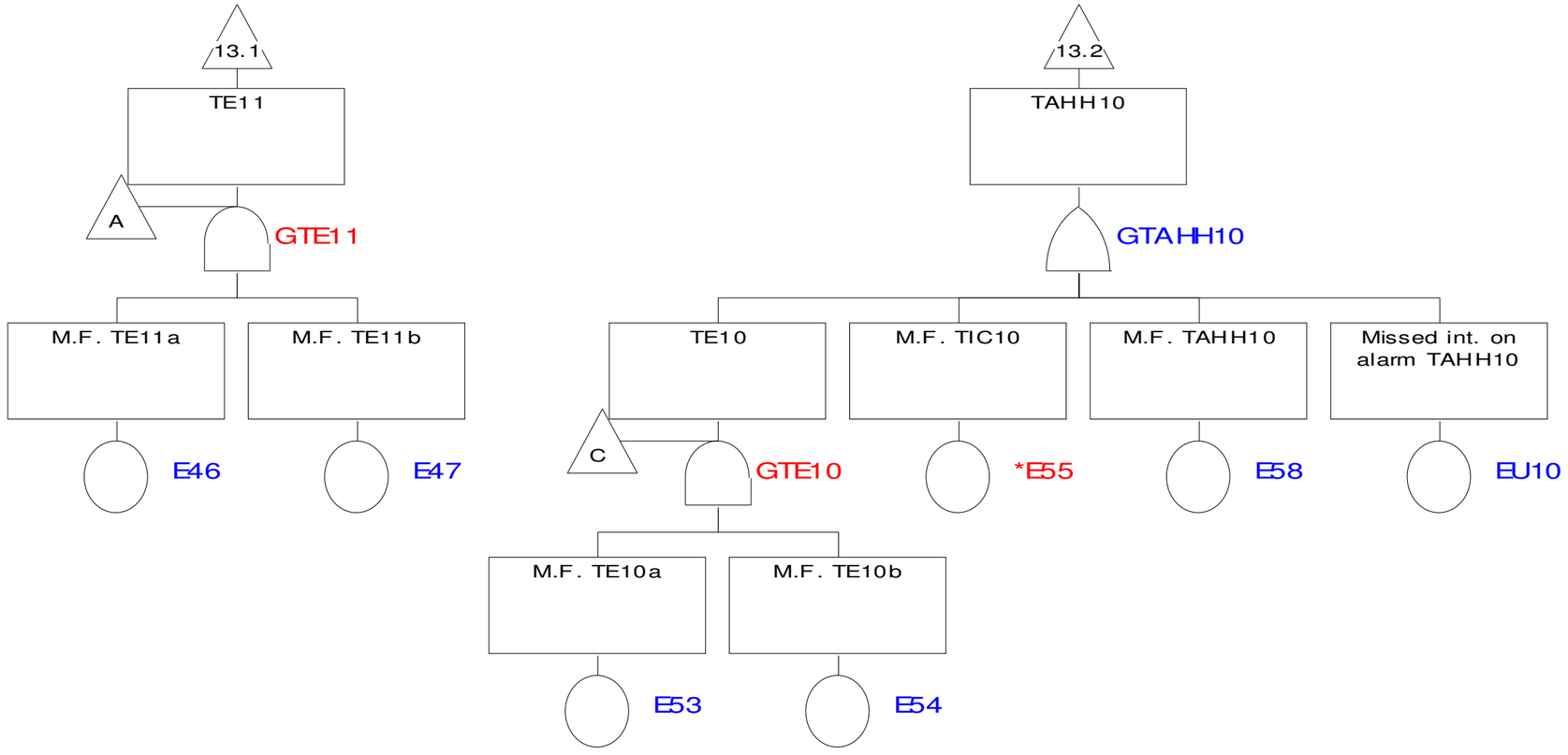

8.1
TAH11
GTAH11
TE11
M.F. TI11
M.F. TAH11
Missed int. on alarm TAH11
A12
GTE11
*E48
E49
EU6

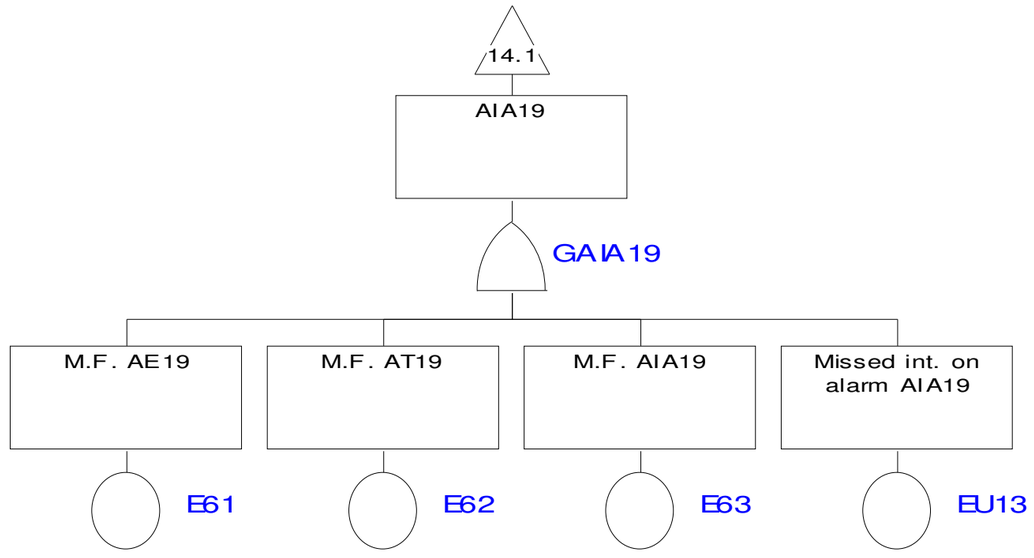

9.1
TSHH11
GTSHH11
TE11
M.F. TI11
M.F. TSHH11
M.F. I04
M.F. XV29
hs16
M.F. KS16
TSHH11(b)
A12
GTE11
*E48
E81
*E82
*E83
B11
GHS16
*E79
10.1
GTSHH1B


10.1
TSHH11(b)
GTSHH1B
M.F. FSC16
M.F. XV13
M.F. XV14
M.F. HS21
M.F. I01
M.F. E-02
*E80
*E31
*E32
*E72
*E73
*E74


11.1
TSHH10
GTSHH10
TE10
M.F. TIC10
M.F. TSHH10
M.F. I04
M.F. XV29
hs16
M.F. KS16
TSHH10(b)
C13
GTE10
*E55
E84
*E82
*E83
B
GHS16
*E79
12.1
GTSHH10B
M.F. HS16a
M.F. HS16b
E77
E78


12.1
TSHH10(b)
GTSHH10B
M.F. FSC16
M.F. XV13
M.F. XV14
M.F. HS21
M.F. I01
M.F. E-02
*E80
*E31
*E32
*E72
*E73
*E74
12.2
TAHH11
GTAHH11
TE11
M.F. TI11
M.F. TAHH11
Missed int. on alarm TAHH11
13.1
GTE11
*E48
E57
EU9


13.1
TE11
A
GTE11
M.F. TE11a
M.F. TE11b
E46
E47
13.2
TAHH10
GTAHH10
TE10
M.F. TIC10
M.F. TAHH10
Missed int. on alarm TAHH10
C
GTE10
*E55
E58
EU10
M.F. TE10a
M.F. TE10b
E53
E54


14.1
AIA19
GAIA19
M.F. AE19
M.F. AT19
M.F. AIA19
Missed int. on alarm AIA19
E61
E62
E63
EU13

Annex III. Reliability data

Annex III.A. Traditional plant

	Failure rate	Probability	
External deviation		0.001	
Filter F01A clogged		0.9	
Filter F01B clogged		0.9	
M.F. PdiT18403	0.1		failures/years
M.F. PdI18403	0.026		failures/years
M.F. PDAH18403	0.37		failures/years
Missed intervention in case of alarm		0.03	
M.F. AE18415		0.062	
M.F. AT18415	0.1		failures/years
M.F. AIC18415	0.29		failures/years
Absence of oxygen		0.001	
M.F. FE18404	0.2		failures/years
M.F. FT18404	0.1		failures/years
M.F. FI18404	0.026		failures/years
M.F. AV18415	0.00003		failures/hours
M.F. AAH18415	0.1		failures/years
Heat recovery H01 dirty		0.001	
M.F. TE18408	0.088		failures/years
M.F. TE18409	0.088		failures/years
M.F. TE18410	0.088		failures/years
M.F. TE18406	0.088		failures/years
M.F. TIC18406	0.29		failures/years
M.F. E01	0.00002		failures/hours
M.F. TE18405	0.088		failures/years
M.F. TIC18405	0.29		failures/years
M.F. TAH18405	0.1		failures/years
M.F. TAL18405	0.1		failures/years
M.F. TE18411	0.088		failures/years
M.F. TI18411	0.026		failures/years
M.F. TAH18411	0.1		failures/years
M.F. TSHH18411		0.0003	
M.F. I216A	0.22		failures/years
M.F. TAHH18411	0.1		failures/years
M.F. TAH18408	0.1		failures/years
M.F. TAH18409	0.1		failures/years
M.F. TAH18410	0.1		failures/years
M.F. AE18416		0.062	
M.F. AT18416	0.1		failures/years
M.F. AAH18416	0.1		failures/years

