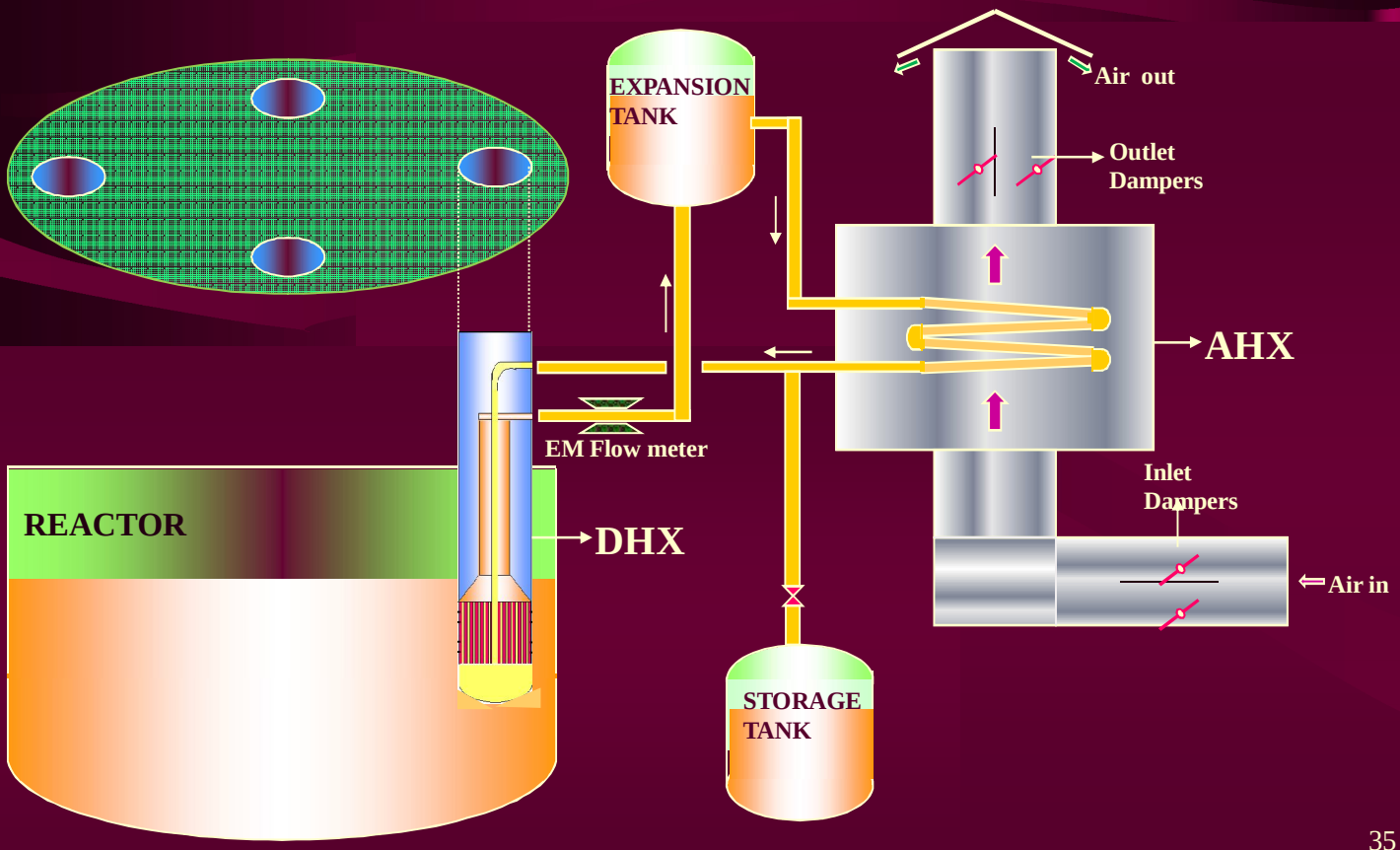
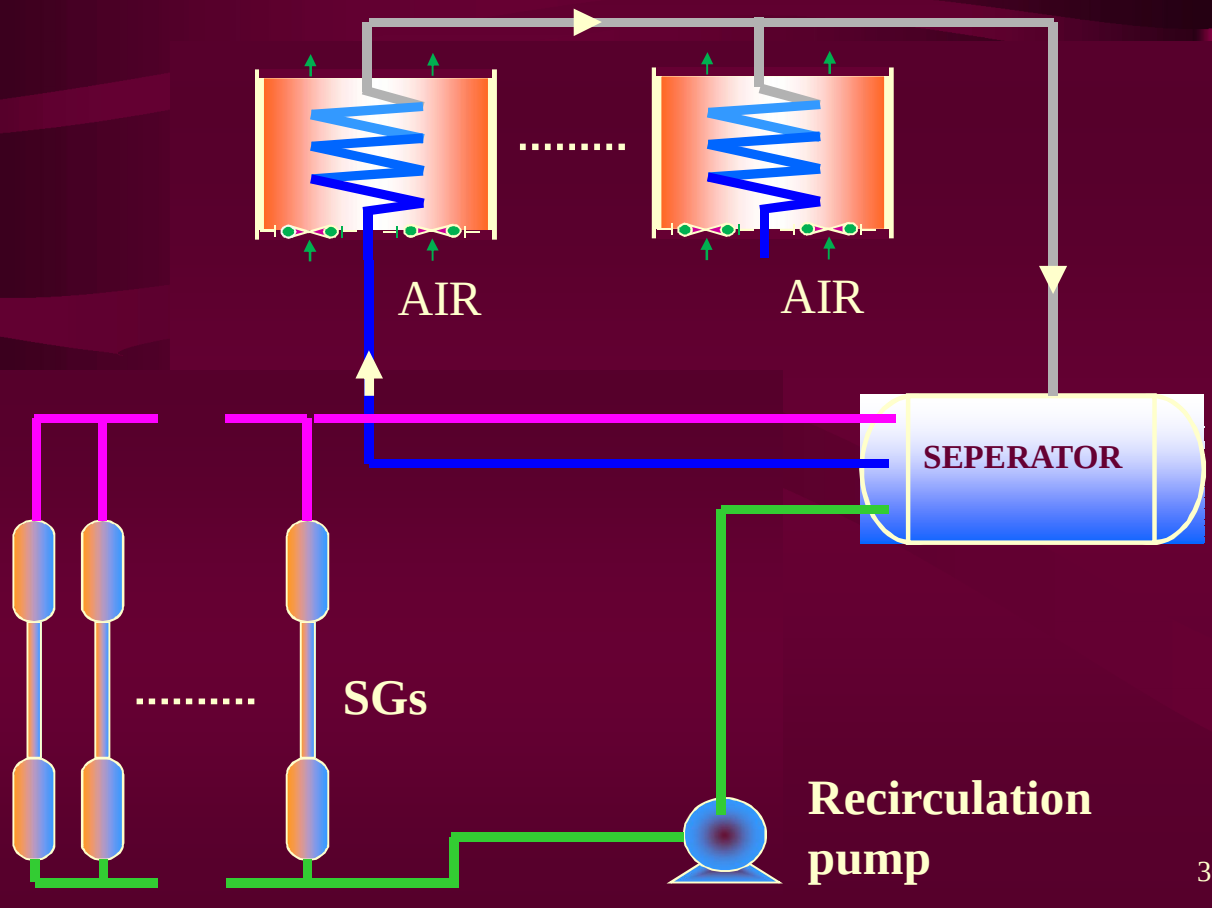
SGDHR System (in PFBR)

