

AP1000 Plant General Overview and Equipment Qualification

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AP1000 Plant Overview and Equipment Qualification

- Industry Activity
- AP1000 Design Features
- I&C Systems and Control Room
- Equipment Qualification

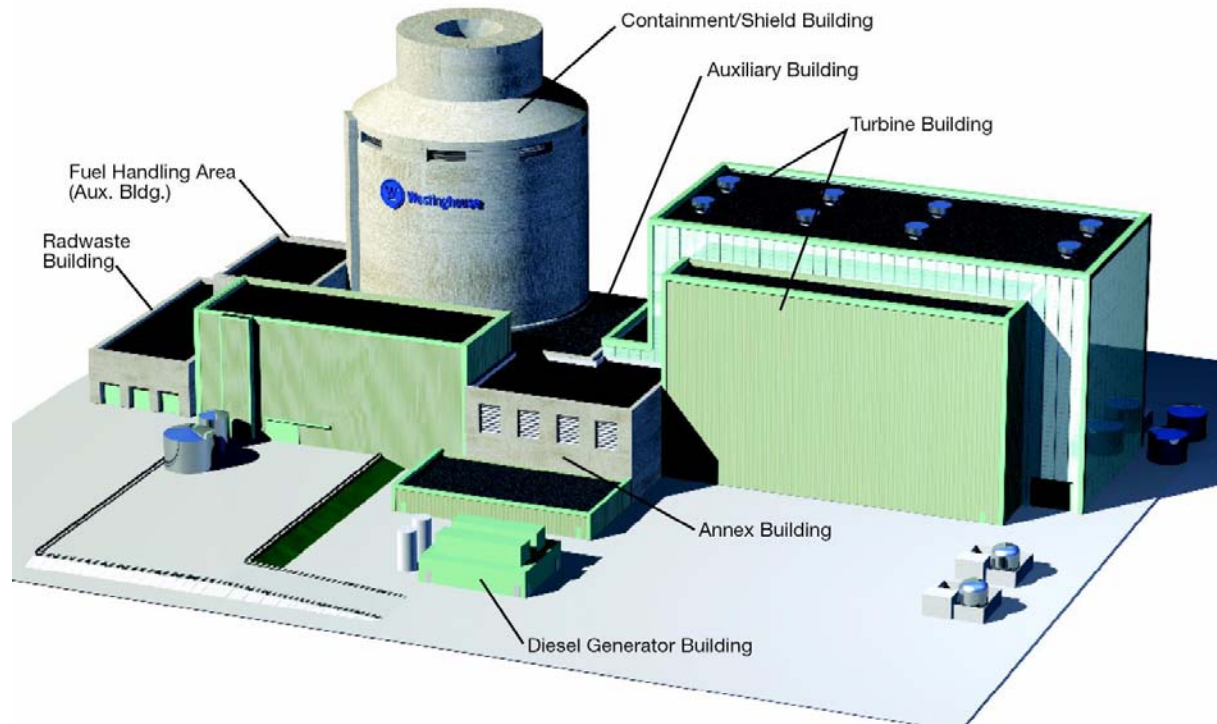
AP1000 - Industry Activity

- Activity by US Utilities to Apply For Combined Operating License Identifying the AP1000 as the Plant Technology for 12 Units
- Chosen by China as the Plant Technology for Four Units
- First Plant in Operation by Authorization to Proceed + 72 months (Dec 2013)

AP1000 Design Features

- Integrated Power Plant Design (NSSS and BOP)
- Simplified Passive Safety Systems
 - No Requirement for Safety AC Power
- Microprocessor, Digital Technology Based I&C
 - Compact Control Room, Electronic Operator Interface
- Extensive use Modular Construction
 - Optimized Plant Arrangements