Annex III.B. Intensified plant

	Failure rate	Probability	
External deviation		0.001	
M.F. AE01		0.062	
M.F. AT01	0.1		failures/years
M.F. AI01	0.026		failures/years
M.F. AAH01	0.1		failures/years
Missed intervention in case of alarm		0.03	
Fault blower B-01	0.00001		failures/hours
M.F. FE05	0.2		failures/years
M.F. FT05	0.1		failures/years
M.F. FIC05	0.29		failures/years
M.F. FCV05	0.00003		failures/hours
M.F. TE03	0.088		failures/years
M.F. TI03	0.026		failures/years
M.F. TAH03	0.1		failures/years
Filter F-01 clogged		0.9	
M.F. PDIT04	0.1		failures/years
M.F. PDI04	0.026		failures/years
M.F. PDAH04	0.37		failures/years
M.F. PT22	0.1		failures/years
M.F. PI22	0.026		failures/years
M.F. PAH22	0.37		failures/years
M.F. AE18		0.062	
M.F. AT18	0.1		failures/years
M.F. AICA18	0.29		failures/years
M.F. FE18	0.2		failures/years
M.F. FT18	0.1		failures/years
M.F. FIC18	0.29		failures/years
M.F. FV18	0.00003		failures/hours
Absence of oxygen		0.001	
M.F. XV12		0.007	
M.F. XV13		0.007	
M.F. XV14		0.007	
M.F. XV15		0.007	
M.F. E-02	0.00002		failures/hours
M.F. TE10a	0.088		failures/years
M.F. TE10b	0.088		failures/years
M.F. TIC10	0.29		failures/years
M.F. KS16	0.22		failures/years
M.F. FSC16	0.22		failures/years
M.F. TE21	0.088		failures/years
M.F. TAH21	0.1		failures/years
M.F. HS21	0.22		failures/years

	Failure rate	Probability	
M.F. I01	0.22		failures/years
M.F. TSH21		0.0003	
M.F. TSH10		0.0003	
M.F. I02	0.22		failures/years
M.F. HS16a	0.22		failures/years
M.F. HS16b	0.22		failures/years
M.F. TE11a	0.088		failures/years
M.F. TE11b	0.088		failures/years
M.F. TI21	0.026		failures/years
M.F. TAH11	0.1		failures/years
M.F. TAH10	0.1		failures/years
M.F. TSHH11		0.0003	
M.F. I04	0.22		failures/years
M.F. XV29		0.007	
M.F. TSHH10		0.0003	
M.F. TAHH11	0.1		failures/years
M.F. TAHH10	0.1		failures/years
M.F. TSL10		0.0003	
M.F. TAL10	0.1		failures/years
M.F. TALL10	0.1		failures/years
M.F. AE19		0.062	
M.F. AT19	0.1		failures/years
M.F. AIA19	0.1		failures/years

Annex IV. Integrated Dynamic Decision Analysis: Logical model

Annex IV.A. Traditional plant

```
!
!Traditional Plant
!
!Input condition
!
1 1, 0.001 1., 3 2, 'Input gas temperature?' 'OK' 'No'
L 1 1, 9, 1
L 1 1, 56, 1
L 1 0, 56, 0
L 1 0, 201, 0, 1
L 1 0, 201, 0
!
2 1, 0.5 1., 3 3, 'How is temperature?' 'High' 'Low'
L 2 0, 103, 0
L 2 1, 103, 1
L 2 0, 201, 1
L 2 1, 201, 2
!
3 1, 0.001 1., 5 4, 'VOC concentration in input?' 'OK' 'No'
L 3 1, 9, 1
L 3 1, 57, 1, 100
L 3 0, 57, 0, 1
4 1, 0.5 1., 5 5, 'How is VOC concentration?' 'High' 'Low'
L 4 0, 104, 0
L 4 1, 104, 1
5 1, 0.001 1., 9 6, 'Flow in input?' 'OK' 'No'
L 5 1, 9, 1
L 5 1, 58, 1, 100
L 5 0, 58, 0
L 5 0, 231, 0, 1
6 1, 0.5 1., 9 9, 'How is flow?' 'High' 'Low'
L 6 1, 107, 1, 10
L 6 0, 107, 0, 10
L 6 0, 231, 1
L 6 1, 231, 2
!
9 1, 0. 1., 40 40,'Input condition?' 'Correct' 'Wrong'
!
!Filters
!
40 1, 0.9 1., 42 41, 'State 1414-F01A?' 'OK' 'Obstructed'
L 40 0, 42, 0
41 1, 0.9 1., 42 42, 'State 1414-F01B?' 'OK' 'Obstructed'
L 41 0, 42, 0
L 41 1, 42, 1
42 1, 0. 1., 56 45, 'How is flow after filters?' 'Normal' 'Low'
L 42 0, 58, 0, 1
L 42 0, 204, 0
L 42 1, 204, 1
!
!Alarm PdAH18403
!
45 1, 0.025 1., 46 53,'State PdIT18403?' 'OK' 'Failed'
L 45 1, 53, 1
46 1, 0.006 1., 51 53, 'State PdI18403?' 'OK' 'Failed'
L 46 1, 53, 1
51 1, 0.088 1., 52 53, 'State PdAH18403?' 'OK' 'Failed'
```

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L 51 1, 53, 1
52 1, 0.03 1., 53 53, 'Operator occur in case of alarm PdAH18403' 'Yes' 'No'
L 52 1, 53, 1
L 52 0, 53, 0
53 1, 0. 1., 55 55, 'PdAH18403 work correctly?' 'Yes' 'No'
L 53 1, 55, 1
L 53 0, 55, 0
!
55 1, 0. 1., 56 56, 'Problem is resolved?' 'Yes' 'No'
L 55 0, 58, 0, 1
L 55 1, 58, 1, 100
L 55 1, 107, 1, 100
L 55 0, 204, 0, 10
L 55 1, 204, 1
!
!Condition after filters
!
56 1, 0. 1., 57 57, 'Temperature after filter is correct?' 'OK' 'No'
L 56 1, 59, 1, 100
L 56 0, 59, 0, 1
L 56 1, 99, 1, 100
L 56 0, 99, 0, 1
57 1, 0. 1., 58 58, 'VOC concentration after filter is correct?' 'OK' 'No'
L 57 1, 59, 1, 100
L 57 0, 59, 0, 1
L 57 1, 100, 1, 100
L 57 0, 100, 0, 1
58 1, 0. 1., 59 59, 'Flow after filter is correct?' 'OK' 'No'
L 58 1, 59, 1, 100
L 58 0, 59, 0, 1
L 58 1, 101, 1, 100
L 58 0, 101, 0, 1
59 1, 0. 1., 80 80, 'Condition after filter is correct?' 'Yes' 'No'
!
!Oxygen input
!
80 1, 6.2e-2 1., 81 85, 'State AE18415?' 'OK' 'Failed'
L 80 1, 85, 1
L 80 1, 92, 1
81 1, 0.095 1., 82 85, 'State AT18415?' 'OK' 'Failed'
L 81 1, 85, 1
L 81 1, 92, 1
82 1, 0.252 1., 83 85, 'State AIC18415?' 'OK' 'Failed'
L 82 1, 85, 1
L 82 1, 92, 1
L 82 0, 92, 0
L 82 0, 260, 0
L 82 1, 260, 1
83 1, 0.231 1., 84 85, 'State AV18415?' 'OK' 'Failed'
L 83 1, 85, 1
L 83 0, 261, 0
L 83 1, 261, 1
84 1, 0.001 1., 87 85, 'Is present oxygen?' 'Yes' 'No'
L 84 1, 85, 1
L 84 1, 86, 1
87 1, 0.181 1., 88 85, 'State FE18404?' 'OK' 'Failed'
L 87 1, 85, 1
```

