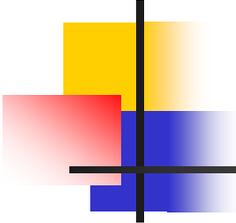


한국형 전산화절차서 개발

한국수력원자력 중앙연구원

정연섭



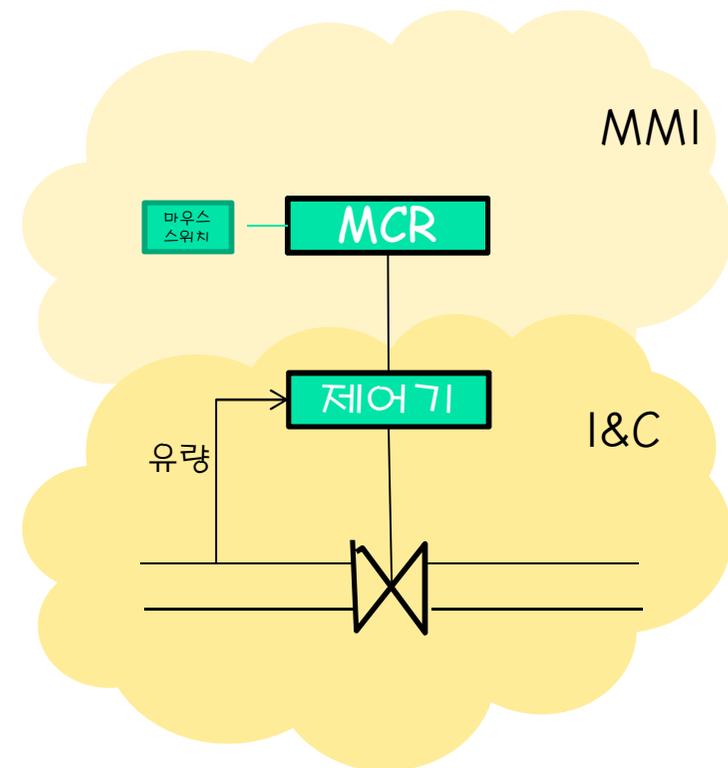
목차

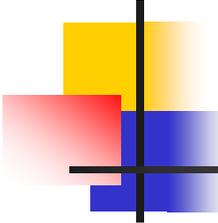
- MMIS, MMI, UI, UX
- MCR MMIS?
- CPS
- HEPP for CPS
- MMIS Issues for CPS

I&C, MMIS, MMI, UI, UX

- 신호의 시작과 끝: 센서, Switch, 기기, 마우스
- 제어주체: 제어기와 사람
- 표시장치: 고정형, 전환형 지시계

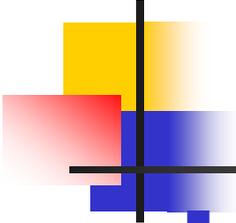
구분	I&C	MMI	MMIS	UI	UX
시작/끝	마우스 제외	마우스포함	마우스 포함	마우스	마우스
제어	자동/수동	수동	자동/수동	수동	수동
표시	고정	고정/전환	고정/전환	전환	전환





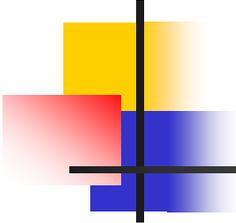
MCR

- MCR의 4대 기능과 표준 표현 형식
 - 감시 : P&ID 형 표시 (유체흐름, 에너지흐름, 모멘텀 흐름)
 - 제어 : Enumeration 상태 표시와 제어
 - 경보: 목록 및 타일
 - 결과
 - 진단 : 현재 MCR에 미 채용
 - 절차서: 표준형식 부재
 - 종이절차서 : Dual Column
 - 전산화절차서 : Flowlogic Diagram



