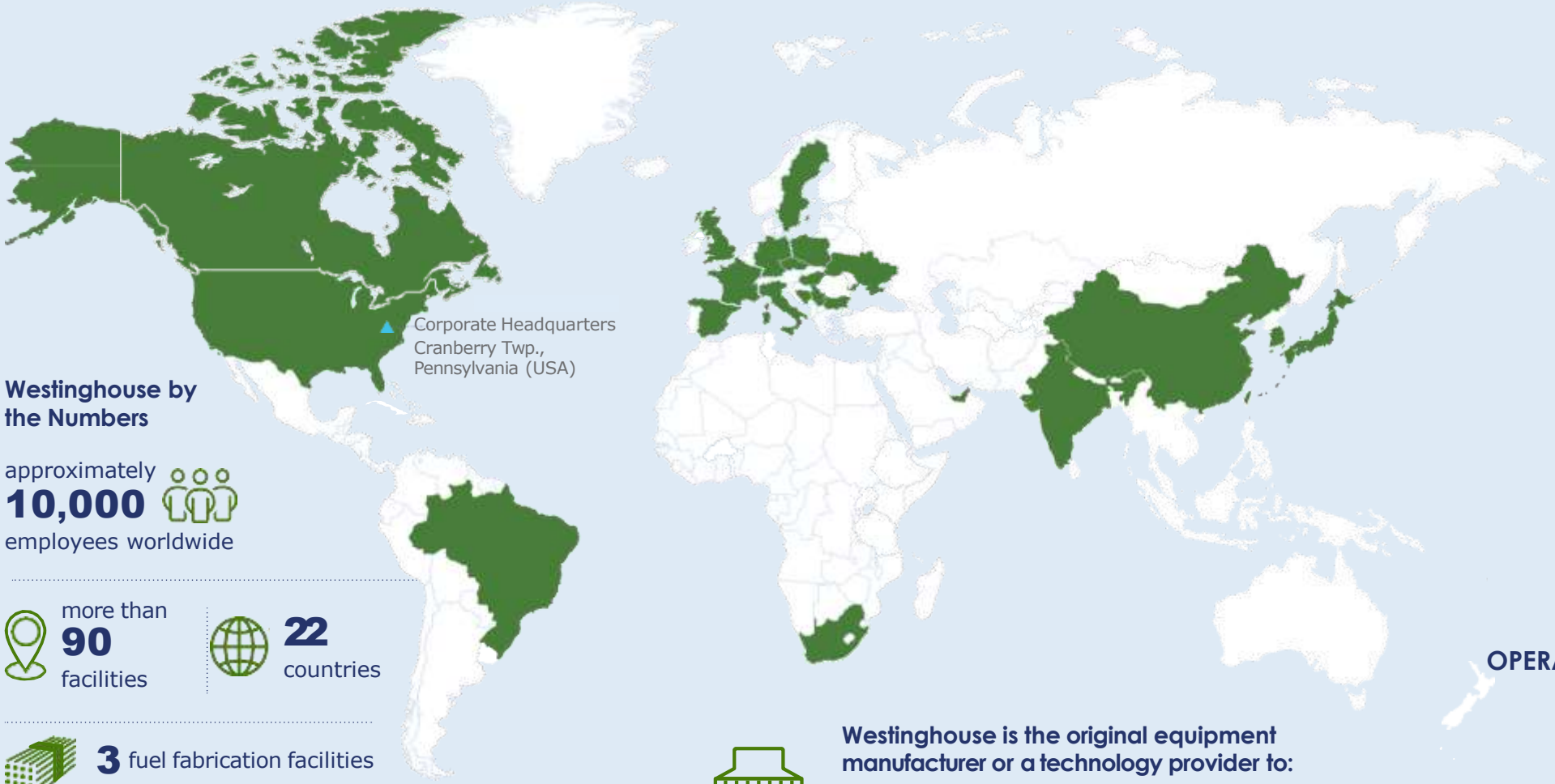

Westinghouse

Westinghouse

Westinghouse Global Presence

Legend

- Corporate Headquarters
- Countries with Westinghouse Presence



Westinghouse by the Numbers

approximately **10,000** employees worldwide

more than **90** facilities

22 countries

3 fuel fabrication facilities

Westinghouse is the original equipment manufacturer or a technology provider to:

~50% of the global nuclear reactor fleet, delivering capacity of ~190,000 carbon-free MWe

Comprised of 4 Business Units

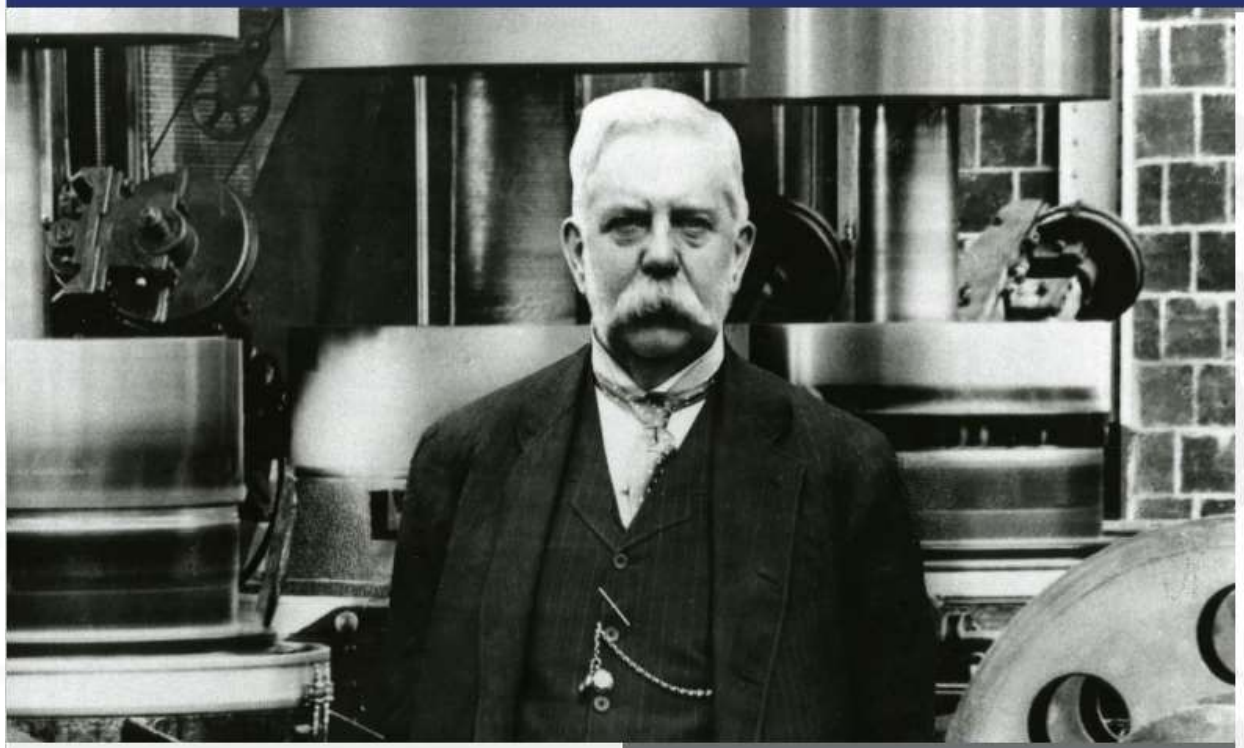
ENERGY SYSTEMS

NUCLEAR FUEL

OPERATING PLANT SERVICES

eVINCI

Westinghouse History



THE INNOVATION CONTINUES

130

YEARS LATER

- Founded by George Westinghouse in 1886

Westinghouse established **59** other companies

He received over **360** patents for his work

- Responsible for some of the world's greatest advances in energy technology
- World's first commercial pressurized water reactor (PWR) in 1957 in Shippingport, Pennsylvania, U.S.

Westinghouse

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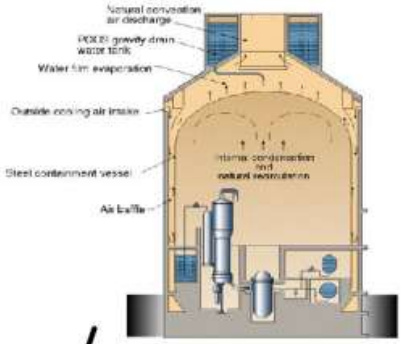
AP1000®

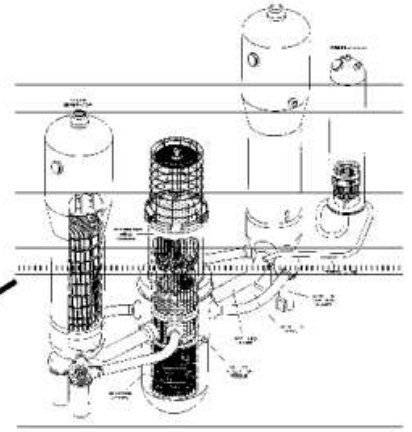
Most Advanced Generation III+ Pressurized Water Reactor

AP1000®

Extensive Testing of Passive Safety Systems

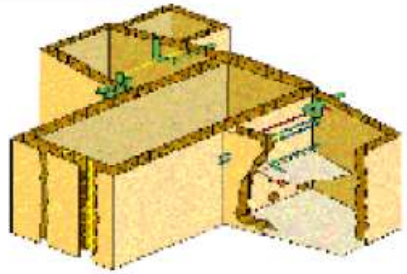
Simplified Passive Safety Systems





Proven Advanced Design Features

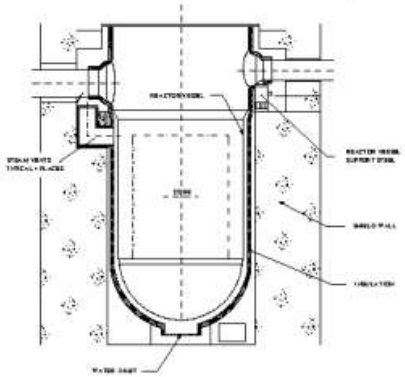
US Licensing Approval

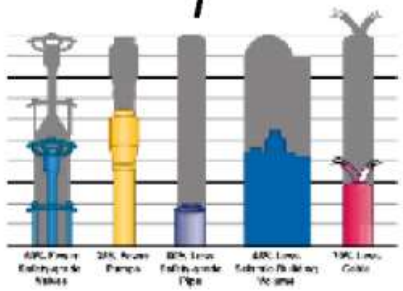


Modular Construction

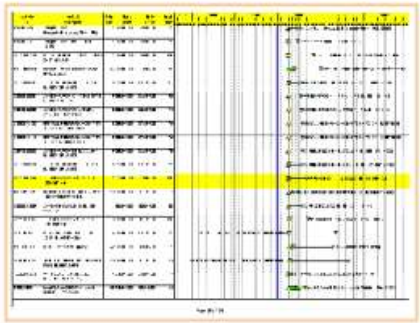
And proven !
4 reactors in China
and 2 in the USA

