

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

고장수목분석을 응용한 화재안전정지분석 방법

(KNS 2025 Autumn Conference)

화재방호 안전현안 및 규제활동 지원용 전산프로그램 개발

Dev. of a computer program to support the FIRE protection safety issues and regulatory activities

2025. 10. 31.

|주|스탠더드시험연구소

STANDARD TESTING & ENGINEERING INC.



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1. INTRODUCTION



Introduction

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

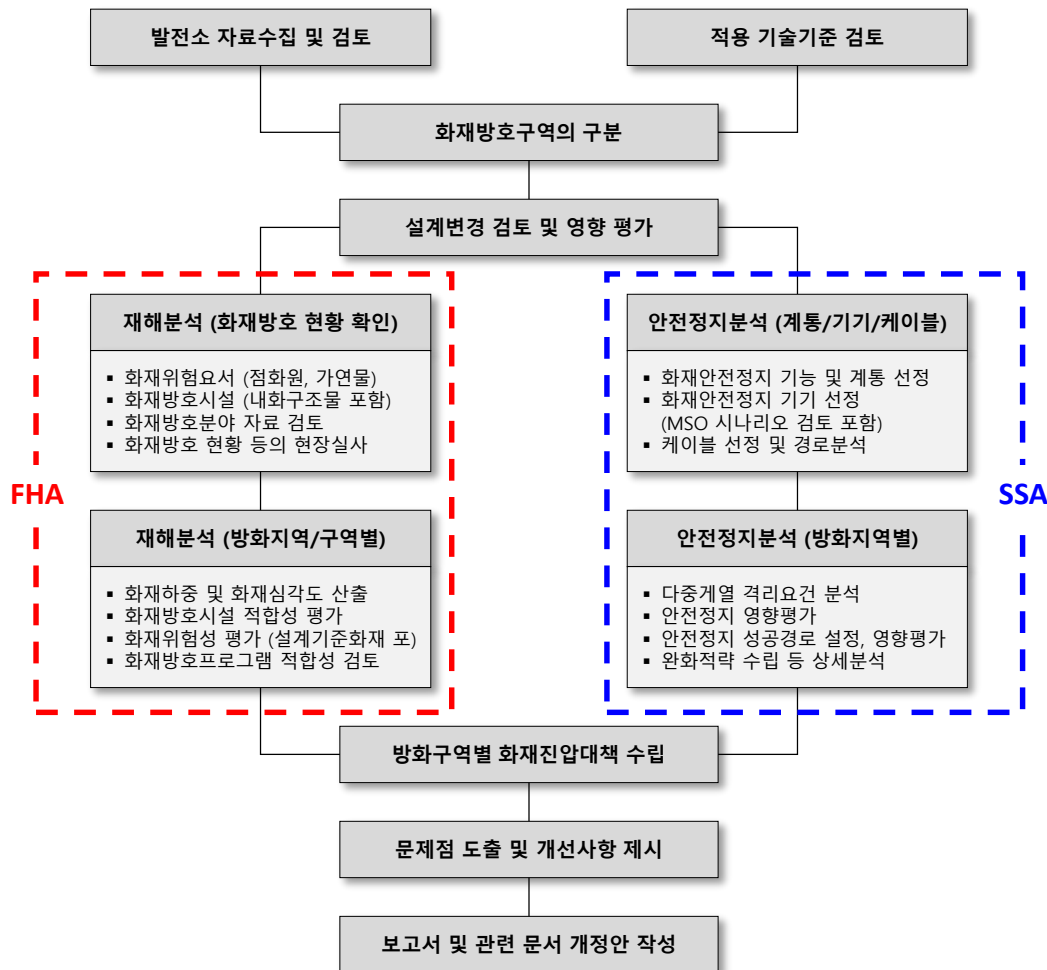


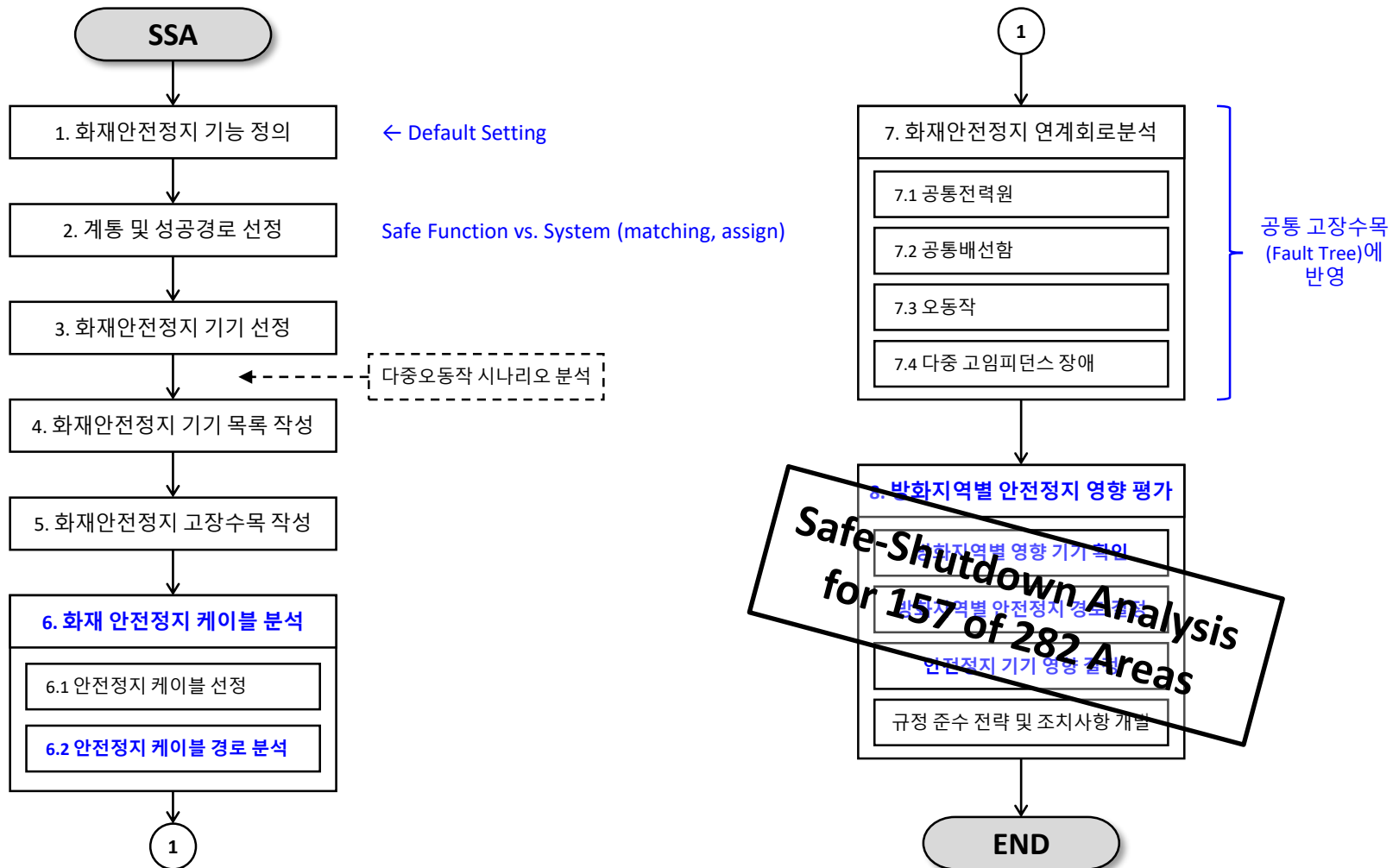
Fig. Work-flow of General Fire Hazard Analysis Process

Introduction

(2/3)

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

■ Post-Fire Safe-Shutdown Analysis



Introduction

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

■ Comparison of Fault Tree in PSA & Post-Fire SSA

	PSA	Post-Fire SSA
Goal	Sys. Failure Probability or Core Damage Frequency (Level 1)	Rx Safe-Shutdown for Fire
Applicable Target	Target System or Plant (Rx Core)	Safe-Shutdown due to Fire in each Fire Area in NPP
Top Event	System Failure or Core Damage	Rx Safe-Shutdown Fail
Intermediate Event (Gate)	Safe Function & System (Reactivity Ctrl., RCS Inventory Ctrl., RCS Pressure Ctrl., Core & RCS Heat Removal, Containment Integrity)	Fire Safe-Shutdown Function & System (Reactivity Ctrl., Reactor Coolant Makeup, Reactor (Decay) Heat Removal, Process Monitoring, Support Function)
Basic Event	Safe System Components (Assign Failure Probability or Failure Rate)	Assigning equal value to Basic Event for Fire-Affected Components & Cables in each Area
Initial Event	Single Event among Internal Event (LOCA, Transient), External Event (Earthquake, Fire, Flooding)	Fire in Each Fire Area (Single Fire, Fire in Single Area)
Quantification	Event Tree – Fault Tree Link, System Fault Tree Integration	Quantification of Area Specific Fault Tree reflected Fire-Affected Components & Cables for each Area
Analysis Result	Sys. Failure Probability or CDF ⇒ Probability (<1)	Success or Failure of Rx Safe-Shutdown (Top = 0.0: Success, Top > 0.0: Fail)
Cut-Set	Minimal Cut-Set	All Cut-Set List

2. Post-Fire SSA Method Applying FTA



2

Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.1 Preparing Plant Common Fault Tree

2.2 Identifying Fire Affected Components & Cables for each Fire Area

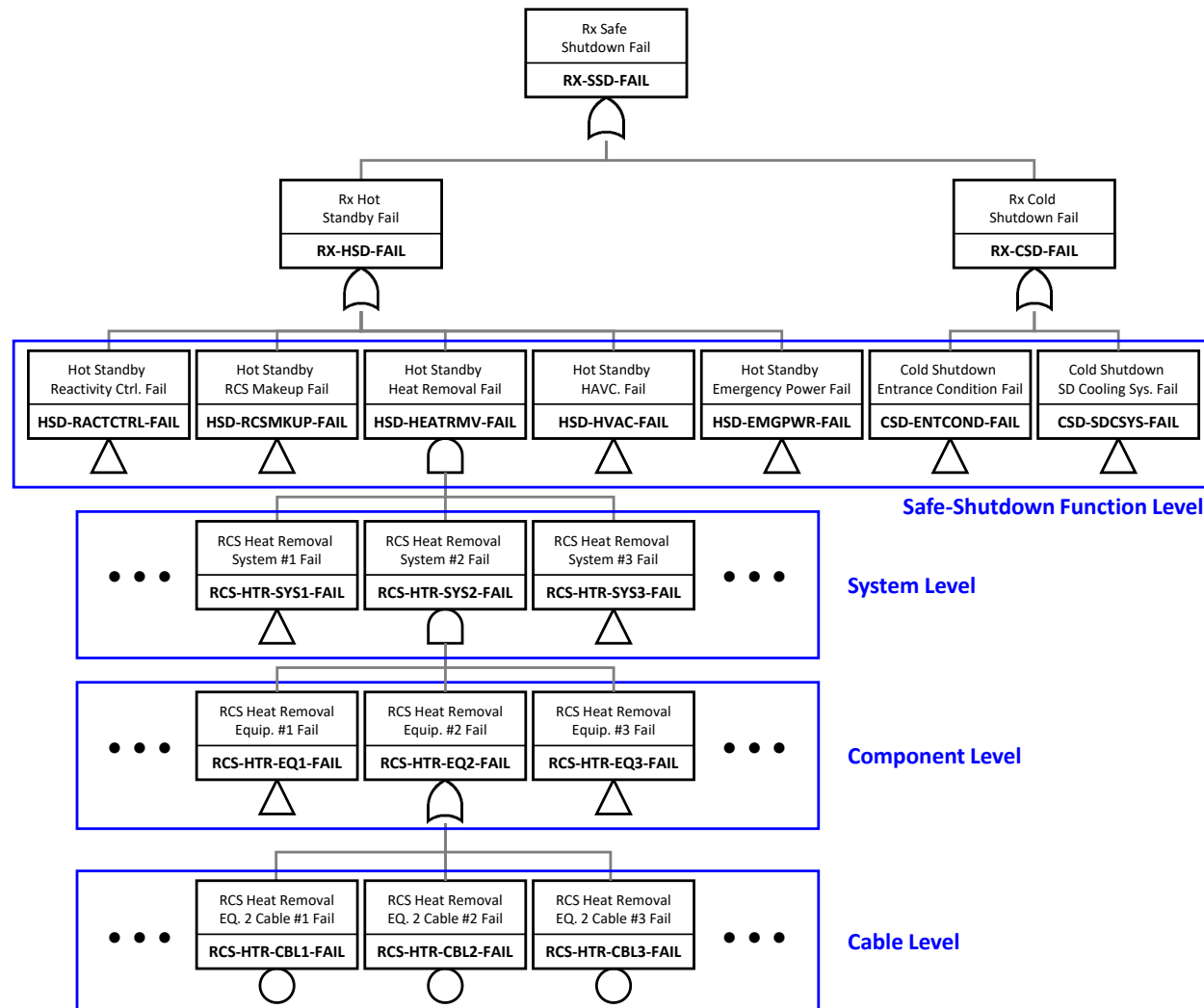
2.3 Generating Area Specific Fault Tree applied the Components/Cables

2.4 Quantifying the Area Specific Fault Tree

Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.1 Preparing Plant Common Fault Tree

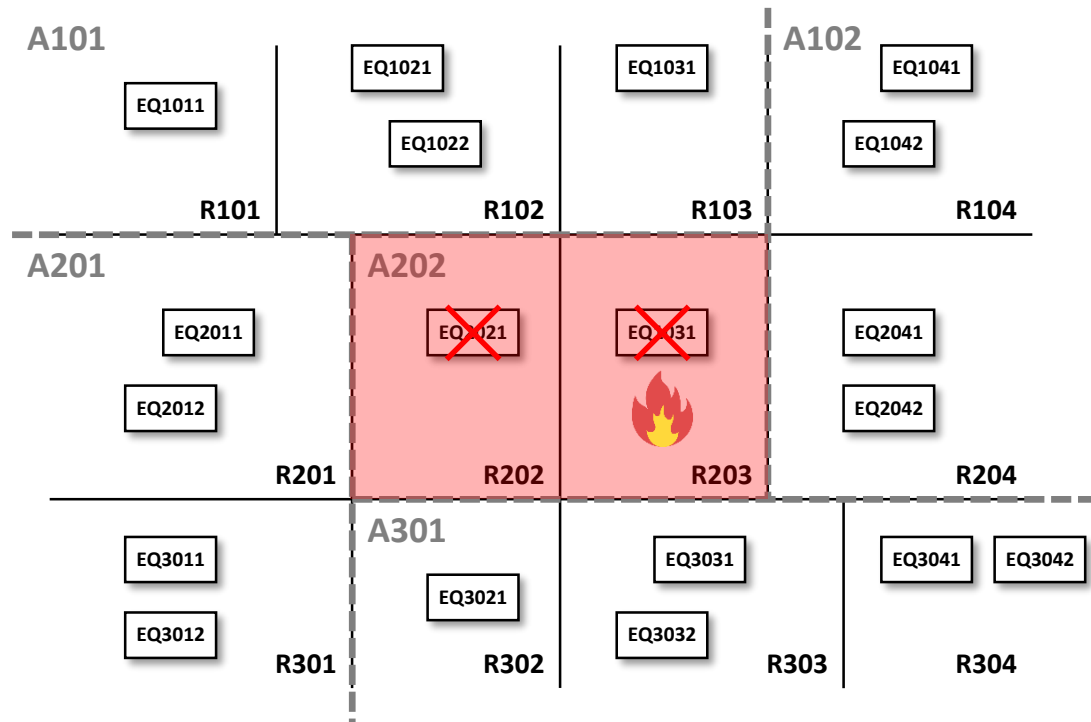


2

Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.2 Identifying Fire Affected Components & Cables for each Fire Area



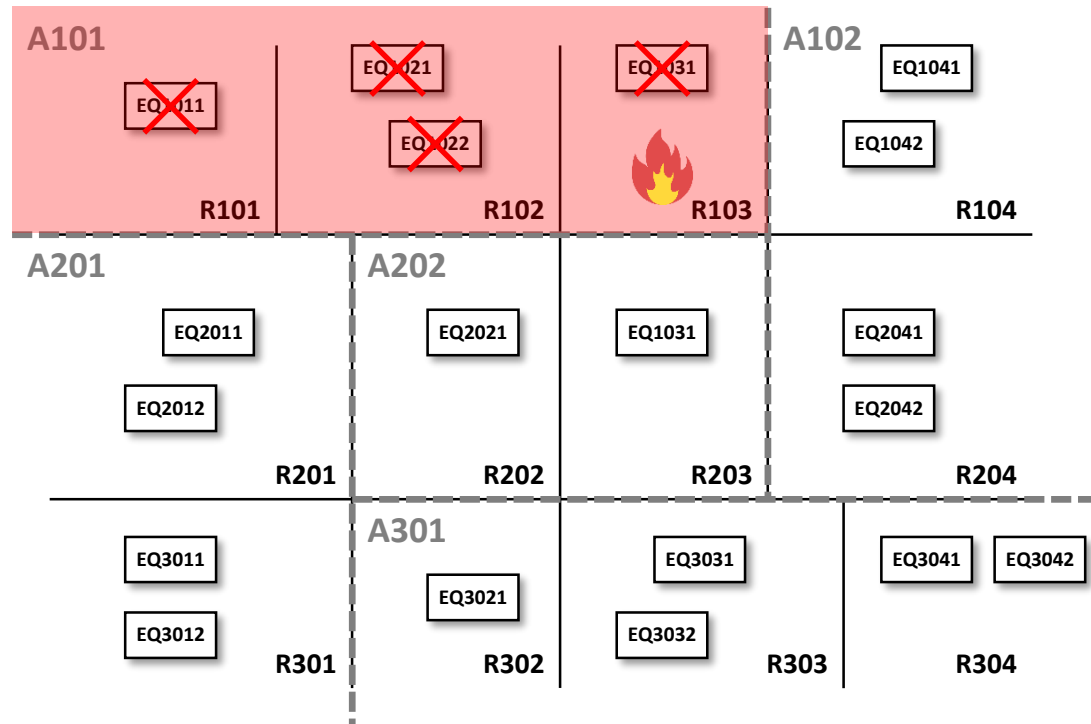
Example 1. Fire Affected Components in Fire Area (a)