절차서 수행의 직무분석

- PBP(Paper Based Procedure)
 - Read 1st Step [on Paper]
 - Check Process Variables [on Monitor]
 - Read 2nd Step [P]
 - Understand Control Target[P]
 - Control Target[M]
- CBP(Computer Based Procedure)
 - Understand Control Target[M]
 - Read 1st Step [M]
 - Check Process Variables [M]
 - Read 2nd Step [M]
 - Control Target[M]
- CBP is easier than PBP because of less context switching and Integration of Information



종이절차서 표현

Expected Actions	Contingency Actions
<ol style="list-style-type: none">1. Close V1012. Verify Flowrate Decreasing	<ol style="list-style-type: none">1. Close V1022. Verify Temperature Decreasing

- Dual Column Format

- Left: Expected Actions
- Right: Contingency Actions
- 1st Rule: when expected action is not satisfied, corresponding contingency actions should be performed.

AP1000 CBP 진화

INIT06: HPESV and HPGV mobility initial (test) procedure

MANUAL AUTO COMMAND ADVISOR Reset Step Access

Start/Stop Conditions Graphics Short Log

Continue To Step 7 Display Alternate Actions Back Up To Step 5

GO TO Step 8

Mode = MANUAL, COMMAND Remaining Time = 00:00

(SLKT#4) (Mon Jan 26 10:59:17 EST 1998)

1 Check pre-start conditions of HPESV and HPGV Mobility test (SLHTN) (VIOLATED) (Mon Jan 26 10:59:52 EST 1998)

5 Check status of HPGV-L-I position sensor (SLKT#4) (Mon Jan 26 13:39:18 EST 1998)

6. Check status of HPGV-L-I position sensor (SLKT #5) (VIOLATED)

- Check HPGV-L-I position is closed. If true, go to step 8. Taking valve closing time measurement.

HPGV-L-I position NOT CLOSED

Actual Vs Specified Valve Closing Time, HPGV-L-I Slow Counts LESS THAN OR EQUAL TO 40 (NOT EVALUATED)

*****COMMANDS ISSUED*****

GO TO Procedure INIT06, Step 8

7 Check status of HPGV-L-I position sensor(SLKT #6)

8 (SLKT #7)

9 Check status of HPESV-L-I position sensor(SLKT #8)

10 Check status of HPESV-L-I position sensor(SLKT #9)

11 (SLKT #10)

Westinghouse CP5 - Westinghouse Proprietary

Procedure List CSF Trees *E-0 E-3

Reactor Trip or Safety Injection

Entry Conditions E-0 Document Background Document Graphics

E-0 Step 23

23. Verify Containment Fan Coolers - RUNNING AT PROPER SPEED

a) Containment pressure - LESS THAN 6.2 PSIG

RNO: Perform the following:

1) Verify Containment Fan Coolers running in elow enard IF NOT THEN start fans in elow

