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# Advanced Boiling Water Reactor (ABWR)

## South Texas Project Units 3 and 4



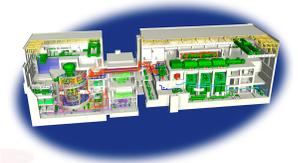
Jay Phelps  
STP Units 3 and 4 Operations Manager

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# Overview

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- Advanced RPV design eliminates external recirculation loops
  - Achieved by use of Reactor Internal Pumps (RIPs)
  - Improved LOCA response
- Improvement in safety profile – Core Damage Frequency (CDF) reduction by an order of magnitude
- Advanced containment design
- Advanced digital control room design – provides capability for plant automated operation

# Comparison of CDFs



Plant or Group	CDF in per reactor-year
Sequoyah (PWR)	$5.7 \times 10^{-5}$
Surry (PWR)	$4.0 \times 10^{-5}$
Peach Bottom (BWR-4)	$4.5 \times 10^{-6}$
Grand Gulf (BWR-6)	$4.0 \times 10^{-6}$
ALWR Goal	$1.0 \times 10^{-5}$
ABWR	$1.6 \times 10^{-7}$

# ABWR to BWR Comparison



	ABWR	BWR
Recirc Flow	10 Internal recirc pumps (RIPs)	2 External recirc loops – Variable recirc pumps – Flow control valves
Control Rods	Fine motion control rod drives – Group or “gang” control capability – Electrical fine motion drive, hydraulically scrammed	Hydraulically operated control rods with single rod operation (exception - BWR6 with limited gang capability)
Plant Control	Automated operation capability	Manual
LOCA Design	RPV water level post-blowdown above top of active fuel (TAF)	RPV water level post-blowdown 2/3 core height with spray cooling
ECCS	3 divisions high pressure + 3 divisions low pressure flooding	1 division high pressure + 2 divisions core spray and low pressure flooding

# ABWR to BWR Comparison



	ABWR	BWR
ATWS Mitigation Features	Advanced design: <ul style="list-style-type: none"><li>– Alternate Rod Insertion (ARI)</li><li>– Recirc Pump Trip (RPT)</li><li>– Auto Standby Liquid Control (SLCS) initiation</li><li>– Fine Motion Control Rod Drive auto run-in</li><li>– Auto feedwater pump runback</li></ul>	10 CFR 50.62 required RPT, ARI and SLCS requirements (exceptions – NMP2, Perry, LGS, and Hope Creek with Redundant Reactivity Control Systems)

# Plant Startup

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- Manual capability by control rod operation and recirc flow control from all rods in to 100% power
- Automated plant startup capability with Power Generation Control System (PGCS) and Automatic Power Regulator (APR)
  - PGCS controls BOP systems with “hold points” for operator confirmation
  - APR controls control rod movement and recirc flow control with “hold points” for operator confirmation
- Automated control requires input from the operator at the hold points to activate the function
- Operator can stop automated operation at any time and resume manual control

# Example Automation Control Display



Hold point display zone

Prepare to start unit

Name of hold point  
Displays the name of a currently selected hold point.

Operation item display zone  
Displays the active item of the selected hold point

(501) XXXX MW

Water supply
Pressure
Speed
Load
Output
Electricity

Rx mode SW Startup
MT start
Generator parallel

Rated output
DW check
RCIC surveillance

ユニット  
起動前準備

Start gland seal system

Increase condenser vacuum

Preparation to start reactor

Start reactor

Start to increase reactor pressure

Start HPCP

Check D/W

RCIC surveillance

Start gland seal system

Start gland seal system

Start data input

- D/W inspection set pressure 1
- D/W inspection set pressure 2
- RCIC surveillance test pressure 1
- RCIC surveillance test pressure 2

!Operation items

Next hold point

Previous hold point  
前小段

Next operation item

Previous operation item

Return

Enable condition disregard

Disable condition disregard

Set data

Operator check

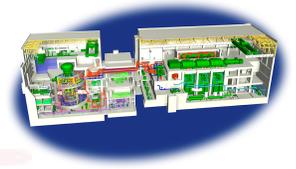
YY/MM/DD  
HH:MM:E

Automation message display zone  
Displays an operation guide (in yellow), progress of the subloop automation (in light blue).