2

Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.2 Identifying Fire Affected Components & Cables for each Fire Area



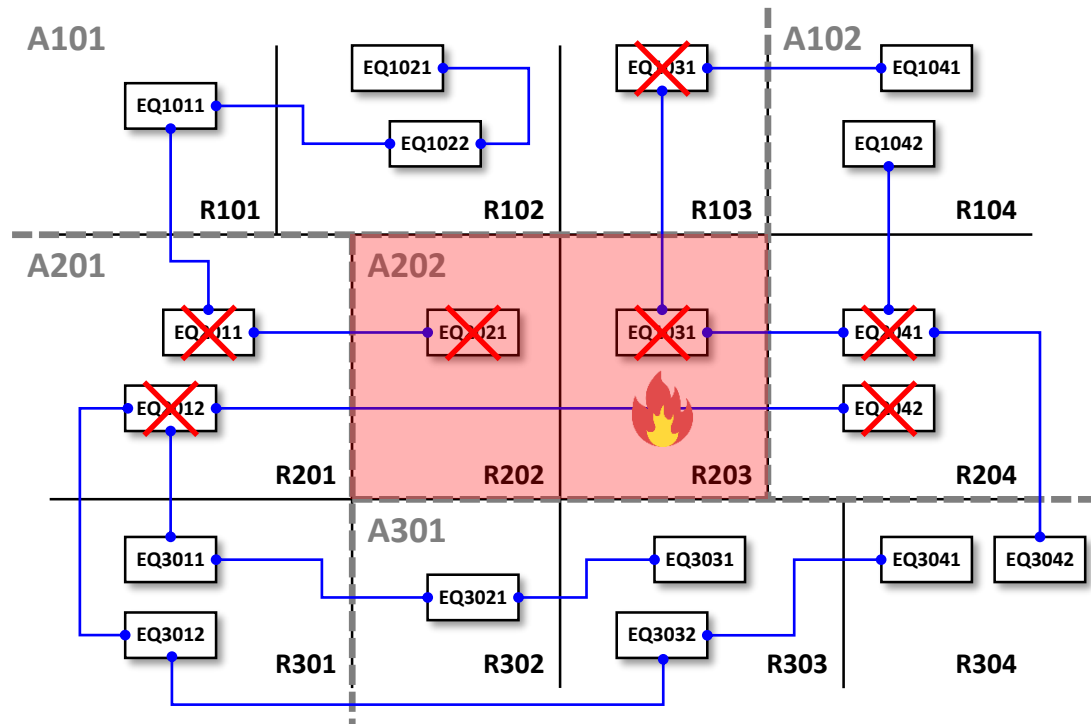
Example 2. Fire Affected Components in Fire Area (b)

2

Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.2 Identifying Fire Affected Components & Cables for each Fire Area



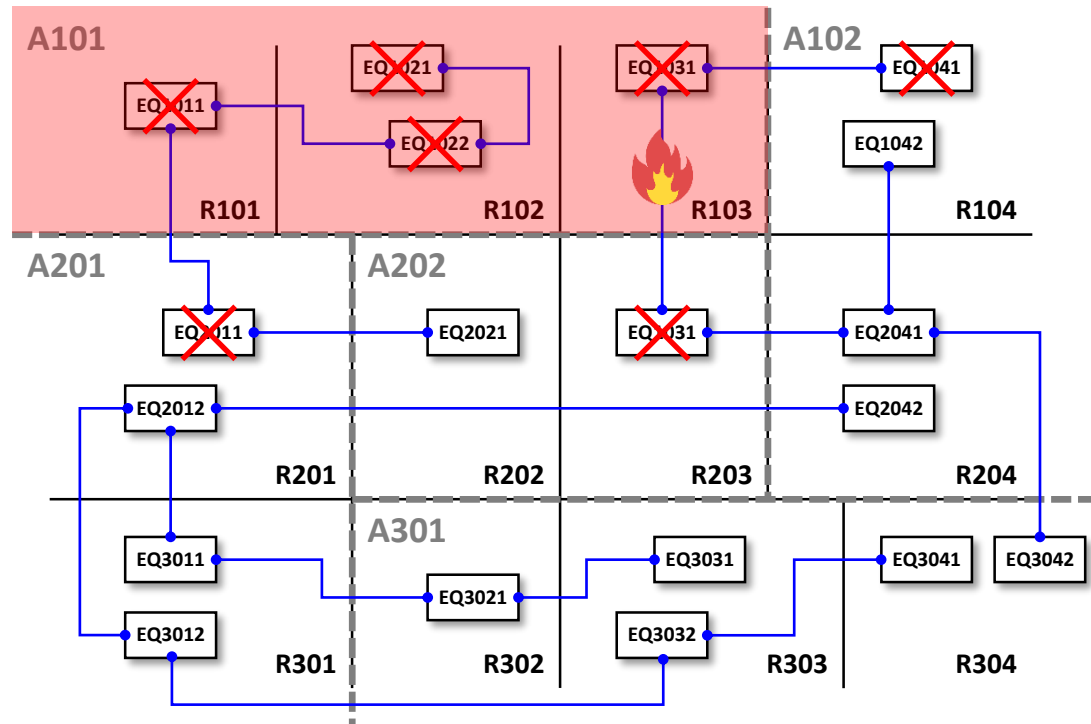
Example 3. Components Affected by Cable Routing (a)

2

Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.2 Identifying Fire Affected Components & Cables for each Fire Area



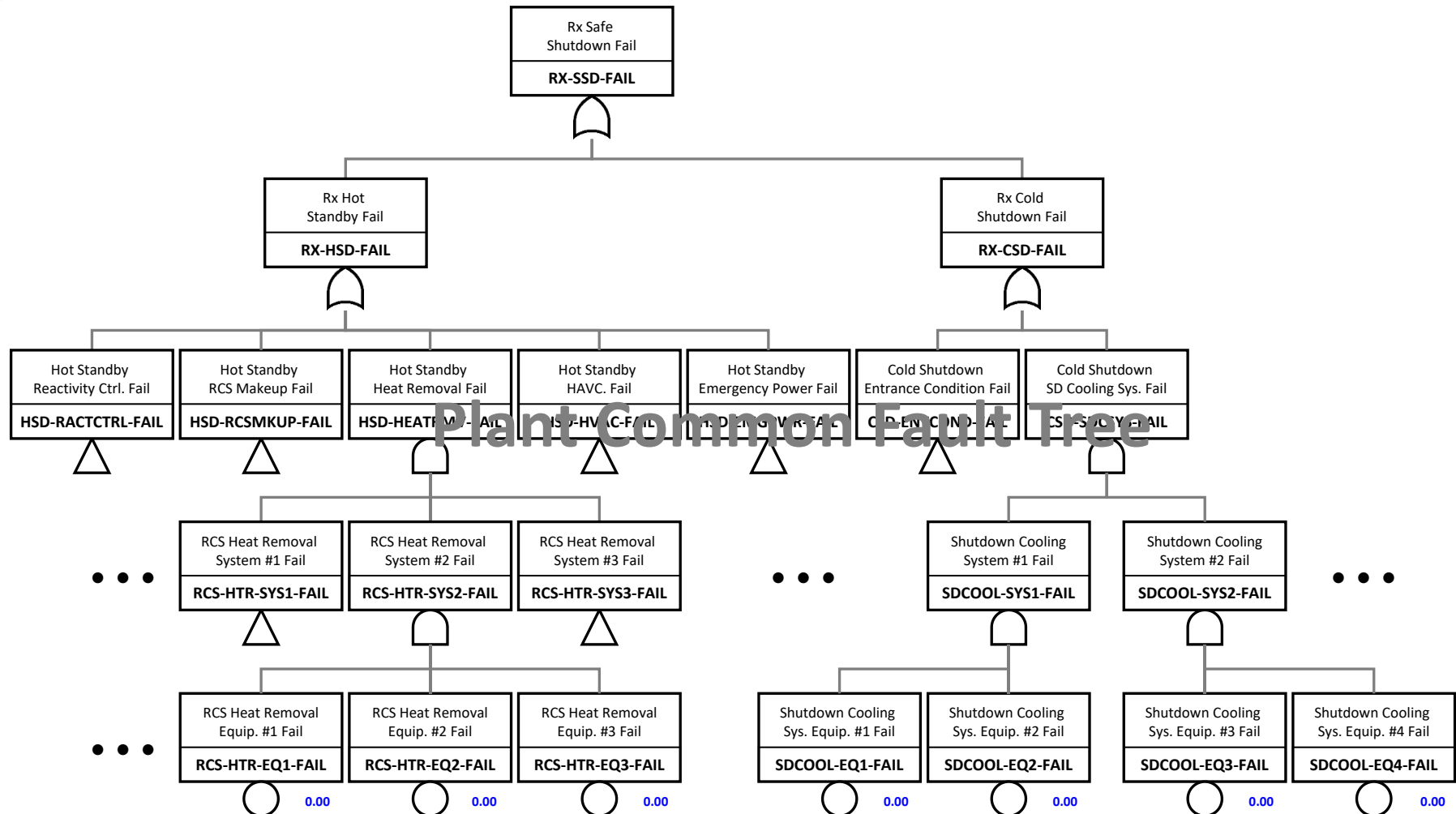
Example 4. Components Affected by Cable Routing (b)

2

Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

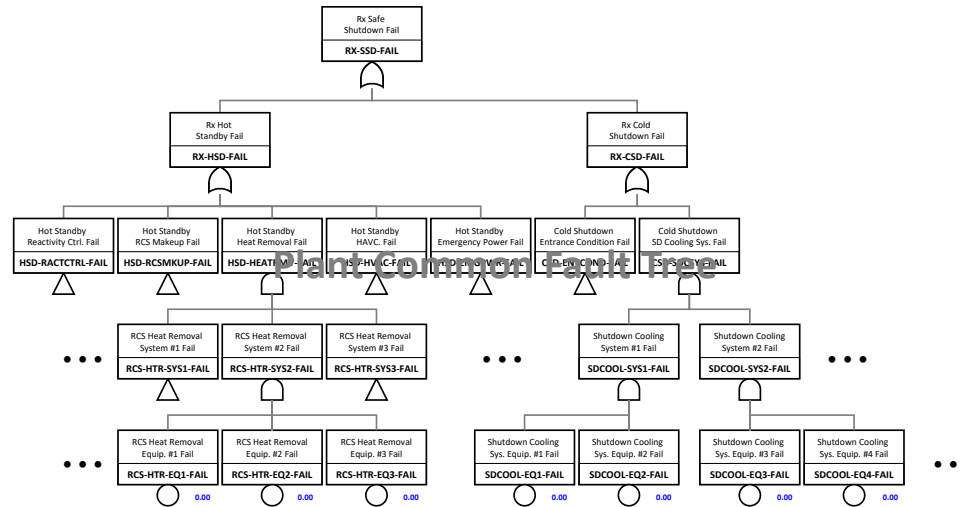
2.3 Generating Area Specific Fault Tree applied the Components/Cables



Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.3 Generating Area Specific Fault Tree applied the Components/Cables

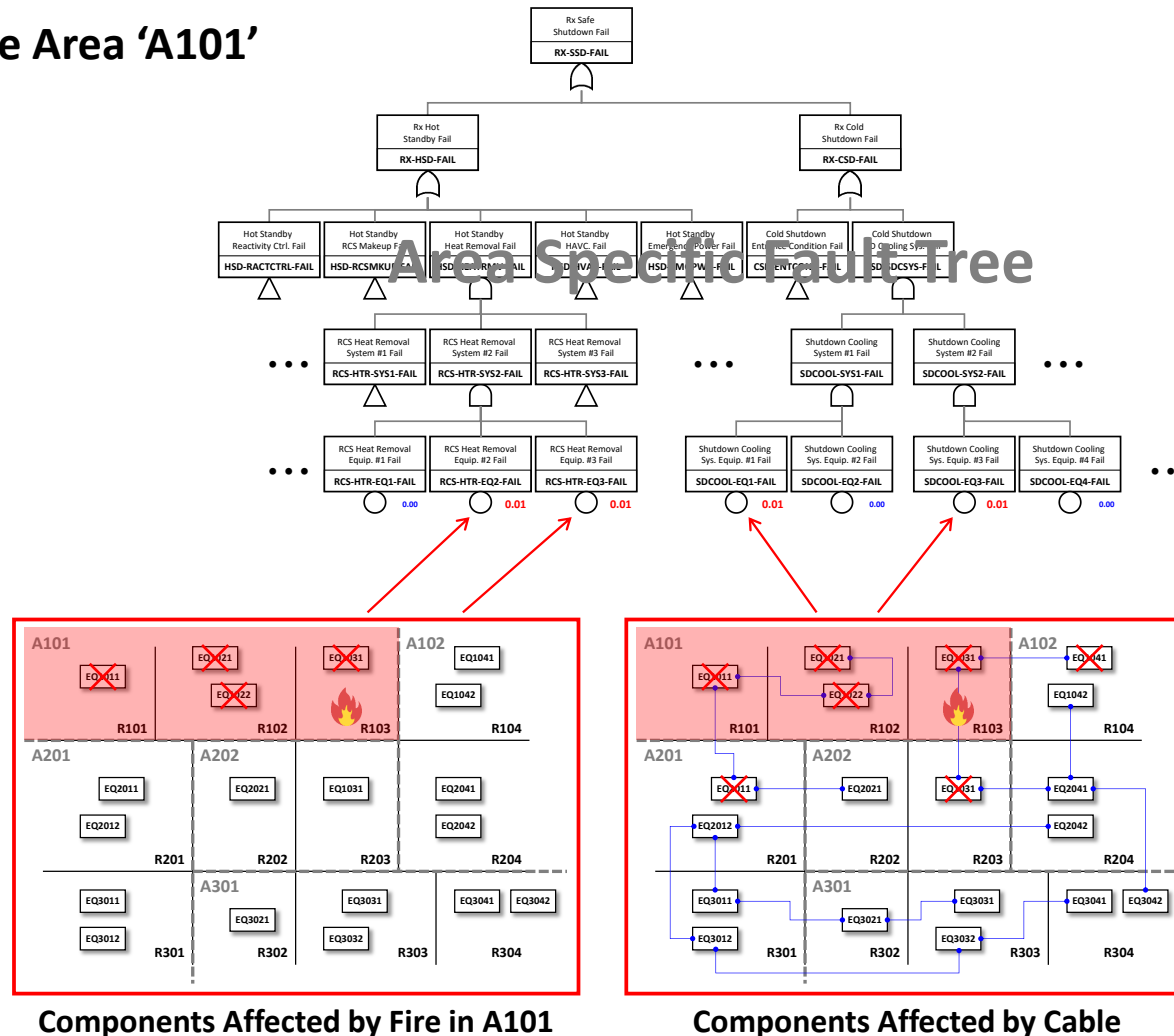


Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.3 Generating Area Specific Fault Tree applied the Components/Cables

Ex) Fire Area 'A101'

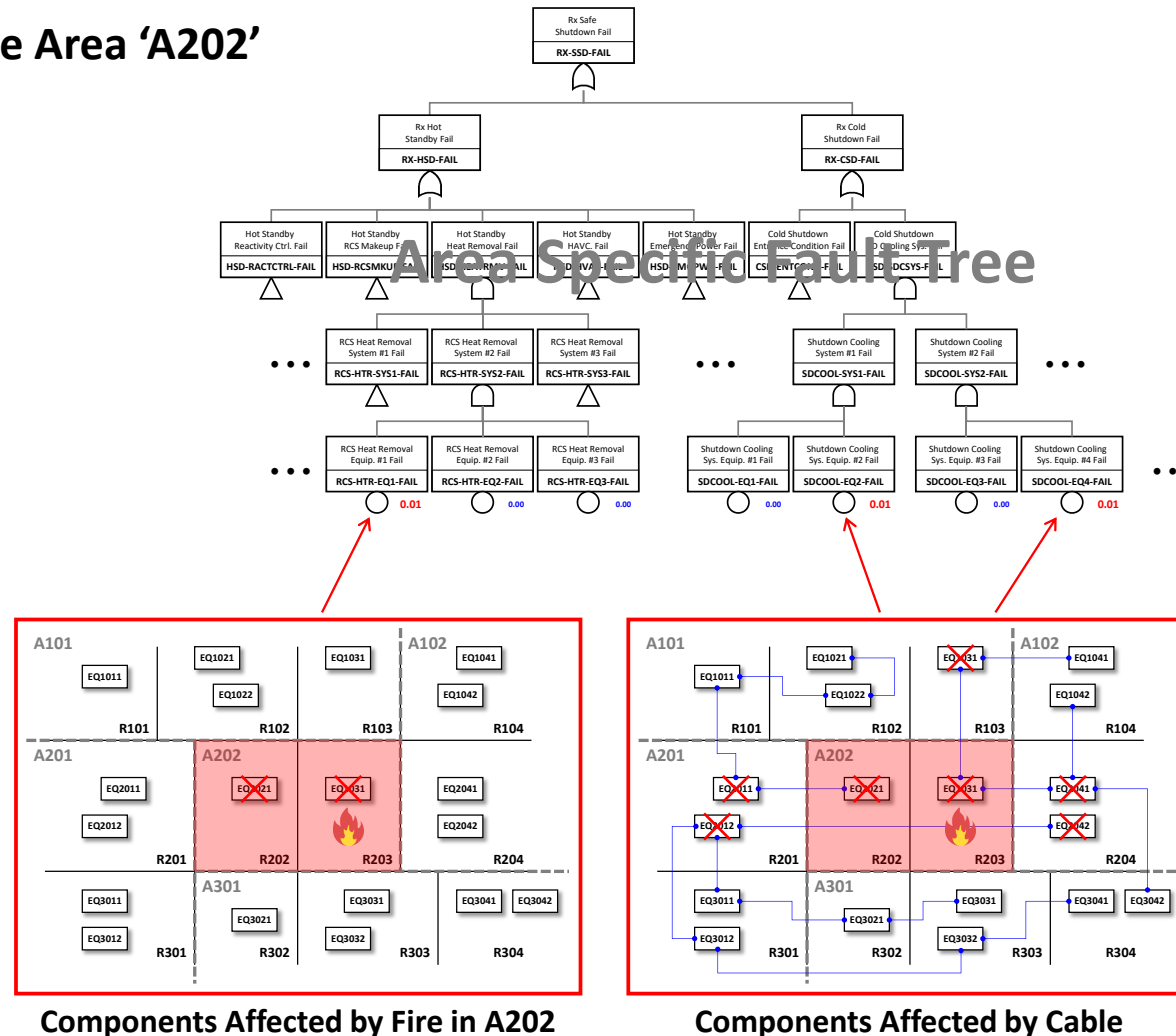


Post-Fire SSA Method applying FTA

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.3 Generating Area Specific Fault Tree applied the Components/Cables