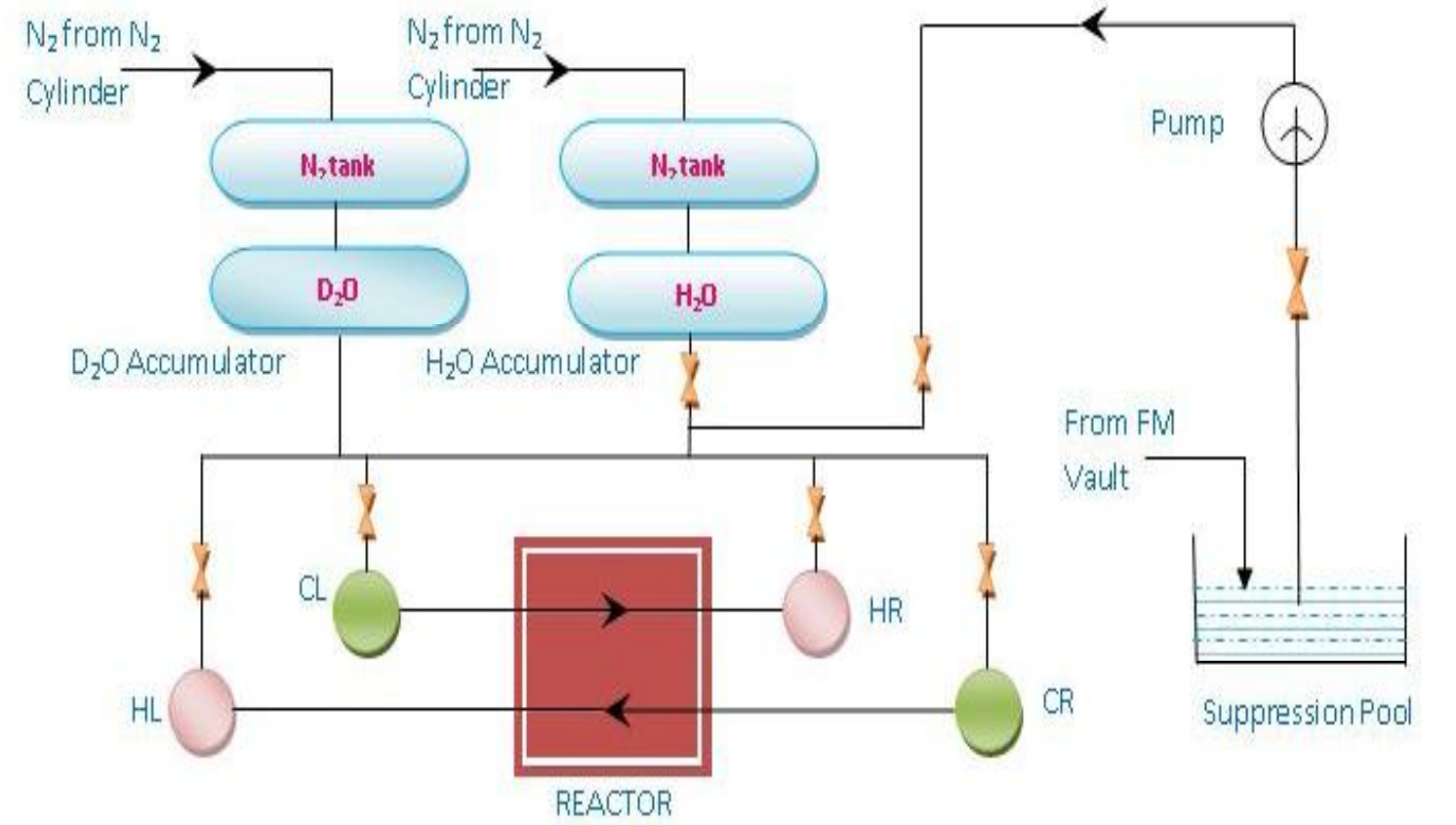


OGDHR System (in PFBR)



Decay Heat Removal Systems for PHWR

Simplified Flow diagram of Emergency Core Cooling System (ECCS)



Decay Heat Removal Systems for PHWR

Emergency Core Cooling System:

- It is designed to remove decay heat from the fuel following LOCA. The pressures in CL, HR are monitored.