```
88 1, 0.095 1., 89 85, 'State FT18404?' 'OK' 'Failed'
L 88 1, 85, 1
89 1, 0.026 1., 85 85, 'State FI18404?' 'OK' 'Failed'
L 89 1, 85, 1
L 89 0, 85, 0
!
85 1, 0. 1., 99 86, 'Input of oxygen is correct?' 'Yes' 'No'
L 85 0, 106, 0, 1
L 85 1, 106, 1, 2
86 1, 0.5 1., 92 99 'How is oxygen concentration?' 'High' 'Low'
L 86 0, 105, 0
L 86 1, 105, 1
!
!Alarm AAH18415
!
92 1, 0. 1., 95 97, ' Detection system of oxygen work?' 'Yes' 'No'
L 92 1, 97, 1
95 1, 0.025 1.,96 97 , 'State of AAH18415?' 'OK' 'Failed'
L 95 1, 97, 1
96 1, 0.03 1., 97 97, 'Operator occur in case of Alarm AAH18415?' 'Yes' 'No'
L 96 1, 97, 1
L 96 0, 97, 0
97 1, 0. 1., 257  99, 'AAH18415 work correctly?' 'Yes-Emergency' 'No'
L 97 0, 257, 2
L 97 1, 105, 0
L 97 1, 106, 1, 100
!
!Condition after oxygen input
!
99 1, 0. 1., 100 103, 'Temperature after input of oxygen is correct?' 'Yes' 'No'
L 99 0, 102, 0
L 99 1, 102, 1, 100
L 99 1, 151, 1,
L 99 0, 151, 0, 1
103 1, 0. 1., 100 100, 'How is temperature after input of oxygen?' 'High' 'Low'
L 103 0, 160, 0, 10
L 103 1, 160, 1, 10
!
100 1, 0. 1., 106 104, 'VOC concentration after input of oxygen is correct?' 'Yes' 'No'
L 100 0, 102, 0
L 100 1, 102, 1, 100
L 100 1, 152, 1, 100
L 100 0, 152, 0, 1
104 1, 0. 1., 106 106, 'How is VOC concentration after input of oxygen?' 'High' 'Low'
L 104 0, 161 0
L 104 1, 161 1
!
106 1, 0. 1., 101 105, 'Oxygen concentration after input of oxygen is correct?' 'Yes' 'No'
L 106 0, 162, 0
L 106 1, 162, 1
L 106 1, 102, 1, 100
L 106 0, 102, 0, 1
105 1, 0. 1., 101 101, 'How is oxygen concentration after input of oxygen?' 'High' 'Low'
L 105 0, 163, 0
L 105 1, 163, 1
!
101 1, 0. 1.,102 107, 'Flow after input of oxygen is correct?' 'Yes' 'No'
```

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L 101 0, 102, 0
L 101 1, 102, 1, 100
L 101 1, 153, 1, 100
L 101 0, 153, 0, 1
107 1, 0. 1., 102 102, 'How is flow after input of oxygen?' 'High' 'Low'
L 107 0, 164 0
L 107 1, 164, 1
!
102 1, 0. 1., 122 122, 'Condition after input of oxygen is correct?' 'Yes' 'No'
!
!
!Heat recovery
!
122 1, 0.001 1., 131 131, 'State recovery?' 'OK' 'Dirty'
L 122 1, 131, 1
L 122 0, 131, 0
131 1, 0.5 1., 151 151, 'How is temperature in recovery?' 'OK' 'Low'
L 131 0, 151, 0, 1
L 131 1, 151, 1, 100
L 131 1, 160, 1
L 131 0, 202, 0
L 131 1, 202, 1
!
!Condition after heat recovery
!
151 1, 0. 1., 152 160, 'Temperature after recovery is correct?' 'Yes' 'No'
L 151 0, 154, 0, 1
L 151 1, 154, 1, 100
160 1, 0. 1., 152 152, 'How is temperature after recovery?' 'High' 'Low'
!
152 1, 0. 1., 162 161, 'VOC concentration after recovery is correct?' 'Yes' 'No'
L 152 0, 154, 0, 1
L 152 1, 154, 1, 100
L 152 0, 227, 0, 1
161 1, 0. 1., 162 162, 'How is VOC concentration after recovery?' 'High' 'Low'
L 161 0, 227, 1, 5
L 161 1, 227, 2, 5
!
162 1, 0. 1., 153 163, 'Oxygen concentration after recovery is correct?' 'Yes' 'No'
L 162 0, 229, 0
L 162 0, 154, 0, 1
L 162 1, 154, 1, 100
163 1, 0. 1., 153 153, 'How is oxygen concentration after recovery?' 'High' 'Low'
L 163 0, 229, 1
L 163 1, 229, 2
!
153 1, 0. 1., 154 164, 'Flow after recovery is correct?' 'Yes' 'No'
L 153 0, 154, 0, 1
L 153 1, 154, 1, 100
164 1, 0. 1., 154 154, 'How is flow after recovery?' 'High' 'Low'
!
154 1, 0. 1., 171 171, 'Condition after recovery is correct?' 'Yes' 'No'
!
!
!Heater
!
!
```

```
171 1, 0.084 1., 172 172, 'State TE18408?' 'OK' 'Failed'
A 171 1, 172, *  176
A 171 1, 173, *  176
172 1, 0.084 1., 173 173, 'State TE18409?' 'OK' 'Failed'
A 172 1, 173, *  176
173 1, 0.084 1., 174 174, 'State TE18410?' 'OK' 'Failed'
L 173 1, 176, 1
174 1, 0.084 1., 175 176, 'State TE18406?' 'OK' 'Failed'
L 174 1, 176, 1
175 1, 0.252 1., 176 176, 'State TIC18406?' 'OK' 'Failed'
L 175 1, 176, 1
L 175 0, 176, 0, 10
176 1, 1. 1., 177 178, 'Detection system  of temperature TIC18406 work?' 'Yes' 'No'
L 176 1, 178 1
L 176 1, 190 1
L 176 0, 190 0
177 1, 0.161 1., 178 178, 'State of heater 1414-E01?' 'OK' 'Failed'
L 177 1, 178, 1
L 177 0, 178, 0
178 1, 0. 1., 227 179, 'Heater system work correctly?' 'Yes' 'No'
L 178 0, 203, 0
179 1, 0.5 1.,  227 227, 'How is temperature in heater?'  'High' 'Low'
L 179 0, 203, 1
L 179 1, 203, 2
!
!
!Reactor
!
!Reactor input condition
!
!
227 2, 0. 0., 1. 1., 231 231 231, 'VOC concentration at entrance of reactor is correct?' 'Yes' 'Hig
L 227 0, 233, 0, 1
L 227 1, 233, 1, 60
L 227 0, 500, 0, 60
L 227 2, 233, 2, 30
L 227 2, 501, 0, 30

L 227 2, 600, 0, 1
L 227 0, 600, 1, 2
L 227 1, 600, 1, 2

L 227 2, 601, 0, 1
L 227 0, 601, 1, 2
L 227 1, 601, 1, 2

L 227 1, 607, 0, 1
L 227 0, 607, 1, 2
L 227 2, 607, 1, 2

231 2, 0. 0., 1. 1., 201 201 201, 'How is flow entrance of reactor is correct?' 'Yes' 'High' 'Low'
L 231 0, 233, 0, 1
L 231 1, 233, 0, 40
L 231 2, 233, 0, 2

L 231 1, 600, 0, 1
L 231 0, 600, 1, 2
```

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L 231 2, 600, 1, 2

201 2, 0. 0., 1. 1., 229 229 229, 'How is temperature in input gas?' 'OK' 'High' 'Low'
L 201 0, 233, 0, 1
L 201 1, 233, 0, 35
L 201 2, 233, 2, 66
L 201 2, 501, 1, 66

L 201 1, 602, 0, 1
L 201 0, 602, 1, 2
L 201 2, 602, 1, 2

L 201 1, 603, 0, 1
L 201 0, 603, 1, 2
L 201 2, 603, 1, 2

L 201 1, 604, 0, 1
L 201 0, 604, 1, 2
L 201 2, 604, 1, 2

L 201 2, 605, 0, 1
L 201 0, 605, 1, 2
L 201 1, 605, 1, 2

L 201 1, 607, 0, 1
L 201 0, 607, 1, 2
L 201 2, 607, 1, 2

229 2, 0. 0.,1. 1., 202 202 202, 'Oxygen concentration at entrance of reactor is correct?' 'Yes' 'H
L 229 0, 233, 0, 1
L 229 1, 233, 0, 1
L 229 2, 233, 2, 100
L 229 2, 501, 1, 100

202 1, 0. 1., 203 203, 'How is temperature in recovery?' 'OK' 'Low'
L 202 0, 233, 0, 1
L 202 1, 233, 2, 100
L 202 1, 501, 1, 100

203 2, 0. 0., 1. 1., 204 204 204 'How is temperature in heater?' 'OK' 'High' 'Low'
L 203 0, 233, 0, 1
L 203 1, 233, 1, 15
L 203 0, 500, 0, 15
L 203 2, 233, 2, 61
L 203 2, 501, 1, 61

L 203 1, 602, 0, 1
L 203 0, 602, 1, 2
L 203 2, 602, 1, 2

L 203 2, 603, 0, 1
L 203 0, 603, 1, 2
L 203 1, 603, 1, 2

L 203 1, 606, 0, 1
L 203 0, 606, 1, 2
L 203 2, 606, 1, 2
```

```
L 203 1, 607, 0, 1
L 203 0, 607, 1, 2
L 203 2, 607, 1, 2

204 1, 0. 1., 600 600, 'How is flow in filter?' 'OK' 'Low'
L 204 0, 233, 0, 1
L 204 1, 233, 0, 5

L 204 1, 601, 0, 1
L 204 0, 601, 1, 2

L 204 1, 604, 0, 1
L 204 0, 604, 1, 2

L 204 1, 605, 0, 1
L 204 0, 605, 1, 2

L 204 1, 606, 0, 1
L 204 0, 606, 1, 2

600 1, 0. 1., 601 601, 'Exception 1: Low VOC and High flow?' 'Yes' 'No'
L 600 1, 233, 0, 1
L 600 0, 233, 2, 100
L 600 0, 501, 1, 100

601 1, 0. 1., 602 602, 'Exception 2: Low VOC and Filter obstructed?' 'Yes' 'No'
L 601 1, 233, 0, 1
L 601 0, 233, 0, 31

602 1, 0. 1., 603 603, 'Exception 3: High Temperature and Heater fault on High?' 'Yes' 'No'
L 602 1, 233, 0, 1
L 602 0, 233, 1, 68
L 602 0, 500, 1, 68

603 1, 0. 1., 604 604, 'Exception 4: High Temperature and Heater fault on Low?' 'Yes' 'No'
L 603 1, 233, 0, 1
L 603 0, 233, 0, 61

604 1, 0. 1., 605 605, 'Exception 5: Filter obstructed and High Temperature?' 'Yes' 'No'
L 604 1, 233, 0, 1
L 604 0, 233, 1, 62
L 604 0, 500, 0, 62

605 1, 0. 1., 606 606, 'Exception 6: Filter obstructed and Heater fault on Low?' 'Yes' 'No'
L 605 1, 233, 0, 1
L 605 0, 233, 2, 67
L 605 0, 501, 0, 67

606 1, 0. 1., 607 607, 'Exception 7: Filter obstructed and Heater fault on High?' 'Yes' 'No'
L 606 1, 233, 0, 1
L 606 0, 233, 1, 90
L 606 0, 500, 2, 90

607 1, 0. 1., 233 233, 'Exception 8: High Temperature, High VOC and Heater fault on High?' 'Yes' 'N
L 607 1, 233, 0, 1
L 607 0, 233, 1, 90
```

```
L 607 0, 500, 2, 90
!
!Reaction condition
233 2, 0. 0., 1. 1., 256 500 501, 'Temperature inside of reactor is correct?' 'Yes' 'High' 'Low'
L 233 0, 256, 0
500 2, 0. 0., 1. 1., 235 235 235, 'Level of High temperature?' 'T1' 'T2' 'T3'
!T1 = Temperature inside reactor higher than first level of alarm
!T2 = Temperature inside reactor higher than second level of alarm
!T3 = Temperature inside reactor sinter catalyst

L 500 0, 256, 0, 1

L 500 1, 256, 0, 1
A 500 1, 242, 257 250

L 500 2, 256, 1, 1
L 500 2, 257, 1, 1
A 500 2, 242, 257 250

501 1, 0. 1., 120 120, 'Level of Low temperature?' 'T-1' 'T-2'
!T-1 = Temperature inside reactor lower than first level of alarm
!T-2 = Temperature inside reactor lower than shout down value