Ex) Fire Area 'A202'



Post-Fire SSA Method applying FTA

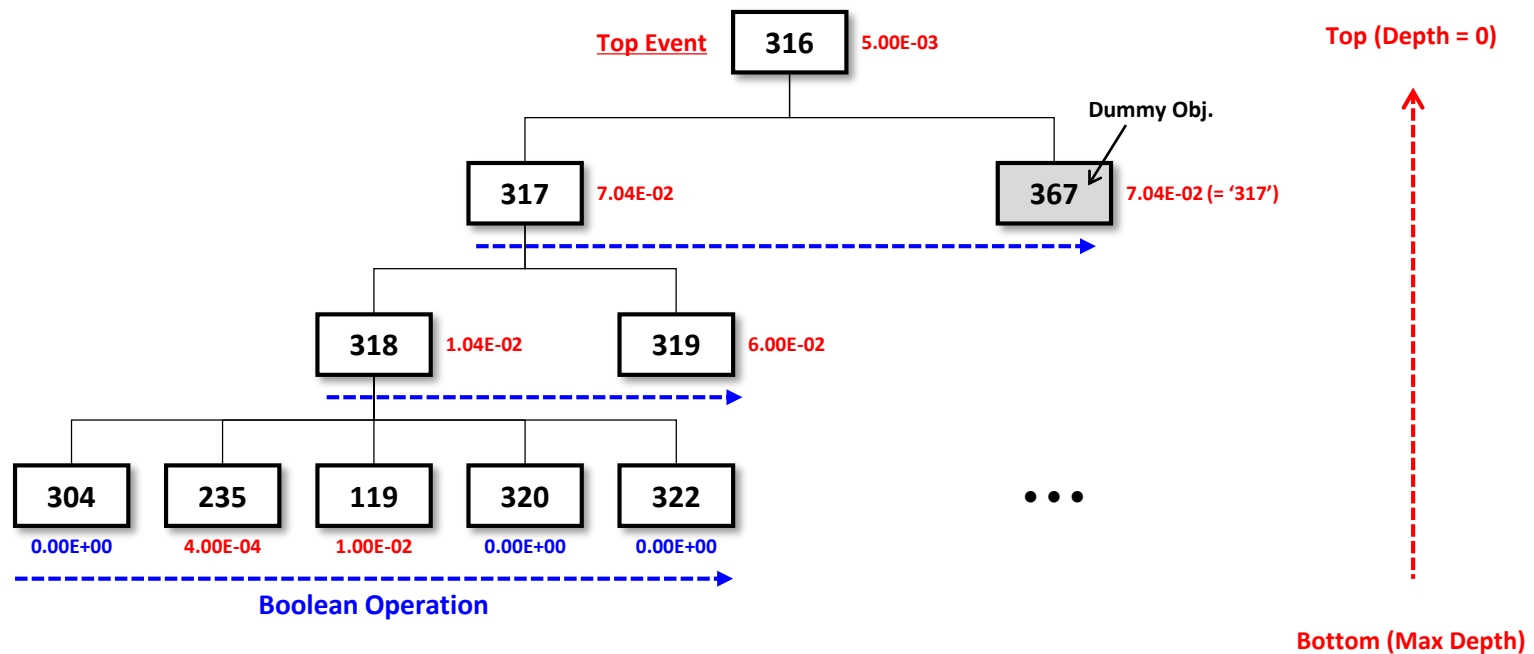
Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

2.4 Quantifying the Area Specific Fault Tree

How to Quantify the Fault Tree

- Start from **Bottom** to **Top**, Boolean Operation Obj. (Gate/Event)

※ Ex. Fire Area: 1A0G0A



3. Computer Program using the Method



3

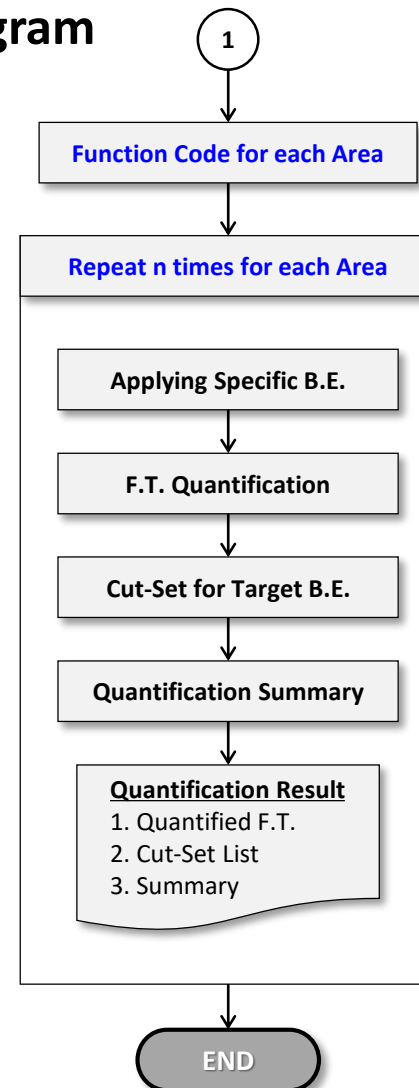
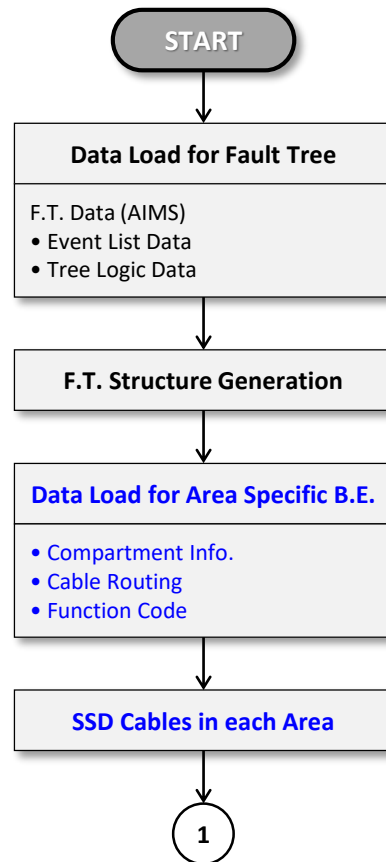
Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.1 Work-flow of the Computer Program

DFIRE FTA for SSA

- Specific B.E. Setting for each Fire Area



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program

- Main UI & Menu Structure
- Common Data Management
- Plant Fault Tree Management
- Post-Fire SSA applying FTA

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Menu Structure)

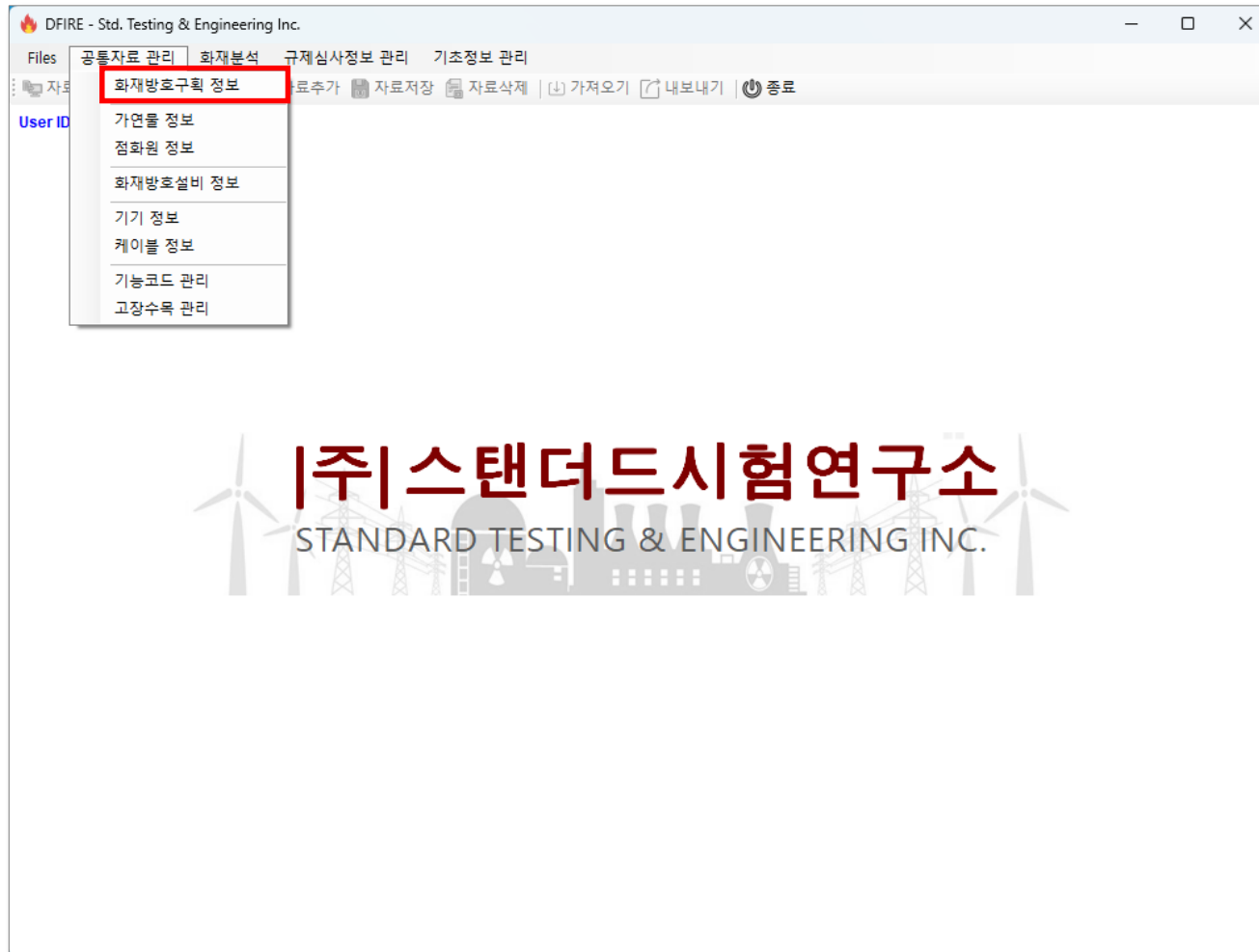


3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Common Data)



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Common Data)

DFire - Fire Compartment Info. Management

자료입력 | 자료추가 | 자료저장 | 자료삭제 | (L) 가져오기 | (R) 내보내기 | 창닫기

WSN3 (Shin-Wolsong 12)

Auxiliary BLDG

- 1A0G0A
- 1A0G0B
- 1A0G1
- 1A0G2
- 1A0G3A
- 1A0G3B
- 1A102A
- 1A102B
- 1A105A
- 1A105B
- 1A106A
- 1A106B
- 1A110
- 1A120A
- 1A120B
- 1A124
- 1A126A
- 1A126B
- 1A127A
- 1A127B
- 1A128A
- 1A128B
- 1A129A
- 1A129B
- 1A132A
- 1A132B
- 1A133A
- 1A133B
- 1A1M01
- 1A221A
- 1A221B
- 1A223

Building Room Fire Area **Fire Zone** Assignment

Fire Zone List of WSN3 (Shin-Wolsong 12)

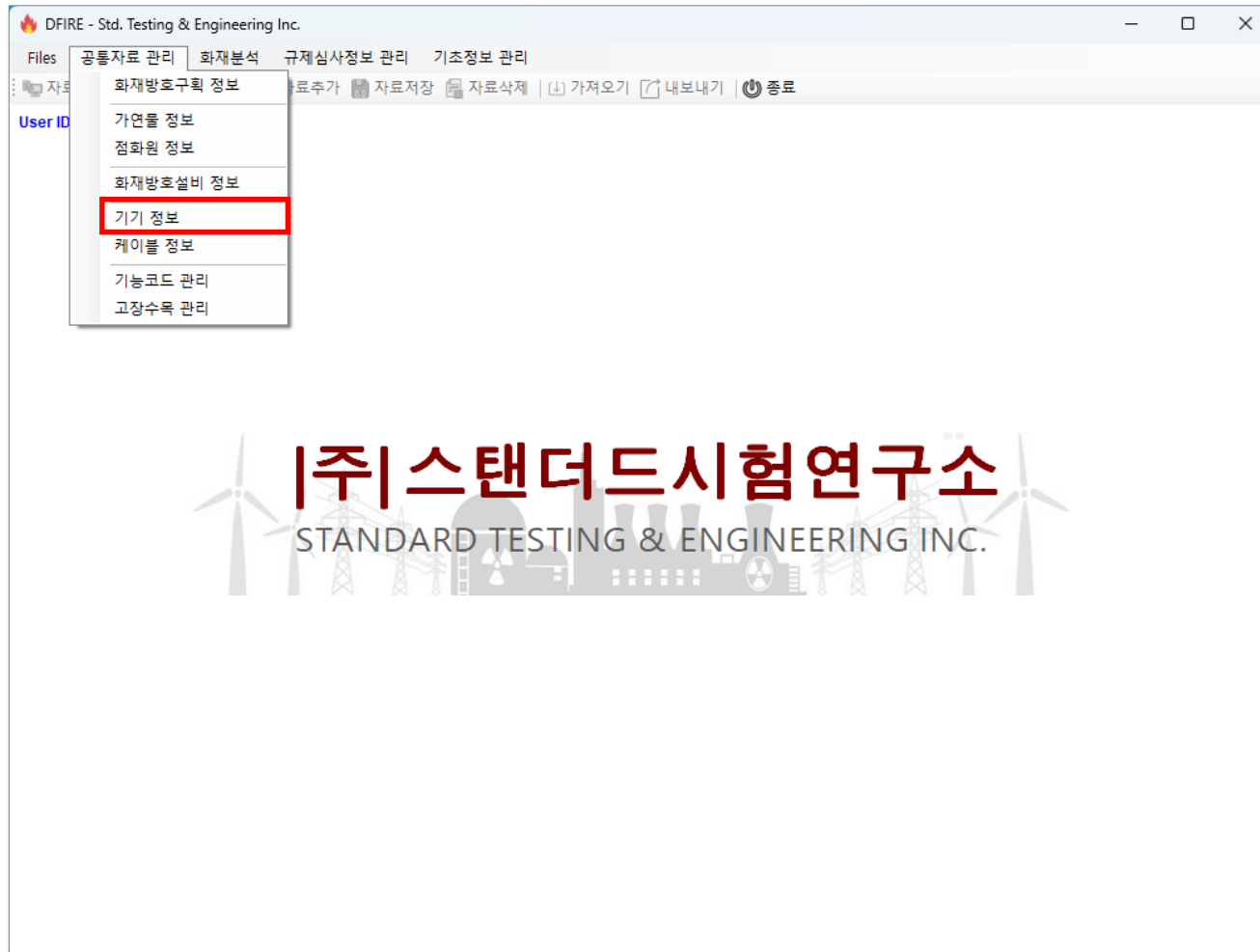
Zone ID	Zone Name Eng.	Zone Name Kor.	Floor Area [ft ²]
1A0G0A-Z1...	AB General Area A - 100ft(Rad)	보조건물 일반지역 A - 100ft(방사선 ...	4,923
1A0G0A-Z1...	AB General Area A - 124ft(Rad)	보조건물 일반지역 A - 124ft(방사선 ...	5,415
1A0G0A-Z1...	AB General Area A - 142ft(Rad)	보조건물 일반지역 A - 142ft(방사선 ...	2,905
1A0G0A-Z1...	AB General Area A - 161ft(Rad)	보조건물 일반지역 A - 161ft(방사선 ...	4,383
1A0G0A-Z58	AB General Area A - 58ft	보조건물 일반지역 A - 58ft	9,948
1A0G0A-Z7...	AB General Area A - 77ft(Clean)	보조건물 일반지역 A - 77ft(방사선 비...	4,167
1A0G0A-Z7...	AB General Area A - 77ft(Rad)	보조건물 일반지역 A - 77ft(방사선 관리)	4,558
1A220A-Z	AUX. Feedwater Storage Tank Room A	보조급수저장탱크실 A	2,272
1A321A-Z	Central Chiller Room A	중앙냉동기실 A	2,039
1A534-Z	MG Set Room	전동발전기실	1,676
1A626A-Z	Main Steam Isolation Valve Room & ...	주증기차단밸브 및 공조계통 기기실 A	4,110
1A723-Z	Air Intake & Exhaust Penthouse	공기 급배기실	294

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Equipment)



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Equipment)

DFire - Equipment Info. Management

자료입력 | 자료추가 | 자료저장 | 자료삭제 | (L) 가져오기 | (R) 내보내기 | 창닫기

WSN3 (Shin-Wolsong 12)

WSN3

- 0
- 1
 - Auxiliary BLDG
 - 1A0G0A
 - 1A0G0B
 - 1A0G1
 - 1A0G2
 - 1A0G3A
 - 1A0G3B
 - 1A102A
 - 1A102B
 - 1A105A
 - 1A105B
 - 1A106A
 - 1A106B
 - 1A110
 - 1A120A
 - 1A120B
 - 1A124
 - 1A126A
 - 1A126B
 - 1A127A
 - 1A127B
 - 1A128A
 - 1A128B
 - 1A129A
 - 1A129B
 - 1A132A
 - 1A132B
 - 1A133A
 - 1A133B
 - 1A1M01

Safe Equip. List in Auxiliary BLDG (Unit 1 of Shin-Wolsong 12)