- The process comprises of 3 phases
  - Heavy Water Injection
  - Light Water Injection
  - Light Water recirculation from suppression pool

RCB Isolation System

- Both the reactors of PHWR and PFBR types are provided with RCB Isolation systems.

- These system monitor the radiation levels in the RCB, ventillation ducts and the effluent gases release to the stack, and pressures in RCB (which tends to rise after LOCA)

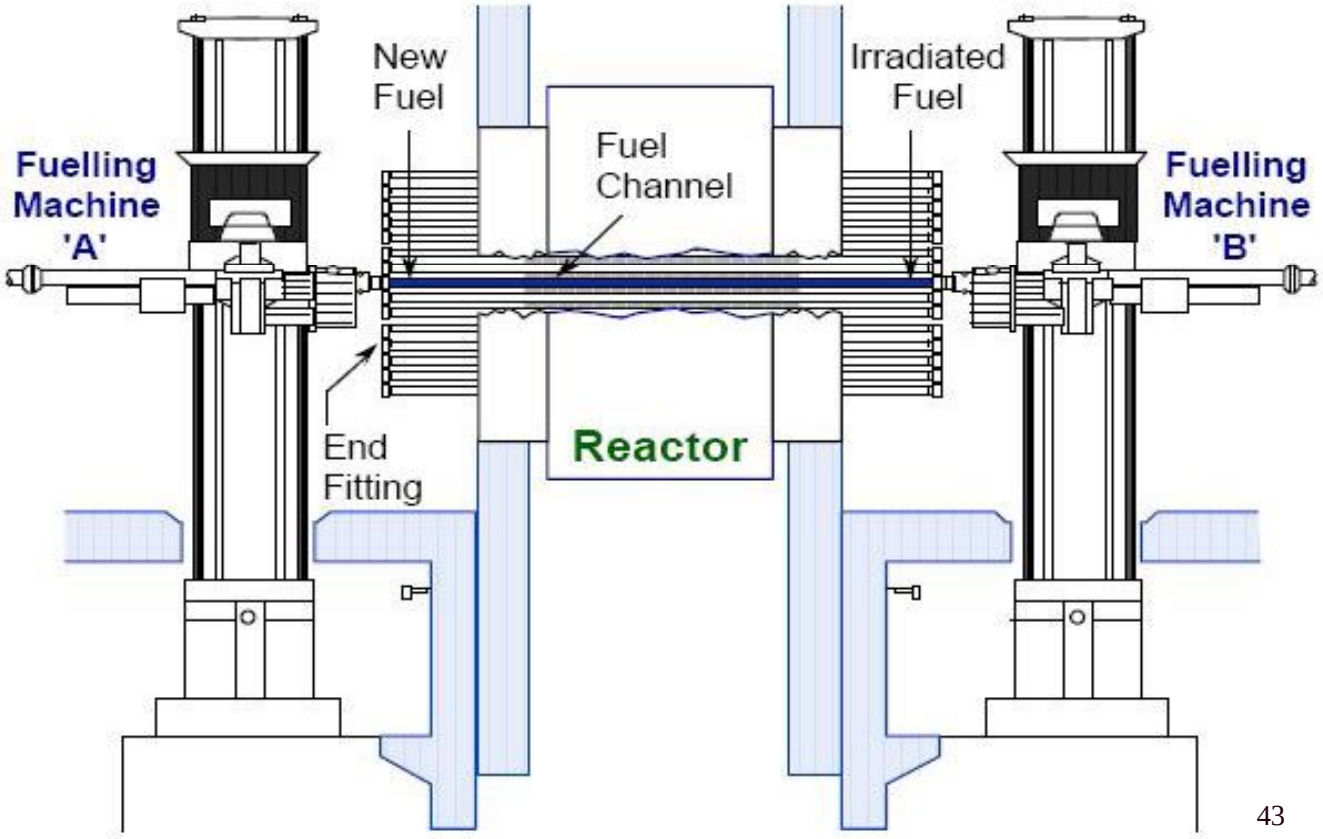
Overall Plant Control

Overall Plant Control (PHWR & PFBR)

PHWR		PFBR	
Reactor Power Control	Closed Loop control	Reactor Power Control	Open Loop control
Primary heat transport	Closed Loop control	Primary Coolant flow control Secondary Coolant flow control	Open Loop control