L 501 0, 256, 0, 1
L 501 1, 256, 1, 1
L 501 1, 257, 0, 1

!
!Temperature alarm
!
!TIC18405 measurement
!
120 1, 0.022 1., 121 135, 'State TE18405?' 'OK' 'Failed'
L 120 1, 135, 1
121 1, 0.070 1., 135 135, 'State TIC18405?' 'OK' 'Failed'
L 121 1, 135, 1
L 121 0, 135, 0
135 1, 0. 1., 145 147, 'Revelator of temperature in recovery work?' 'Yes' 'No'
L 135 1, 147, 1, 2
L 135 1, 141, 1, 2
!
!
!TAH18405
!
139 1, 0.025 1., 140 141, 'State TAH18405?' 'OK' 'Failed'
L 139 1, 141, 1
140 1, 0.03 1., 141 141 ,'Operator occur in case of Alarm TAH18405?' 'Yes' 'No'
L 140 1, 141, 1
L 140 0, 141, 0
141 1, 0. 1., 257 256, 'Alarm TAH18405 work correctly?' 'Yes-Emergency' 'No'
L 141 0, 257, 2
!
!TAL18405
!
145 1, 0.025 1., 146 147, 'State TAL18405?' 'OK' 'Failed'
L 145 1, 147, 1
146 1, 0.03 1., 147 147, 'Operator occur in case of Alarm TAL18405?' 'Yes' 'No'
```

```
L 146 0, 147, 0
L 146 1, 147, 1
147 1, 0. 1., 257 256, 'Alarm  TAL18405 work correctly?' 'Yes-Emergency' 'No'
L 147 0, 257, 2
!
!High temperature reactor alarm
!
235 1, 0.088 1., 236 238,'State TE18411?' 'Ok' 'Failed'
L 235 1, 238, 1
236 1, 0.006 1., 238 238, 'State TI18411?' 'Ok' 'Failed'
L 236 1, 238, 1
L 236 0, 238, 0
238 1, 0. 1., 240 242, 'Revelator of temperature in reactor work?' 'Yes' 'No'
L 238 1, 242, 1, 2
L 238 1, 252, 1, 2
L 238 1, 247, 1, 2
!
!TAH18411
!
240 1, 0.025 1., 241 242, 'State TAH18411?' 'Ok' 'Failed'
L 240 1, 242, 1
241 1, 0.03 1., 242 242, 'Operator occur in case of Alarm TAH18411?' 'Yes' 'No'
L 241 1, 242, 1
L 241 0, 242, 0
242 1, 0. 1., 257 256, 'Alarm TAH18411 work correctly?' 'Yes-Emergency' 'No'
L 242 0, 257, 2, 2
!
!TSHH18411
!
250 1, 0.0003 1., 251 252, 'State TSHH18411?' 'Ok' 'Failed'
L 250 1, 252, 1
251 1, 0.054 1., 260 252, 'State I216A?' 'Ok' 'Failed'
L 251 1, 252, 1
260 1, 0.252 1., 261 252, 'State AIC18415?' 'OK' 'Failed'
L 260 1, 252, 1
261 1, 0.231 1.,252 252, 'State AV18415?' 'OK' 'Failed'
L 261 0, 252, 0
L 261 1, 252, 1
252 1, 0. 1., 257 245, 'Protective device TSHH18411 work correctly?' 'Yes-Emergency' 'No'
L 252 0, 257, 2, 2
!
!TAHH18411
!
245 1, 0.025 1., 246 247, 'State TAHH18411?' 'Ok' 'Failed'
L 245 1, 247, 1
246 1, 0.03 1., 247 247, 'Operator occur in case of Alarm TAHH18411?' 'Yes' 'No'
L 246 1, 247, 1
L 246 0, 247, 0
247 1, 0. 1., 257 195, 'Alarm TAHH18411  work correctly?' 'Yes-Emergency' 'No'
L 247 0, 257, 2, 2
A 247 1, 135, 139 141
!
!High temperature heater alarm
!
190 1, 0. 1., 195 199, 'Detection system of temperature TIC18404 work?' 'Yes' 'No'
L 190 1, 199, 1
195 1, 0.025 1., 198 196, 'State TAH18408?' 'OK' 'Failed'
```

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196 1, 0.025 1., 198 197, 'State TAH18409?' 'OK' 'Failed'
197 1, 0.025 1., 198 199, 'State TAH18410?' 'OK' 'Failed'
L 197 1, 199, 1
198 1, 0.03 1., 199 199 ,'Operator occur in case of Alarm TAH1808/09/10?' 'Yes' 'No'
L 198 0, 199, 0
L 198 1, 199, 1
199 1, 0. 1., 257 120, 'Alarm AH1808/09/10 work correctly?' 'Yes-Emergency' 'No'
L 199 0, 257, 2, 2
!
!Finaly reactor condition
!
256 1, 0. 1., 258 257, 'Reactor work correctly?' 'Yes' 'No'
L 256 0, 258, 0
L 256 1, 258, 1
257 2, 0. 0., 1. 1., 258 258 258, 'How is reactor?' 'Cold' 'Hot- Catalyst sintered' 'Emergency'
L 257 1, 258, 1
L 257 0, 258, 1
L 257 2, 258, 1
A 257 2, 258, * 321
L 257 2, 321, 1, 100
258 1, 0. 1., 321 300, 'How is VOC concentration in output of reactor?' 'Ok' 'High'
L 258 0, 321, 0
L 258 1, 321, 1, 1
!
!Output alarm
!
!Alarme AAH18416
!
300 1, 0.062 1., 301 316,'State AE18416?' 'Ok' 'Failed'
L 300 1, 316, 1
301 1, 0.025 1., 311 316,'State AT18416?' 'Ok' 'Failed'
L 301 1, 316, 1
311 1, 0.025 1., 312 316, 'State AAH18416?' 'Ok' 'Failed'
L 311 1, 316, 1
312 1, 0.03 1., 316 316, 'Operator occur in case of Alarm AAH18416?' 'Yes' 'No'
L 312 1, 316, 1
L 312 0, 316, 0
316 1, 0. 1., 321 321, 'AAH18416 work correctly?' 'Yes-Emergency' 'No'
L 316 0, 321, 1, 1
L 316 1, 321, 1, 1
!
321 1, 0. 1., 0 0, 'How is VOC concentration in output of plant?' 'Ok' 'High'
```

Annex IV.B. Intensified plant

```
!
!Intensified plant
!Reverse flow reactor
!
!Input condition
!
1 1, 0.001 1., 3 2, 'Input gas temperature?' 'OK' 'No'
L 1 0, 20, 0
L 1 1, 20, 1
2 1, 0.5 1., 3 3, 'How is temperature?' 'High' 'Low'
L 2 0, 21, 0
L 2 1, 21, 1
3 1, 0.001 1., 5 4, 'VOC concentration in input?' 'OK' 'No'
L 3 0, 22, 0
L 3 1, 22, 1, 1
4 1, 0.5 1., 5 5, 'How is VOC concentration?' 'High' 'Low'
A 4 0, 5, 10 *
A 4 0, 6, 10 10
L 4 0, 23, 0
L 4 1, 23, 1
5 1, 0.001 1., 20 6, 'Flow in input?' 'OK' 'No'
L 5 0, 24, 0
L 5 1, 24, 1
6 1, 0.5 1., 20 20, 'How is flow?' 'High' 'Low'
L 6 0, 25, 0
L 6 1, 25, 1
!
!Alarm AAH01
!
10 1, 0.062 1., 11 15, 'State AE01?' 'OK' 'Failed'
L 10 1, 15, 1
11 1, 0.025 1., 12 15, 'State AT01?' 'OK' 'Failed'
L 11 1, 15, 1
12 1, 0.006 1., 13 15, 'State AI01?' 'OK' 'Failed'
L 12 1, 15, 1
13 1, 0.025 1., 14 15, 'State AAH01?' 'OK' 'Failed'
L 13 1, 15, 1
14 1, 0.03 1., 15 15, 'Operator occur in case of alarm AAH01?' 'Yes' 'No'
L 14 1, 15, 1
L 14 0, 15, 0
15 1, 0. 1., 602 20, 'AAH01 work correctly?' 'Yes-Emergency' 'No'
L 15 0, 602, 2, 100
L 15 1, 22, 1, 100
!
!Condition after Input
!
20 1, 0. 1., 22 21, 'Temperature after input zone is correct?' 'Yes' 'No'
L 20 0, 26, 0, 1
L 20 1, 26, 1, 100
L 20 0, 80, 0, 1
L 20 1, 80, 1, 1
21 1, 0. 1., 22 22, 'How is temperature after input zone?' 'High' 'Low'
L 21 0, 70, 0
A 21 0, 55, 70 *
A 21 0, 56, 70 70
L 21 0, 81, 0
L 21 1, 81, 1
```