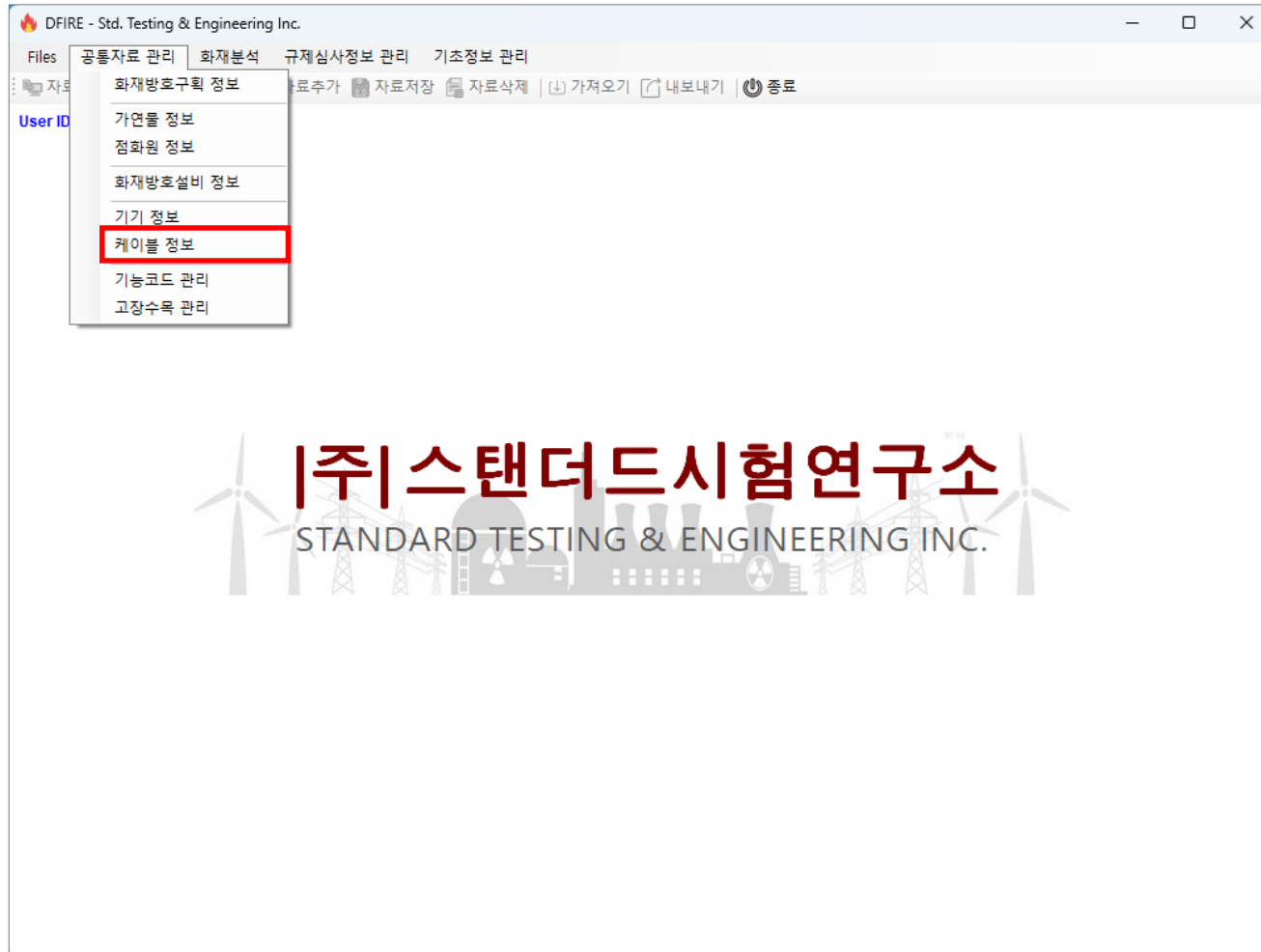
Room ID	Room Name	Equip. No.	Equip. Type	Equip. Desc.	Reactivit...	Coolant ...
1A303A	General Access Area	606-M-HV18A	HV	GENERAL ACCESS AREA CUBL...		
1A327A	Mechanical PENET. Area	441-J-TE-0351Y	TE	LPSI HEADER 1 INLET TEMPER...		
1A327A	Mechanical PENET. Area	441-V-0321	MOV	HPSI PUMP PP02A HOT LEG I...		O
1A327A	Mechanical PENET. Area	441-V-0635	MOV	LPSI HEADER 1 CONTAINMEN...		
1A327A	Mechanical PENET. Area	441-V-0636	MOV	HPSI HEADER ISOLATION VALVE		O
1A327A	Mechanical PENET. Area	441-V-0637	MOV	HPSI HEADER ISOLATION VALVE		O
1A327A	Mechanical PENET. Area	441-V-0645	MOV	LPSI HEADER 1 CONTAINMEN...		
1A327A	Mechanical PENET. Area	606-M-HV15A	HV	MECHANICAL PENETRATION ...		
1A327A	Mechanical PENET. Area	633-V-0903A	MOV	SUPPLY CROSS-TIE LINE A ISO...		
1A327A	Mechanical PENET. Area	633-V-0904A	MOV	SUPPLY CROSS-TIE LINE A ISO...		
1A327A	Mechanical PENET. Area	441-V-0646	MOV	HPSI HEADER ISOLATION VALVE		O
1A327A	Mechanical PENET. Area	441-V-0647	MOV	HPSI HEADER ISOLATION VALVE		O
1A327A	Mechanical PENET. Area	441-V-0689	MOV	SHUTDOWN COOLING WAR...		
1A327A	Mechanical PENET. Area	442-V-0035	MOV	CONTAINMENT SPRAY ISOLAT...		O
1A327A	Mechanical PENET. Area	461-V-0161	MOV	RCP COOLER CCW CONTAIN...		O
1A327A	Mechanical PENET. Area	461-V-0163	MOV	RCP COOLER CCW CONTAIN...		O
1A329	Let Down HX Valve Room	451-V-0110X	AOV	LETDOWN ORFICE #1 ISOLAT...		O
1A329	Let Down HX Valve Room	451-V-0110Y	AOV	LETDOWN ORFICE #2 ISOLAT...		O
1A329	Let Down HX Valve Room	451-V-0110Z	AOV	LETDOWN ORFICE #3 ISOLAT...		O
1A329	Let Down HX Valve Room	451-V-0526	SOV	LETDOWN CONTROL BYPASS ...		O
1A330A	Mechanical PENET. Area	451-V-0523	AOV	LETDOWN OUTSIDE CNMT IS...		O
1A330A	Mechanical PENET. Area	542-V-0043	MOV	AF ISOLATION VALVE		
1A330A	Mechanical PENET. Area	542-V-0045	MOV	AF ISOLATION VALVE		
1A3M02	Valve Room	461-V-0960	AOV	LETDOWN HX. CCW CONTRO...		O
1A425A	Electric Penetration Area	441-E-IN01C	IN	125V DC/480V AC INVERTER ...		
1A425A	Electric Penetration Area	441-E-SQ01C	SQ	MOTOR STARTER FOR VSI-653		
1A425A	Electric Penetration Area	606-M-HV19A	HV	ELECTRICAL PENETRATION AR...		
1A425A	Electric Penetration Area	606-M-HV20A	HV	ELECTRICAL PENETRATION AR...		
1A425A	Electric Penetration Area	827-E-MC03A	MC	CLASS DIV. A 1E 480V MCC (P...		
1A425A	Electric Penetration Area	827-E-MC06A	MC	CLASS 1E 480V DIV. A MTOR ...		

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Cable & Routing)



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Cable & Routing)

Cable Routing List in Area 1A0G0B (Auxiliary BLDG, Unit 1 of Shin-Wolsong 12)

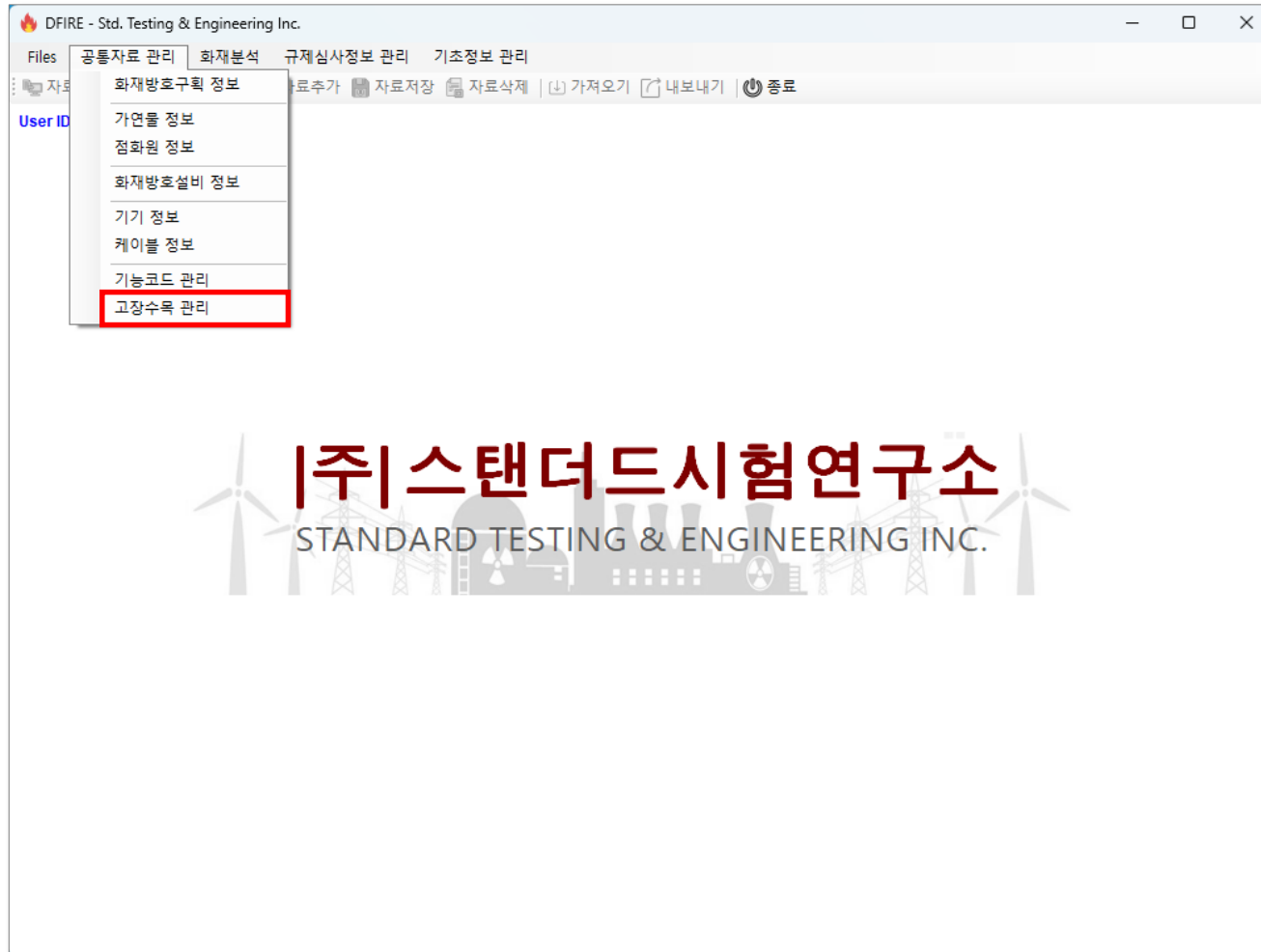
Fire Area	Fire Zone	Room ID	Room Name	Cable No.	Sequence ...	Raceway	Wire
1A0G0B	1A0G0B-Z...	1A303B	General Access Area	1-606-C-02-A-D-...	1	1-323-K-21-D10B	
1A0G0B	1A0G0B-Z...	1A303B	General Access Area	1-606-C-07-B-S-...	1	1-323-K-21-S01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-606-C-02-A-D-...	2	1-323-T-21-D02B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-606-C-02-A-D-...	1	1-323-K-21-D03B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-606-C-02-A-D-...	2	1-323-T-21-D02B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-606-C-02-A-D-...	3	1-323-T-21-D01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-606-C-02-A-D-...	4	1-323-T-23-D01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-601-C-01-B-D-...	22	1-323-T-21-D02B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-601-C-01-B-D-...	23	1-323-T-21-D01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-601-C-01-B-D-...	24	1-323-T-23-D01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-601-C-01-D-D-...	25	1-323-T-21-D02B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-601-C-01-D-D-...	26	1-323-T-21-D01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-601-C-01-D-D-...	27	1-323-T-23-D01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-603-C-05-F-D-...	7	1-323-T-23-D01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-603-C-05-F-D-...	8	1-323-T-21-D01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-603-C-05-F-D-...	9	1-323-T-21-D02B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-455-C-02-C-D-...	3	1-323-K-21-D02A	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-455-C-02-C-J-...	3	1-323-K-21-J02A	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-455-C-02-D-D-...	1	1-323-K-22-D04B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-455-C-02-D-D-...	3	1-323-K-22-D01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-455-C-02-D-D-...	5	1-323-K-21-D04B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-455-C-02-D-D-...	6	1-323-T-21-D02B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-455-C-02-D-J-...	3	1-323-K-22-J01B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-455-C-02-D-J-...	5	1-323-K-21-J07B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-455-C-02-D-J-...	6	1-323-T-21-J02B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-461-C-04-D-J-...	21	1-323-T-21-J02B	
1A0G0B	1A0G0B-Z...	1A327B	Mechanical PENET. Area	1-461-C-04-D-J-...	22	1-323-T-21-J01B	

3

Computer Program using the Method

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3.2 Screen Shots of the Computer Program (Fault Tree)



3

Computer Program using the Method

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3.2 Screen Shots of the Computer Program (Fault Tree)

DFire - Common Fault Tree Data Management

Target Plant: WSN3 Inquiry

Shin-Wolsong 12

Event List **Tree Logic** F.T. File Loading F.T. Generating

Tree Logic Data of WSN3 (Shin-Wolsong 12)