PRA and Severe Accident Mitigation Features





Reduced Components and Commodities



Short Construction Schedule

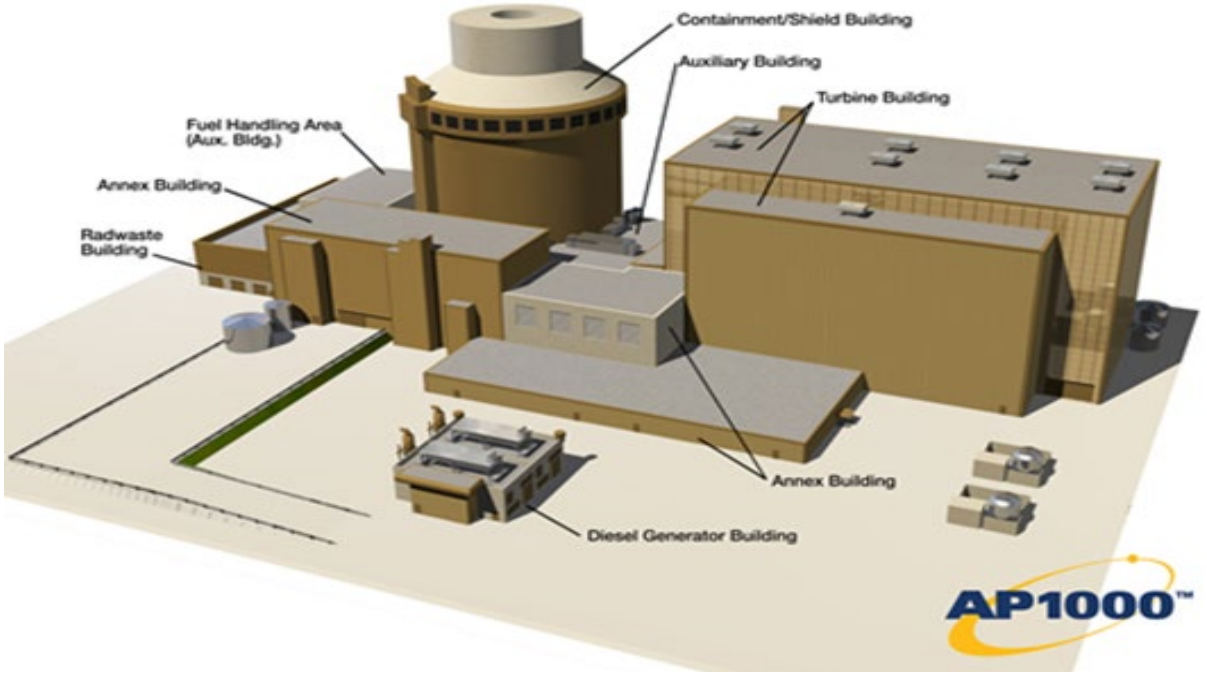
AP1000 Bulgaria Procurement Scope Split

Westinghouse

- Augmented Nuclear Island Procurement
  - ✓ Containment (CV, Modules, NSSS Equipment, Valves, etc.)
  - ✓ Shield Building
  - ✓ Auxiliary Building (Modules, Valves, Aux. Equipment, etc.)
  - ✓ Annex Building (Valves, Cranes, Aux. Equipment, etc.)
  - ✓ Diesel Generator Building
  - ✓ Radwaste Building
- Turbine Building First Bay (Valves, Batteries, Aux. Equipment, etc.)
- Solid Radwaste Treatment Facility (SRTF)
- Turbine Island Procurement

Constructor

- Balance of Plant facilities and equipment (Permanent Facilities)
  - ✓ AP1000® Plant Yard
  - ✓ Circulating Water System
  - ✓ Water and Sewage Treatment
  - ✓ Switchyard
  - ✓ Warehouses
- Bulk commodities procurement – both for the Nuclear Island and Turbine Island
- Construction – all permanent and temporary works within the development area



WBS 9
Electrical Equipment

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WBS 9 – Backup Diesel Generator

- MS40 Diesel Generator Units
  - Two (2) Units; 3-Phase
  - 60 Hz: 6900 V; 6500 kVA
  - 50 Hz: 11000 V; 6500 kVA
  - Non-Nuclear Safety
- MS41 Diesel Generator Starting Air Packages
  - Two (2) Air Start Motors
  - Provide three (3) consecutive “cold” starts without recharging
- MS42 Diesel Generator Radiator Packages
  - Two (2) separate cooling circuits
  - Jacket water cooling circuit
  - Aftercooler/oil cooler cooling circuit
- MS90 Post 72 Hour Temporary Power Supply Units
  - Two (2) ancillary diesel generators
  - 60 Hz: 480/277 Vac; 80 kW
  - 50 Hz: 400/230Vac; 80 kW
  - Non-Nuclear Safety

- MS07 Diesel Fuel Oil Transfer Packages
  - ASME VIII
  - Non-Nuclear Safety

WBS 9 – Uninterruptible Power Supply

Uninterruptible Power Supply (UPS)

- DB02 Non-Class 1E Batteries: Six (6) Batteries with sixty (60) cells each
- DC02 Non-1E Battery Chargers
- DT02 Non-1E Regulating Transformer
- DU02 Non-1E UPS and Inverters
- DV01 Automatic Battery Monitors

WBS 9 – Transformers

- ET01 Main Step-Up Transformers (MSUTs)
  - Four (4) Units (Single Phase)
  - 460 MVA
  - 60 Hz:
    - 26 kV ; Site Voltage (230 / 575 kV)
  - 50 Hz:
    - 26 kV ; Site Voltage (220 / 400 kV)
- ET02 Three-Winding Unit Auxiliary Transformers (UATs)
  - Two (2) Units (3-Phase)
  - 60 Hz:
    - 76 MVA
    - 26 kV ; 6.9 kV
  - 50 Hz:
    - 76 MVA
    - 26 kV ; 11 kV
- ET03 Two-Winding Unit Auxiliary Transformer (UAT)
  - One (1) Unit (3-Phase)
  - 60 Hz:
    - 33 MVA
    - 26 kV ; 6.9 kV
  - 50 Hz: 33 MVA; 26 kV , 11 kV
- ET04 Reserve Auxiliary Transformers (RATs)
  - Two (2) Units (3-Phase)
  - 60 Hz:
    - 76 MVA
    - 6.9 kV ; Site Voltage (230 / 575 kV)
  - 50 Hz: 76 MVA; 11 kV – Site

WBS 9 – Other Electrical

Switchgear, Switchboards, Switches

- ES21 Switchgear, Non-1E
- DF02 Non-Class 1E Fused Transfer Switch Boxes
- DS02 Non-Class 1E DC Switchboards
- EA04 Non-Class 1E Low Voltage Bus Transfer Switches

Security Equipment

- JS01 Seismic Monitoring
- JS03 Plant Security Computer Equipment
- JS31 Plant Security Cameras (CCTV)
- EE03 Plant Security Electrical Enclosures

Panels

- DD02 Non-Class 1E DC Distribution Panels
- EA02 Non-Class 1E AC Distribution Panels
- ED01 AC Distribution Panels
- EP01 Auxiliary Control Panels
- EP10 MCR Load Shed Control Panels (Main Control Room)

Misc.

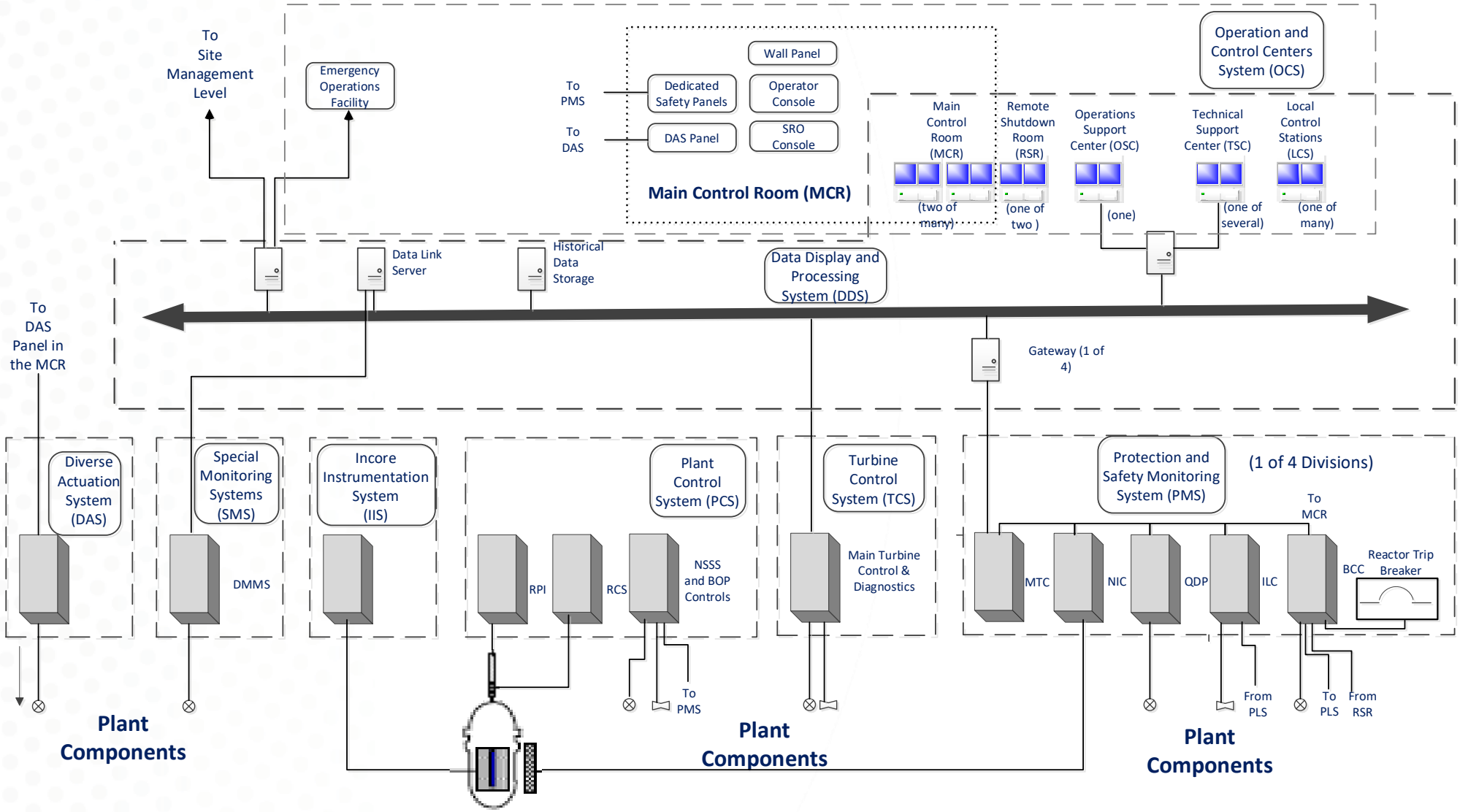
- ES03 Generator Circuit Breaker
- EH02 Hydrogen Igniters
- EJ02 Non-1E Junction and Terminal Boxes
- DF03 Class 1E Spare Battery Termination Boxes
- EK21 Load Centers
- EW31 Fiber-optic Cable
- MA01 Centrifugal – Vane Axial Fans

Required Skills for Electrical Equipment

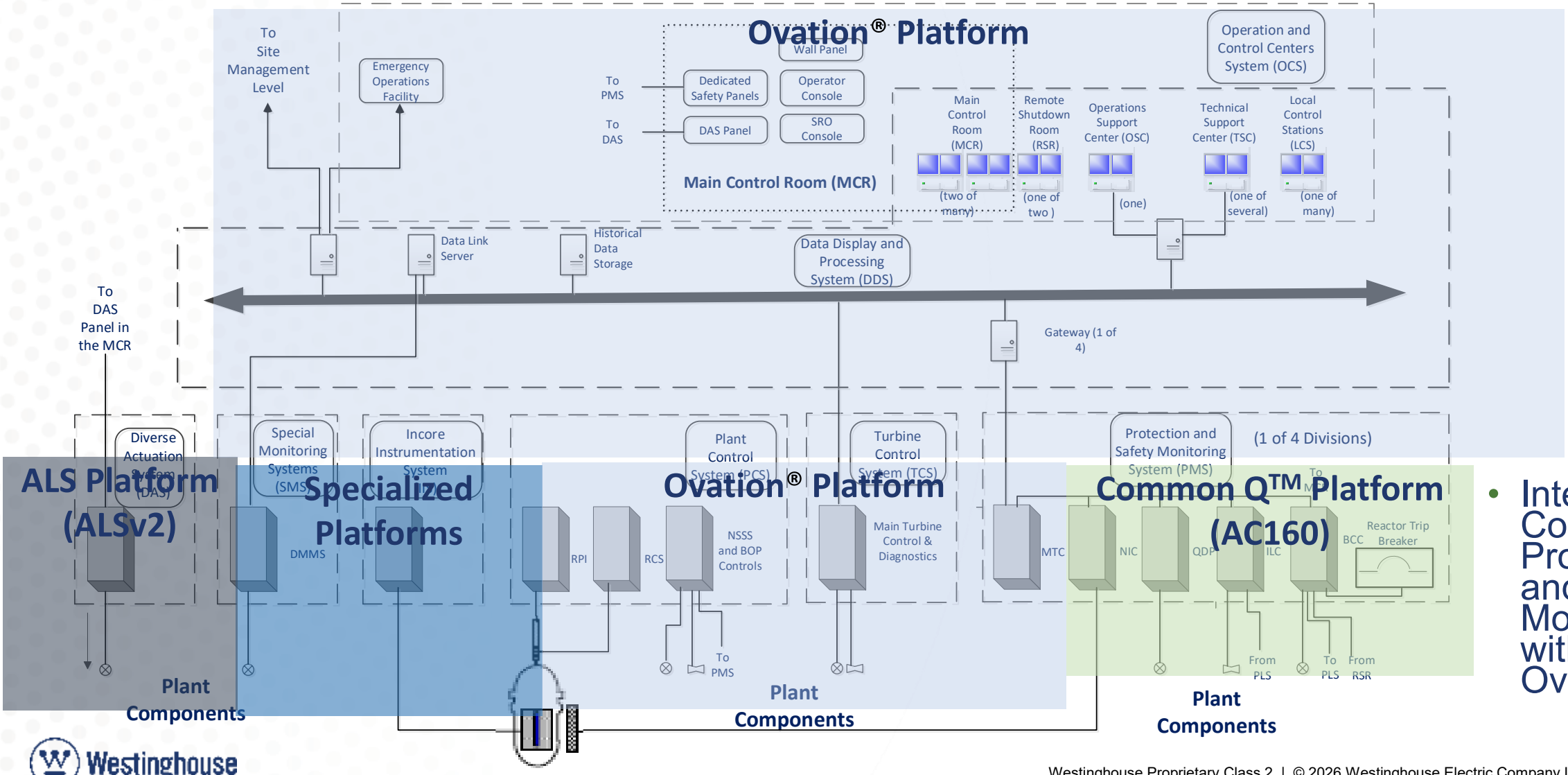
- **Electrical and Other Standards**
  - International Electrotechnical Commission (IEC)
  - Institute of Electrical and Electronics Engineers (IEEE)
  - American National Standards Institute (ANSI)
- **Manufacturing Services**
  - Experience with bending, cutting, rolling, forming, and milling fabrication processes
  - On-site processing, e.g., vapor phase, rolling
  - Painting and coating
  - Cleanliness
  - Equipment integration (e.g., controllers and switchgear, monitoring and instrumentation, pumps with motors, etc.)
- **Engineering Services**
  - Creating drawings, design calculations, seismic calculations, manufacturing procedures (cleaning, welding, heat treatment, coating, marking, NDE, packaging, etc.), technical manuals
  - 3-D Modeling
- **Testing**
  - On-site Testing Capabilities, e.g., performance/factory acceptance, load, hydrostatic testing
  - Off-site Testing Options, e.g., chemical and particle analyses
- **Quality Program**
  - Creating Quality Plans (QPs) including manufacturing, testing and inspection points
  - Assembly of Quality Assurance Data Packages
- **Product Qualification**
  - Welding procedures and welders (American Welding Standard (AWS))
  - Final dimensional inspection