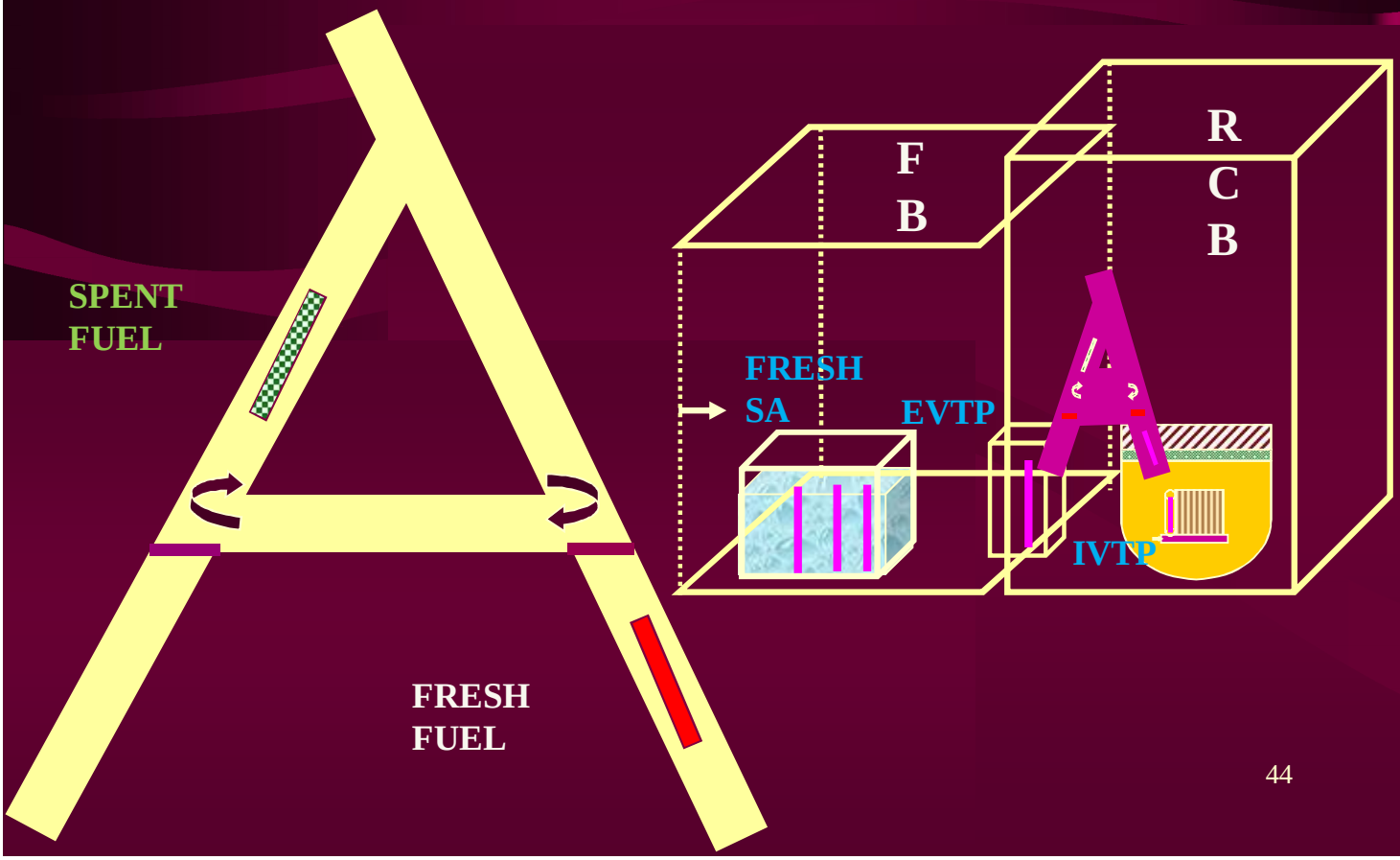
Fuel Handling System

Fuel Handling in PHWR

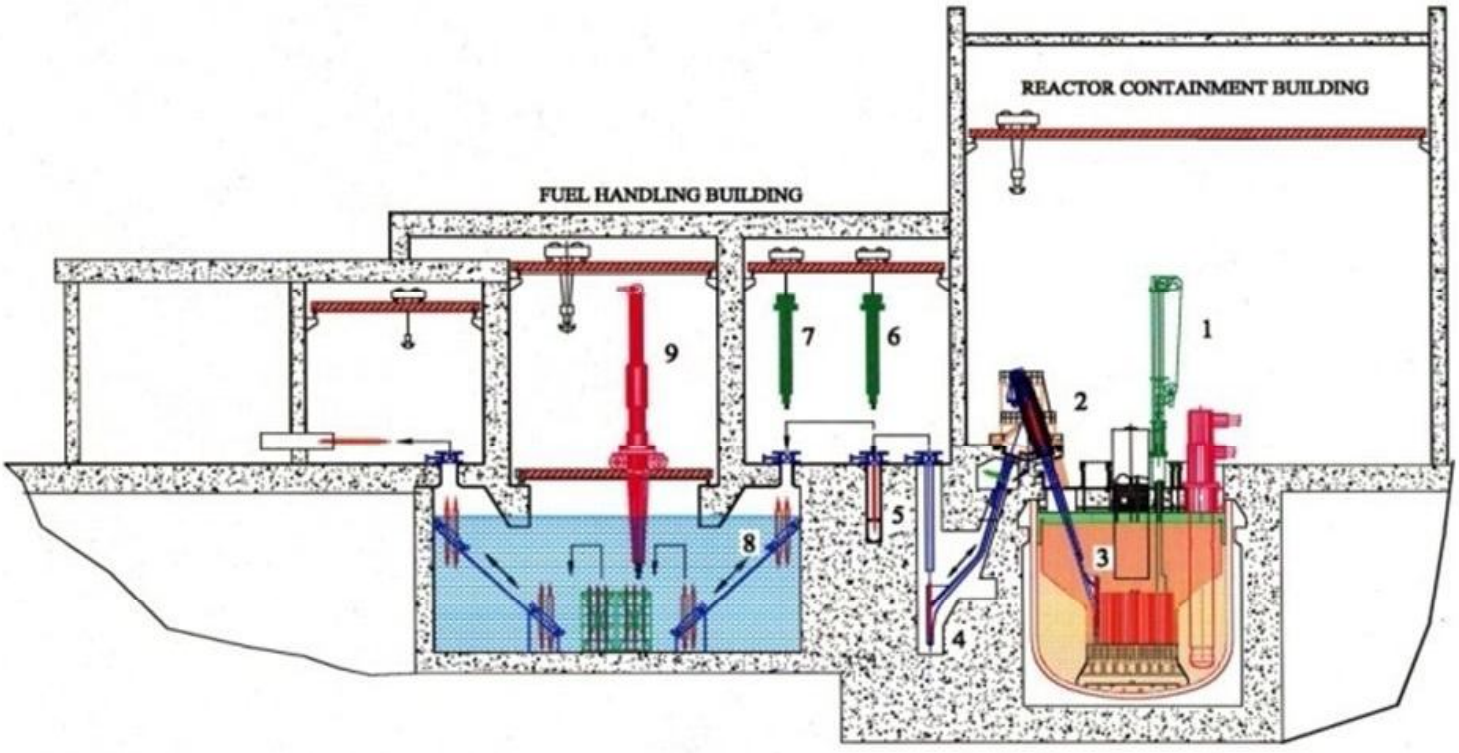


Component Handling – IFTM (PFBR)