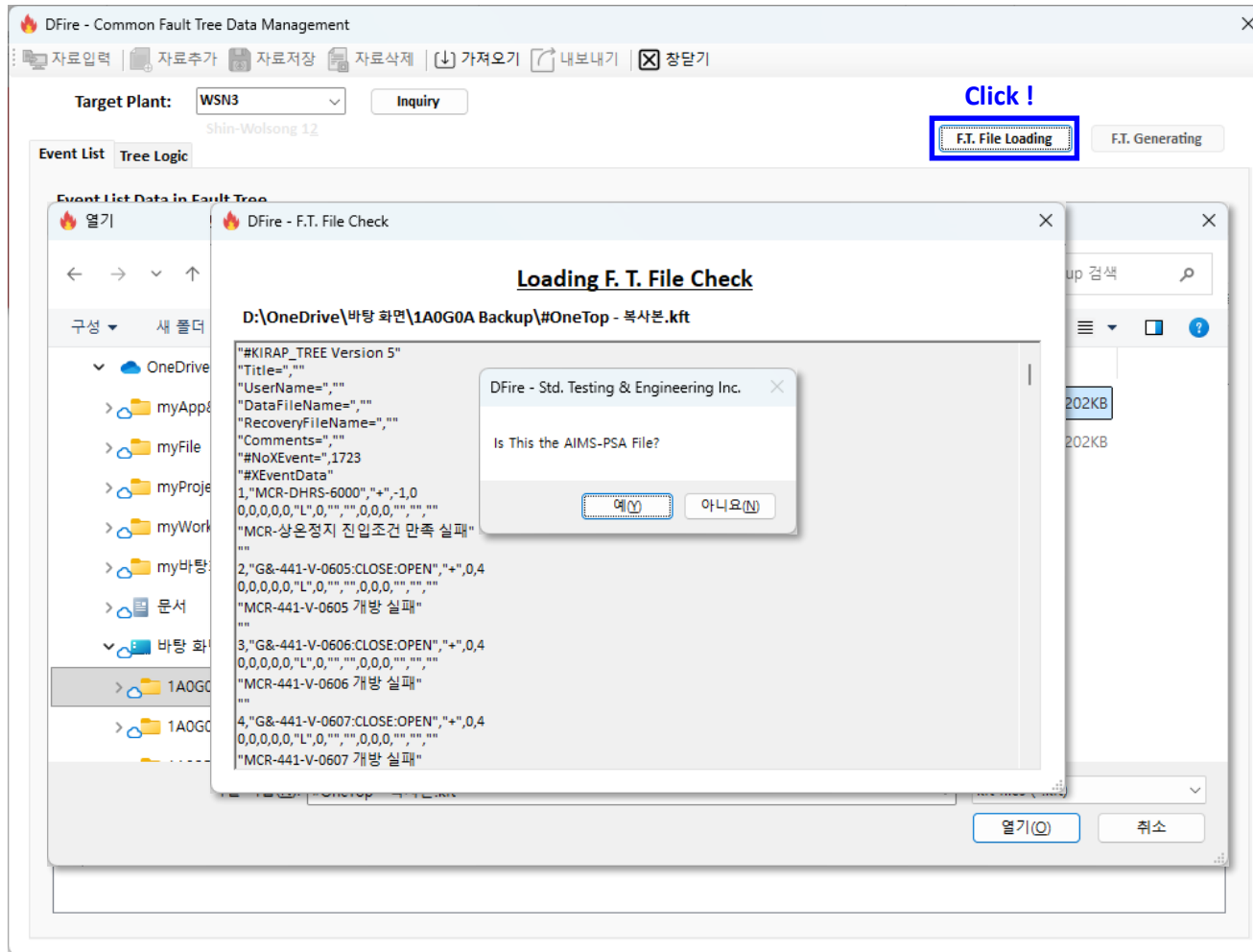
No.	Obj. Type	Obj. Name	Obj. Desc.	Sub. No.	Sub. Name	Sub. Desc.
1	+	MCR-DHRS-6000	MCR-상온정지 진입조건 만족 실패	1	MCR-DHRS-6001	MCR-안전주입탱크 배기 실패
1	+	MCR-DHRS-6000	MCR-상온정지 진입조건 만족 실패	2	MCR-DHRS-6002	MCR-안전주입탱크 격리 실패
2	+	G&-441-V-0605:CLOSE:OPEN	MCR-441-V-0605 개방 실패	1	441-V-0605:CLOSE:OPEN	MCR-441-V-0605 개방 실패
2	+	G&-441-V-0605:CLOSE:OPEN	MCR-441-V-0605 개방 실패	2	752-J-PA03A-01(C_POWER)	
2	+	G&-441-V-0605:CLOSE:OPEN	MCR-441-V-0605 개방 실패	3	841-E-MC01A(SOL_POWER)	
3	+	G&-441-V-0606:CLOSE:OPEN	MCR-441-V-0606 개방 실패	1	441-V-0606:CLOSE:OPEN	MCR-441-V-0606 개방 실패
3	+	G&-441-V-0606:CLOSE:OPEN	MCR-441-V-0606 개방 실패	2	752-J-PA03A-01(C_POWER)	
3	+	G&-441-V-0606:CLOSE:OPEN	MCR-441-V-0606 개방 실패	3	841-E-MC01A(SOL_POWER)	
4	+	G&-441-V-0607:CLOSE:OPEN	MCR-441-V-0607 개방 실패	1	441-V-0607:CLOSE:OPEN	MCR-441-V-0607 개방 실패
4	+	G&-441-V-0607:CLOSE:OPEN	MCR-441-V-0607 개방 실패	2	752-J-PA03A-01(C_POWER)	
4	+	G&-441-V-0607:CLOSE:OPEN	MCR-441-V-0607 개방 실패	3	841-E-MC01A(SOL_POWER)	
5	+	G&-441-V-0608:CLOSE:OPEN	MCR-441-V-0608 개방 실패	1	441-V-0608:CLOSE:OPEN	MCR-441-V-0608 개방 실패
5	+	G&-441-V-0608:CLOSE:OPEN	MCR-441-V-0608 개방 실패	2	752-J-PA03A-01(C_POWER)	
5	+	G&-441-V-0608:CLOSE:OPEN	MCR-441-V-0608 개방 실패	3	841-E-MC01A(SOL_POWER)	
6	+	G&-441-V-0613:CLOSE:OPEN	MCR-441-V-0613 개방 실패	1	441-V-0613:CLOSE:OPEN	MCR-441-V-0613 개방 실패
6	+	G&-441-V-0613:CLOSE:OPEN	MCR-441-V-0613 개방 실패	2	752-J-PA03B-01(C_POWER)	
6	+	G&-441-V-0613:CLOSE:OPEN	MCR-441-V-0613 개방 실패	3	841-E-MC01B(SOL_POWER)	
7	+	G&-441-V-0623:CLOSE:OPEN	MCR-441-V-0623 개방 실패	1	441-V-0623:CLOSE:OPEN	MCR-441-V-0623 개방 실패
7	+	G&-441-V-0623:CLOSE:OPEN	MCR-441-V-0623 개방 실패	2	752-J-PA03B-02(C_POWER)	
7	+	G&-441-V-0623:CLOSE:OPEN	MCR-441-V-0623 개방 실패	3	841-E-MC01B(SOL_POWER)	
8	+	G&-441-V-0633:CLOSE:OPEN	MCR-441-V-0633 개방 실패	1	441-V-0633:CLOSE:OPEN	MCR-441-V-0633 개방 실패
8	+	G&-441-V-0633:CLOSE:OPEN	MCR-441-V-0633 개방 실패	2	752-J-PA03B-01(C_POWER)	
8	+	G&-441-V-0633:CLOSE:OPEN	MCR-441-V-0633 개방 실패	3	841-E-MC01B(SOL_POWER)	
9	+	G&-441-V-0643:CLOSE:OPEN	MCR-441-V-0643 개방 실패	1	441-V-0643:CLOSE:OPEN	MCR-441-V-0643 개방 실패
9	+	G&-441-V-0643:CLOSE:OPEN	MCR-441-V-0643 개방 실패	2	752-J-PA03B-01(C_POWER)	
9	+	G&-441-V-0643:CLOSE:OPEN	MCR-441-V-0643 개방 실패	3	841-E-MC01B(SOL_POWER)	
10	+	G&-441-V-0614:CLOSE:OPEN	MCR-441-V-0614 경계 실패	4	441-V-0614:CLOSE:OPEN	MCR-441-V-0614 경계 실패

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Fault Tree)



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Fault Tree)

DFire - Common Fault Tree Data Management

Target Plant: WSN3 Inquiry

Shin-Wolsong 12

Event List Tree Logic

F.T. File Loading F.T. Generating

Event List Data in Fault Tree

No.	Obj. Name	Obj. Type	Mean Val.	Calc. T...	Lambda	Tau	Dist. T...	Lamb...	Tau U...	Factor	Obj. Desc.
1	MCR-DHRS-6000	+	0.00E+000	0			L				MCR-상온정지 진입조건 만족 실패
2	G&-441-V-0605:CLOSE:OPEN	+	0.00E+000	0			L				MCR-441-V-0605 개방 실패
3	G&-441-V-0606:CLOSE:OPEN	+	0.00E+000	0			L				MCR-441-V-0606 개방 실패
4	G&-441-V-0607:CLOSE:OPEN	+	0.00E+000	0			L				MCR-441-V-0607 개방 실패
5	G&-441-V-0608:CLOSE:OPEN	+	0.00E+000	0			L				MCR-441-V-0608 개방 실패
6	G&-441-V-0613:CLOSE:OPEN	+	0.00E+000	0			L				MCR-441-V-0613 개방 실패
7	G&-441-V-0623:CLOSE:OPEN	+	0.00E+000	0			L				MCR-441-V-0623 개방 실패
8	G&-441-V-0633:CLOSE:OPEN	+	0.00E+000	0			L				MCR-441-V-0633 개방 실패
9	G&-441-V-0643:CLOSE:OPEN	+	0.00E+000	0			L				MCR-441-V-0643 개방 실패
10	G&-441-V-0614:OPEN:CLOSE	+	0.00E+000	0			L				MCR-441-V-0614 격리 실패
11	G&-441-V-0624:OPEN:CLOSE	+	0.00E+000	0			L				MCR-441-V-0624 격리 실패
12	G&-441-V-0634:OPEN:CLOSE	+	0.00E+000	0			L				MCR-441-V-0634 격리 실패
13	G&-441-V-0644:OPEN:CLOSE	+	0.00E+000	0			L				MCR-441-V-0644 격리 실패
14	MCR-SIAS-0000	+	0.00E+000	0			L				MCR-SIAS-오실효
15	MCR-SIAS-1001	2	0.00E+000	0			L				SIAS-PRESSURIZER PRESSURE(W
16	MCR-SIAS-1002	2	0.00E+000	0			L				SIAS-CNMT PRESS NARROW RA
17	431-J-PT-0104:NON-SPUR...	B	0.00E+000	0			L				MCR-431-J-PT-0104 오실효
18	431-J-PT-0103:NON-SPUR...	B	0.00E+000	0			L				MCR-431-J-PT-0103 오실효
19	431-J-PT-0102A:NON-SPUR...	B	0.00E+000	0			L				MCR-431-J-PT-0102A 오실효
20	431-J-PT-0102B:NON-SPUR...	B	0.00E+000	0			L				MCR-431-J-PT-0102B 오실효
21	431-J-PT-0102C:NON-SPUR...	B	0.00E+000	0			L				MCR-431-J-PT-0102C 오실효
22	431-J-PT-0102D:NON-SPUR...	B	0.00E+000	0			L				MCR-431-J-PT-0102D 오실효
23	763-J-PT-0351A:NON-SPUR...	B	0.00E+000	0			L				MCR-763-J-PT-0351A 오실효
24	763-J-PT-0351B:NON-SPUR...	B	0.00E+000	0			L				MCR-763-J-PT-0351B 오실효
25	763-J-PT-0351C:NON-SPUR...	B	0.00E+000	0			L				MCR-763-J-PT-0351C 오실효
26	763-J-PT-0351D:NON-SPUR...	B	0.00E+000	0			L				MCR-763-J-PT-0351D 오실효
27	MCR-DHRS-6001	+	0.00E+000	0			L				MCR-아저주이탱크 배기 실패

DFire - Std. Testing & Engineering Inc.

Total 10097 Lines (EventList: 1723 EA, TreeLogic: 891 EA)

확인

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Fault Tree)

WSN3 (Shin-Wolsong 12)

Common Fault Tree Structure

No.	x	y	z	Obj. ID	Up Obj.	Obj. Type	Up-z	Obj. Name	Obj. Descript
1				316	-	+	-	SSA-0000	안전정지 불만
2	1	1	1	317	316	+		MCR-0000	MCR-안전정지 불
3	1	2	2	367	316	+		RSP-0000	RSP-안전정지 불
4	2	1	1	318	317	+	1	MCR-HSD-0000	MCR-고유대기 불
5	2	2	2	319	317	+	1	MCR-CSD-0000	MCR-상용정지 불
6	3	1	1	304	318	+	1	MCR-RC-0000	MCR-고유대기반응도
7	3	2	2	235	318	+	1	MCR-PICS-0000	MCR-고유대기원자로 냉각
8	3	3	3	119	318	+	1	MCR-DHRS-0000	MCR-고유대기전열계
9	3	4	4	320	318	=	1	MCR-HVAC-0000	MCR-HVAC 불
10	3	5	5	322	318	*	1	MCR-SUPP-2200	MCR-비상전원
11	3	1	6	1	319	+	2	MCR-DHRS-6000	MCR-상용정지 진일조
12	3	2	7	94	319	*	2	MCR-DHRS-7000	MCR-상용정지 정지냉
13	4	1	1	306	304	*	1	MCR-RC-0011	MCR-반응도제어변수
14	4	2	2	305	304	*	1	MCR-MSO38	MCR-부주의함 불
15	4	1	3	267	235	+	2	MCR-PICS-0011	MCR-원자로냉각재 제
16	4	2	4	268	235	+	2	MCR-PICS-0012	MCR-원자로냉각재 압
17	4	3	5	269	235	+	2	MCR-PICS-0013	MCR-원자로냉각재 변
18	4	1	6	187	119	*	3	MCR-DHRS-0011	MCR-증기발생
19	4	2	7	188	119	+	3	MCR-DHRS-0012	MCR-증기발생기 부주
20	4	1	8	321	320	+	4	MCR-MSO54	MCR-HVAC 불
21	4	1	9	1165	322	+	5	MCR-SUPP-2201	MCR-A계열 비상디젤발
22	4	2	10	1166	322	+	5	MCR-SUPP-2202	MCR-B계열 비상디젤발
23	4	1	11	27	1	+	6	MCR-DHRS-6001	MCR-안전주입밸브
24	4	2	12	28	1	+	6	MCR-DHRS-6002	MCR-안전주입밸브
25	4	1	13	95	94	+	7	MCR-DHRS-7001	MCR-A계열 정지냉각
26	4	2	14	96	94	+	7	MCR-DHRS-7002	MCR-B계열 정지냉각
27	5	1	1	302	306	+	1	G&S-731-J-RW-0001...	MCR-731-J-RW-000
28	5	2	2	303	306	+	1	G&S-731-J-RW-0001...	MCR-731-J-RW-000
29	5	1	3	307	305	+	2	MCR-RC-0021	MCR-RMWP
30	5	2	4	308	305	*	2	MCR-RC-0022	MCR-RMWP TO CVCS
31	5	3	5	309	305	+	2	MCR-RC-0023	부사스 부주신

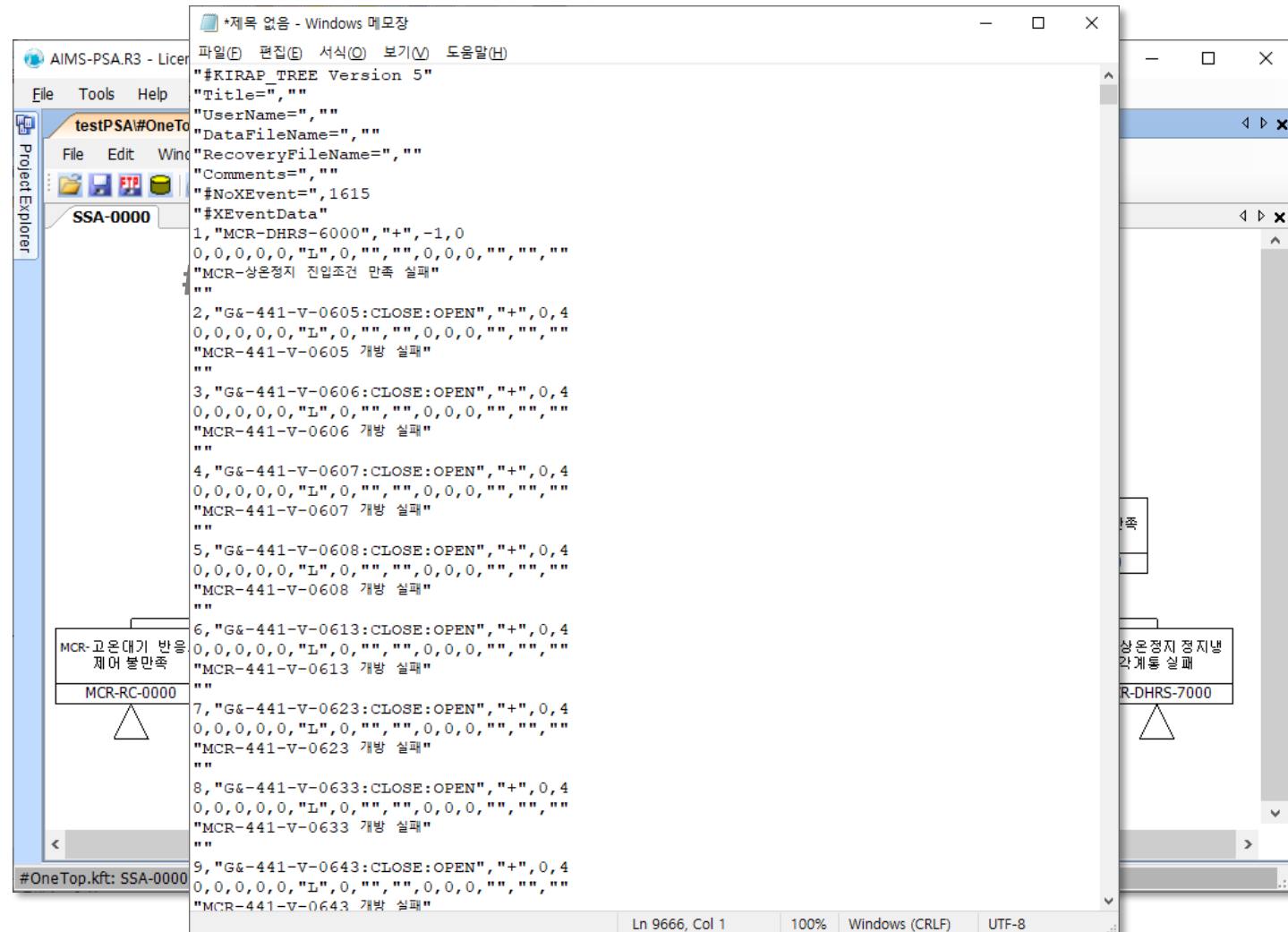
OK, Save Data NO, Discard

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Fault Tree Structure Generating

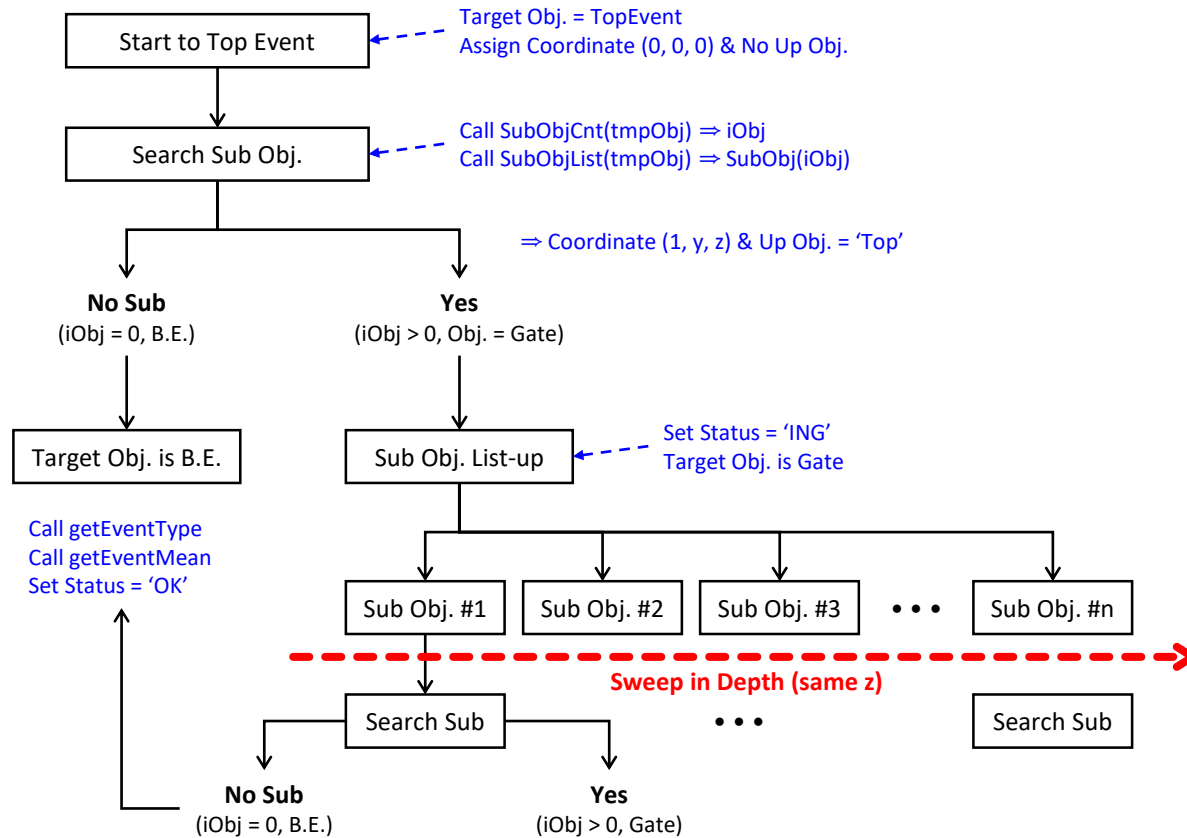


3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Fault Tree Structure Generating (Cont.)