Down RNO Go

Step 23

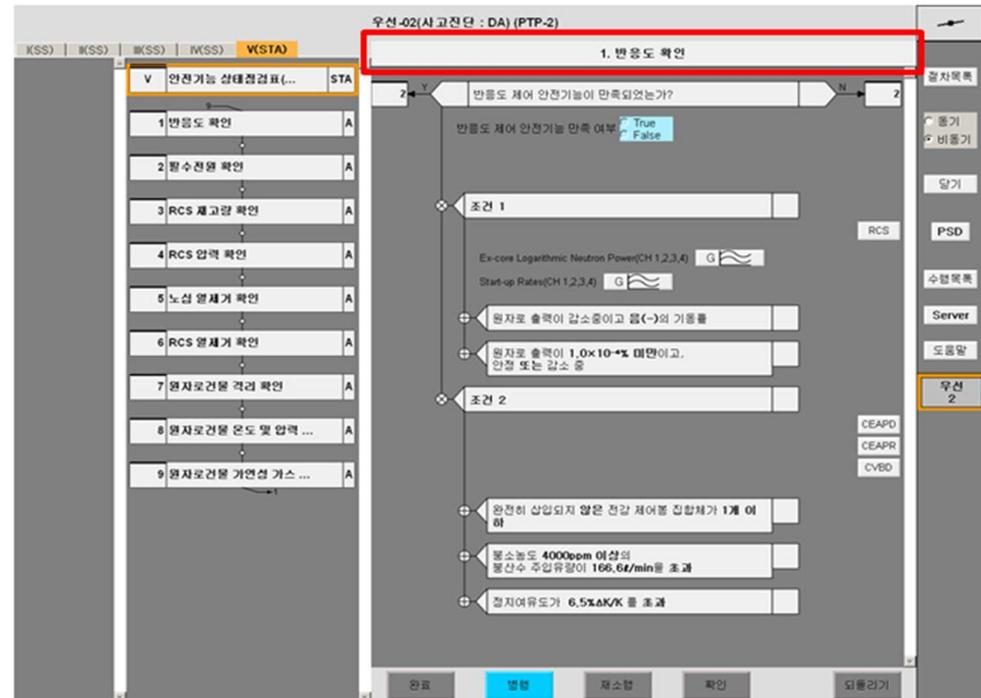
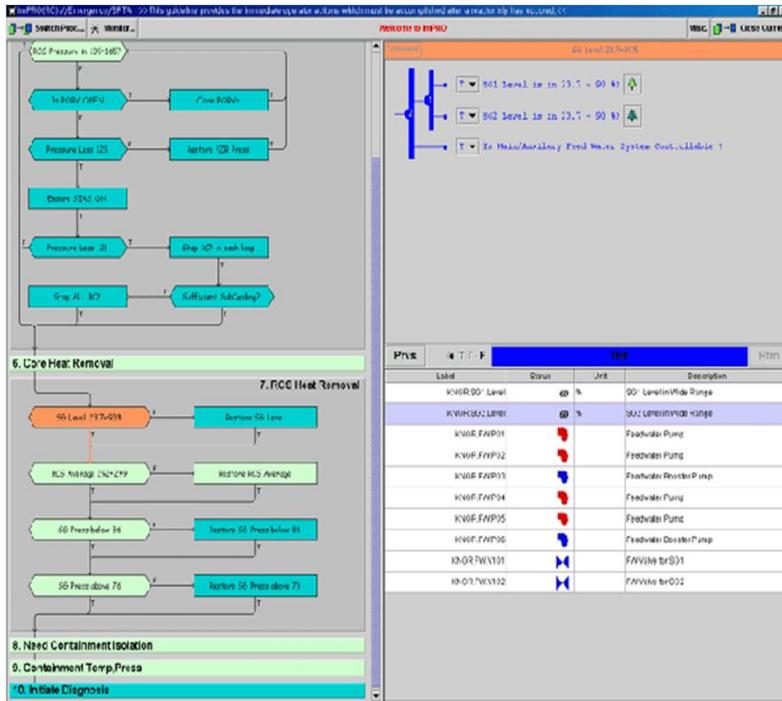
Step 23a