AP1000 I&C Overview

AP1000 High Level Plant I&C Architecture



High Level AP1000 Plant I&C Architecture – with Westinghouse Platform Overlay

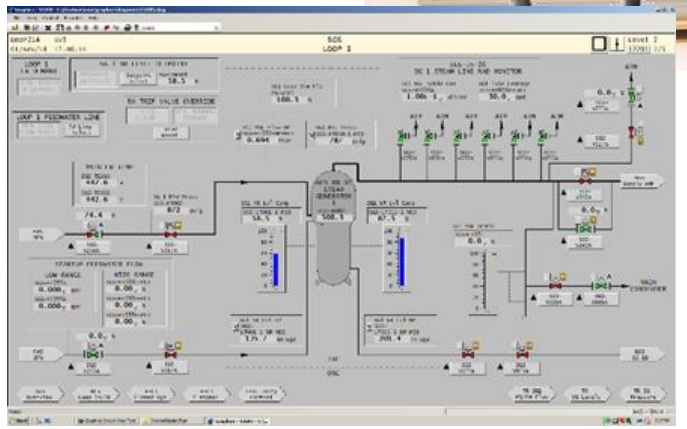


- Integrated Control, Protection and Monitoring – with Platform Overlay

Systems Overview

Ovation® Based Non-Safety I&C Systems Scope

- Plant Control System Scope:
  - Control of Plant fluid systems
  - Control of Electrical and Ventilation systems
  - NSSS & BOP control functions
- Includes Main Turbine Diagnostic and Control System (TCPS)
- Includes Digital Rod Control System (DRCS)
- Includes Digital Rod Position Indication (DRPI)
- Includes Workstation Interfaces
  - Operator Stations
  - Engineering Stations, Domain Controllers
  - Redundant Historians
  - Specialized Drops for nuclear applications, computerized procedures, and alarm presentation
- Based on Emerson Ovation® platform
- AP1000 scope:
  - ~2500 components
  - ~ 5500 sensors
  - ~ 30 packaged systems



Ovation Recommended by Westinghouse for use as the Reactor Plant Control System (RPCS) including the overall Human Machine Interface (HMI) for the Rolls Royce SMR project

Ovation® I/O Layout

Redundant Power Supplies

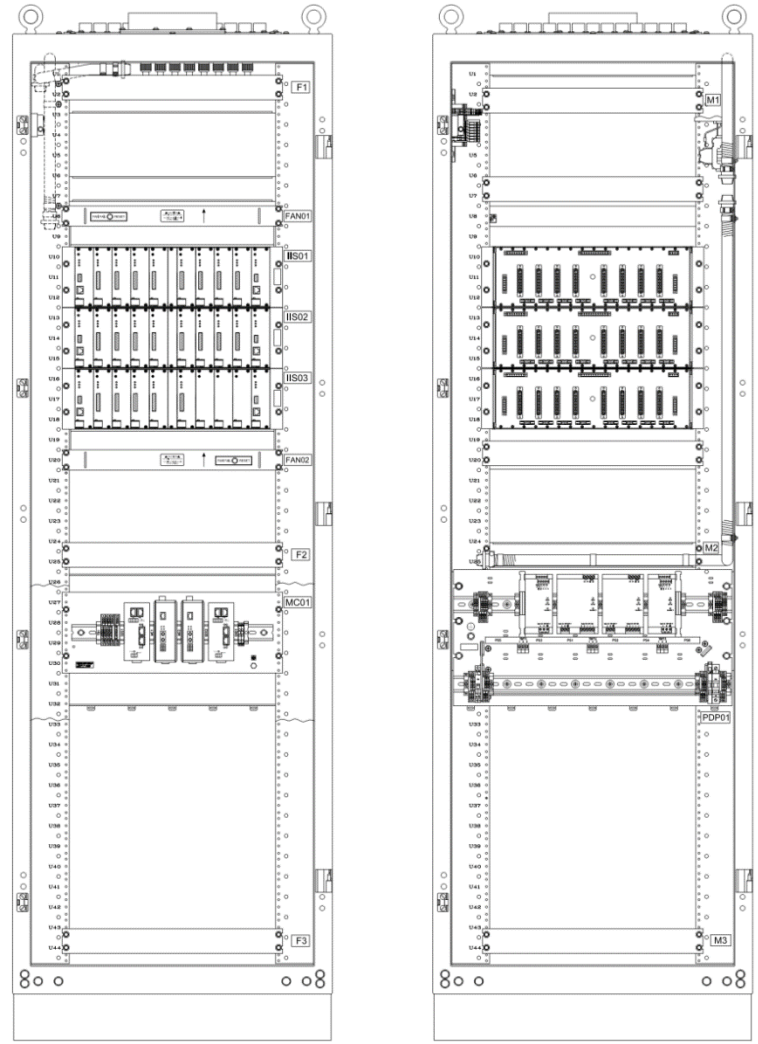
Controllers and Vertical I/O

Controllers, Redundant Power Supplies, Horizontal I/O

Westinghouse

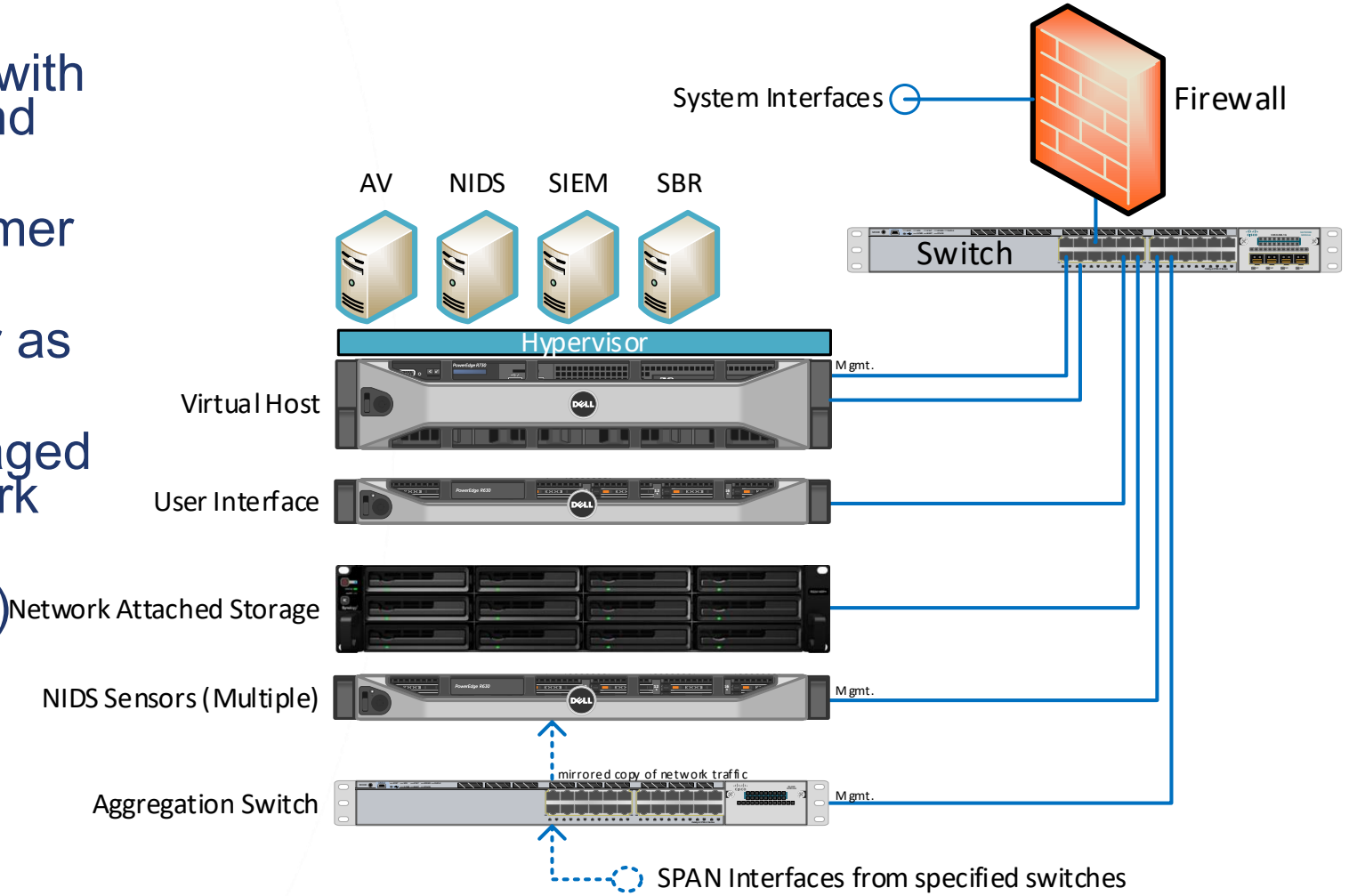
IIS – In-Core Instrumentation System

- The new plant IIS Signal Processing System (SPS) is a non-safety system that consists of two non-safety AP1000 Class E seismic category II cabinets.
- The IIS SPS is located inside containment and is connected to 42 IITAs via the MI Cables.
- The IIS SPS consist of two identical cabinets with 50% of the IITAs connected to each for redundancy purposes.
- The IIS SPS cabinets contain the Signal Processing Electronics (SPE)
  - The SPE uses embedded firmware to convert low-current analog signals from the detectors to multiplexed digitized data. It then transmits the digitized data to the external host software via Modbus TCP/IP.



Cyber – Cyber Security Monitoring System

- Non-Safety system
- CYS consists of three cabinets with virtual host, network storage, and multiple NIDS sensors
- Applications installed are customer dependent
- Cabinets are same part number as DDS
- Cabinets are expected to be staged immediately next to DDS network cabinets for testing
- Monitored Systems (Integration)
  - DDS
  - PLS
  - SMS
  - BEACON - Limited Functions

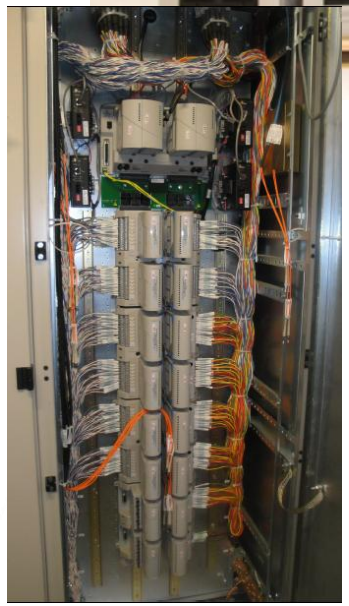


DDS – Data Display and Processing System

- The DDS sits between the PLS and OCS and performs data processing for information collection within the DDS and presentation through the OCS.
- The system also performs advanced calculations for plant optimization.
- The DDS utilizes commercially available computer servers and networking equipment mounted in cabinets.
- This is a non-safety related system.