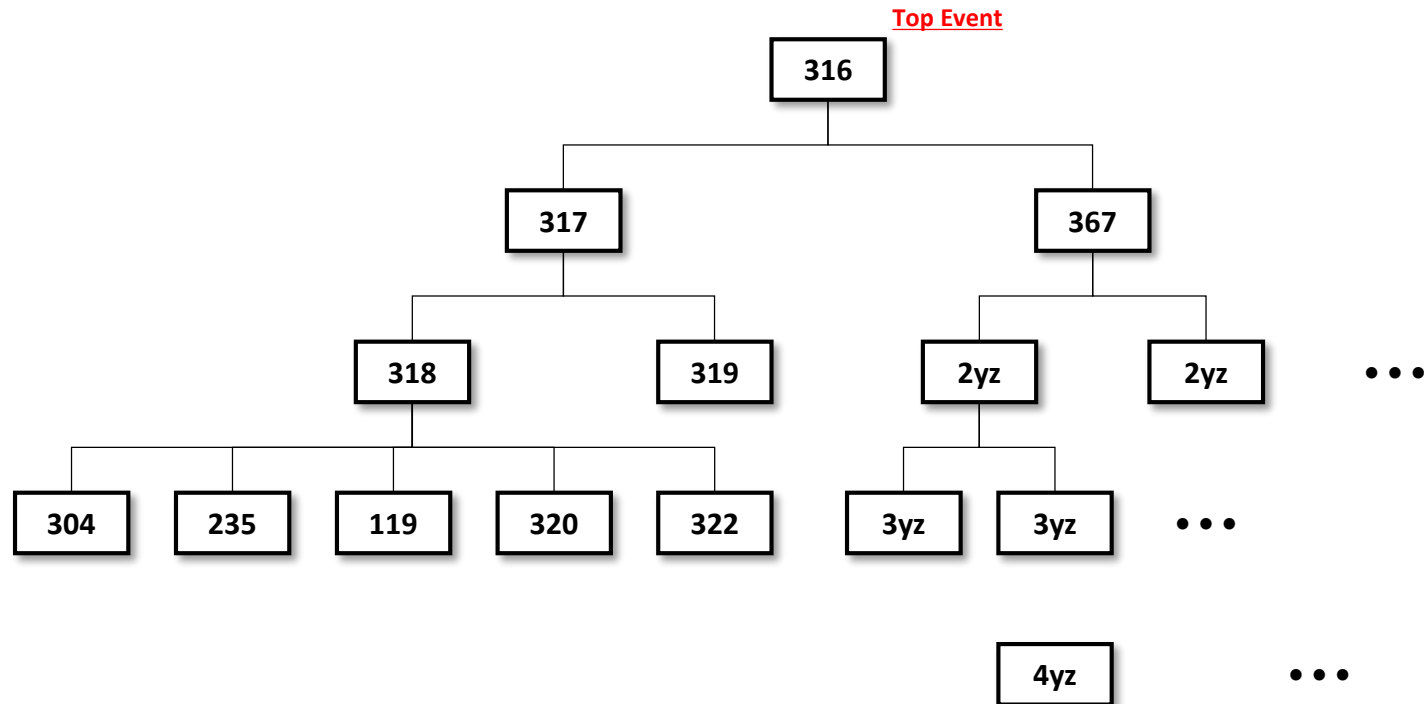


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Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Fault Tree Structure Generating (Cont.)

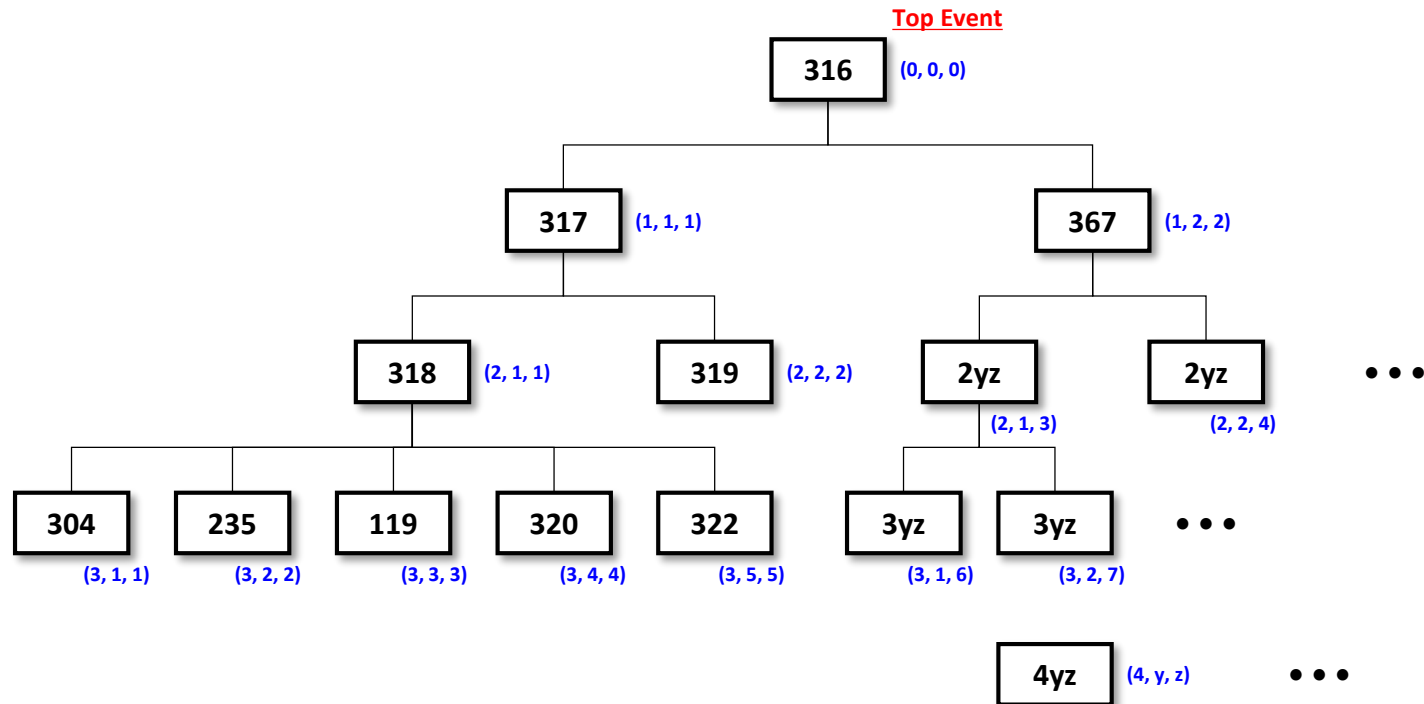


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Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Fault Tree Structure Generating (Cont.)

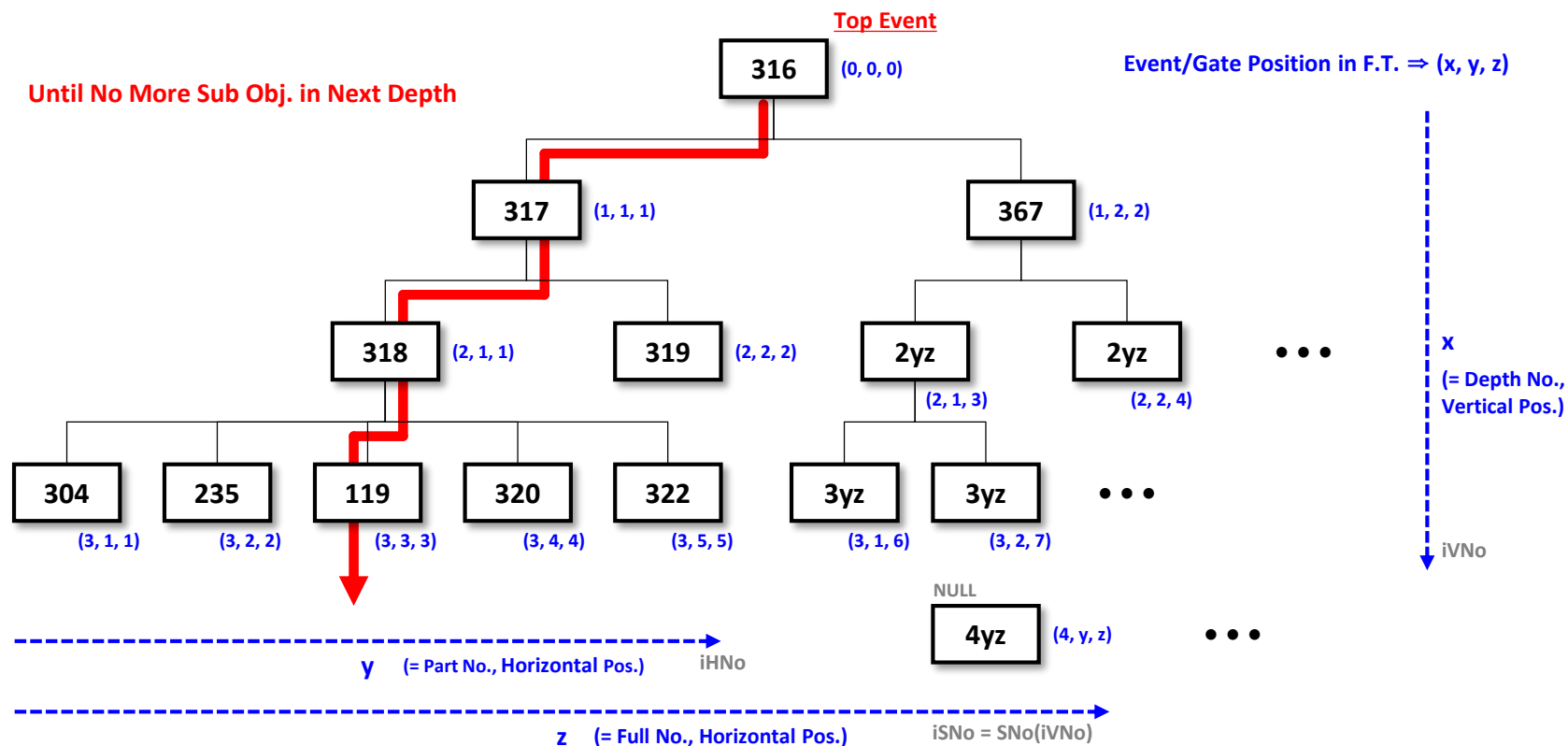


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Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Fault Tree Structure Generating (Cont.)



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

✂ Fault Tree Structure Generating (Cont.)

DFire - Common F.T. Structure Generating

WSN3 (Shin-Wolsong 12)

Common Fault Tree Structure

(from EventList)				(from TreeLogic)														
Tree Structure: FaultTree()				Target Object			Sub Object List											
Seq. No.	Up Obj.	Type	Mean Val.	Obj. ID	G Type	No. of Sub	Sub #1	Sub #2	Sub #3	Sub #4	Sub #5	Sub #6	Sub #7	...				
316	-	Top		316	*	2	317	367						Top Event				
317	316	+		317	+	2	318	319										
367	316	+		367										N/A				
318	317	+		318	+	5	304	235	119	320	322							
319	317	+		319	+	2	1	94										
304	318	+		304	+	2	306	305										
235	318	+		235	+	3	267	268	269									
119	318	+		119	+	2	187	188										
		=		320	=	1	321											
		*		322	*	2	1165	1166										
1	319	+		1	+	2	27	28										
94	319	*		94	*	2	95	96										

FaultTree(iNum, 1~7)

22	4	2	10	1166	322	+	5	MCR-SUPP-2202	MCR-B계열 비상디젤발전기
23	4	1	11	27	1	+	6	MCR-DHRS-6001	MCR-안전주입밸브
24	4	2	12	28	1	+	6	MCR-DHRS-6002	MCR-안전주입밸브
25	4	1	13	95	94	+	7	MCR-DHRS-7001	MCR-A계열 정지냉각계
26	4	2	14	96	94	+	7	MCR-DHRS-7002	MCR-B계열 정지냉각계
27	5	1	1	302	306	+	1	G&-731-J-RW-0001...	MCR-731-J-RW-000
28	5	2	2	303	306	+	1	G&-731-J-RW-0001...	MCR-731-J-RW-000
29	5	1	3	307	305	+	2	MCR-RC-0021	MCR-RMWP
30	5	2	4	308	305	*	2	MCR-RC-0022	MCR-RMWP TO CVC
31	5	3	5	309	305	*	2	MCR-RC-0023	부스터 부스터

OK, Save Data

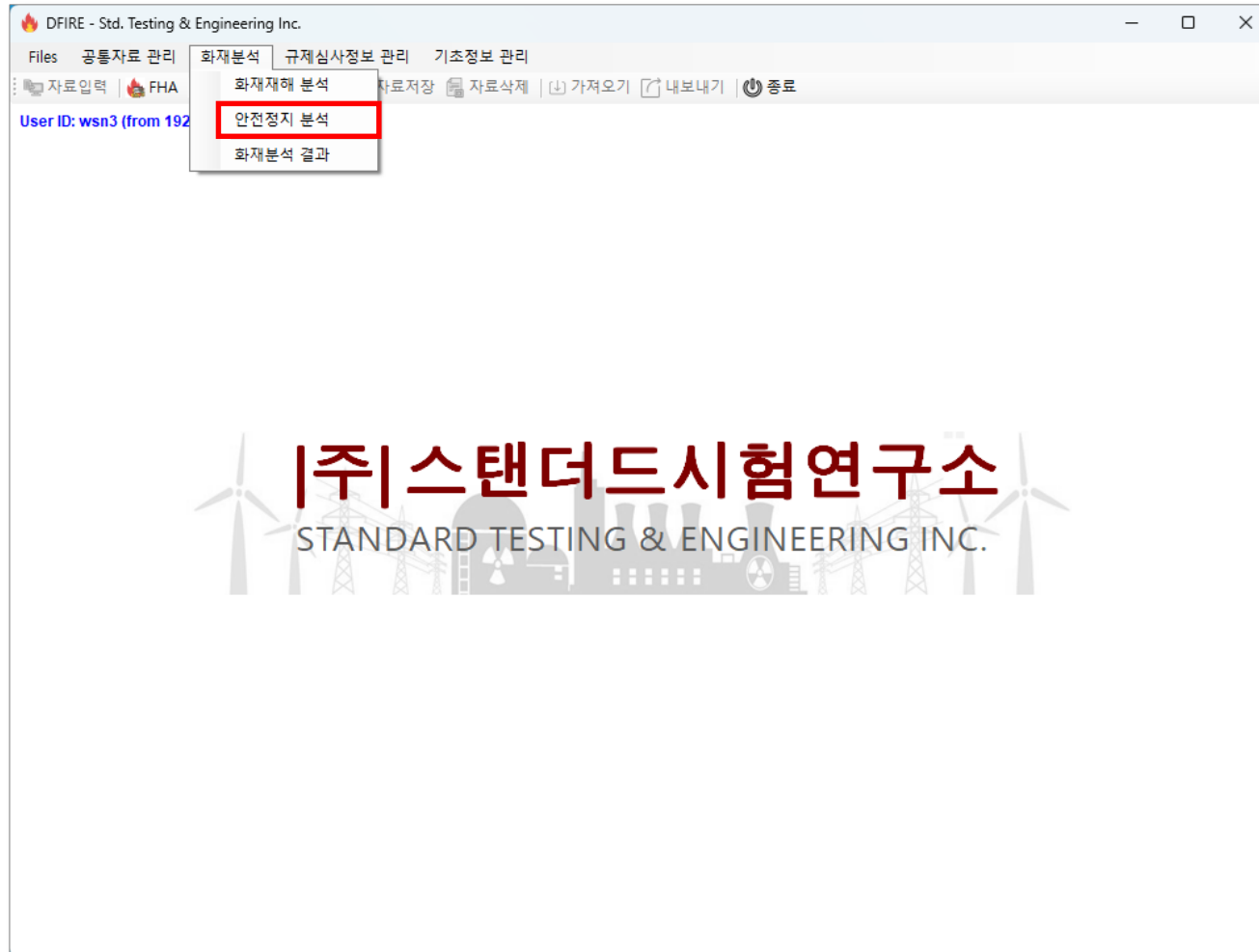
NO, Discard

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (SSA)



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (SSA)

DFire - Safe Shutdown Analysis

Target Plant: WSN3
Shin-Wolsong 12

Ref. Date: 2024-08-20

Inquiry Click !

Fire Affected Equip. & Cables in the Plant

Affected Safety Equip. Affected Safety Cables

DFire - Processing ...

Loading Fire Affected Equip./Cables ...

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (SSA)

DFire - Safe Shutdown Analysis

Target Plant: WSN3 Ref. Date: 2024-08-20 Inquiry Analysis Click !