‘A’ FRAME



Component Handling in PFBR



1. TRANSFER ARM
2. INCLINED FUEL TRANSFER MACHINE
3. IN VESSEL TRANSFER POSITION
4. EX VESSEL TRANSFER POSITION
5. SPENT SUBASSEMBLY WASHING FACILITY
6. CELL TRANSFER MACHINE (Fresh Subassembly)
7. CELL TRANSFER MACHINE (Spent Subassembly)
8. UNDER WATER TROLLEY
9. SPENT SUBASSEMBLY STORAGE BAY TRANSFER MACHINE

SPENT SUBASSEMBLY HANDLING

Fuel Handling System

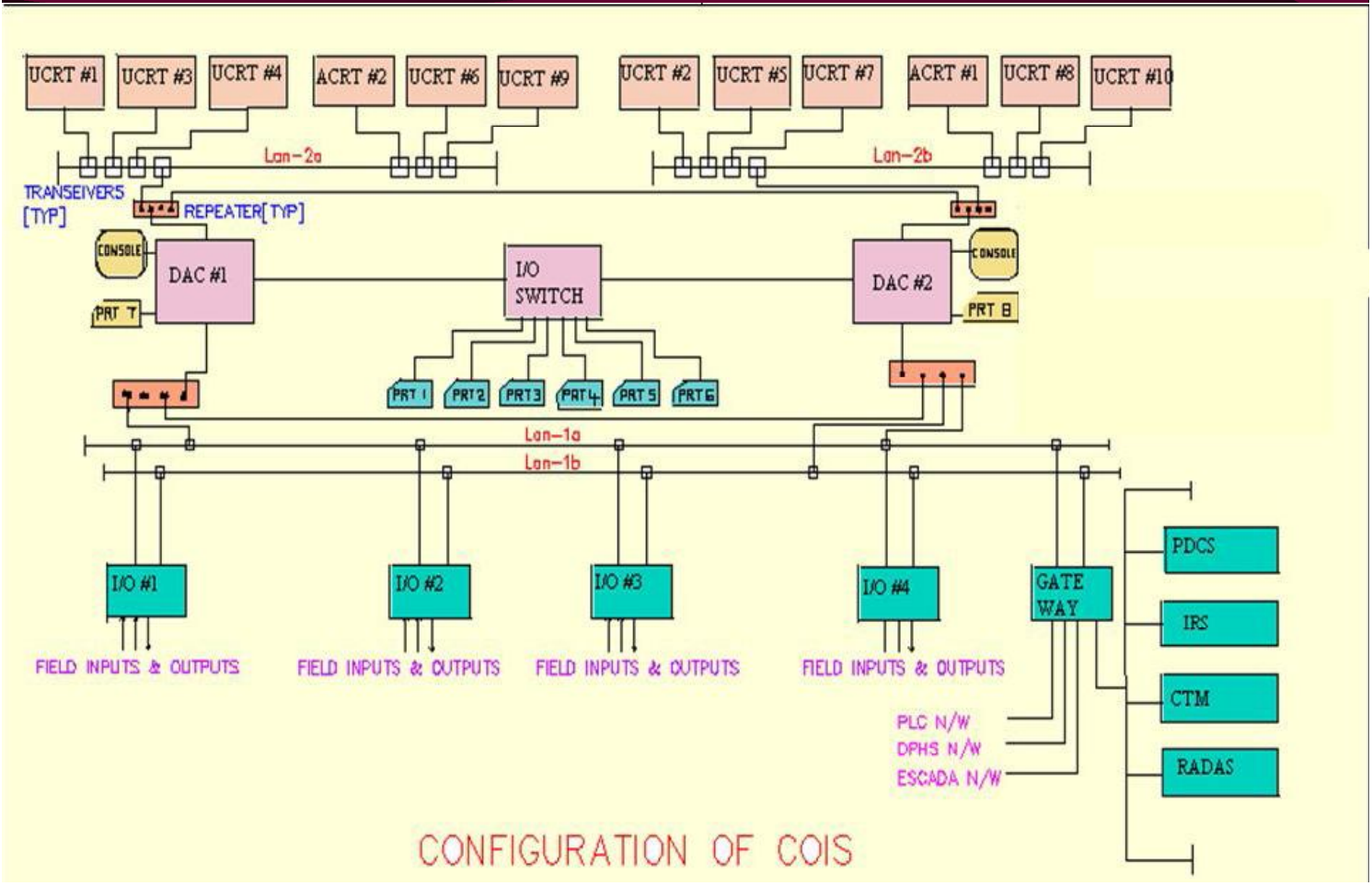
PARAMETER	PHWR	PFBR
Type of Reactor	Horizontal	Vertical
Fuel Assembly	Fuel Bundles 600mm long	Fuel sub assembly 4500mm long
No. of Fueling Machines	Two	One
Operation Mechanism	Hydraulic and Pneumatic	Motor
Fuel Loading	On power	Off power
C & I Hardware	Microcomputer based and discrete semi – conductor IC based	Microcomputer based with dual redundancy
Connectivity to COIS/DDCS	Independent system	Integrated with Plant DDCS.