PLS – Plant Control System

- The PLS controls the nuclear power plant operations automatically or manually, such as starting up the plant, maintaining steady operations, and tripping or shutting down the plant.
- The PLS is built on a commercially available third-party platform (Emerson Ovation®) with custom-developed application software to perform the designed functions.
- This is a non-safety related system

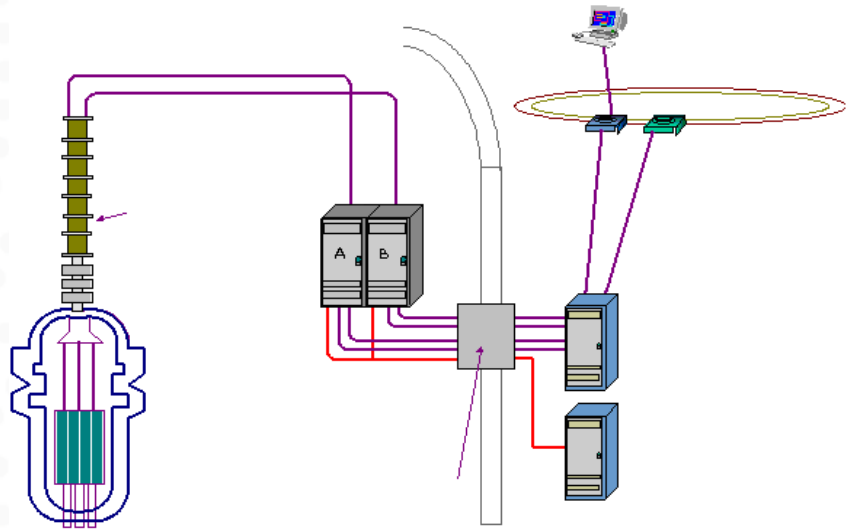


DRCS - Digital Rod Control System Cabinets

- Design addresses Rod Control System operational events (INPO events)
- Designed to prevent single failure rod drops
- Modular System – Multiple configurations of Selecting and Moving Cabinets suited for each plant configuration
- One Basic Design/Common Components
- Multiple Rod Drop Prevention Methods
- Advanced Diagnostic Features

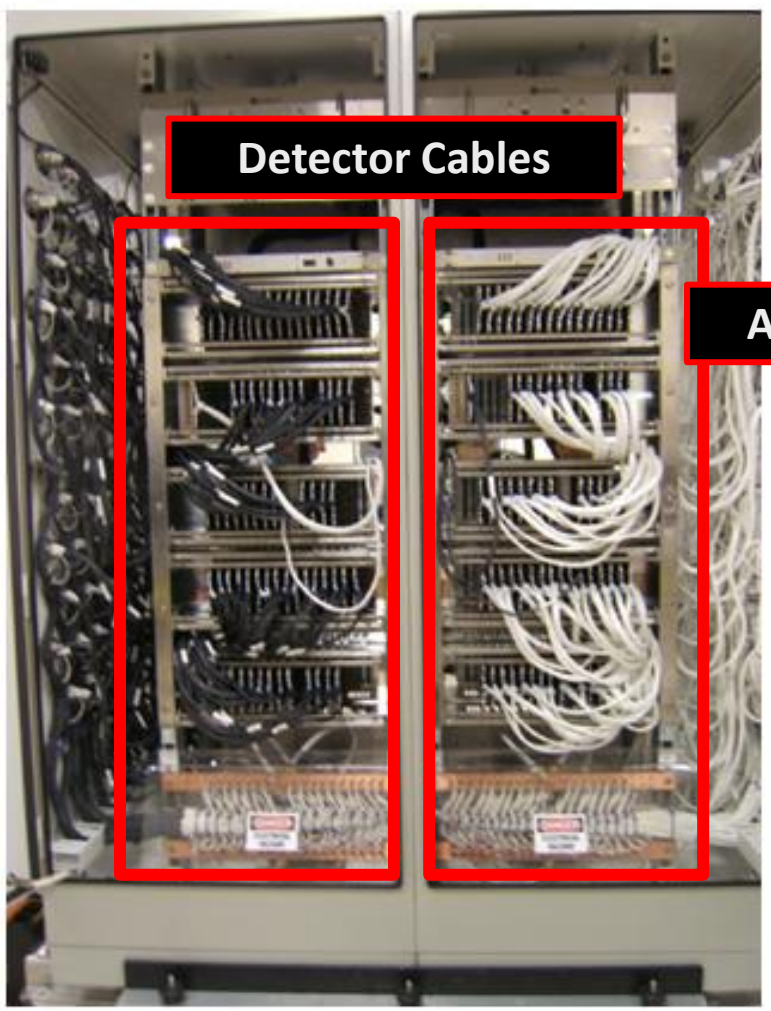
DRPI - Digital Rod Position Indicator

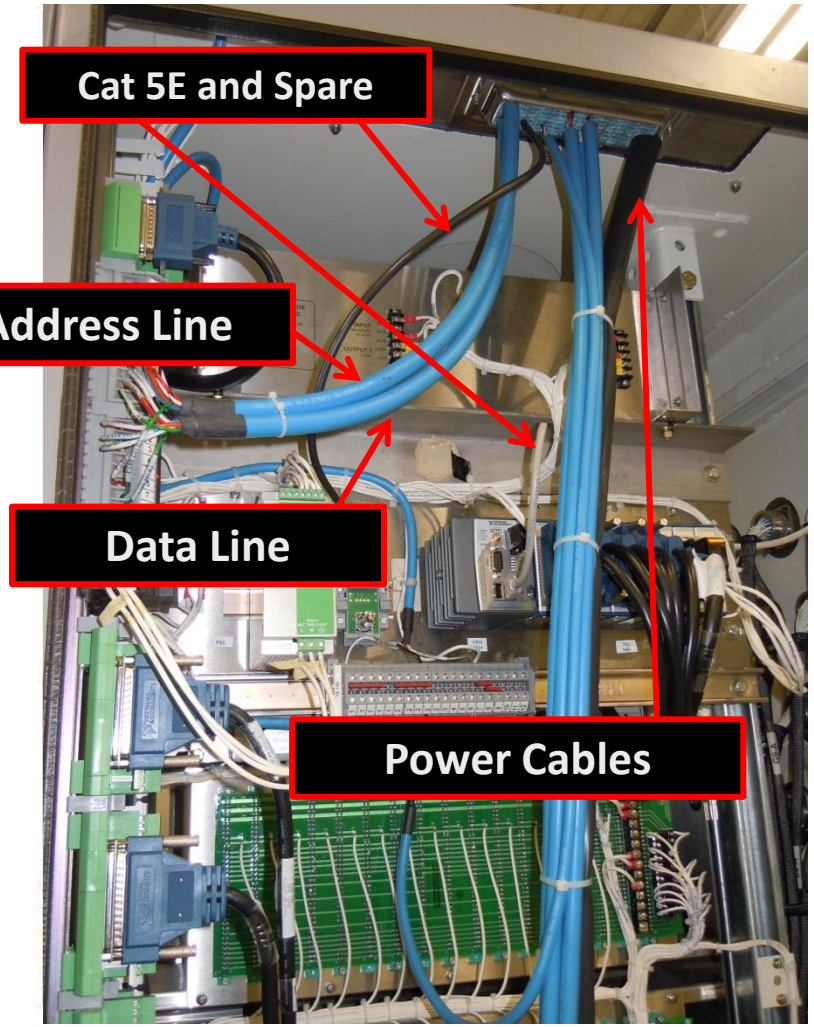
- The DRPI system provides feedback on the positions of the control rods to the PLS and plant operators. The DRPI consists of electronic cabinets and detectors. This is a non-safety related system



DRPI - Digital Rod Position Indicator Data Cabinet

DRPI - Digital Rod Position Indicator Data Cabinet External Connections





SMS - Special Monitoring System

- DMIMS-DX has one cabinet which houses the general assembly
- Provides a bidirectional link from the DMIMS-DX (Platform) to the Ovation Application Server system
  - Data transferred to and from Ovation
  - The hardware connection is Ethernet link

Modular Construction Approach

Shorter construction schedule – Improved quality – Reduced field work

Factory production of modules

Transport Modules

On-site module assembly

Plant Operation

Site Survey and Preparation

Site Construction

Construction and module assembly

Requires pre-engineering and early procurement – More work done in parallel

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WBS3 - Mechanical Modules - General Information

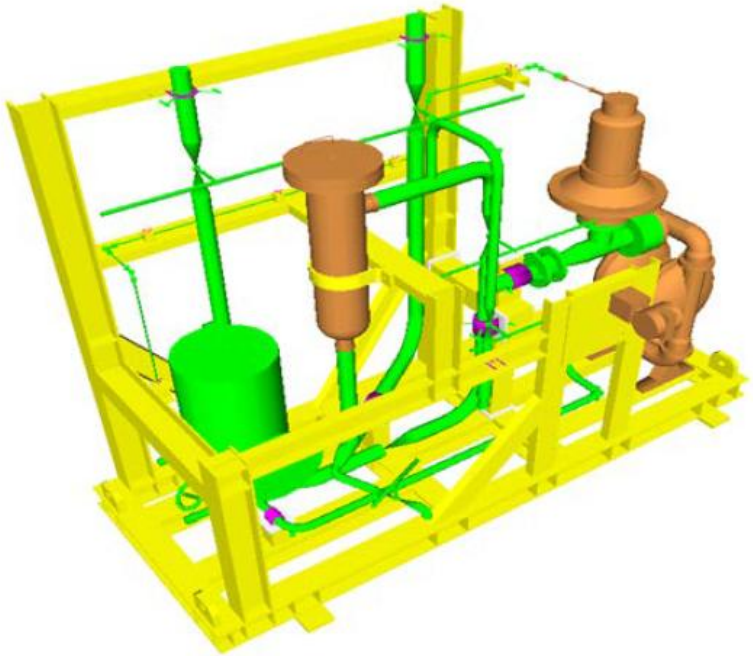
- All Non-Safety Mechanical Modules are non ASME III (Safety Class D at highest), and are to be located either in the Auxiliary Building or Containment,
- All Non-Safety Mechanical Modules include piping fabrication,
- All Non-Safety Mechanical Modules are build as a skid system,
- All Non-Safety Mechanical Modules are designed to be transported by truck,
- Piping and pipe supports, HVAC ducts and cable trays are in the Mechanical Module supplier scope,
- All equipment, beyond the above will be in Westinghouse scope to procure and provide to the Mechanical Module fabricator (tanks, pumps, HX, valves, actuators, etc.),
- Procurement and installation of electrical and I&C is not in Mechanical Module supplier scope.