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22 1, 0. 1., 24 23, 'VOC concentration after input zone is correct?' 'Yes' 'No'
L 22 0, 26, 0, 1
L 22 1, 26, 1, 100
L 22 0, 82, 0
L 22 1, 82, 1
23 1, 0. 1., 24 24, 'How is VOC concentration after input zone?' 'High' 'Low'
L 23 0, 83, 0
L 23 1, 83, 1
24 1, 0. 1., 26 25, 'Flow after input zone is correct?' 'Yes' 'No'
L 24 0, 26, 0, 1
L 24 1, 26, 1, 100
L 24 1, 84, 1, 10
L 24 0, 84, 0, 1
25 1, 0. 1., 26 26, 'How is flow after input zone?' 'High' 'Low'
L 25 0, 85, 0, 1
L 25 1, 85, 1, 1
26 1, 0. 1., 50 50, 'Condition after input zone is correct?' 'Yes' 'No'
!
!
!Blower
!
!
50 1, 0.084 1., 51 51, 'State Blower B-01?' 'OK' 'Failed'
L 50 1, 55, 1, 10
L 50 1, 56, 1, 100
A 50 1, 53, 55 55
51 1, 0.0.181 1., 52 55, 'State FE05?' 'OK' 'Failed'
L 51 1, 55, 1
52 1, 0.095 1., 53 55, 'State FT05?' 'OK' 'Failed'
L 52 1, 55, 1
53 1, 0.252 1., 54 55, 'State FIC05?' 'OK' 'Failed'
L 53 1, 55, 1
54 1, 0.231 1., 55 55, 'State FCV05?' 'OK' 'Failed'
L 54 1, 55, 1
L 54 0, 55, 0, 1
55 1, 0. 1., 80 56, 'Flow in the blower is correct?' 'Yes' 'No'
L 55 0, 84, 0, 1
L 55 1, 84, 1, 100
56 1, 0.5 1., 80 80, 'How is flow in the blower?' 'High' 'Low'
L 56 0, 85, 0, 10
L 56 1, 85, 1, 10
!
!Alarm TAH03
!
70 1, 0. 1., 71 75, 'Condition permit to work TAH03?' 'Yes' 'No'
71 1, 0.022 1., 72 75, 'State TE03?' 'OK' 'Failed'
L 71 1, 75, 1
72 1, 0.006 1., 73 75, 'State TI03?' 'OK' 'Failed'
L 72 1, 75, 1
73 1, 0.025 1., 74 75, 'State TAH03?' 'OK' 'Failed'
L 73 1, 75, 1
74 1, 0.03 1., 75 75, 'Operator occur in case of Alarm TAH03?' 'Yes' 'No'
L 74 1, 75, 1
L 74 0, 75, 0
75 1, 0. 1.,602 80, 'TAH03 work correctly?' 'Yes-Emergency' 'No'
L 75 0, 602, 2, 100
L 75 1, 80, 1, 100
```

```
!
!Condition after blower
!
80 1, 0. 1., 82 81, 'Temperature after blower is correct?' 'Yes' 'No'
L 80 0, 86, 0, 1
L 80 1, 86, 1, 100
L 80 0, 115, 0
L 80 1, 115, 1
81 1, 0. 1., 82 82, 'How is temperature after blower?' 'High' 'Low'
L 81 0, 116, 0
L 81 1, 116, 1
82 1, 0. 1., 84 83, 'VOC concentration after blower is correct?' 'Yes' 'No'
L 82 0, 86, 0, 1
L 82 1, 86, 1, 100
L 82 0, 117 0
L 82 1, 117 1
83 1, 0. 1., 84 84, 'How is VOC concentration after blower?' 'High' 'Low'
L 83 0, 118 0
L 83 1, 118 1
84 1, 0. 1., 86 85, 'Flow after blower is correct?' 'Yes' 'No'
L 84 0, 86, 0, 1
L 84 1, 86, 1, 100
L 84 0, 119, 0, 1
L 84 1, 119, 1, 30
85 1, 0. 1., 86 86, 'How is flow after blower?' 'High' 'Low'
L 85 0, 120, 0, 5
L 85 1, 120, 1, 5
86 1, 0. 1., 100 100, 'Condition after blower is correct?' 'Yes' 'No'
!
!Filter
!
100 1, 0.9 1., 101 101, 'State filter F-01?' 'OK' 'Obstructed'
L 100 0, 101, 0, 1
L 100 1, 101, 1, 100
101 1, 0. 1., 115 105, 'How is flow after filters?' 'Normal' 'Low'
L 101 0, 119, 0, 1
L 101 1, 119, 1, 10
!
!Alarm PDAH04
!
105 1, 0.025 1., 106 109, 'State PDIT04?' 'OK' 'Failed'
L 105 1, 109, 1
106 1, 0.006 1., 107 109, 'State PDI04?' 'OK' 'Failed'
L 106 1, 109, 1
107 1, 0.088 1., 108 109, 'State PDAH04?' 'OK' 'Failed'
L 107 1, 109, 1
108 1, 0.03 1., 109 109, 'Operator occur in case of alarm PDAH04?' 'Yes' 'No'
L 108 1, 109, 1
L 105 0, 109, 0
109 1, 0. 1., 115 110, 'PDAH04 work correctly?' 'Yes' 'No'
L 109 0, 119, 0, 20
!
!Alarm PAH22
!
110 1, 0.025 1., 111 114, 'State PT22?' 'OK' 'Failed'
L 110 1, 114, 1
111 1, 0.006 1., 112 114, 'State PI22?' 'OK' 'Failed'
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L 111 1, 114, 1
112 1, 0.088 1., 113 114, 'State PAH22?' 'OK' 'Failed'
L 112 1, 114, 1
113 1, 0.03 1., 114 114, 'Operator occur in case of alarm PAH22?' 'Yes' 'No'
L 113 1, 114, 1
L 113 0, 114, 0
114 1, 0. 1., 115 115, 'PAH22 work correctly?' 'Yes' 'No'
L 114 0, 119, 0, 20
L 114 1, 120, 1, 100
!
!Condition after filters
!
115 1, 0. 1., 117 116, 'Temperature after filter is correct?' 'OK' 'No'
L 115 0, 121 0, 1
L 115 1, 121 1, 100
L 115 0, 175 0
L 115 1, 175 1
116 1, 0. 1., 117 117, 'How is temperature after filter?' 'High' 'Low'
L 116 0, 176 0
L 116 1, 176 1
117 1, 0. 1., 119 118, 'VOC concentration after filter is correct?' 'OK' 'No'
L 117 0, 121 0, 1
L 117 1, 121 1, 100
L 117 0, 177 0
L 117 1, 177 1
118 1, 0. 1., 119 119, 'How is VOC concentration after blower?' 'High' 'Low'
L 118 0, 178 0
L 118 1, 178 1
119 1, 0. 1., 121 120, 'Flow after filter is correct?' 'OK' 'No'
L 119 0, 121 0, 1
L 119 1, 121 1, 100
L 119 0, 181 0
L 119 1, 181 1
120 1, 0. 1., 121 121, 'How is flow after blower?' 'High' 'Low'
L 120 0, 182 0
L 120 1, 182 1
121 1, 0. 1., 150 150, 'Condition after filter is correct?' 'Yes' 'No'
!
!Oxygen input
!
150 1, 0.062 1., 151 160, 'State AE18?' 'OK' 'Failed'
L 150 1, 160, 1
L 150 1, 165, 1
151 1, 0.095 1., 152 160, 'State AT18?' 'OK' 'Failed'
L 151 1, 160 1
L 151 1, 165, 1
152 1, 0.252 1., 153 160, 'State AICA18?' 'OK' 'Failed'
L 152 1, 160 1
L 152 1, 165, 1
L 152 0, 165, 0
153 1, 0.181 1., 154 160, 'State FE18?' 'OK' 'Failed'
L 153 1, 160, 1
154 1, 0.095 1., 155 160, 'State FT18?' 'OK' 'Failed'
L 154 1, 160, 1
155 1, 0.252 1., 156 160, 'State FIC18?' 'OK' 'Failed'
L 155 1, 160, 1
156 1, 0.231 1., 157 160, 'State FV18?' 'OK' 'Failed'
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L 156 1, 160, 1
157 1, 0.001 1., 160 160, 'Is present oxygen?' 'Yes' 'No'
L 157 1, 160, 1
L 157 0, 160, 0
L 157 1, 161, 1
160 1, 0. 1., 175 161, 'Input of oxygen is correct?' 'Yes' 'No'
L 160 0, 179, 0, 10
L 160 1, 179, 1, 1
161 1, 0.5 1., 165 175, 'How is oxygen concentration?' 'High' 'Low'
L 161 0, 180, 0
L 161 1, 180, 1
!
!Alarm AICA18
!
165 1, 0. 1., 166 167, 'Detection system oxygen work?' 'Yes' 'No'
L 165 1, 167, 1
166 1, 0.03 1., 167 167, 'Operator occur in case of Alarm AICA18?' 'Yes' 'No'
L 166 1, 167, 1
L 166 0, 167, 0
167 1, 0. 1., 602 175, 'AICA18 work correctly?' 'Yes-Emergency' 'No'
L 167 1, 179, 1, 10
L 167 1, 180, 0, 10
L 167 0, 602, 2
!
!Condition after oxygen input
!
175 1, 0. 1., 177 176, 'Temperature after input of oxygen is correct?' 'Yes' 'No'
L 175 0, 183, 0, 1
L 175 1, 183, 1, 100
L 175 0, 210, 0
L 175 1, 210, 1
176 1, 0. 1., 177 177, 'How is temperature after input of oxygen?' 'High' 'Low'
L 176 1, 211, 1, 10
L 176 0, 211, 0, 10
177 1, 0. 1., 179 178, 'VOC concentration after input of oxygen is correct?' 'Yes' 'No'
L 177 0, 183, 0, 1
L 177 1, 183, 1, 100
L 177 0, 275, 0, 1
L 177 1, 275, 1, 10

L 177 0, 700, 1, 2
L 177 0, 701, 1, 2
L 177 0, 702, 1, 2
L 177 0, 703, 1, 2
L 177 0, 704, 1, 2

178 1, 0. 1., 179 179, 'How is VOC concentration after input of oxygen?' 'High' 'Low'
L 178 0, 276, 0, 80
L 178 1, 276, 1, 80

L 178 0, 701, 0, 1
L 178 1, 701, 1, 2
L 178 1, 700, 0, 1
L 178 0, 700, 1, 2
L 178 1, 702, 0, 1
L 178 0, 702, 1, 2
L 178 1, 703, 0, 1
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L 178 0, 703, 1, 2
L 178 0, 704, 0, 1
L 178 1, 704, 1, 2