Containment Pressure LESS THAN 6.2 PSIG (PCS-P005-MED [-23.80]) < 6.2 AND

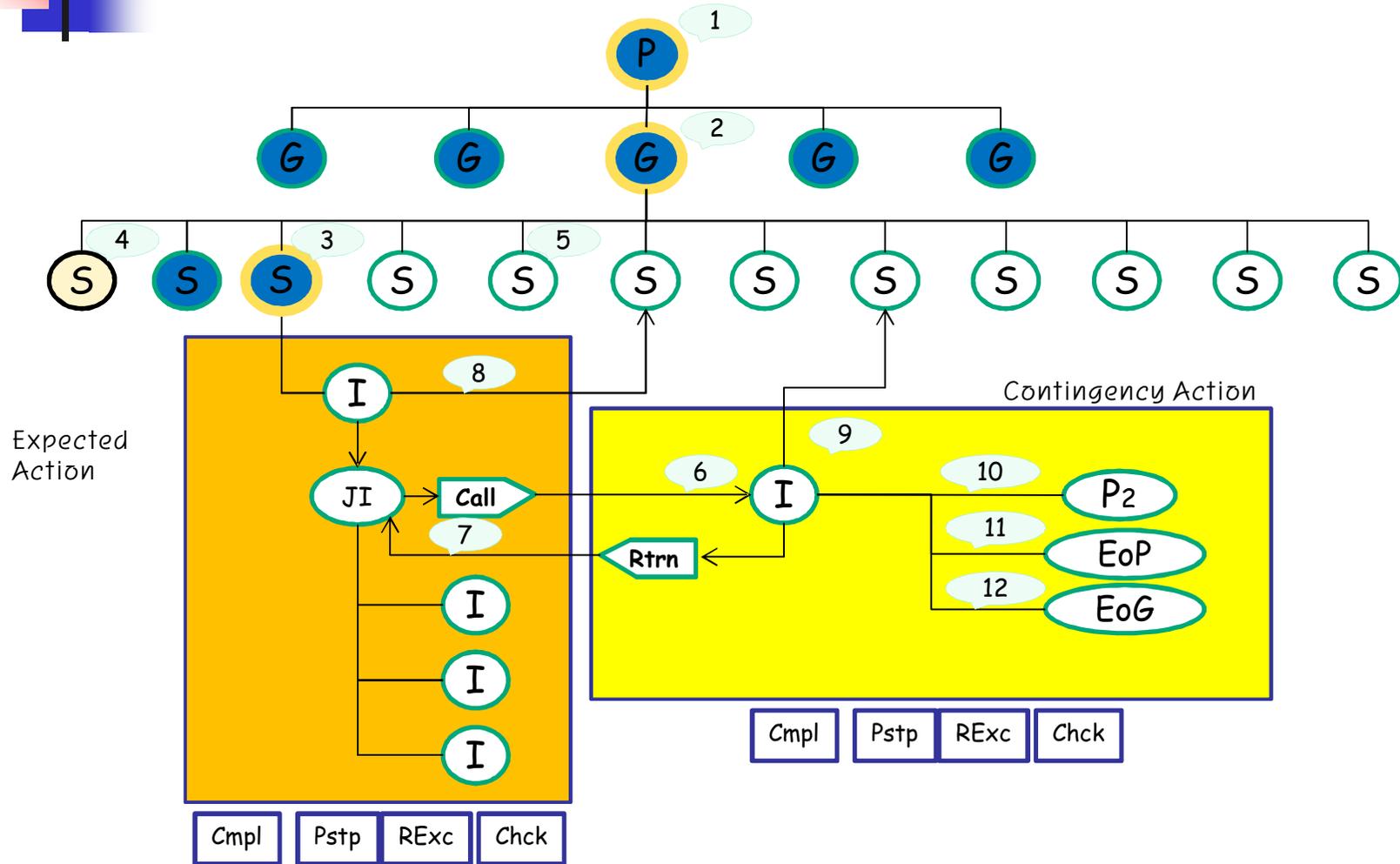
Step 23b

Containment Temperature is LESS THAN 230 DEGREES F

APR1400 CBP 진화



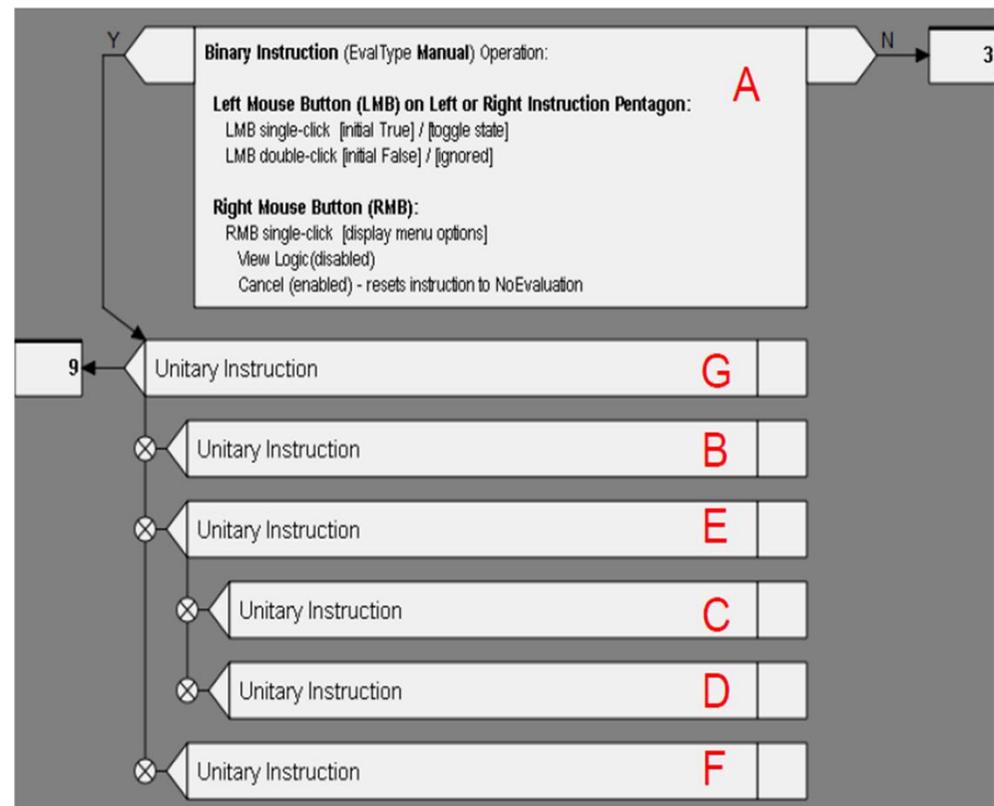
APR1400 CBP를 위한 절차분해



Flowlogic Diagram이라는 표현형태

■ Example transversal in Flowlogic Diagram

- **A** instruction performed initially
- Child instructions of **G** are **B, E, F**, so that **B** is performed next.
- Child instructions of **E** is **C, D** so that **C, D** is performed next
- **E** is evaluated by joining **C, D** with AND
- **F** is performed
- **G** is evaluated by joining **B, E, F** with AND