AP1000 Plant Design Features- Building Layout

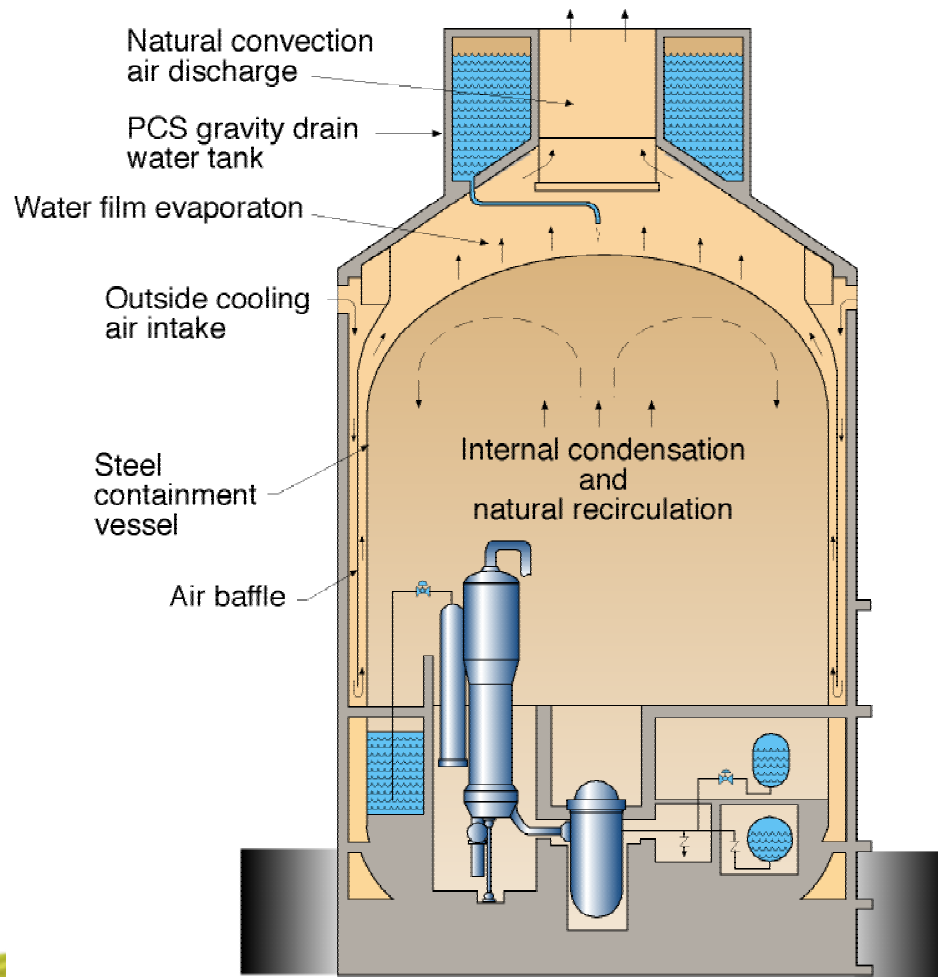


AP1000 Design Features – Passive Safety Features

- Passive Decay Heat Removal
- Passive Safety Injection
- Passive Containment Cooling
- Passive Heating Ventilation Air Conditioning

AP 1000 Design Features

Passive Core Cooling System



- Actuated By Fail Safe Valves
- Water Drains By Gravity onto outside of steel containment vessel
- Water Evaporates into Natural Circulation of Air Flow

AP1000 Design Features

Passive Design System – Design Simplification

- AP1000 uses:

- ~50% Fewer Valves

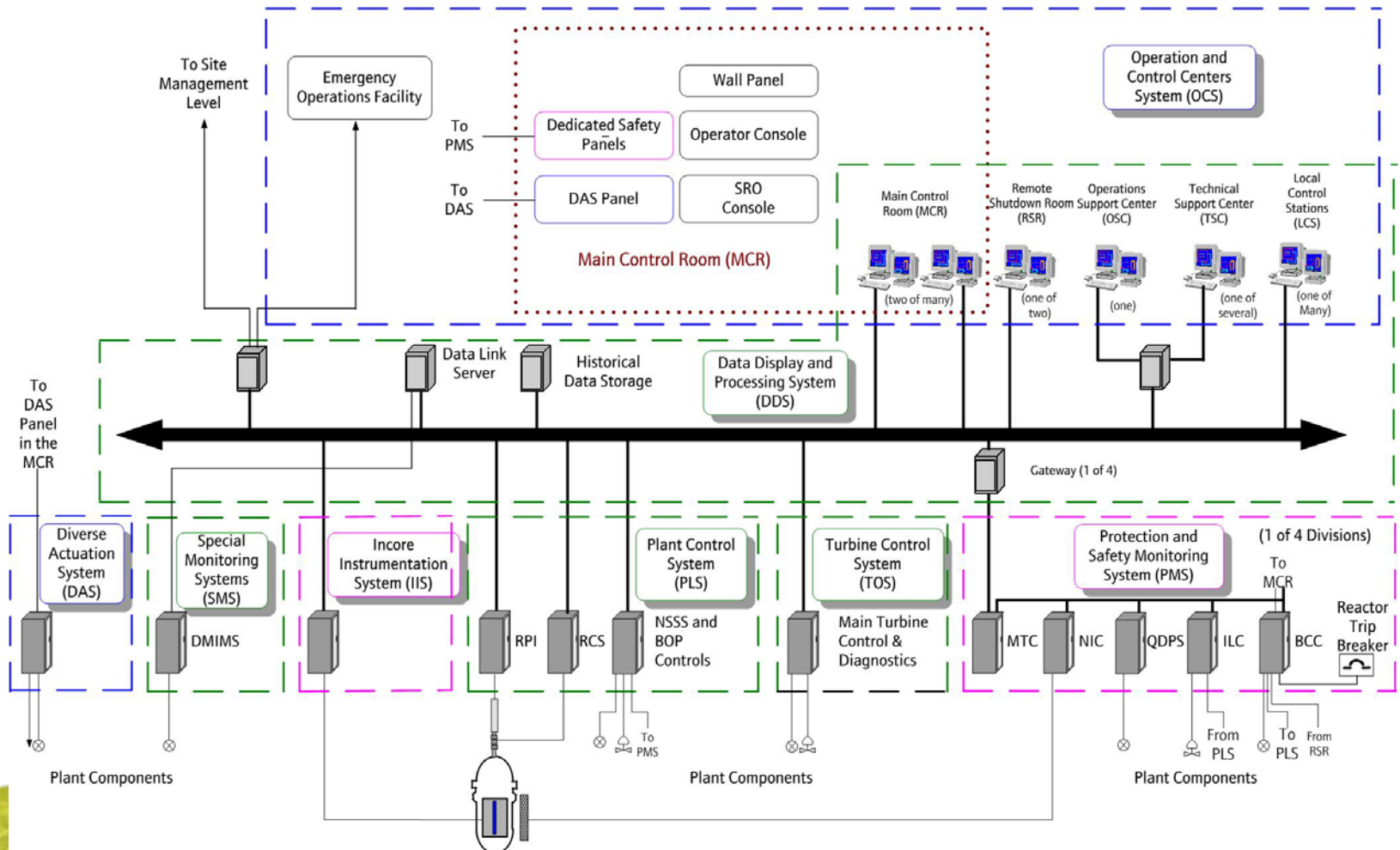
- ~83% Less Safety Grade Pipe

- ~87% Less Cable

- ~35% Fewer Pumps

- ~50% Less Seismic Building Volumes
Than An equivalent Conventional Reactor

AP 1000 – I&C System Architecture



AP1000 - Major I&C Systems

- **Protection and Safety Monitoring System (PMS)**
 - Microprocessor / software based (Westinghouse Common Q)
- **Diverse Actuation System (DAS)**
 - Backs up PMS, Different architecture, hardware & software from PMS
- **Plant Control System (PLS)**
 - Microprocessor based system
- **Operation and Control Centers System (OCS)**
 - Includes main control room, remote shutdown room, etc.