179 1, 0. 1., 181 180, 'Oxygen concentration after input of oxygen is correct?' 'Yes' 'No'
L 179 0, 183, 0, 1
L 179 1, 183, 1, 100
L 179 0, 275, 0, 1
180 1, 0. 1., 181 181, 'How is oxygen concentration after input of oxygen?' 'High' 'Low'
L 180 0, 275, 0, 1
L 180 1, 275, 1, 100
L 180 1, 276, 1, 99
L 180 1, 528, 1, 70
181 1, 0. 1., 183 182, 'Flow after input of oxygen is correct?' 'Yes' 'No'
L 181 0, 183, 0, 1
L 181 1, 183, 1, 10
L 181 0, 275, 0, 1
L 181 1, 275, 0, 1

L 181 0, 702, 1, 2

182 1, 0. 1., 183 183, 'How is flow after input of oxygen?' 'High' 'Low'
L 182 0, 275, 0, 2
L 182 1, 275, 0, 2

L 182 1, 702, 0, 1
L 182 0, 702, 1, 2


183 1, 0. 1., 210 210, 'Condition after input of oxygen is correct?' 'Yes' 'No'
!
!Reactor
!Reactor input condition
!
!
210 1, 0. 1., 700 211, 'Temperature inside of reactor is correct?' 'Yes' 'No'
L 210 0, 275, 0, 1
L 210 1, 275, 1, 10

L 210 0, 700, 1, 2
L 210 0, 701, 1, 2
L 210 0, 703, 1, 2
L 210 0, 704, 1, 2

211 1, 0. 1., 700 700, 'How is temperature inside of reactor?' 'High' 'Low'

L 211 0, 276, 0, 10
L 211 1, 275, 0, 11

L 211 0, 700, 0, 1
L 211 1, 700, 1, 2
L 211 1, 701, 0, 1
L 211 0, 701, 1, 2
L 211 1, 703, 0, 1
L 211 0, 703, 1, 2
L 211 0, 704, 0, 1
L 211 1, 704, 1, 2
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!
!Exception
!
700 1, 0. 1., 701 701, 'Exception 1: Low VOC and High gas temperature?' 'Yes' 'No'
L 700 0, 275, 0, 50
701 1, 0. 1., 702 702, 'Exception 2: High VOC and Low gas temperature?' 'Yes' 'No'
L 701 0, 275, 0, 50
702 1, 0. 1., 703 703, 'Exception 3: Low VOC and Low Flow, TSL10 can not work?' 'Yes' 'No'
L 702 0, 528, 1, 2
703 1, 0. 1., 704 704, 'Exception 4: Low VOC and Low gas temperature, TSL10 can not work?' 'Yes' 'N
L 703 0, 528, 1, 2
L 703 0, 275, 1, 50
704 1, 0. 1., 230 230, 'Exception 5: High VOC and High gas temperature, TSH10 and TSH21 can not wor
L 704 0, 385, 1, 2
L 704 0, 408, 1, 2
!
!Valve
!
!XV12
230 1, 0.007 1., 232 231, 'State XV12?' 'OK' 'Failed'
L 230 0, 240, 0, 1
L 230 0, 241, 0, 1
L 230 0, 244, 1, 10
L 230 0, 407, 0, 1
L 230 1, 407, 1, 10
L 230 0, 386, 0, 1
L 230 1, 386, 1, 10
L 230 0, 527, 0, 1
L 230 1, 527, 1, 10

L 230 0, 250, 0
L 230 0, 251, 1, 10
L 230 0, 252, 1, 10
L 230 0, 254, 1, 10

231 1, 0.5 1., 232 232, 'How is fault XV12?' 'Open' 'Close'
L 231 1, 240, 1, 10
L 231 0, 240, 0, 1
L 231 1, 241, 1, 12
L 231 0, 241, 0, 1
L 231 0, 244, 1, 11

L 231 0, 252, 0, 1
L 231 1, 252, 1, 10
L 231 0, 254, 0, 1
L 231 1, 254, 1, 10

232 1, 0.007 1., 234 233, 'State XV13?' 'OK' 'Failed'
L 232 0, 240, 0
L 232 0, 244, 1, 10
L 232 0, 241, 1, 10
L 232 0, 407, 0, 1
L 232 1, 407, 1, 10
L 232 0, 386, 0, 1
L 232 1, 386, 1, 10
L 232 0, 527, 0, 1
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L 232 1, 527, 1, 10
L 232 0, 448, 0, 1
L 232 1, 448, 0, 1
L 232 0, 468, 0, 1
L 232 1, 468, 0, 1

L 232 0, 250, 0, 1
L 232 0, 252, 0, 1
L 232 0, 254, 1, 10

233 1, 0.5 1., 234 234, 'How is fault XV13?' 'Open' 'Close'
L 233 1, 241, 1, 10
L 233 0, 241, 0, 11
L 233 0, 240, 1, 10
L 233 0, 244, 0, 1
L 233 1, 244, 1, 10

L 233 1, 250, 1, 10
L 233 0, 250, 0, 1
L 233 1, 252, 1, 10
L 233 0, 252, 0, 1
L 233 0, 254, 1, 10

234 1, 0.007 1., 236 235, 'State XV14?' 'OK' 'Failed'
L 234 0, 240, 0, 1
L 234 0, 242, 0, 1
L 234 0, 244, 1, 10
L 234 0, 407, 0, 1
L 234 1, 407, 1, 10
L 234 0, 386, 0, 1
L 234 1, 386, 1, 10
L 234 0, 527, 0, 1
L 234 1, 527, 1, 10
L 234 0, 448, 0, 1
L 234 1, 448, 0, 1
L 234 0, 468, 0, 1
L 234 1, 468, 0, 1

L 234 0, 250, 0
L 234 0, 254, 1, 10
L 234 0, 251, 1, 10

235 1, 0.5 1., 236 236, 'How is fault XV14?' 'Open' 'Close'
L 235 1, 240, 1, 10
L 235 0, 240, 0, 1
L 235 1, 242, 1, 10
L 235 0, 242, 0, 1
L 235 0, 244, 1, 10

L 235 1, 251, 1, 10
L 235 0, 251, 0, 11
L 235 0, 250, 1, 10
L 235 0, 254, 0, 1
L 235 1, 254, 1, 10

236 1, 0.007 1., 240 237, 'State XV15?' 'OK' 'Failed'
L 236 0, 240, 0
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L 236 0, 241, 1, 10
L 236 0, 242, 1, 10
L 236 0, 244, 1, 10
L 236 0, 407, 0, 1
L 236 1, 407, 1, 10
L 236 0, 386, 0, 1
L 236 1, 386, 1, 10
L 236 0, 527, 0, 1
L 236 1, 527, 1, 10

L 236 0, 250, 0, 1
L 236 0, 251, 0, 1
L 236 0, 254, 1, 10

237 1, 0.5 1., 240 240, 'How is fault XV15?' 'Open' 'Close'
L 237 0, 242, 0, 1
L 237 1, 242, 1, 10
L 237 0, 244, 0, 1
L 237 1, 244, 1, 10

L 237 1, 250, 1, 10
L 237 0, 250, 0, 1
L 237 1, 251, 1, 12
L 237 0, 251, 0, 1
L 237 0, 254, 1, 11
!
!How pass gas inside reactor in phase XV12-->XV14
!
240 1, 0. 1., 241 241, 'XV12 --> XV14 OK?' 'Yes' 'No' 0|1
L 240 1, 243, 0, 1
L 240 0, 243, 1, 10
L 240 0, 245, 0
241 1, 0. 1., 242 242, 'XV12 --> XV14 Bypass down?' 'Yes' 'No' 0|1
L 241 1, 243, 0, 1
L 241 0, 243, 1, 10
L 241 0, 245, 1
242 1, 0. 1., 244 244, 'XV12 --> XV14 Bypass up?' 'Yes' 'No' 0|1
L 242 1, 243, 0, 1
L 242 0, 243, 1, 10
L 242 0, 245, 1
244 1, 0. 1., 243 243, 'XV12 --> XV14 reverse?' 'Yes' 'No' 0|1
L 244 1, 243, 0, 1
L 244 0, 243, 1, 10
L 244 0, 245, 2
243 1, 0. 1., 245 245, 'XV12 --> XV14 can not pass?' 'Yes' 'No' 0|1
L 243 0, 245, 3
!
245 3, 0. 0. 0., 1. 1. 1., 250 250 250 250 , 'How pass the gas during phase XV12 ---> XV14?' 'OK' '
L 245 1|2|3, 286, 1
L 245 0, 286, 0
L 245 0|1|2, 292 1, 100
L 245 3, 292, 0, 10
L 245 1, 603, 1, 100
A 245 1, 601, 603 *
!
!How pass gas inside reactor in phase XV15-->XV13
!
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250 1, 0. 1., 251 251, 'XV15 --> XV13 OK?' 'Yes' 'No' 0|1
L 250 1, 253, 0, 1
L 250 0, 253, 1, 10
L 250 0, 255, 0
251 1, 0. 1., 252 252, 'XV15 --> XV13 Bypass up?' 'Yes' 'No' 0|1
L 251 1, 253, 0, 1
L 251 0, 253, 1, 10
L 251 0, 255, 1
252 1, 0. 1., 254 254, 'XV15 --> XV13 Bypass down?' 'Yes' 'No' 0|1
L 252 1, 253, 0, 1
L 252 0, 253, 1, 10
L 252 0, 255, 1
254 1, 0. 1., 253 253, 'XV15 --> XV13 reverse?' 'Yes' 'No' 0|1
L 254 1, 253, 0, 1
L 254 0, 253, 1, 10
L 254 0, 255, 2
253 1, 0. 1., 255 255, 'XV15 --> XV13 can not pass?' 'Yes' 'No' 0|1
L 253 0, 255, 3
!
255 3, 0. 0. 0., 1. 1. 1., 292 292 292 292, 'How pass the gas during phase XV15 ---> XV13?' 'OK' 'B
L 255 0|1|2, 292 1, 100
L 255 3, 292, 0, 10
L 255 1|2|3, 287, 1
L 255 0, 287, 0
L 255 1, 603, 1, 100
A 255 1, 601, 603 *
!
!Remember how gas pass in reactor
!
292 1, 0. 1., 286 286, 'Condition where gas never can pass in reactor?' 'Yes' 'No'
L 292 0, 603, 0, 100
L 292 0, 408, 1, 10
L 292 0, 385 , 1, 10
286 1, 0. 1., 287 287, 'In phase XV12-->XV14 how occur the gas flow?' 'OK' 'NO'
A 286 1, 287, 289 290
L 286 0, 288, 0
L 286 1, 289, 0
287 1, 0. 1., 288 289, 'In phase XV15-->XV13 how occur the gas flow?' 'OK' 'NO'
L 287 0, 288, 0
L 287 1, 289, 0
L 287 0, 289, 0
L 287 1, 290, 0
288 1, 0. 1., 275 289,'Gas inside reactor pass correctly?' 'Yes' 'No'
L 288 0, 275, 0, 1
289 1, 0. 1., 275 290, 'In 1 phase gas pass in the reactor zone in wrong way?' 'Yes' 'No'
L 289 0, 275, 1, 100
L 289 0, 276, 1, 100
L 289 0, 528, 1