Operation switches for data input, confirmation, etc.

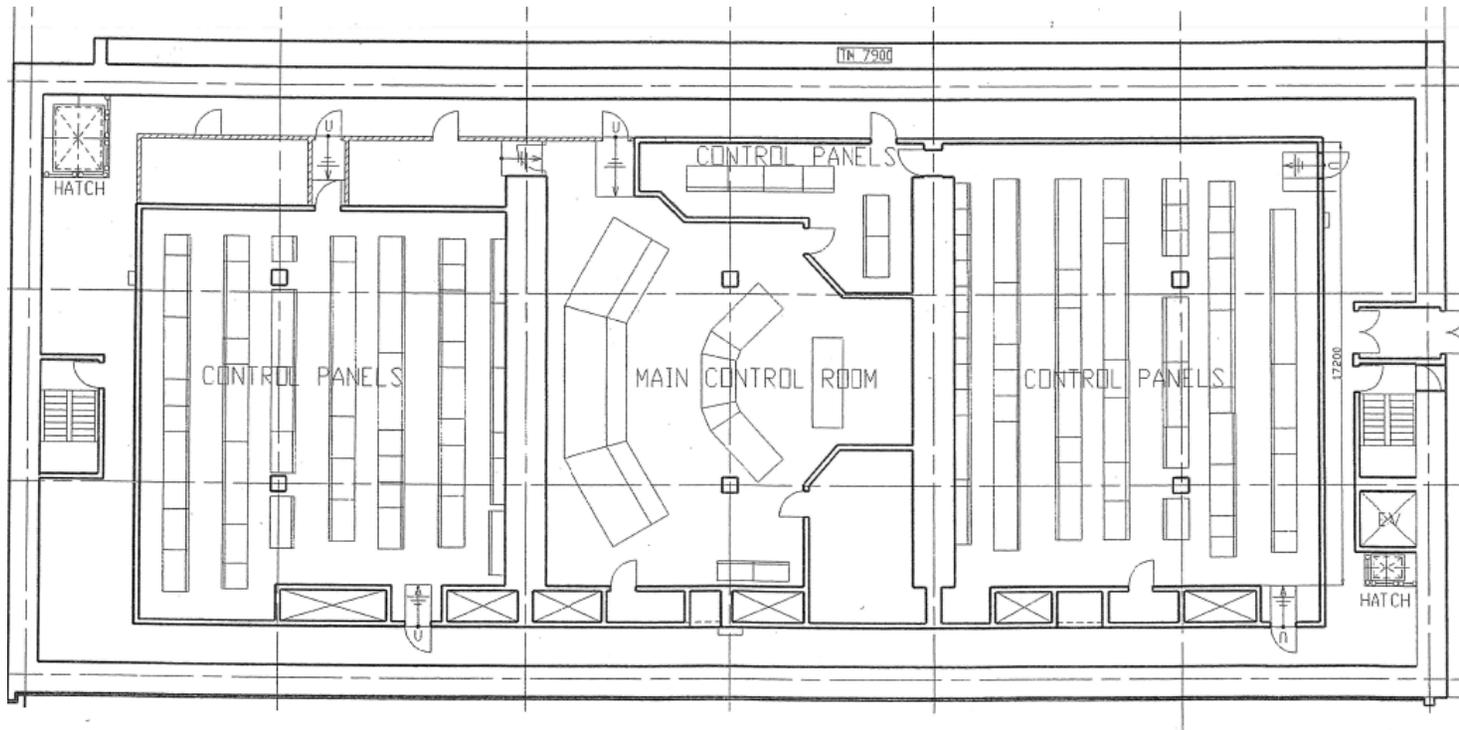
# Procedures Capability

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- Capability exists for a computer based procedure system
  - Example: from alarm page transfer to the associated Alarm Response Procedure
- Minimizes operator need to locate procedures
- Ability to remain at control panel and monitor proper plant response

# Control Room Layout – Preliminary Drawing



# Control Room Layout – Picture of Kashiwazaki-Kariwa Control Room Simulator



# Control Room Layout – Picture of Kashiwazaki-Kariwa Control Room Simulator