Shin-Wolsong 12

Fire Affected Equip./Cables in Auxiliary BLDG (Unit 1 of Shin-Wolsong 12)

Fire Affected Equip. Fire Affected Cables

Cable No.	Equip. 1	Equip. 2	Function Code	AIMS Code
1-431-C-01-A-J-B-M	1-821-E-SW01M	1-752-J-PA01	431-M-PP01A:START:...	431-M-PP01A:START:STOP
1-431-C-01-A-S-A-M	1-752-J-PA01	1-751-J-PM05	431-M-PP01A:START:...	431-M-PP01A:START:STOP
1-431-C-01-A-S-B-M	1-752-J-PA01	1-754-J-RU01B	431-M-PP01A:START:...	431-M-PP01A:START:STOP
1-431-C-01-B-J-B-M	1-821-E-SW01M	1-752-J-PA01	431-M-PP02A:START:...	431-M-PP02A:START:STOP
1-431-C-01-B-S-A-M	1-752-J-PA01	1-751-J-PM05	431-M-PP02A:START:...	431-M-PP02A:START:STOP
1-431-C-01-B-S-B-M	1-752-J-PA01	1-754-J-RU01B	431-M-PP02A:START:...	431-M-PP02A:START:STOP
1-431-C-01-C-J-B-N	1-821-E-SW01N	1-752-J-PA02	431-M-PP01B:START:...	431-M-PP01B:START:STOP
1-431-C-01-C-S-A-N	1-752-J-PA02	1-751-J-PM05	431-M-PP01B:START:...	431-M-PP01B:START:STOP
1-431-C-01-C-S-B-N	1-752-J-PA02	1-754-J-RU01B	431-M-PP01B:START:...	431-M-PP01B:START:STOP
1-431-C-01-D-J-B-N	1-821-E-SW01N	1-752-J-PA02	431-M-PP02B:START:...	431-M-PP02B:START:STOP
1-431-C-01-D-S-A-N	1-752-J-PA02	1-751-J-PM05	431-M-PP02B:START:...	431-M-PP02B:START:STOP
1-431-C-01-D-S-B-N	1-752-J-PA02	1-754-J-RU01B	431-M-PP02B:START:...	431-M-PP02B:START:STOP
1-431-C-01-E-J-B-M	1-839-E-EA15M-J1	1-752-J-PA01	431-M-PP01A:START:...	431-M-PP01A:START:STOP
1-431-C-01-E-J-E-M	1-839-E-EA15M-J1	1-752-J-PA01	431-M-PP02A:START:...	431-M-PP02A:START:STOP
1-431-C-01-F-J-B-N	1-839-E-EA12N-J1	1-752-J-PA02	431-M-PP01B:START:...	431-M-PP01B:START:STOP
1-431-C-01-F-J-E-N	1-839-E-EA12N-J1	1-752-J-PA02	431-M-PP02B:START:...	431-M-PP02B:START:STOP
1-431-C-03-A-S-B-M	1-752-J-PA01	1-751-J-PM05	431-M-PZ01-P1:ON:...	431-M-PZ01-P1:ON:OFF
1-431-C-03-B-S-B-N	1-752-J-PA02	1-751-J-PM05	431-M-PZ01-P2:ON:...	431-M-PZ01-P2:ON:OFF
1-431-C-03-C-J-A-M	1-826-E-MC22M	1-771-J-MX05	431-M-PZ01-B1:ON:...	431-M-PZ01-B1:ON/OFF:OFF
1-431-C-03-C-S-B-M	1-752-J-PA01	1-751-J-PM05	431-M-PZ01-B1:ON:...	431-M-PZ01-B1:ON/OFF:OFF
1-431-C-03-C-S-C-M	1-752-J-PA01	1-754-J-RU01B	431-M-PZ01-B1:ON:...	431-M-PZ01-B1:ON/OFF:OFF
1-431-C-03-D-J-A-N	1-826-E-MC22N	1-771-J-MX06	431-M-PZ01-B2:ON:...	431-M-PZ01-B2:ON/OFF:OFF
1-431-C-03-D-S-B-N	1-752-J-PA02	1-751-J-PM05	431-M-PZ01-B2:ON:...	431-M-PZ01-B2:ON/OFF:OFF
1-431-C-03-D-S-C-N	1-752-J-PA02	1-754-J-RU01B	431-M-PZ01-B2:ON:...	431-M-PZ01-B2:ON/OFF:OFF
1-431-C-04-A-J-A-M	1-824-E-LC01M	1-771-J-MX05	431-M-PZ01-B3:ON:...	431-M-PZ01-B3:ON/OFF:OFF
1-431-C-04-A-J-B-M	1-752-J-PA01	1-751-J-PM05	431-M-PZ01-B1:ON:...	431-M-PZ01-B1:ON/OFF:OFF
1-431-C-04-A-J-B-M	1-752-J-PA01	1-751-J-PM05	431-M-PZ01-B2:ON:...	431-M-PZ01-B2:ON/OFF:OFF
1-431-C-04-B-J-B-M	1-752-J-PA01	1-751-J-PM05	431-M-PZ01-B3:ON:...	431-M-PZ01-B3:ON/OFF:OFF

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (SSA)

 DFire - Safe Shutdown Analysis (by FTA) ×

Plant ID: WSN3 Plant Name: Shin-Wolsong 12 Ref. Date: 2024-08-20

Safe Shutdown Analysis using FTA for each Fire Area ☒ Keep Going Click ! Start !

Unit	Building	Area ID	Area Name	No. of Cables	No. of F-Code	FTA Target	FTA Result
1	Auxiliary BLDG	1A0G0A	AB General Area A	782	778	O	Fail
1	Auxiliary BLDG	1A0G0B	AB General Area B	799	792	O	Fail
1	Auxiliary BLDG	1A0G1	Buttress Enclosure & Divisi...	27	27	O	OK
1	Auxiliary BLDG	1A0G2	Access Aisle Area	119	114	O	OK
1	Auxiliary BLDG	1A0G3A	Air Intake Area A	1	1	O	
1	Auxiliary BLDG	1A0G3B	Air Intake Area B			-	
1	Auxiliary BLDG	1A102A	Stair A West (58"~100")	67	67	O	
1	Auxiliary BLDG	1A102B	Stair B West (58"~100")	2		O	
1	Auxiliary BLDG	1A105A	Pipe Shaft A			-	
1	Auxiliary BLDG	1A105B	Pipe Shaft B			-	
1	Auxiliary BLDG	1A106A	Stair A East (58"~161")	7	7	O	
1	Auxiliary BLDG	1A106B	Stair B East (58"~161")	26	26	O	
1	Auxiliary BLDG	1A110	Elevator Hoistway			-	
1	Auxiliary BLDG	1A120A	CCW Pump Area A	34	34	O	
1	Auxiliary BLDG	1A120B	CCW Pump Area B	31	31	O	
1	Auxiliary BLDG	1A124	AUX. Charging Pump Room	4	4	O	
1	Auxiliary BLDG	1A126A	Charging Pump Area A	7	7	O	
1	Auxiliary BLDG	1A126B	Charging Pump Area B	14	14	O	
1	Auxiliary BLDG	1A127A	LPSI Pump Room A	15	15	O	
1	Auxiliary BLDG	1A127B	LPSI Pump Room B	13	13	O	
1	Auxiliary BLDG	1A128A	CS Pump Room A	10	10	O	
1	Auxiliary BLDG	1A128B	CS Pump Room B	18	18	O	

3

Computer Program using the Method

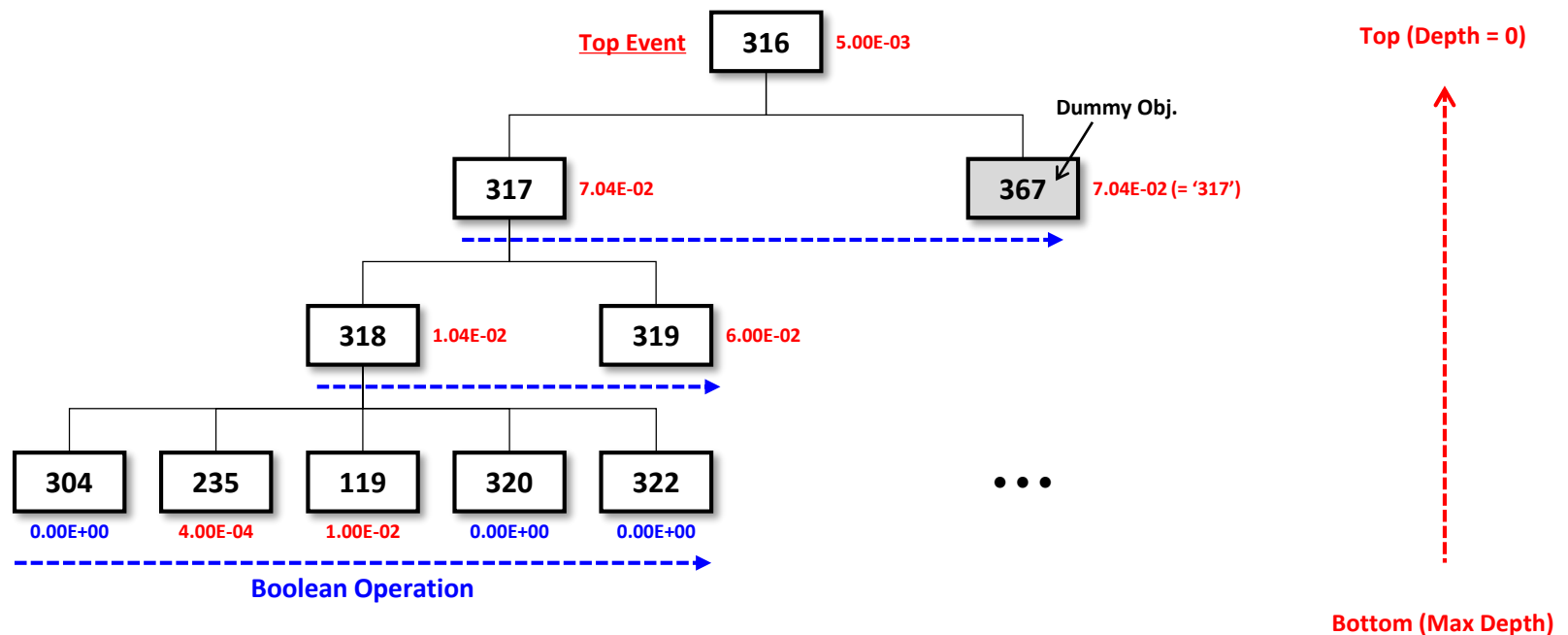
Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Fault Tree Quantification

Work-flow for F.T. Quantification

- Start from **Bottom** to **Top**, Boolean Operation Obj. (Gate/Event)

※ Ex. Fire Area: 1A0G0A



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Example of F.T. Quantification Result

Estimated Fault Tree: FaultTree()								the Object (Gate/Event) Info.		the Object			Sub Object & Logic Val.						
x	y	z	Seq. No.	Up Obj.	Type	Mean	Logic	Obj. Description		Obj. ID	Type	No. Sub	Sub #1	Sub #2	Sub #3	Sub #4	Sub #5	Sub #6	Sub #7
0	0	0	316	-	Top	4.94E-03	T	안전정지 불만족		316	*	2	317	367					
1	1	1	317	316	+	7.03E-02	T	MCR-안전정지 불만족		317	+	2	318	319					
1	2	2	367	316	+	7.03E-02	T	RSP-안전정지 불만족		367									
2	1	1	318	317	+	1.03E-02	T	MCR-고온대기 불만족		318	+	5	304	235	119	320	322		
2	2	2	319	317	+	6.00E-02	T	MCR-상온정지 불만족		319	+	2	1	94					
3	1	1	304	318	+	0.00E+00	F	MCR-고온대기 반응도제어 불만족		304	+	2	306	305					
3	2	2	235	318	+	3.00E-04	T	MCR-Example Fire Area: 1A0G0A		+	3	267	268	269					
3	3	3	119	318	+	1.00E-02	T			+	2	187	188						
3	4	4	320	318	=	0.00E+00	F			=	1	321							
3	5	5	322	318	*	0.00E+00	F	MCR-비상전원 상실		322	*	2	1165	1166					
3	1	6	1	319	+	6.00E-02	T	MCR-상온정지 진입조건 만족 실패		1	+	2	27	28					
3	2	7	94	319	*	0.00E+00	F	MCR-상온정지 정지냉각계통 실패		94	*	2	95	96					
4	1	1	306	304	*	0.00E+00	F	MCR-반응도제어 변수감시 실패		306	*	2	302	303					
4	2	2	305	304	*	0.00E+00	F	MCR-부주의한 봉소 회석		305	*	3	307	308	309				
4	1	3	267	235	+	1.00E-04	T	MCR-원자로냉각재 채고량 관리		267	+	4	285	240	236	286			
4	2	4	268	235	+	2.00E-04	T	MCR-원자로냉각재 압력제어 실패		268	+	5	271	272	243	244	273		
4	3	5	269	235	+	0.00E+00	F	MCR-원자로냉각재 변수감시 실패		269	+	2	274	275					
4	1	6	187	119	*	0.00E+00	F	MCR-증기발생기1,2 잔열제거 불만족		187	*	2	189	190					
4	2	7	188	119	+	1.00E-02	T	MCR-증기발생기 부주의한 증기방출		188	+	2	152	153					



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ F.T. Quantification Result Comparison (DFIRE vs. AIMS-PSA)

Fire Area	Gate	Name	Type	DFIRE	AIMS-PSA
1A0G0A (AB General Area A)	SSA-0000	Safe-Shutdown X	AND	4.94E-03	3.978e-002
	MCR-0000	MCR – S.S. X	OR	7.03E-02	3.978e-002
	MCR-HSD-0000	MCR – Hot Standby X	OR	1.03E-02	3.919e-004
	MCR-CSD-0000	MCR – Cold Standby X	OR	6.00E-02	3.940e-002
1A0G0B (AB General Area B)	SSA-0000	Safe-Shutdown X	AND	4.99E-03	4.000e-002
	MCR-0000	MCR – S.S. X	OR	7.06E-02	4.000e-002
	MCR-HSD-0000	MCR – Hot Standby X	OR	1.06E-02	6.242e-004
	MCR-CSD-0000	MCR – Cold Standby X	OR	6.00E-02	3.940e-002
1A325A (Class 1E S/W Room A)	SSA-0000	Safe-Shutdown X	AND	1.63E-03	2.013e-002
	MCR-0000	MCR – S.S. X	OR	4.03E-02	2.013e-002
	MCR-HSD-0000	MCR – Hot Standby X	OR	3.30E-04	3.311e-004
	MCR-CSD-0000	MCR – Cold Standby X	OR	4.00E-02	1.990e-002
1A325B (Class 1E S/W Room B)	SSA-0000	Safe-Shutdown X	AND	1.60E-03	2.972e-002
	MCR-0000	MCR – S.S. X	OR	4.00E-02	2.972e-002
	MCR-HSD-0000	MCR – Hot Standby X	OR	3.00E-05	2.857e-005
	MCR-CSD-0000	MCR – Cold Standby X	OR	4.00E-02	2.970e-002
1A421A (Cable Spreading Area A)	SSA-0000	Safe-Shutdown X	AND	7.77E-03	0.000e+00
	MCR-0000	MCR – S.S. X	OR	8.63E-02	5.401e-002
	MCR-HSD-0000	MCR – Hot Standby X	OR	6.28E-03	5.457e-003
	MCR-CSD-0000	MCR – Cold Standby X	OR	8.00E-02	4.901e-002
1A421B (Cable Spreading Area B)	SSA-0000	Safe-Shutdown X	AND	6.49E-03	5.909e-002
	MCR-0000	MCR – S.S. X	OR	8.06E-02	5.909e-002
	MCR-HSD-0000	MCR – Hot Standby X	OR	5.70E-04	6.725e-004
	MCR-CSD-0000	MCR – Cold Standby X	OR	8.00E-02	5.852e-002

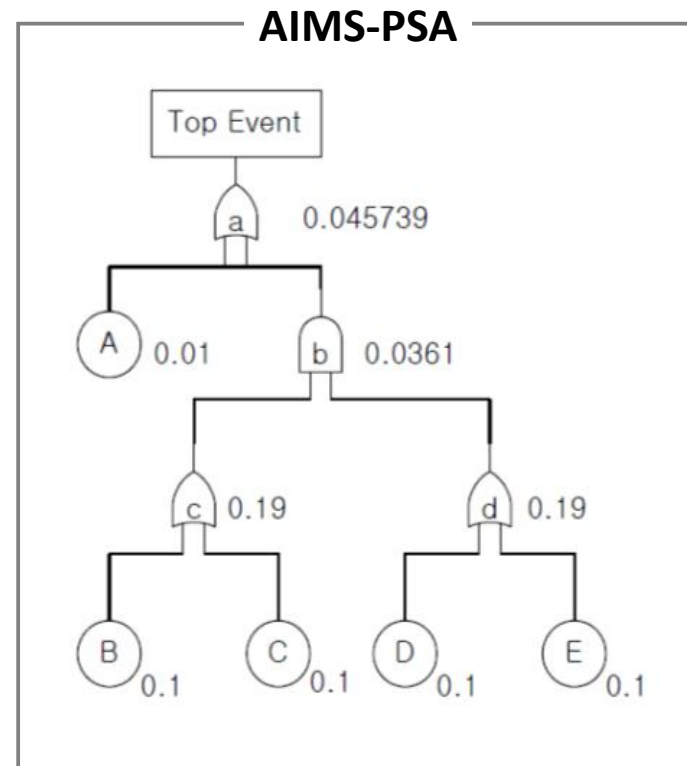
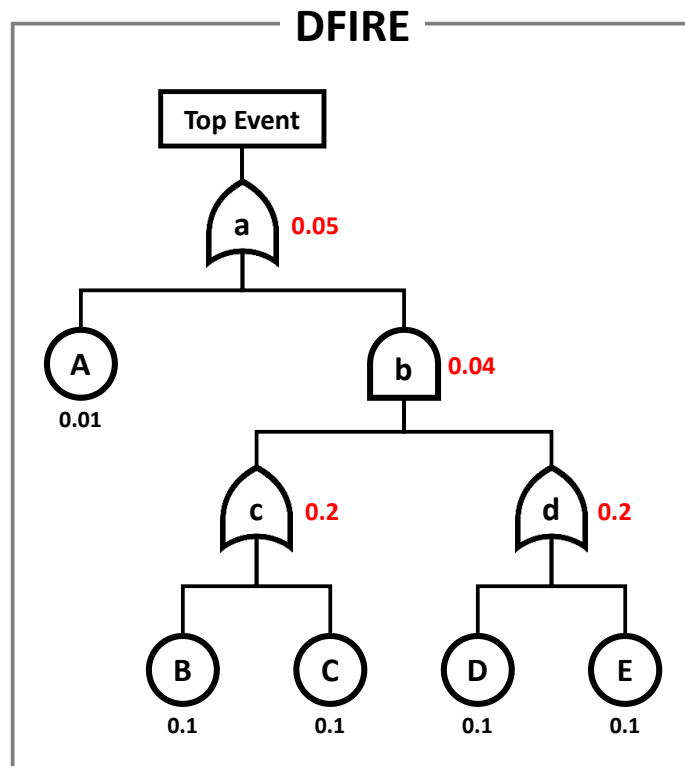
3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ F.T. Quantification Result Comparison (DFIRE vs. AIMS-PSA)

Fault Tree **Why are the Results Different?**



= 0.04901

※ Fault Tree 방법론 개요 (KAERI), AIMS-PSA Release 2 Reference Manual Rev.1.2

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ F.T. Quantification Result Comparison (DFIRE vs. AIMS-PSA)

Fault Tree Why are the Results Different?