290 1, 0. 1., 270 270, 'In 2 phases gas pass in the reactor zone in wrong way?' 'Yes' 'No'
A 290 0, 284, 291 *
A 290 0, 285, 291 291
!
!Reaction temperature control
!
270 1, 0.022 1., 280 285, 'State E-02?' 'OK' 'Failed'
L 270 0, 275, 1, 1
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L 270 1, 275, 1, 10
L 270 0, 384 0
L 270 1, 384 1
L 270 0, 451 0
L 270 1, 451 1
L 270 0, 471 0
L 270 1, 471 1
280 1, 0.084 1., 282 281, 'State TE10a?' 'OK' 'Failed'
L 280 0, 360, 0
L 280 1, 360, 1
L 280 0, 500, 0
L 280 1, 500, 1
281 1, 0.084 1., 282 285, 'State TE10b?' 'OK' 'Failed'
L 281 0, 361, 0
L 281 1, 361, 1
L 281 0, 501, 0
L 281 1, 501, 1
L 281 1, 275, 1, 10
282 1, 0.252 1., 283 285, 'State TIC10?' 'OK' 'Failed'
L 282 0, 362, 0
L 282 1, 362, 1
L 282 0, 502, 0
L 282 1, 502, 1
L 282 1, 275, 1, 10
L 282 0, 275, 0, 1
283 1, 0.197 1., 284 285, 'State KS16?' 'OK' 'Failed'
L 283 0, 275, 0, 1
L 283 1, 275, 1, 1
L 283 0, 405, 0
L 283 1, 405, 1
L 283 0, 446, 0
L 283 1, 446, 1
L 283 0, 466, 0
L 283 1, 466, 1
L 283 0, 525, 0
L 283 1, 525, 1
284 1, 0.197 1., 275 285, 'State FSC16?' 'OK' 'Failed'
L 284 0, 275, 0, 1
L 284 1, 275, 1, 1
L 284 0, 406, 0
L 284 1, 406, 1
L 284 0, 447, 0
L 284 1, 447, 1
L 284 0, 467, 0
L 284 1, 467, 1
L 284 0, 527, 0
L 284 1, 527, 1
L 284 0, 291, 0
285 1, 0.5 1., 275 275 , 'How fault in control temperature change the reactor temperature' 'High' '
L 285 0, 276, 0, 51
L 285 1, 276, 1, 51
L 285 0, 291, 1
L 285 1, 291, 2
291 2, 0. 0., 1. 1., 275 275 275, 'In case of 2 way wrong gas passage how is reaction temperature?'
L 291 1|2, 275, 1, 100
L 291 0, 275, 0, 102
L 291 1, 276, 0, 100
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L 291 2, 276, 1, 100
L 291 2, 528, 1
L 291 1, 385, 1
L 291 1, 408, 1

275 1, 0. 1., 601 276, 'Temperature inside of reactor is correct?' 'Yes' 'No'
L 275 1, 601, 1, 1
L 275 0, 601, 0, 0
276 1, 0. 1., 350 500, 'How is temperature inside reactor?' 'High' 'Low'
L 276 0, 602, 0, 1
L 276 1, 602, 1, 1
!
!Alarms
!
!
!High temperature
!
!TSH21
350 1, 0.022 1., 351 380, 'State TE21?' 'OK' 'Failed'
L 350 1, 380, 1
351 1, 0.006 1., 380 380, 'State TI21?' 'OK' 'Failed'
L 351 1, 380, 1
L 351 0, 380, 0

380 1, 0. 1., 381 385, 'Revelator 21 of temperature inside reactor work?' 'Yes' 'No'
L 380 1, 385, 1
L 380 1, 355, 1
L 380 0, 355, 0