Group A Mechanical Modules (QTY=8)

- All very similar modules (almost same size and weight), up to 2,74m x 1,22m x 2,13m and 1021kg weight,
- Relatively low fabrication complexity,
- Examples:

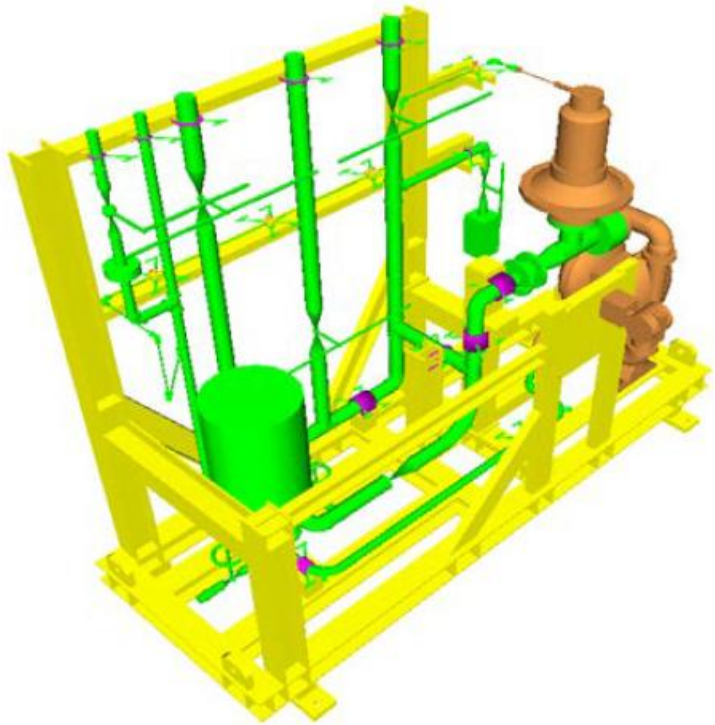
KB20 – WLS Chemical Waste Pump

Safety Class D
Non-Seismic



KB21 – WLS Effluent Holdup Pump A

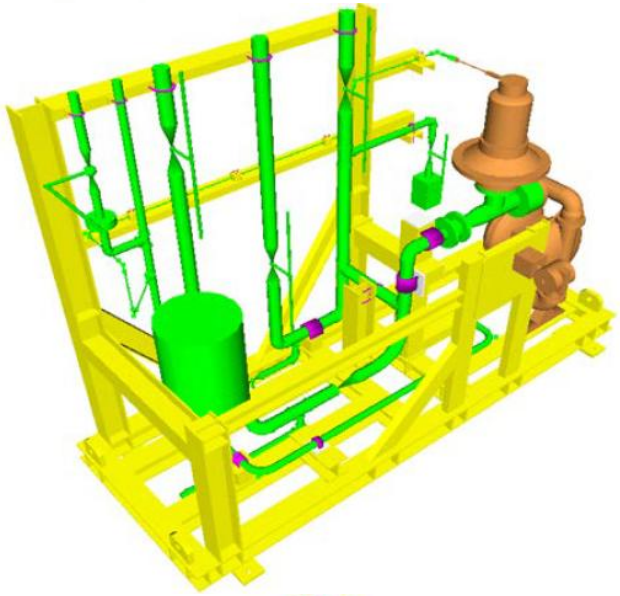
Safety Class D
Non-Seismic



Group A Mechanical Modules (QTY=8)

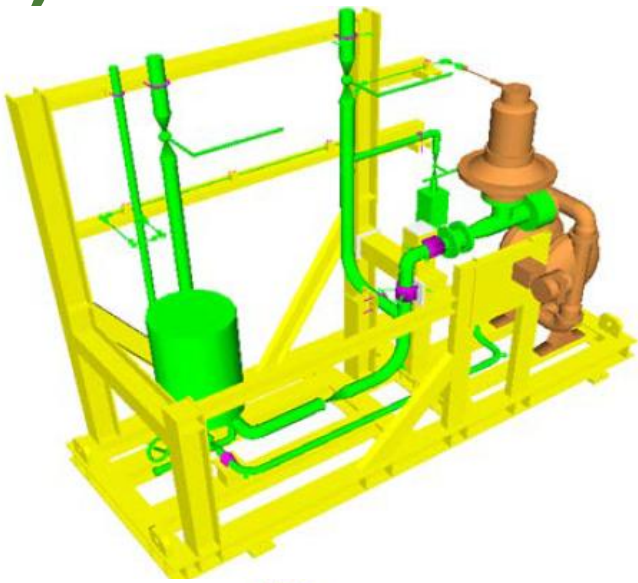
KB22 – WLS Effluent Holdup Pump B

Safety Class D
Non-Seismic



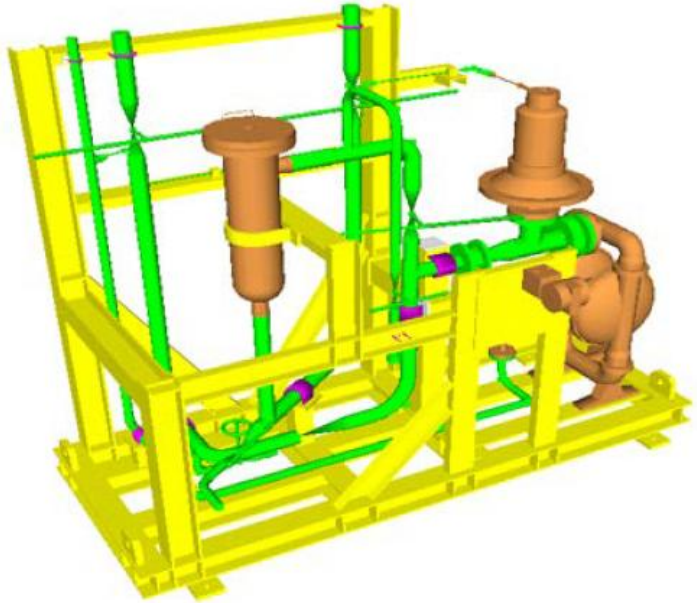
KB23 – WLS Monitor Pump C

Safety Class D
Non-Seismic



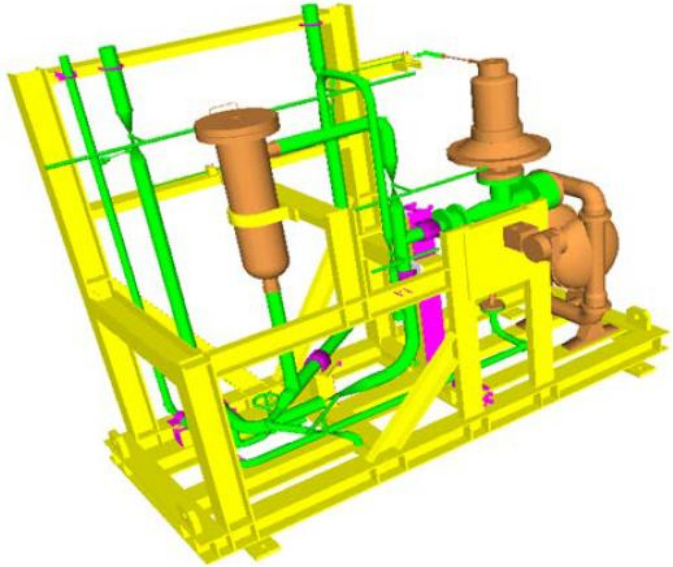
KB27 – WLS Waste Holdup Pump A

Safety Class D
Non-Seismic



KB28 – WLS Waste Holdup Pump B

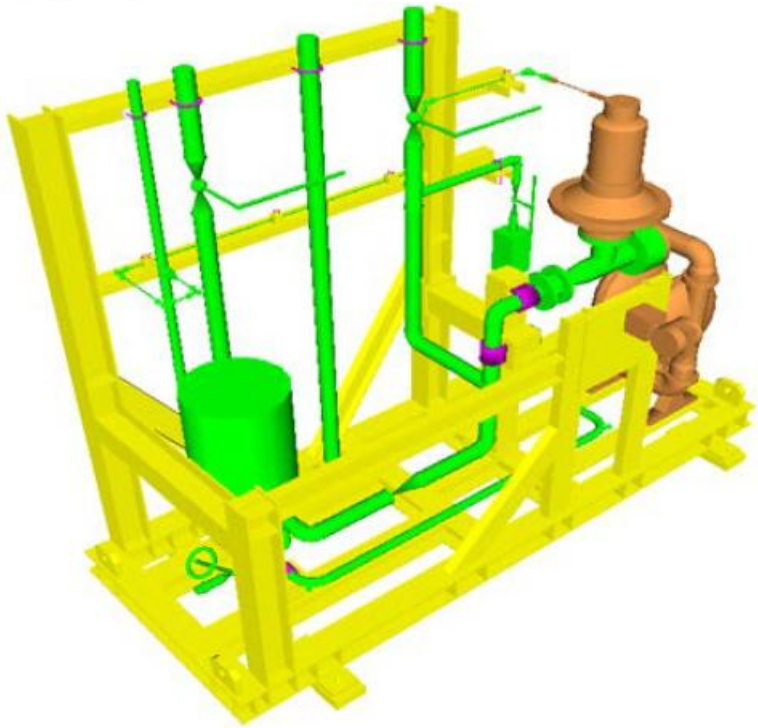
Safety Class D
Non-Seismic



Group A Mechanical Modules (QTY=8)

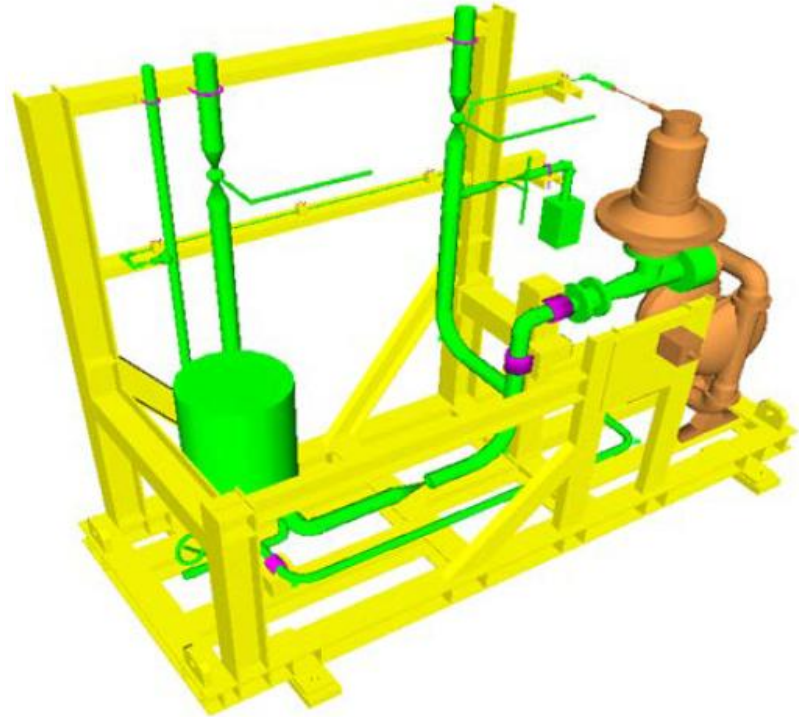
KB37 – WLS Monitor Pump A

Safety Class D
Seismic C-II



KB38 – WLS Monitor Pump B

Safety Class D
Seismic C-II

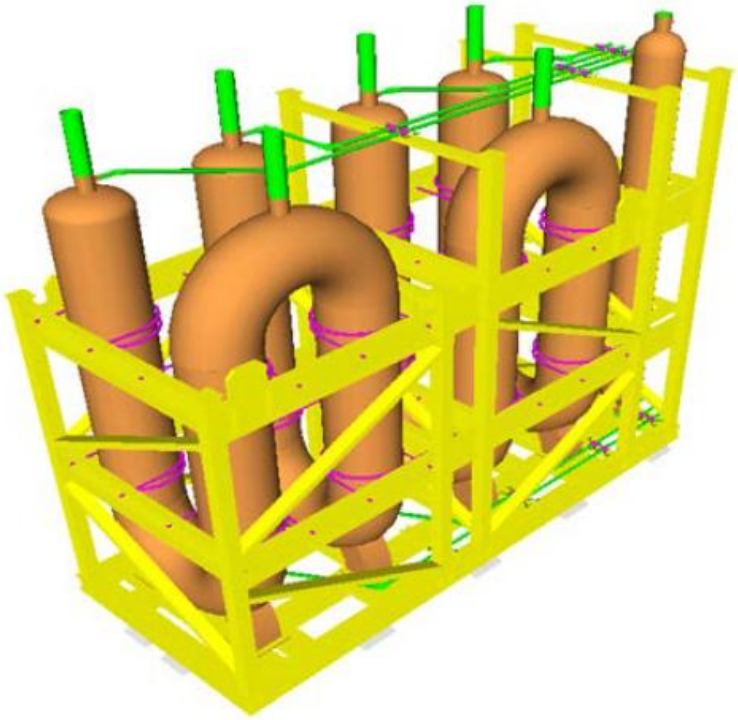


Group B Mechanical Modules (QTY=16)

- Average size modules, with weights up to 7t, all including some equipment and piping,
- Low and medium fabrication complexity,
- Examples:

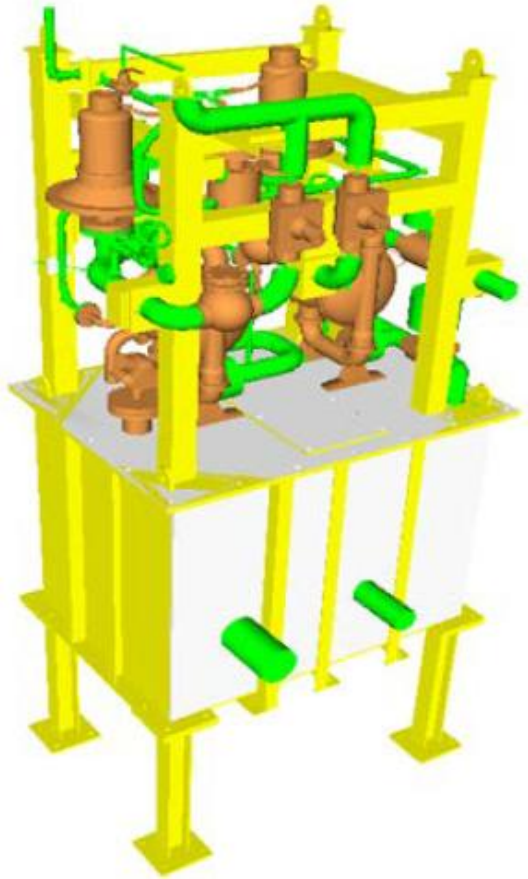
KB04 – WGS Delay and Guard Bed

Safety Class D
Non-Seismic



KB10 – WWS Sump Module

Safety Class E
Non-Seismic



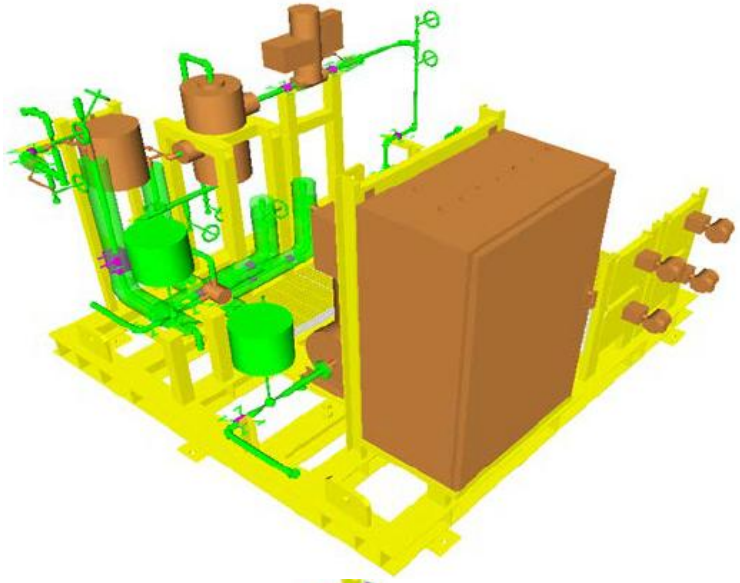
Group B Mechanical Modules (QTY=16)

KB13 – WRS Sump Pump Module

Safety Class D
Non-Seismic

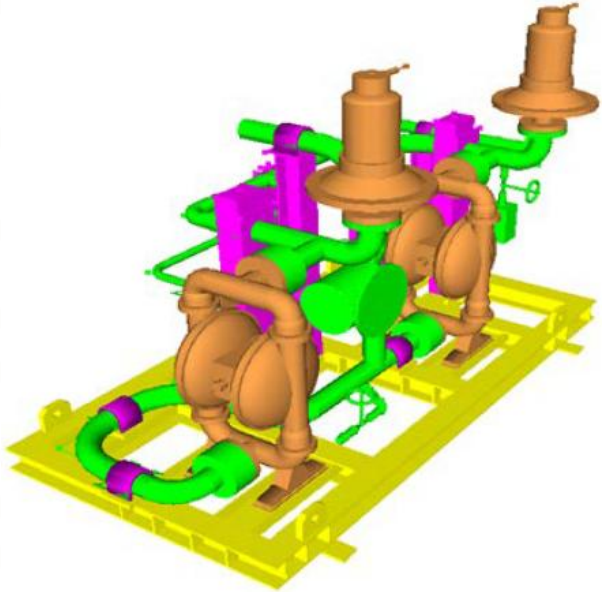
KB14 – WGS Equipment/Valve Module

Safety Class D
Non-Seismic



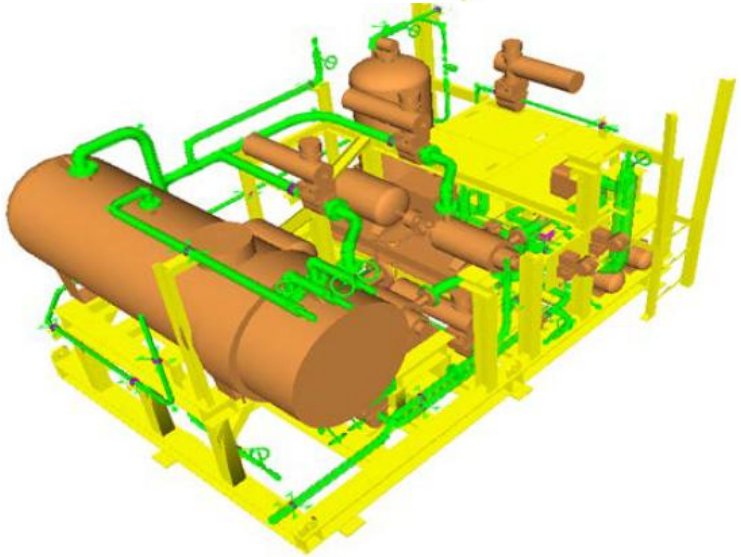
KB15 – Degasifier Discharge Pump

Safety Class D
Non-Seismic



KB16 – WLS Degasifier Module

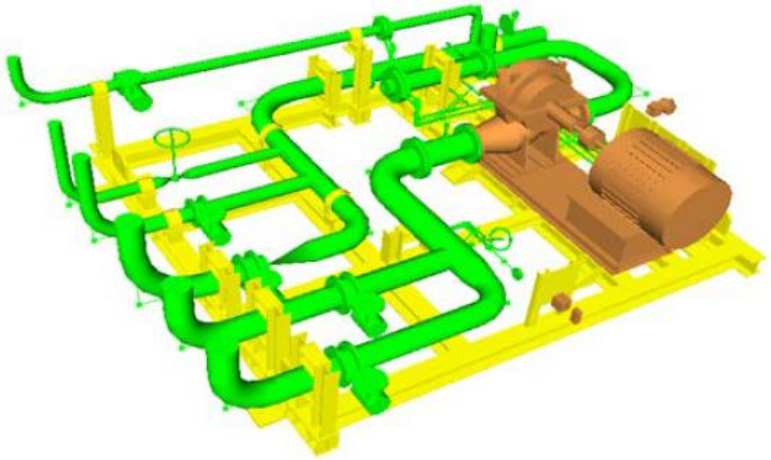
Safety Class D
Non-Seismic



Group B Mechanical Modules (QTY=16)

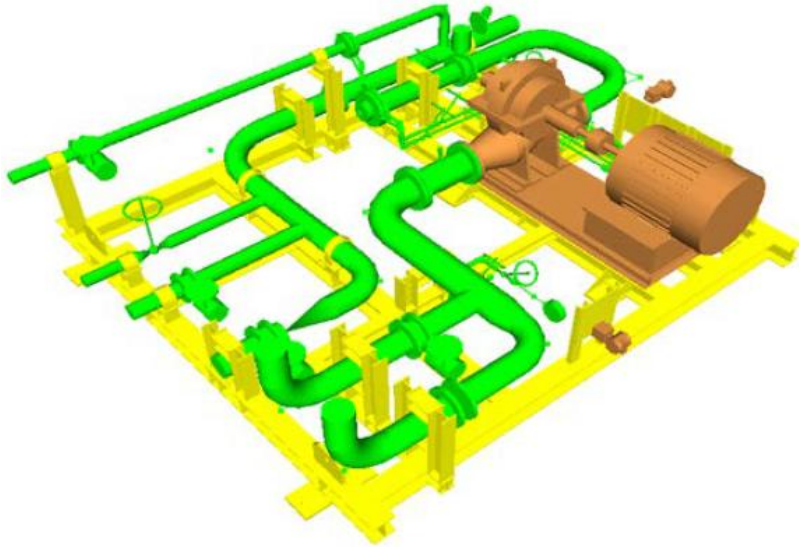
KB25 – SFS Pump A Module

Safety Class D
Non-Seismic



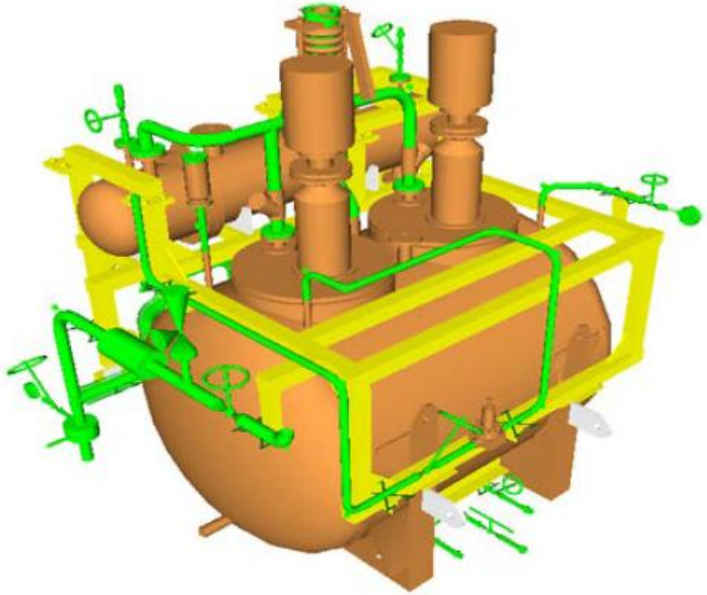
KB26 – SFS Pump B Module

Safety Class D
Non-Seismic



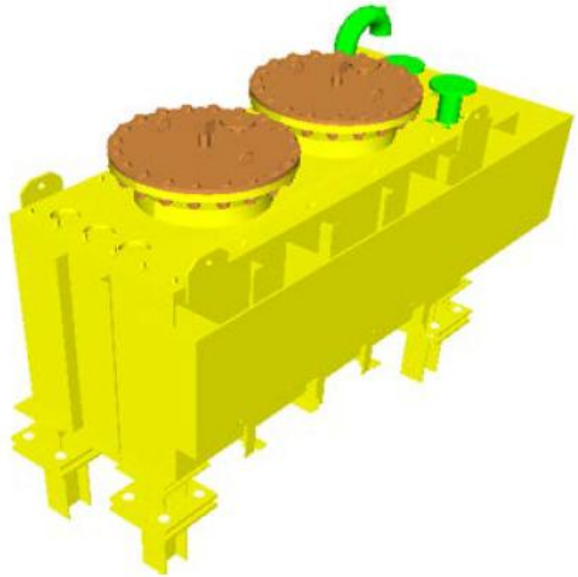
KQ10 – Reactor Cooland Module

Safety Class D
Non-Seismic



KQ11 – WLS Sump Pump

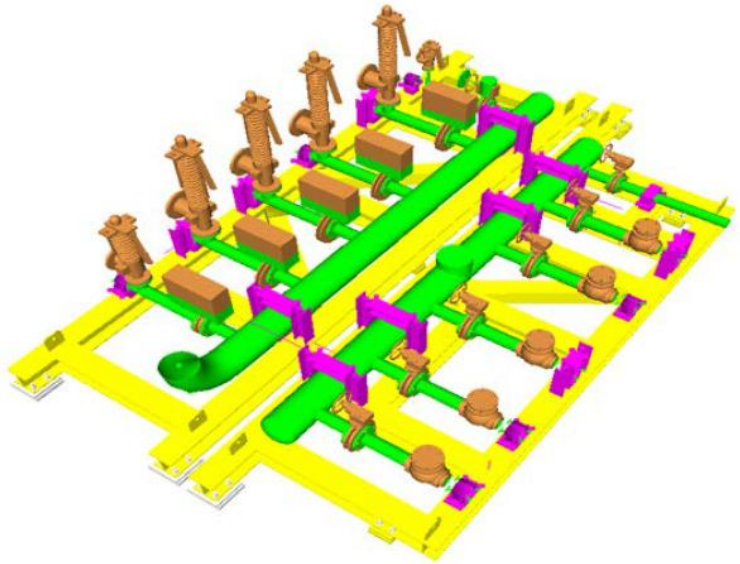
Safety Class D
Non-Seismic



Group B Mechanical Modules (QTY=16)