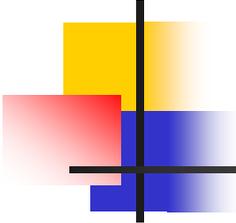


HFEP for CPS

- HFEP for MCR와 차이점
 - CPS는 MCR의 단위시스템으로 HFEP for MCR 이행
 - CPS 화면 설계를 위해 별도의 인간공학활동 필요
 - 원전의 필수안전기능 분석에 초점이 맞춘 FRA, FA에서는 화면설계 입력 요건 발굴 어려움
 - 단순화된 PSF 분석으로는 CPS 화면설계 어려움

- HFE V&V 방법과 FSAR기술, CPS 중심평가

구분	구비성	상향 적합성	하향 적합성	유요성
예비 HFE평가	가능	가능		
1차 통합	가능	가능	가능	가능
CPS 중심평가	가능	가능	가능	가능
2차 통합	가능	가능	가능	가능
발전소 확인	가능	가능		



MMIS Issues for CPS

- 단일본의 절차서 수행 (Place Keeping) 유지
- 불만족 조치와 예상조치의 동일 페이지 표시
- 시스템의 안전등급, 품질등급 향상
 - 체계적이고 수학적인 절차서 언어 정립
- 정보, 제어망의 통신속도 향상
 - 이미지 처리, 수행완료된 절차서 열람에 유리
- 전산화절차서로 전환된 절차서 확대
 - EOP, GOP, AOP, ARP, SOP, SAMG