Argon & Nitrogen Systems

- Sodium is highly inflammable when exposed to air
- To provide inert atmosphere to sodium
  - Argon is used as cover gas in sodium tanks
  - Nitrogen is circulated in interspaces of guard pipes and tanks
- C & I systems for Argon & Nitrogen are safety class – 2 and requirement is unique to FBR's

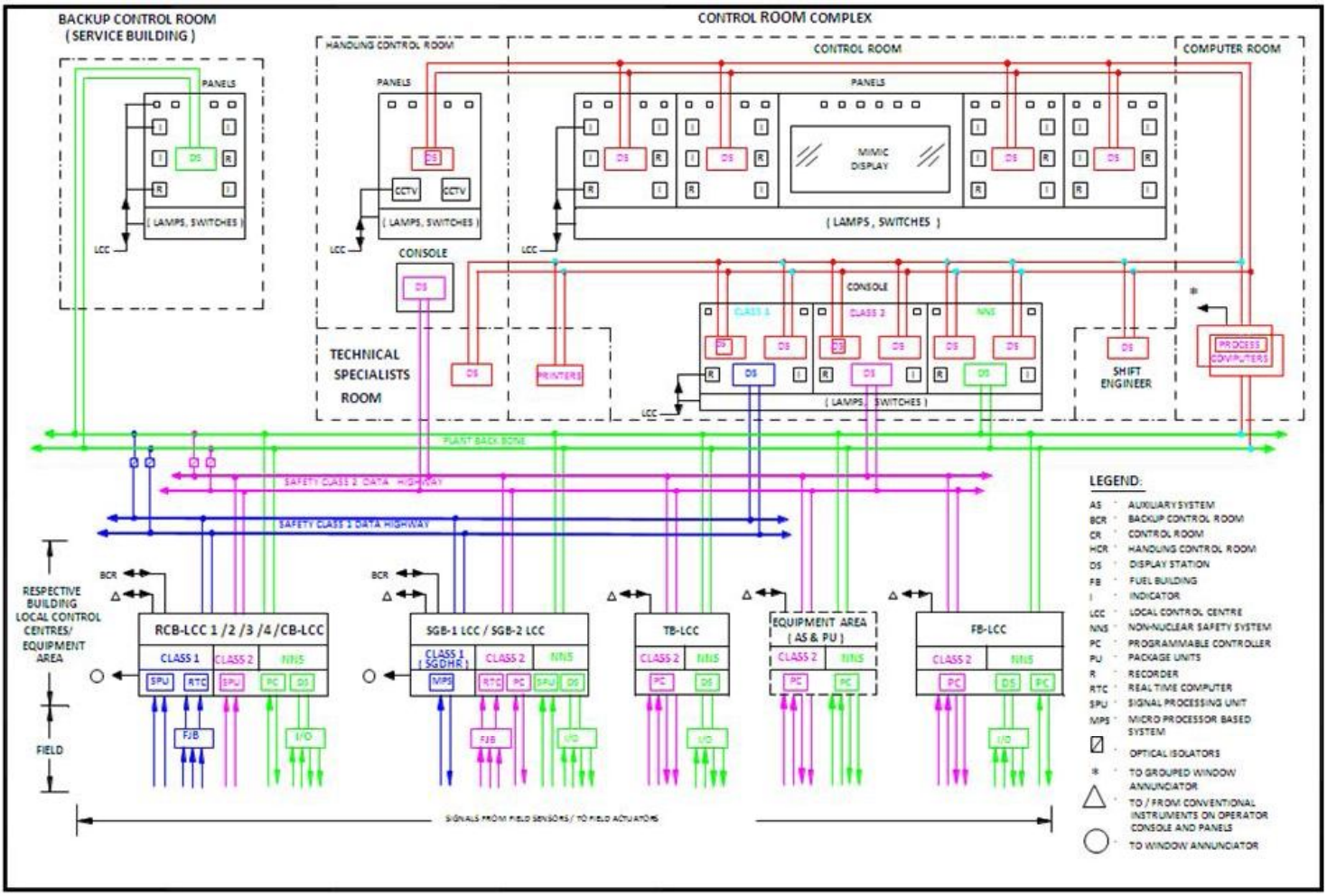
Operator Interface

COIS (PHWR)



CONFIGURATION OF COIS

DDCS (PFBR)


BACKUP CONTROL ROOM
(SERVICE BUILDING)
CONTROL ROOM COMPLEX
HANDLING CONTROL ROOM
CONTROL ROOM
COMPUTER ROOM
PANELS
MIMIC DISPLAY
(LAMPS, SWITCHES)
CONSOLE
TECHNICAL SPECIALISTS ROOM
PRINTERS
SHIFT ENGINEER
PROCESS COMPUTERS
PLANT BACK BONE
SAFETY CLASS 2 DATA HIGHWAY
SAFETY CLASS 1 DATA HIGHWAY
RESPECTIVE BUILDING LOCAL CONTROL CENTRES/ EQUIPMENT AREA
FIELD
RCB-LCC 1 /2 /3 /4 /CB-LCC
SGB-1 LCC / SGB-2 LCC
TB-LCC
EQUIPMENT AREA (AS & PU)
FB-LCC
CLASS 1
CLASS 2
NNS
SIGNALS FROM FIELD SENSORS / TO FIELD ACTUATORS
LEGEND:
AS AUXILIARY SYSTEM
BCR BACKUP CONTROL ROOM
CR CONTROL ROOM
HCR HANDLING CONTROL ROOM
DS DISPLAY STATION
FB FUEL BUILDING
I INDICATOR
LCC LOCAL CONTROL CENTRE
NNS NON-NUCLEAR SAFETY SYSTEM
PC PROGRAMMABLE CONTROLLER
PU PACKAGE UNITS
R RECORDER
RTC REAL TIME COMPUTER
SPU SIGNAL PROCESSING UNIT
MPS MICRO PROCESSOR BASED SYSTEM
OPTICAL ISOLATORS
TO GROUPED WINDOW ANNUNCIATOR
TO / FROM CONVENTIONAL INSTRUMENTS ON OPERATOR CONSOLE AND PANELS
TO WINDOW ANNUNCIATOR