AP1000 - Major I&C Systems (Cont'd)

- **Data Display and Processing System (DDS)**
 - Non-Class 1E Displays, Alarms, Communication Network, etc.
- **Main Turbine Control & Diagnostic System (TOS)**
 - Turbine control and protection
- **In-core Instrumentation System (IIS)**
 - In-core flux detectors and thermocouples
- **Special Monitoring Systems (SMS)**
 - Digital metal impact monitor (Westinghouse DMIMS)
 - Seismic Monitoring System

AP1000 - Advanced Control Room

- **Compact Control Room**

- Designed for 1 Reactor Operator and 1 Supervisor

- **Displays**

- Plant status / overview via wall panel (non-1E DDS)
- Detail display via workstation video displays (non-1E DDS)
- **Small number of dedicated displays; safety (1E PMS) & diverse (non-1E DAS)**

- **Controls**

- Soft controls (non-1E DDS)
- Small number of dedicated **switches; safety (1E PMS) & diverse (non-1E DAS)**

- **Advanced Alarm Management**

- **Computer Based Procedures**

- Paper backup



AP1000 - Equipment Qualification Overview

- Standard Design
 - Generic Qualification Requirements
- Seismic Qualification (IEEE 344-1987)
- Environmental Qualification (IEEE 323-1974)
- Electromagnetic Compatibility Qualification (Regulatory Guide 1.180 Revision 1)

AP1000 - Equipment Qualification - Seismic

- Standard Design
- Seismic Qualification
 - Generic Spectra (all sites)
 - Current Qualification Guidelines Based on IEEE 344-87
 - Seismic Qualification Requirements are Identified in Equipment Specifications



AP1000 – Equipment Qualification - Environmental

- Standard Design
- Environmental Qualification
 - Mild Environment
 - Mild Environment (Radiation Harsh)
 - Harsh Environment



AP1000 – Equipment Qualification - Environmental

- Standard Design
- Environmental Qualification
 - Mild Environment
(Normal Abnormal Environmental Conditions)
 - Maximum Temperature and Humidity Limits are the same as Westinghouse PWR Plant Conditions
 - Time Duration is Specific to AP1000 Plant

AP1000 – Equipment Qualification - Environmental

- Standard Design
- Environmental Qualification
 - Mild Environment (Radiation Harsh)
 - Normal and Abnormal Temperature Conditions are same as mild environment
 - Radiation Aging Need to be Considered for Equipment Located in Radiation Harsh Areas

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Equipment Qualification - Environmental

- Standard Design
- Environmental Qualification
 - Harsh Environment Conditions
 - Temperature
 - Radiation
 - Modified Conditions are more favorable
- Environmental Conditions are Specified in the Equipment Specifications

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Equipment Qualification - Environmental

- Standard Design – Environmental Type Tests

Type Test	Mild	Radiation-Harsh	Harsh
Thermal Aging			X
Thermal Cycling			X
Radiation Aging		X	X
Wear Aging	X	X	X
Normal/Abnormal Extremes	X	X	
Vibration Aging	X	X	X
DBA			X
Post-DBA			X

AP1000 - Equipment Qualification - EMC

- Standard Design
- Electromagnetic Compatibility
 - Emissions Type Tests
 - Conducted Emissions
 - Radiated Emissions
 - Immunity Type Tests
 - Radio Frequency Interference (RFI)
 - Surge (Power Supply and I/O)
 - Electro Static Discharge (ESD)
 - Power Supply Immunity
 - Electrical Fast Transient/Burst (EFT/B)
 - Conducted Immunity, etc



AP1000 - Equipment Qualification - EMC

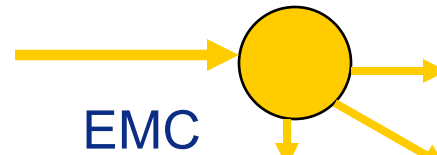
- Standard Design
- Type Test Requirements
 - US NRC Regulatory Guide 1.180 Revision 1
 - EMC CE Mark Requirements (as applicable)
European Union (EU) Directive on EMC – 89/336/EEC, as amended by 92/31/EEC and 93/68/EEC (New Directive 2004/108/EC)
- EMC Conditions are Specified in the Equipment



AP1000 Plant Overview

Summary

- Industry Activity
- AP1000 Design Features
- I&C Systems and Main Control Room
- Equipment Qualification
- ??????



Seismic



Environmental