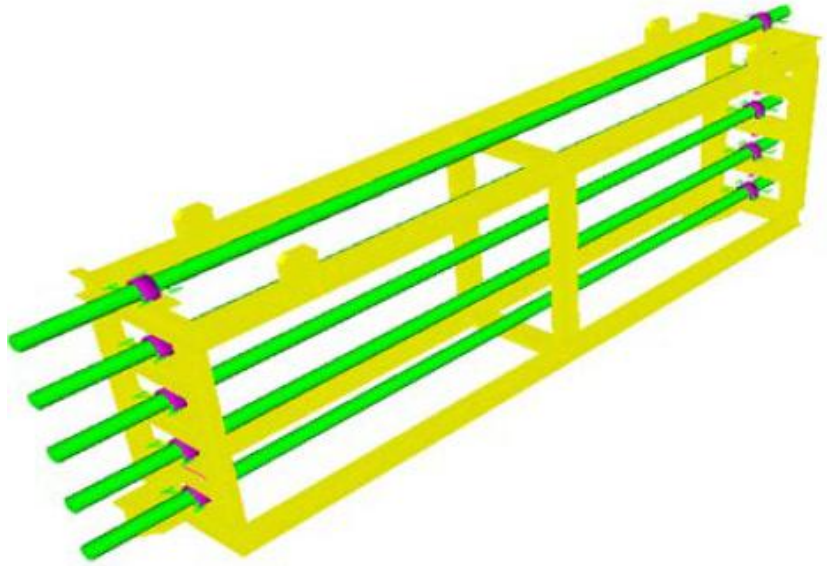
Q402 (Submodule A and B) – CCS Distribution Piping Module

Safety Class D
Seismic C-II



R106 – Room 12171 Commodity Module

Safety Class D
Non-Seismic

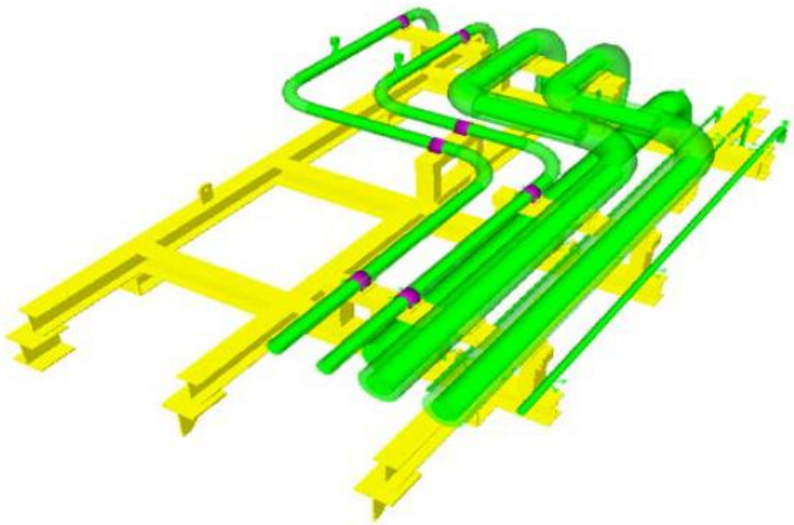


R216 – Room 12271 WLS Valve Module

Safety Class D
Non-Seismic

R474– Room 12371 Train Bay

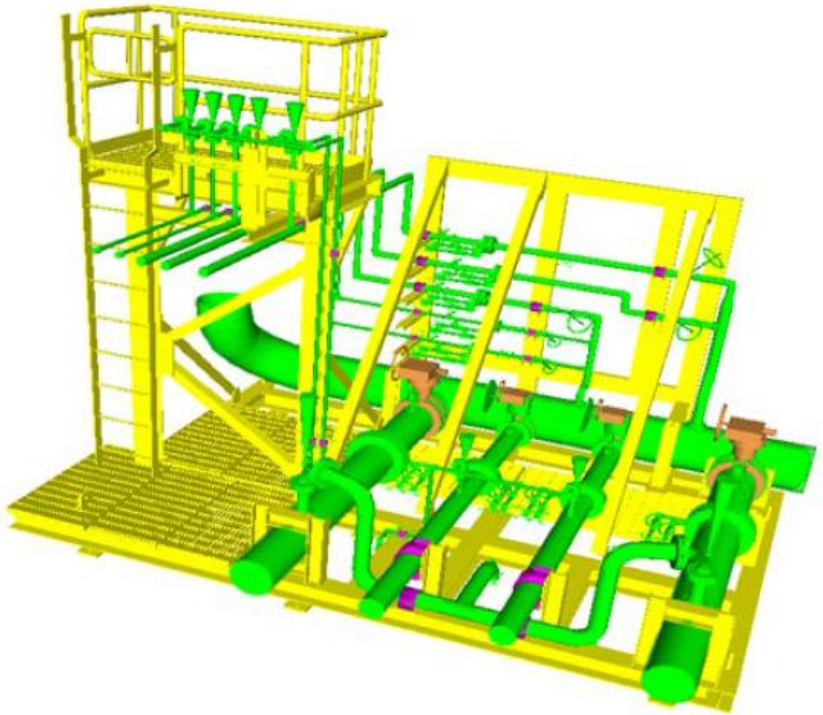
Safety Class E
Non-Seismic



Group B Mechanical Modules (QTY=16)

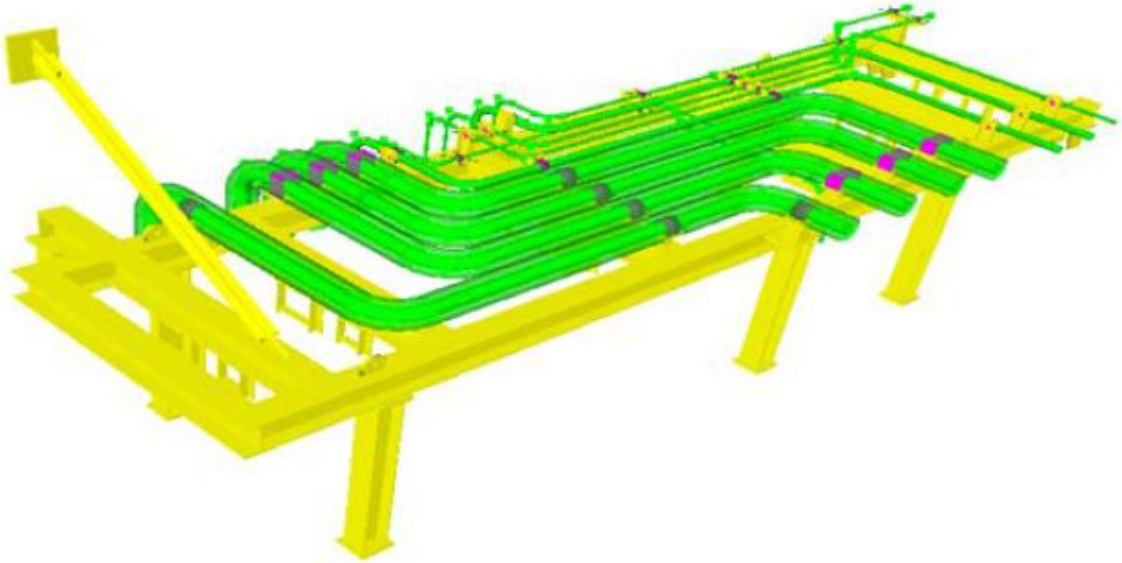
R501 – Room 12561 CCS Return Valve

Safety Class D
Non-Seismic



R503 – Room 12561 Commodity Module

Safety Class D
Non-Seismic

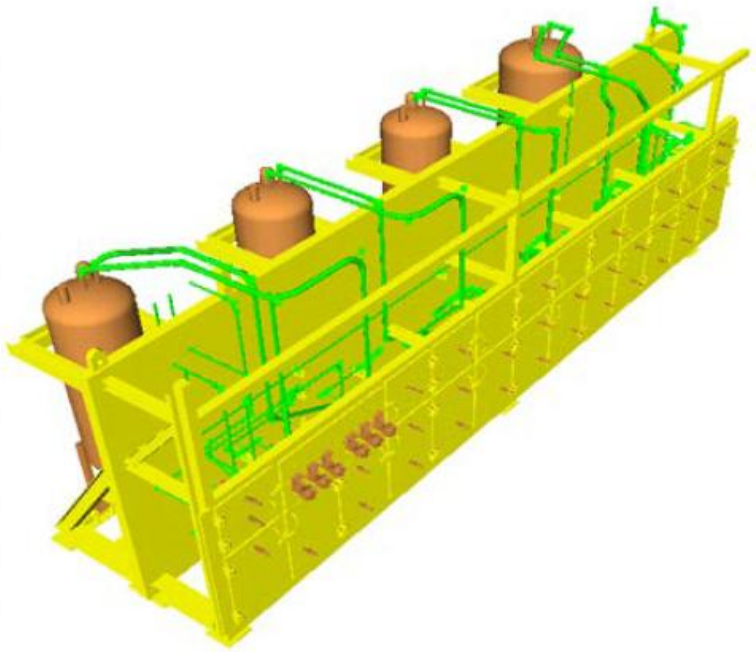


Group C Mechanical Modules (QTY=5)

- Large and heaviest modules, with biggest dimensions up to 14m and weight up to 70,5t; KQ22 ,KQ23, KB11, KB12 require large and thick steel plates, thus lead time for such material might be longer,
- High and medium fabrication complexity,
- Examples:

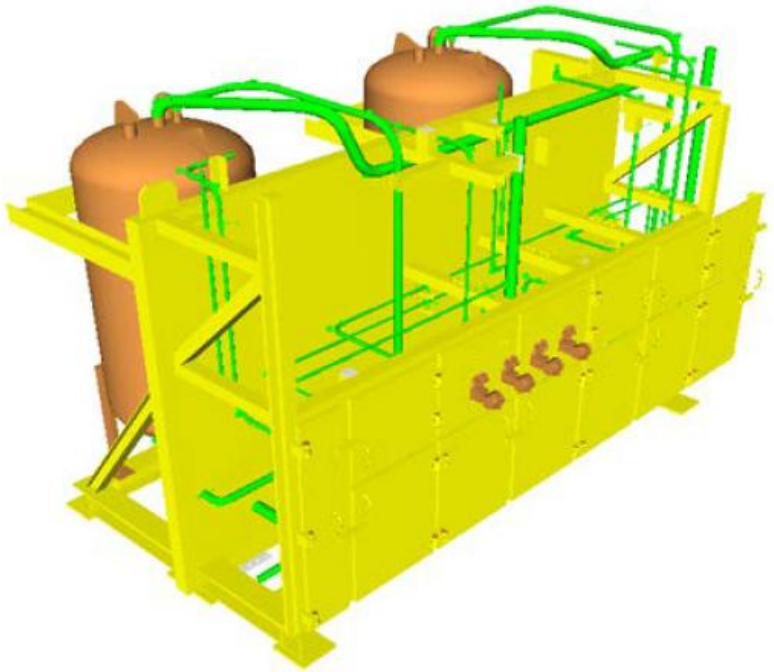
KB11 – WLS Carbon Filter/Ion Exchange

Safety Class D
Non-Seismic



KB12 – Spent Fuel Demineralizer

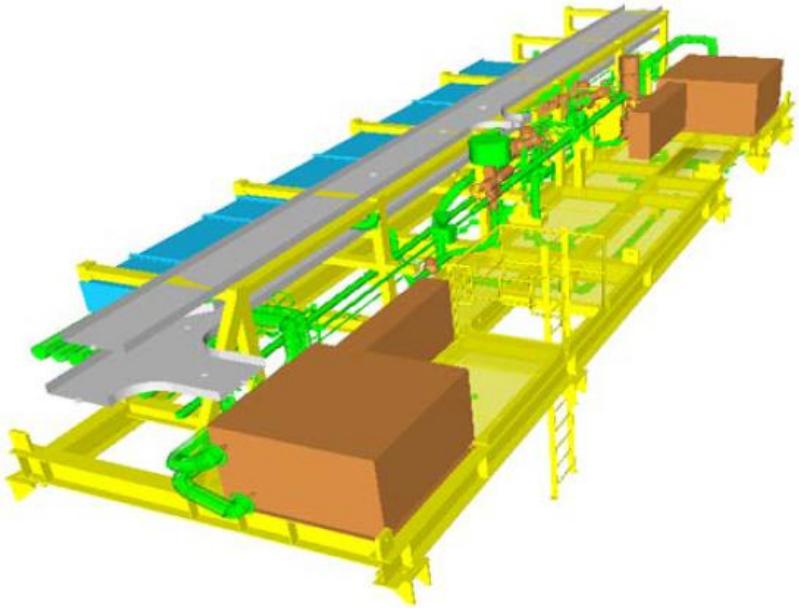
Safety Class D
Non-Seismic



Group C Mechanical Modules (QTY=5)