Operator Interface

Features	DDCS	COIS
GUI features	Provided	Provided
Log function	Provided	Provided
Supervisory Control	Provided using display units of DDCS system	Provided using display units of control systems
Large Video Screen Display	67” video screens 2 nos are provided for plant schematic / mimic display	Not used
Types of Displays	Dedicated displays for SC-1, SC-2 and NNS systems on Consoles	Universal and alarm displays provided

C & I Architecture & Data Communication

C & I Architecture & Data Communication

Features	PHWR	PFBR
Architecture	Independent Control Systems connected to COIS	Networked DDCS architecture
No. of I/Os	20000	18000
Communication media:		
Field to Control System	Copper cables	Copper cables
Control system to DDCS/COIS	Copper cables	UTP & FOC Cables
Control system to Control room	Copper cables	Copper cables
Between Control system	Copper cables	Plant data bus

References

Technical Specifications of PHWR & PFBR.

THANK YOU

VME System Boards

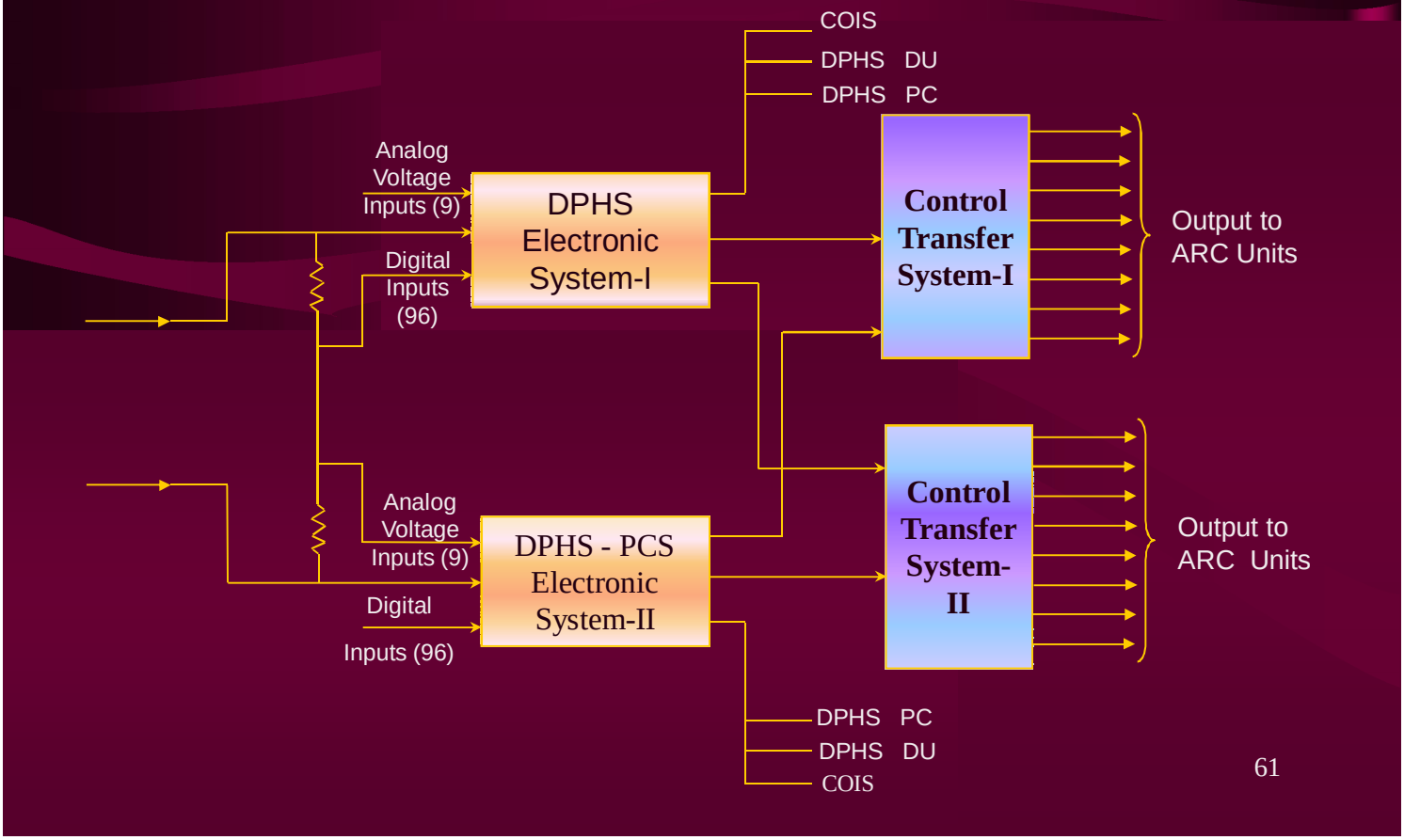
VME System Boards	SOLC System Boards
ED-20	SOLC P1 Backplane
Analog Input Board	SOLC P2 Backplane
Analog Output Board	ORing Card of SOLC
Digital Input Board	Logic Card of SOLC
Digital Output (Opto) Board	
Digital Output (Relay) Board	
Counter Timer Card	
Synchro to Digital Card (SDC)	
VME Backplane P1	
I/O Backplane P2	