□ Inclusion-Exclusion 방식에 의한 정확한 계산

	1차	2차	3차	4차	5차	
	A	ABD	ABDE	ABCDE	ABCDE	
	BD	ABE	ABCD	ABCDE		
	BE	ACD	ABCDE	ABCDE		
	CD	ACE	ABCDE	ABCDE		
	CE	BDE	ABCE	BCDE		
		BCD	ACDE			
		BCDE	BCDE			
		BCDE	BCDE			
		BCE	BCDE			
		CDE	BCDE			
	5*1e-2	4*1e-4	4*1e-5	4*1e-6	1.00E-06	
		4*1e-3	2*1e-6	1*1e-4		
		2*1e-4	4*1e-4			저체계
계	0.05	-0.0046	0.000442	-0.000104	0.000001	0.04574

DFIRE

← Vs. →

AIMS

※ Fault Tree 방법론 개요 (KAERI), AIMS-PSA Release 2 Reference Manual Rev.1.2

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Computer Program using the Method

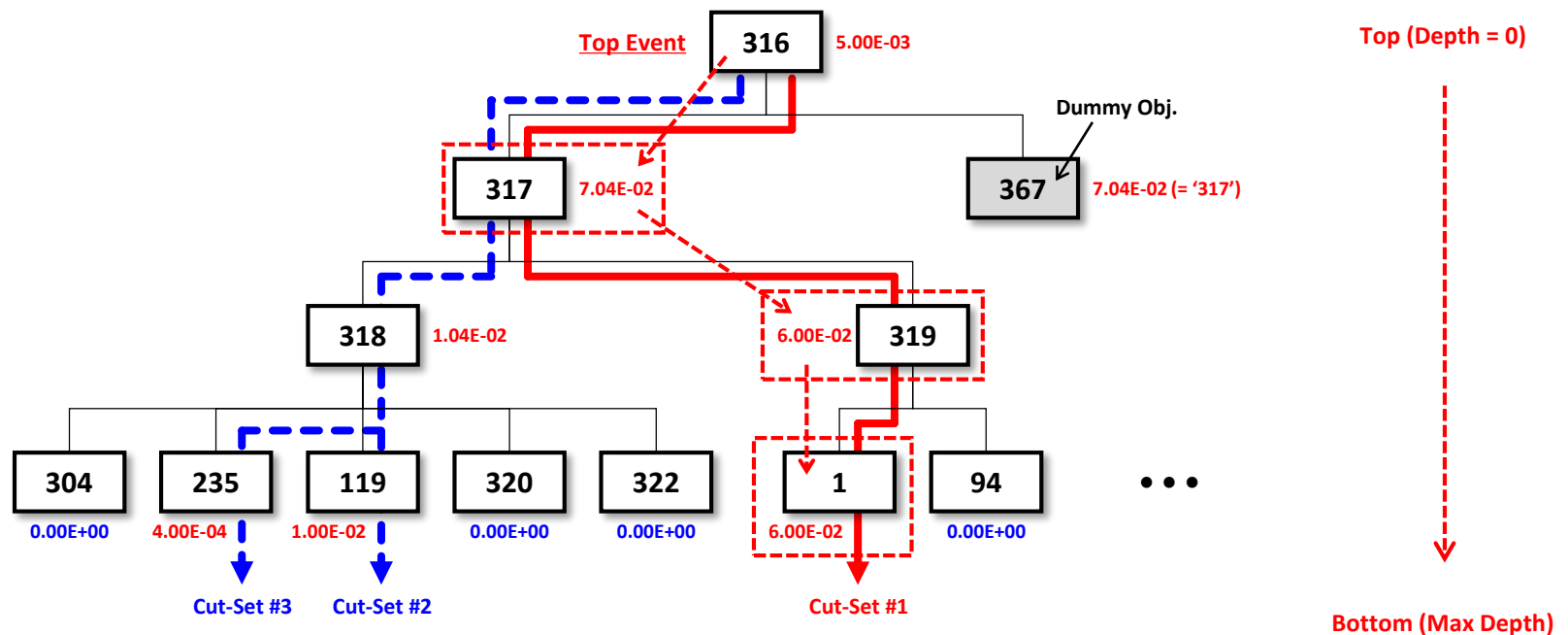
Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Cut-Set of the Fault Tree

How to Search Minimal Cut-Set

- Start from **Top** to **Bottom**, Obj. with Max. Mean Val. in FT Level (= Depth)

※ Ex. Fire Area: 1A0G0A



3

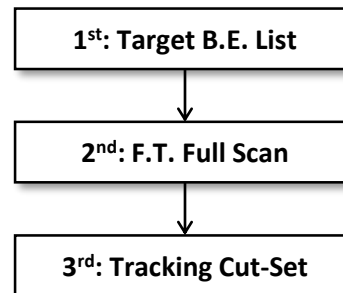
Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Cut-Set of the Fault Tree (Cont.)

How to Search All Cut-Set

- Triple-Loop (Target B.E. List & B.E. in F.T. & Tracking from the B.E. to Top)



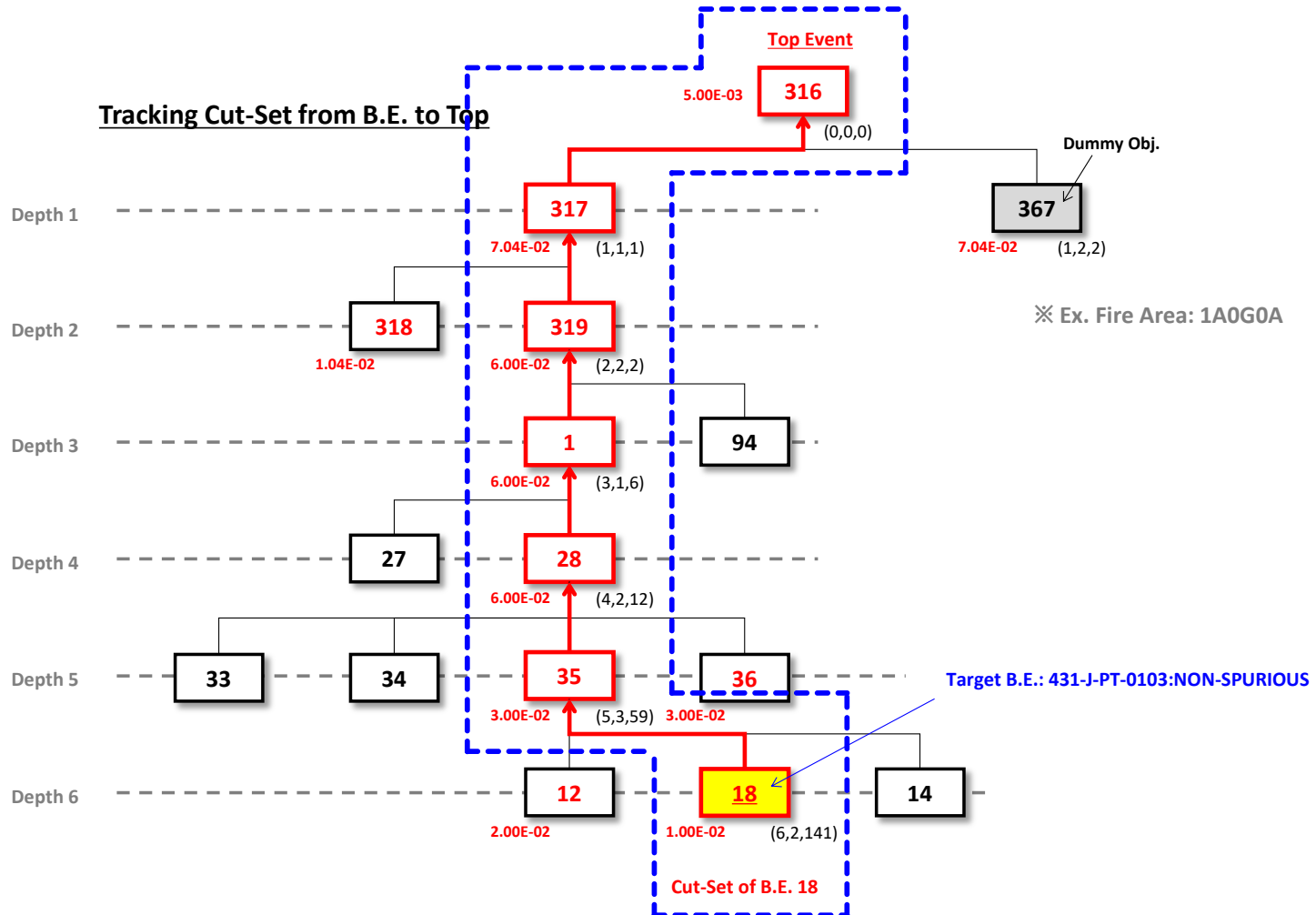
Tracking Cut-Set from B.E. to Top

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Cut-Set of the Fault Tree (Cont.)



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

※ Example of FTA Result: Cut-Set of the F.T.

Cut-Set
No.
(ICS)

Estimated Fault Tree: FaultTree() ⇒ Cut-Set List-Up

x	y	z	Seq. No.	Up Obj.	Type	Mean	Logic
1	0	0	316	-	Top	4.94E-03	T
1	1	1	317	316	+	7.03E-02	T
1	2	2	319	317	+	6.00E-02	T
1	3	1	1	319	+	6.00E-02	T
1	4	2	28	1	+	6.00E-02	T
1	5	3	35	28			
1	6	2	18	35			
2	0	0	316	-	Top	4.94E-03	T
2	1	1	317	316	+	7.03E-02	T
2	2	2	319	317	+	6.00E-02	T
2	3	1	1	319	+	6.00E-02	T
2	4	2	28	1	+	6.00E-02	T
2	5	4	36	28	+	3.00E-02	T
2	6	2	18	36	B	1.00E-02	T

Example Fire Area: 1A0G0A

the Object (Gate/Event) Info.

Obj. Name	Obj. Description
SSA-0000	안전정지 불만족
MCR-0000	MCR-안전정지 불만족
MCR-CSD-0000	MCR-상온정지 불만족
MCR-DHRS-6000	MCR-상온정지 진입조건 만족 실패
MCR-DHRS-6002	MCR-안전주입탱크 격리 실패
MCR-DHRS-6017	MCR-안전주입탱크 1C 격리 실패
0103:NON-SPURIOUS	MCR-431-J-PT-0103 오신호
SSA-0000	안전정지 불만족
MCR-0000	MCR-안전정지 불만족
MCR-CSD-0000	MCR-상온정지 불만족
MCR-DHRS-6000	MCR-상온정지 진입조건 만족 실패
MCR-DHRS-6002	MCR-안전주입탱크 격리 실패
MCR-DHRS-6018	MCR-안전주입탱크 1D 격리 실패
431-J-PT-0103:NON-SPURIOUS	MCR-431-J-PT-0103 오신호

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3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program



3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (Overall Analysis Result)

DFire - Analysis Results Review

Target Plant: **WSN3** Inquiry Auxiliary BLDG

Shin-Wolsong 12

Fire Analysis Results in Auxiliary BLDG (Unit 1 of Shin-Wolsong 12)

Overall Fire Analysis Results Safe-Shutdown Analysis Results Detail

Double Click !

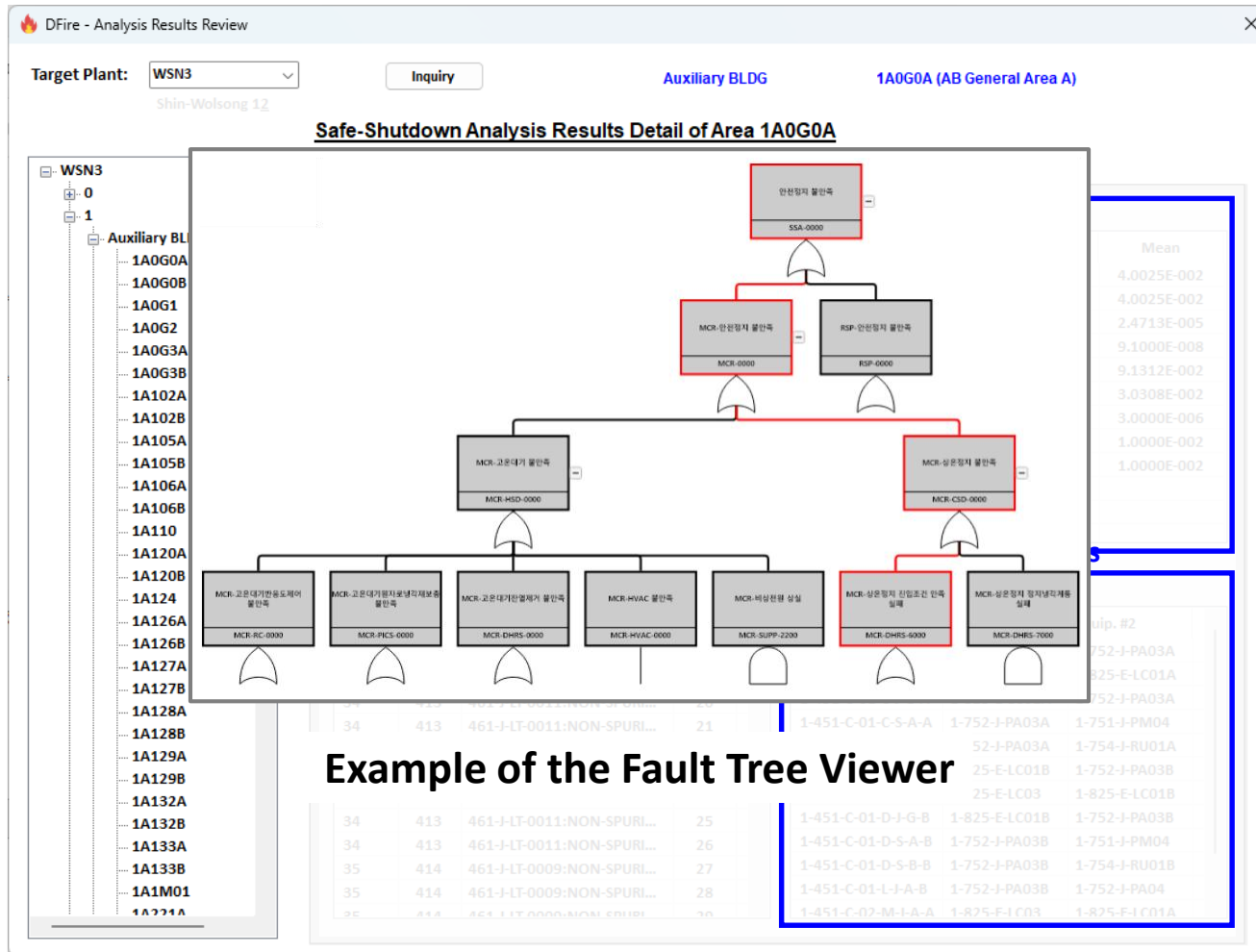
	Heat Load (Btu)	Fire Load (Btu...)	Severity (...)	Rating (hr)	FTA Result	Top Mean
AB General Area A	632,502,025	13,018	10	0.5	Fail	4.0025E-002
AB General Area B	571,064,794	12,185	10	0.5	Fail	4.0516E-002
Buttress Enclosure & Divi...	6,270,133	5,346	5	0.5	OK	0.0000E+000
Access Aisle Area	241,541,762	22,809	18	0.5	OK	0.0000E+000
Air Intake Area A	0	0	0	0.0		
Air Intake Area B	0	0	0	0.0		
Stair A West (58~100')	3,800,934	29,238	22	0.5		
Stair B West (58~100')	4,369,836	33,615	26	0.5		
Pipe Shaft A	472,570	379	1	0.5		
Pipe Shaft B	0	0	0	0.0		
Stair A East (58~161')	0	0	0	0.0		
Stair B East (58~161')	0	0	0	0.0		
Elevator Holstway	0	0	0	0.0		
CCW Pump Area A	11,965,541	7,526	6	0.5		
CCW Pump Area B	11,628,155	7,314	6	0.5		
AUX. Charging Pump Room	3,112,400	8,390	7	0.5		
Charging Pump Area A	2,779,471	6,191	5	0.5		
Charging Pump Area B	2,786,956	6,208	5	0.5		
LPSI Pump Room A	2,905,164	7,245	6	0.5		
LPSI Pump Room B	3,160,359	7,882	6	0.5		
CS Pump Room A	5,845,909	15,264	12	0.5		
CS Pump Room B	6,206,688	16,206	13	0.5		
HPSI Pump Room A	3,776,723	9,660	8	0.5		
HPSI Pump Room B	3,647,427	9,329	7	0.5		
MD AFWP Room A	2,210,965	2,921	3	0.5		
MD AFWP Room B	2,633,140	4,008	4	0.5		
TD AFWP Room A	41,901,796	81,522	62	1.5		
TD AFWP Room B	41,901,796	81,522	62	1.5		

3

Computer Program using the Method

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

3.2 Screen Shots of the Computer Program (SSA Result Detail)



4. Future Work & Plan



4

Future Work & Plan

Post-Fire Safe-Shutdown Analysis Method for Fire Area of Nuclear Power Plant Applying Fault Tree Analysis

- ❖ Test by KOLAS Accreditation Organization (Nov. 2025)
- ❖ S/W V&V for the Computer Program
- ❖ Applying the Method & the Computer Program on FHA Project

감사합니다

이 논문은 대한민국 정부(원자력안전위원회)의 재원으로 한국원자력안전재단의 지원을 받아 수행된 연구인 “**화재방호 안전현안 및 규제활동 지원용 전산프로그램 개발**”
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|주|스탠더드시험연구소

STANDARD TESTING & ENGINEERING INC.