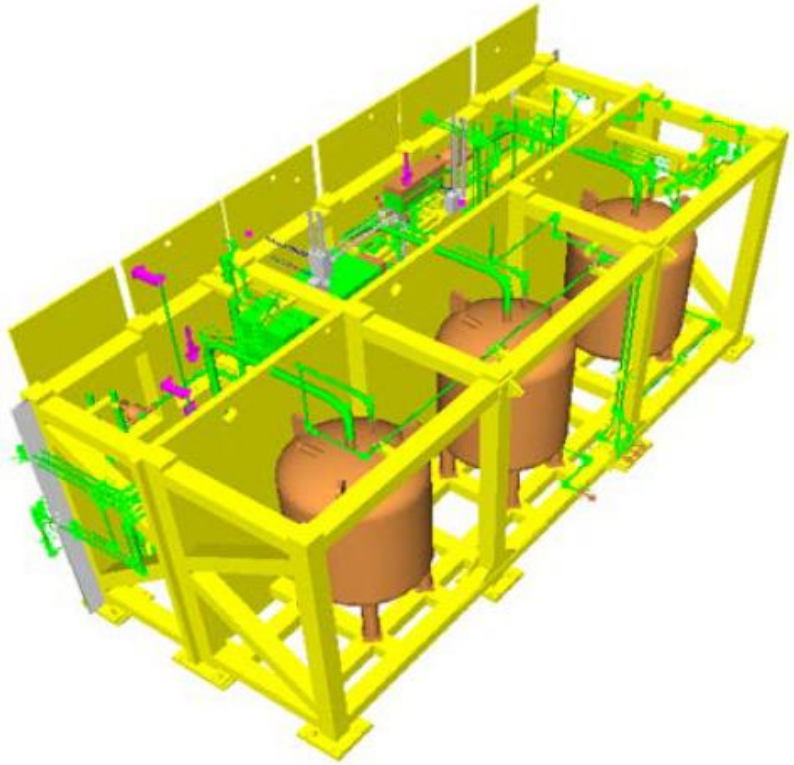
KB33 – CVS Makeup Pump Platform

Safety Class D
Non-Seismic



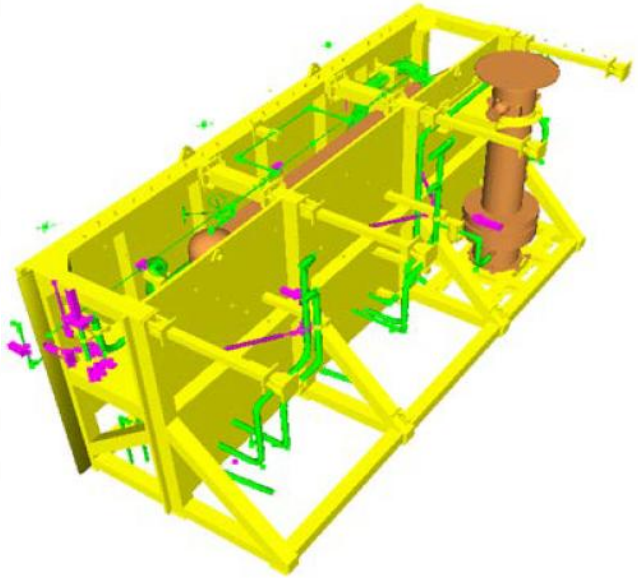
KQ22 – Lower CVS Module

Safety Class D
Seismic C-II



KQ23 – Upper CVS Module

Safety Class D
Seismic C-II



Group D Mechanical Modules (QTY=8)

- Very similar filter modules, with the possibility to be all fabricated within one shop,
- Medium fabrication complexity as a result of welding small and thick plates together,
- Examples:

KU20 – Filter Module (3 Modules)

Safety Class D
Seismic C-II

KU21 – Filter Module (5 Modules)

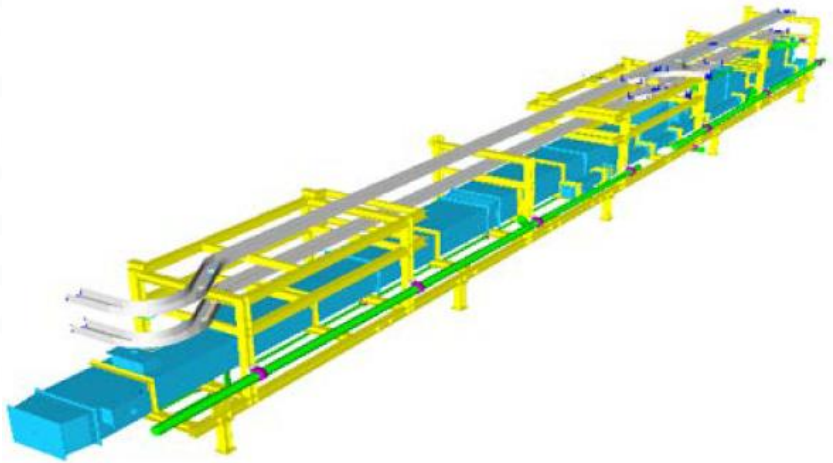
Safety Class D
Non-Seismic

Group E Mechanical Modules (QTY=8)

- Very similar piping, HVAC and cable tray modules, long with length of 12 to almost 18m, and weight up to 11136 kg,
- Low and medium fabrication complexity due to the variety and length of different piping, ducts and trays,
- Examples:

R104 – Rm. 12171 / 12172 Comm. Module

Safety Class D Non-Seismic



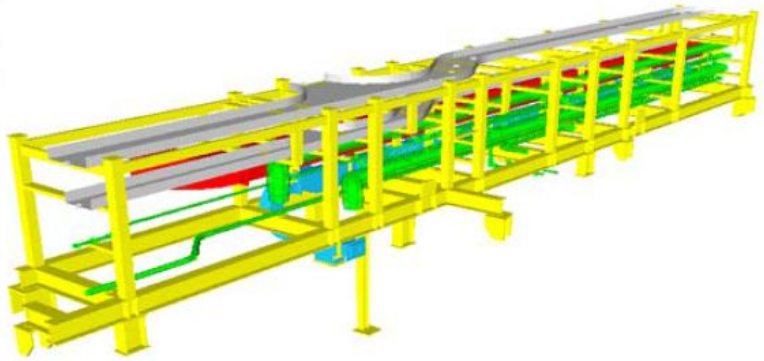
R151 – Rm 12151
Commodity / Platform

Safety Class D
Non-Seismic

Group E Mechanical Modules (QTY=8)

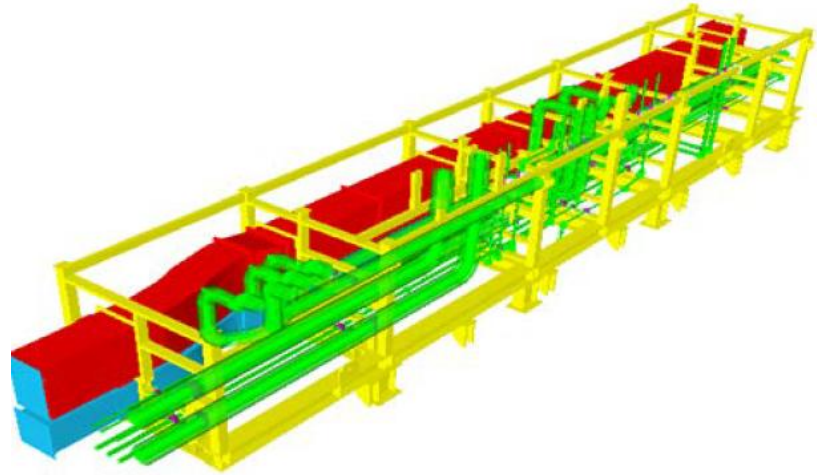
R155 - Rm 12155
Commodity / Platform

Safety Class D
Non-Seismic



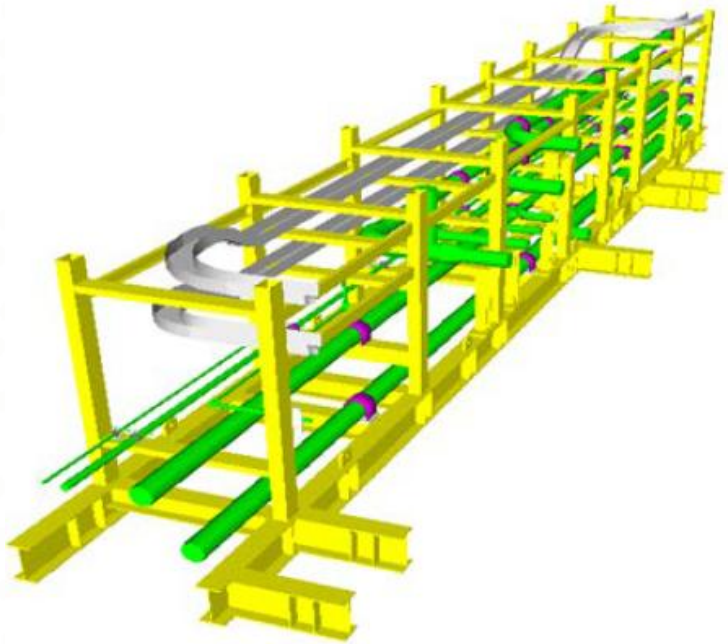
R161 - Room 12161
Commodity Module

Safety Class D
Non-Seismic



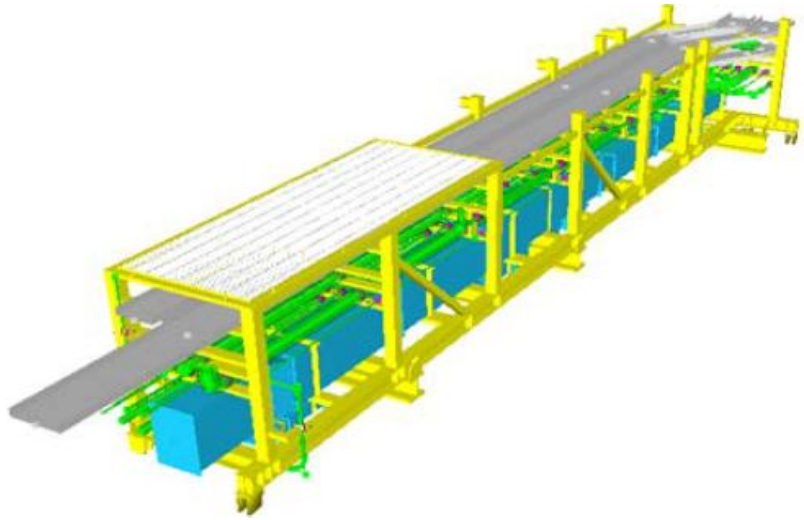
R219 - Rm. 12272-74
Commodity Module

Safety Class D
Non-Seismic



R251 - Rm. 12272-74
Commodity Module

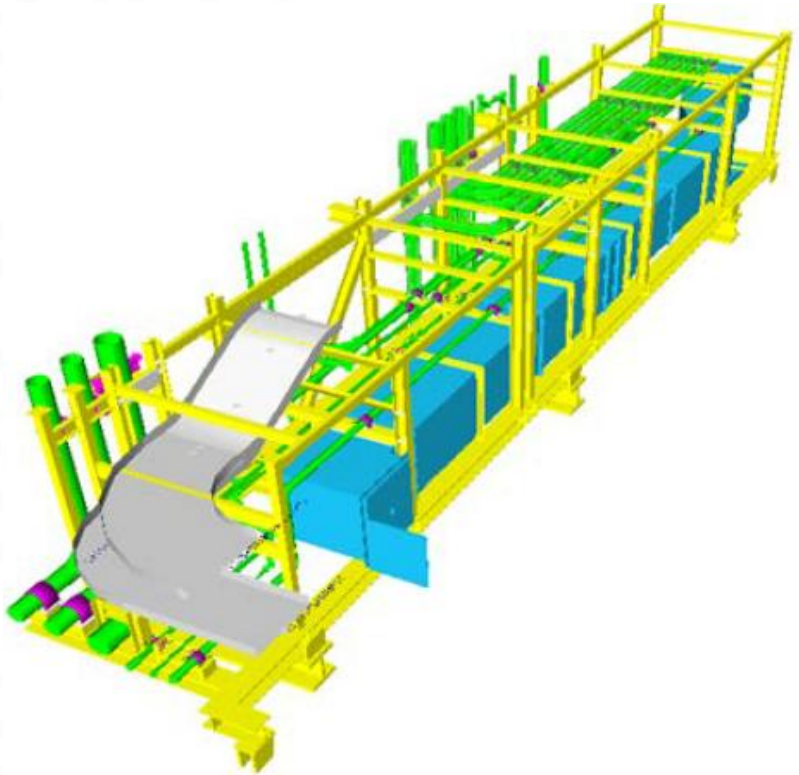
Safety Class D
Non-Seismic



Group E Mechanical Modules (QTY=8)

R261 - Room 12261
Commodity Module

Safety Class D
Non-Seismic



R451 - Room 12461
Commodity Module

Safety Class E
Non-Seismic