381 1, 3e-4 1., 382 385, 'State TSH21?' 'OK' 'Failed'
L 381 1, 385, 1
382 1, 0.054 1., 383 385, 'State HS21?' 'OK' 'Failed'
L 382 1, 385, 1
L 382 1, 449, 1
L 382 0, 449, 0
L 382 1, 469, 1
L 382 0, 469, 0
383 1, 0.054 1., 384 385, 'State I01?' 'OK' 'Failed'
L 383 1, 385, 1
L 383 1, 450, 1
L 383 0, 450, 0
L 383 1, 470, 1
L 383 0, 470, 0
384 1, 0.022 1., 386 385, 'State E-02?' 'OK' 'Failed'
L 384 1, 385, 1
L 384 0, 385, 0
L 384 1, 451, 1
L 384 0, 451, 0
L 384 1, 471, 1
L 384 0, 471, 0
386 1, 0.0 1., 385 385, 'State valve XV?' 'OK' 'Failed'
L 386 1, 385, 1
L 386 0, 385, 0
385 1, 0. 1., 600 360, 'Protective device TSH21 work correctly?' 'Yes' 'No'
L 385 0, 600, 0
!
!TSH10
```

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360 1, 0.084 1., 362 361, 'State TE10a?' 'OK' 'Failed'
361 1, 0.084 1., 362 400, 'State TE10b?' 'OK' 'Failed'
L 361 1, 400, 1
362 1, 0.252 1., 400 400, 'State TIC10?' 'OK' 'Failed'
L 362 1, 400, 1
L 362 0, 400, 0

400 1, 0. 1., 401 408, 'Revelator 10 of temperature inside reactor work?' 'OK' 'No'
L 400 1, 408, 1
L 400 1, 366, 1
L 400 0, 430, 0
L 400 1, 430, 1
L 400 0, 366, 0

401 1, 3e-4 1., 402 408, 'State TSH10?' 'OK' 'Failed'
L 401 1, 408, 1
402 1, 0.197 1., 403 408, 'State I02?' 'OK' 'Failed'
L 402 1, 408, 1
403 1, 0.054 1., 405 404, 'State HS16a?' 'OK' 'Failed'
L 403 1, 444, 1
L 403 0, 444, 0
L 403 1, 464, 1
L 403 0, 464, 0
404 1, 0.054 1., 405 408, 'State HS16b?' 'OK' 'Failed'
L 404 1, 408, 1
L 404 1, 445, 1
L 404 0, 445, 0
L 404 1, 465, 1
L 404 0, 465, 0
405 1, 0.197 1., 406 408, 'State KS16?' 'OK' 'Failed'
L 405 1, 408, 1
L 405 1, 446, 1
L 405 0, 446, 0
L 405 1, 466, 1
L 405 0, 466, 0
406 1, 0.197 1., 407 408, 'State FSC16?' 'OK' 'Failed'
L 406 1, 408, 1
L 406 1, 447, 1
L 406 0, 447, 0
L 406 1, 467, 1
L 406 0, 467, 0
407 1, 0.0 1., 408 408, 'State valve XV?' 'OK' 'Failed'
L 407 1, 408, 1
L 407 0, 408, 0
408 1, 0. 1., 600 325, 'Protective device TSH10 work correctly?' 'Yes' 'No'
L 408 0, 600, 0
L 408 1, 600, 1
!
!TAH11
!
325 1, 0.022 1., 327 326, 'State TE11a?' 'OK' 'Failed'
326 1, 0.022 1., 327 331, 'State TE11b?' 'OK' 'Failed'
L 326 1, 331, 1
327 1, 0.006 1., 331 331, 'State TI11?' 'OK' 'Failed'
L 327 1, 331, 1
L 327 0, 331, 0
331 1, 0. 1., 328 330, 'Revelator 11 of temperature inside reactor work?' 'OK' 'No'
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L 331 1, 330, 1
L 331 1, 420, 1
L 331 0, 420, 0
328 1, 0.025 1., 329 330, 'State TAH11?' 'OK' 'Failed'
L 328 1, 330, 1
329 1, 0.03 1., 330 330, 'Operator occur in case of alarm TAH11?' 'Yes' 'No'
L 329 1, 330, 1
L 329 0, 330, 0
330 1, 0. 1., 602 355, 'Alarm TAH11 work correctly?' 'Yes-Emergency' 'No'
L 330 0, 602, 2
!
!THA21
!
355 1, 0. 1., 352 354, 'Revelator 21 of temperature inside reactor work?' 'OK' 'No'
L 355 1, 354, 1

352 1, 0.025 1., 353 354, 'State TAH21?' 'OK' 'Failed'
L 352 1, 354, 1
353 1, 0.03 1., 354 354, 'Operator occur in case of alarm TAH21?' 'Yes' 'No'
L 353 1, 354, 1
L 353 0, 354, 0
354 1, 0. 1., 602 366, 'Alarm TAH21 work correctly?' 'Yes-Emergency' 'No'
L 354 0, 602, 2
!
!TAH10
!
366 1, 0. 1., 363 365, 'Revelator 10 of temperature inside reactor work?' 'OK' 'No'
L 366 1, 365, 1

363 1, 0.025 1., 364 365, 'State TAH10?' 'OK' 'Failed'
L 363 1, 365, 1
364 1, 0.03 1., 365 365, 'Operator occur in case of alarm TAH10?' 'Yes' 'No'
L 364 1, 365, 1
L 364 0, 365, 0
365 1, 0. 1., 602 440, 'Alarm TAH10 work correctly?' 'Yes-Emergency' 'No'
L 365 0, 602, 2
!
!TSHH11
440 1, 0. 1., 441 452, 'Revelator 11 of temperature inside reactor work?' 'OK' 'No'
L 440 1, 452, 1
L 440 1, 420, 1
L 440 0, 420, 0
441 1, 3e-4 1., 442 452,'State TSHH11?' 'OK' 'Failed'
L 441 1,452, 1
442 1, 0.054 1., 443 452, 'State I04?' 'OK' 'Failed'
L 442 1,452, 1
L 442 1, 462, 1
L 442 0, 462, 0
443 1, 0.007 1., 444 452, 'State XV29?' 'OK' 'Failed'
L 443 1, 452, 1
L 443 1, 463, 1
L 443 0, 463, 0
444 1, 0.054 1., 446 445, 'State HS16a?' 'OK' 'Failed'
445 1, 0.054 1., 446 452, 'State HS16b?' 'OK' 'Failed'
L 445 1,452, 1
446 1, 0.197 1., 447 452, 'State KS16?' 'OK' 'Failed'
L 446 1, 452, 1
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447 1, 0.197 1., 448 452, 'State FSC16?' 'OK' 'Failed'
L 447 1, 452, 1
448 1, 0.0 1., 449 452, 'State of valve XV13 e XV14 permit reduce temperature?' 'Yes' 'No'
L 448 1, 452, 1
449 1, 0.054 1., 450 452, 'State HS21?' 'OK' 'Failed'
L 449 1, 452, 1
450 1, 0.054 1., 451 452, 'State I01?' 'OK' 'Failed'
L 450 1, 452, 1
451 1, 0.022 1., 452 452, 'State E-02?' 'OK' 'Failed'
L 451 1, 452, 1
L 451 0, 452, 0
452 1, 0. 1., 600 460, 'Protective device TSHH21 work correctly?' 'Yes-Emergency' 'No'
L 452 0, 600, 1
L 452 0, 602, 2, 10
!
!TSHH10
!
460 1, 0. 1., 461 472, 'Revelator 10 of temperature inside reactor work?' 'OK' 'No'
L 460 1, 472, 1
L 460 1, 430, 1
L 460 0, 430, 0
461 1, 3e-4 1., 462 472,'State TSHH10?' 'OK' 'Failed'
L 461 1,472, 1
462 1, 0.054 1., 463 472, 'State I04?' 'OK' 'Failed'
L 462 1, 472, 1
463 1, 0.007 1., 464 472, 'State XV29?' 'OK' 'Failed'
L 463 1, 472, 1
464 1, 0.054 1., 466 465, 'State HS16a?' 'OK' 'Failed'
465 1, 0.054 1., 466 472, 'State HS16b?' 'OK' 'Failed'
L 465 1, 472, 1
466 1, 0.197 1., 467 472, 'State KS16?' 'OK' 'Failed'
L 466 1, 472, 1
467 1, 0.197 1., 468 472, 'State FSC16?' 'OK' 'Failed'
L 467 1, 472, 1
468 1, 0. 1., 469 472, 'State of valve XV13 e XV14 permit reduce temperature?' 'Yes' 'No'
L 468 1, 472, 1
469 1, 0.054 1., 470 472, 'State HS21?' 'OK' 'Failed'
L 469 1, 472, 1
470 1, 0.054 1., 471 472, 'State I01?' 'OK' 'Failed'
L 470 1, 472, 1
471 1, 0.022 1., 472 472, 'State E-02?' 'OK' 'Failed'
L 471 1, 472, 1
L 471 0, 472, 0
472 1, 0. 1., 600 420, 'Protective device TSHH10 work correctly?' 'Yes-Emergency' 'No'
L 472 0, 600, 1
L 472 0, 602, 2
L 472 1, 600, 1
!
!TAHH11
!
420 1, 0. 1., 421 423, 'Revelator 11 of temperature inside reactor work?' 'OK' 'No'
L 420 1, 423, 1

421 1, 0.025 1., 422 423, 'State TAHH11?' 'OK' 'Failed'
L 421 1, 423, 1
422 1, 0.03 1., 423 423, 'Operator occur in case of alarm TAHH11?' 'Yes' 'No'
L 422 1, 423, 1
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L 422 0, 423, 0
423 1, 0. 1., 602 430, 'Alarm TAHH11 work correctly?' 'Yes-Emergency' 'No'
L 423 0, 602, 2
!
!TAHH10
!
430 1, 0. 1., 431 433, 'Revelator 10 of temperature inside reactor work?' 'OK' 'No'
L 430 1, 433, 1

431 1, 0.025 1., 432 433, 'State TAHH10?' 'OK' 'Failed'
L 431 1, 433, 1
432 1, 0.03 1., 433 433, 'Operator occur in case of alarm TAHH10?' 'Yes' 'No'
L 432 1, 433, 1
L 432 0, 433, 0
433 1, 0. 1., 602 600, 'Alarm TAHH10 work correctly?' 'Yes-Emergency' 'No'
L 433 1, 600, 1
L 433 0, 602, 2
!
!Low temperature
!
!TSL10
!
500 1, 0.084 1., 502 501, 'State TE10a?' 'OK' 'Failed'
501 1, 0.084 1., 502 520, 'State TE10b?' 'OK' 'Failed'
L 501 1, 520, 1
502 1, 0.252 1., 520 520, 'State TIC10?' 'OK' 'Failed'
L 502 1, 520, 1
L 502 0, 520, 0

520 1, 0. 1., 521 528, 'Revelator 10 of temperature inside reactor work?' 'OK' 'No'
L 520 1, 528, 1
L 520 1, 503, 1
L 520 0, 503, 0
L 520 1, 550, 1
L 520 0, 550, 0

521 1, 3e-4 1., 522 528, 'State TSL10?' 'OK' 'Failed'
L 521 1, 528, 1
522 1, 0.054 1., 523 528, 'State I02?' 'OK' 'Failed'
L 522 1, 528, 1
523 1, 0.054 1., 525 524, 'State HS16a?' 'OK' 'Failed'
524 1, 0.054 1., 525 528, 'State HS16b?' 'OK' 'Failed'
L 404 1, 408, 1
525 1, 0.197 1., 526 528, 'State KS16?' 'OK' 'Failed'
L 405 1, 408, 1
526 1, 0.197 1., 527 528, 'State FSC16?' 'OK' 'Failed'
L 406 1, 408, 1
527 1, 0. 1., 528 528, 'State valve XV?' 'OK' 'Failed'
L 527 1, 528, 1
L 527 0, 528, 0
528 1, 0. 1., 600 503, 'Protective device TSL10 work correctly?' 'Yes-Emergency' 'No'
L 528 0, 600, 0
L 528 1, 600, 1
!
!TAL10
!
503 1, 0. 1., 504 506, 'Revelator 10 of temperature inside reactor work?' 'OK' 'No'
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L 503 1, 506, 1

504 1, 0.025 1., 505 506, 'State TAL10?' 'OK' 'Failed'
L 504 1, 506, 1
505 1, 0.03 1., 506 506, 'Operator occur in case of alarm TAL10?' 'Yes' 'No'
L 505 1, 506, 1
L 505 0, 506, 0
506 1, 0. 1., 602 550, 'Alarm TAL10 work correctly?' 'Yes-Emergency' 'No'
L 506 0, 602, 2
!
!TALL10
!
550 1, 0. 1., 551 553, 'Revelator 10 of temperature inside reactor work?' 'OK' 'No'
L 520 1, 553, 1
551 1, 0.025 1., 552 553, 'State TALL10?' 'OK' 'Failed'
L 551 1, 553, 1
552 1, 0.03 1., 553 553, 'Operator occur in case of alarm TALL10?' 'Yes' 'No'
L 552 1, 553, 1
L 552 0, 553, 0
553 1, 0. 1., 602 600, 'Alarm TALL10 work correctly?' 'Yes-Emergency' 'No'
L 553 1, 600, 1
L 553 0, 602, 2
!
!Reactor condition
!
600 1, 0. 1., 601 601, 'The temperature is returned at normal value?' 'Yes' 'No'
L 600 0, 601, 0, 10
L 600 1, 601, 1, 10
601 1, 0. 1., 603 602, 'How is temperature inside of reactor?' 'OK' 'Wrong'
L 601 0, 603, 0
602 2, 0. 0. 1. 1., 603 603 650, 'What is reactor condition??' 'Cat. Sintered' 'Shutdown' 'Emergenc
L 602 0, 603, 1
L 602 1, 603, 1
L 602 2, 650, 1
603 1, 0. 1., 650 640, 'How is condition of exhausted gas?' 'OK' 'High VOC'
L 603 0, 650, 0, 10
L 603 1, 650, 1, 1
!
!Output alarm
!
!AIA19
!
640 1, 0.062 1., 641 644, 'State AE19?' 'OK' 'Failed'
L 640 1, 644, 1
641 1, 0.025 1., 642 644, 'State AT19?' 'OK' 'Failed'
L 641 1, 644, 1
642 1, 0.025 1., 643 644, 'State AIA19?' 'OK' 'Failed'
L 642 1, 644, 1
643 1, 0.03 1., 644 644, 'Operator occur in case of alarm AIA19?' 'Yes' 'No'
L 643 1, 644, 1
L 643 0, 644, 0
644 1, 0. 1., 650 650, 'Alarm AIA19 work correctly?' 'Yes-Emergency' 'No'
L 644 0, 650, 1, 10
L 644 1, 650, 1, 1
650 1, 0. 1., 0 0, 'How is VOC concentration in output of plant?' 'Ok' 'High'
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