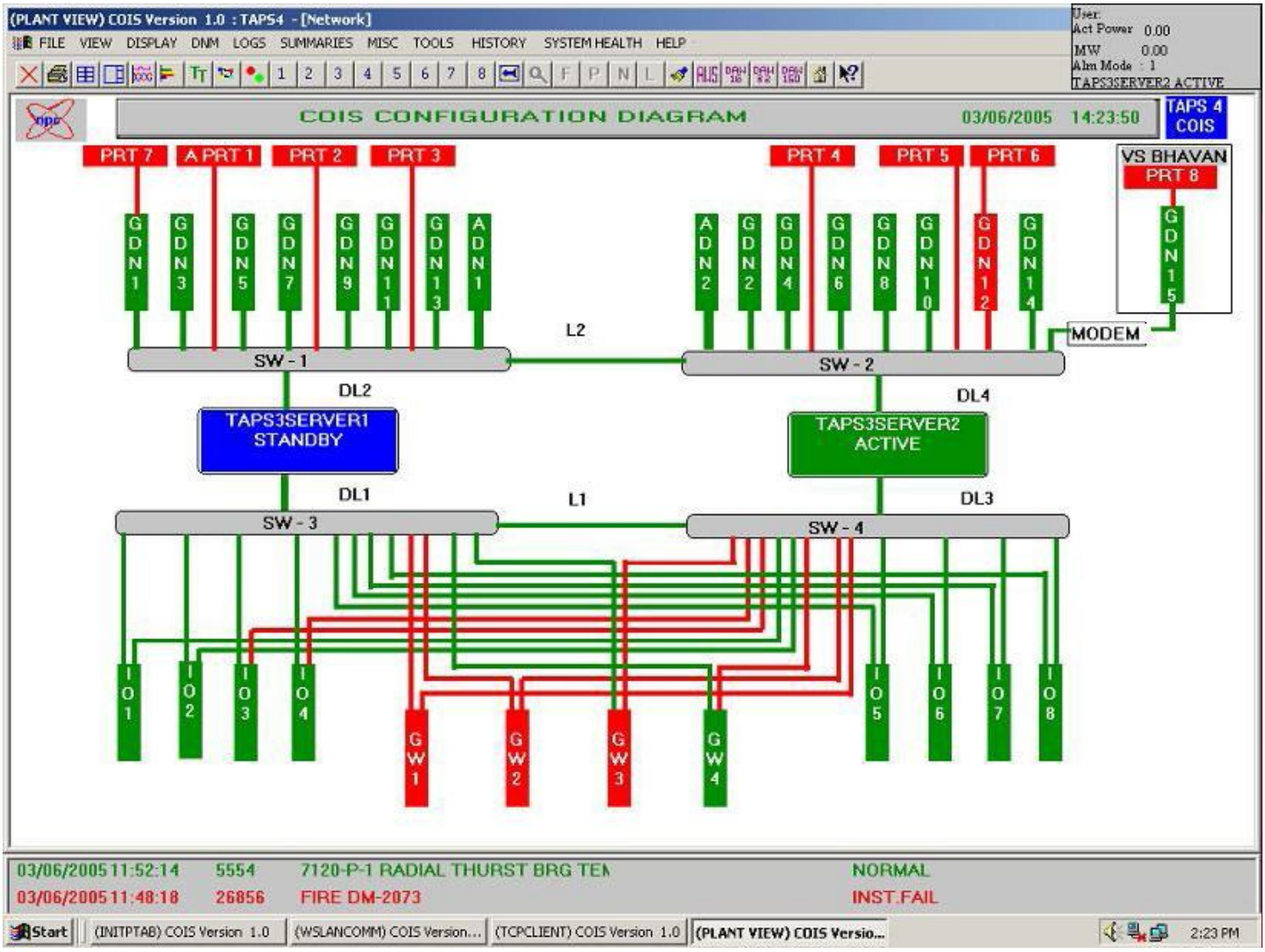
NNS System Boards

AT89C51 Micro Controller based RTU boards

RTU System Boards
16-Ch Analog Input Board
30-Ch Digital Input Board
16-Ch Thermocouple Input Board
16-Ch Leak Detector Input Board
16-Ch Relay Output Board
16-Ch Digital Input & 16-Ch Relay output Board
16-Ch Digital Input 8-Ch Analog Input & 8-Ch Relay output Board (Universal Board)
Backplane

DPHS — Reactor Regulating System for PHWR




(PLANT VIEW) COIS Version 1.0 : TAPS4 - [Network]
FILE VIEW DISPLAY DNM LOGS SUMMARIES MISC TOOLS HISTORY SYSTEM HEALTH HELP
User:
Act Power 0.00
MW 0.00
Alm Mode : 1
TAPS3SERVER2 ACTIVE
COIS CONFIGURATION DIAGRAM
03/06/2005 14:23:50
TAPS 4 COIS
PRT 7
A PRT 1
PRT 2
PRT 3
PRT 4
PRT 5
PRT 6
VS BHAVAN
PRT 8
GDN1
GDN3
GDN5
GDN7
GDN9
GDN11
GDN13
ADN1
ADN2
GDN2
GDN4
GDN6
GDN8
GDN10
GDN12
GDN14
GDN15
MODEM
L2
SW - 1
SW - 2
DL2
DL4
TAPS3SERVER1 STANDBY
TAPS3SERVER2 ACTIVE
DL1
L1
DL3
SW - 3
SW - 4
IO1
IO2
IO3
IO4
GW1
GW2
GW3
GW4
IO5
IO6
IO7
IO8
03/06/2005 11:52:14 5554 7120-P-1 RADIAL THURST BRG TEM NORMAL
03/06/2005 11:48:18 26856 FIRE DM-2073 INST.FAIL
Start
(INITPTAB) COIS Version 1.0
(WSLANCOMM) COIS Version...
(TCPCLIENT) COIS Version 1.0
(PLANT VIEW) COIS Versio...
2:23 PM

COIS Panel (TAPS)

Monitoring Control and Diagnostic System (MCDS) of Kudankulum Nuclear Power Plant

An Overview

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Kamlesh Nathani
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Presented in ISA(D)POWAT 2010, Mumbai May 28th -29th, 2010