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
AP1000

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
# AP1000

**Environment Qualification - Environmental**

- **Standard Design – Environmental Type Tests**

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AP1000 - Equipment Qualification - EMC

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