ACR-700
Plant Layout
CNSC Presentation

Brian Pedherney
Plant Layout Specialist
ACR Development Project
2004 March 16

AECL•EACL 1952 50 2002

Canada

AECL Atomic Energy of Canada Limited
EACL Énergie atomique du Canada limitée

ACR Plant Layout

Agenda

Describe

- Site, Plant and Building Layout
- Safety Design Guides Relationship with Layout
- Overall Layout of Buildings
- Specific SDG Layout Examples
- Layout Summary
- 3D CADDS Walkthrough

ACR Plant Layout

Layout Concepts

- **Layout Concepts build from a variety of disciplines:**
  - **Safety Systems**
  - **Seismic and Environmental Qualification**
  - **Separation of Systems**
  - **Fire Protection**
  - **Containment Isolation**
  - **Radiation Protection and Accessibility**
  - **Constructability**
  - **Operations and Maintenance**
  - **Human Factors**

ACR Plant Layout

Safety Design Guides

- **Current ACR SDGs:**
  - 001, Safety Related Systems
  - 002, Seismic Qualification
  - 003, Environmental Qualification
  - 004, Separation of Systems and Components
  - 005, Fire Protection
  - 006, Containment
  - 007, Radiation Protection
- **Requirements exported from SDG's and other high level documents outlined in Design Requirement documents are captured in 2D Plant Layout drawings for use by 3D CADDS development teams**

ACR Plant Layout

Safety Design Guide 001: Safety Related Systems

- **High level requirement to list and catagorize safety related systems**
  - **Shutdown System #1**
  - **Ventilation Isolation**
  - **Emergency Coolant Injection System**
  - **Long Term Cooling System**
  - **Shutdown System #2**
  - **Containment System**
  - **Reserve Water System**

ACR Plant Layout

Safety Design Guide 002: Seismic Qualification

- **Seismic systems to be located within seismically qualified structures**
  - **RB, RAB, MCB, MB, RSW Pumphouse**
- **MCR available during and after a seismic event**
- **SCA housed within seismically qualified RAB structure**

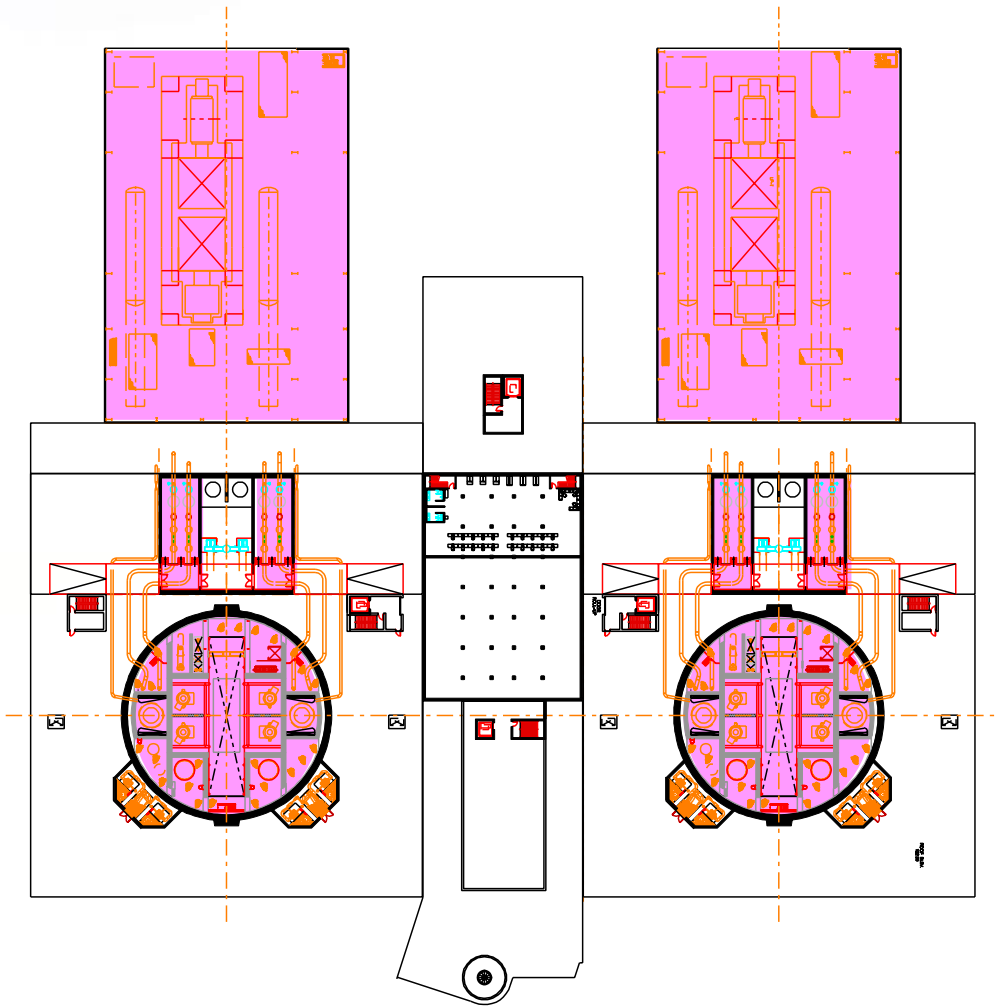
ACR Plant Layout

Safety Design Guide 003: Environmental Qualification

- **Harsh environment kept within RB and TB**
- **RAB protected from high energy systems**
  - **Steam, feedwater, and blowdown lines are run outside RAB between RB and TB**
- **RAB roof is protected from pipe breaks**

ACR Plant Layout

Safety Design Guide 003: Environmental Qualification

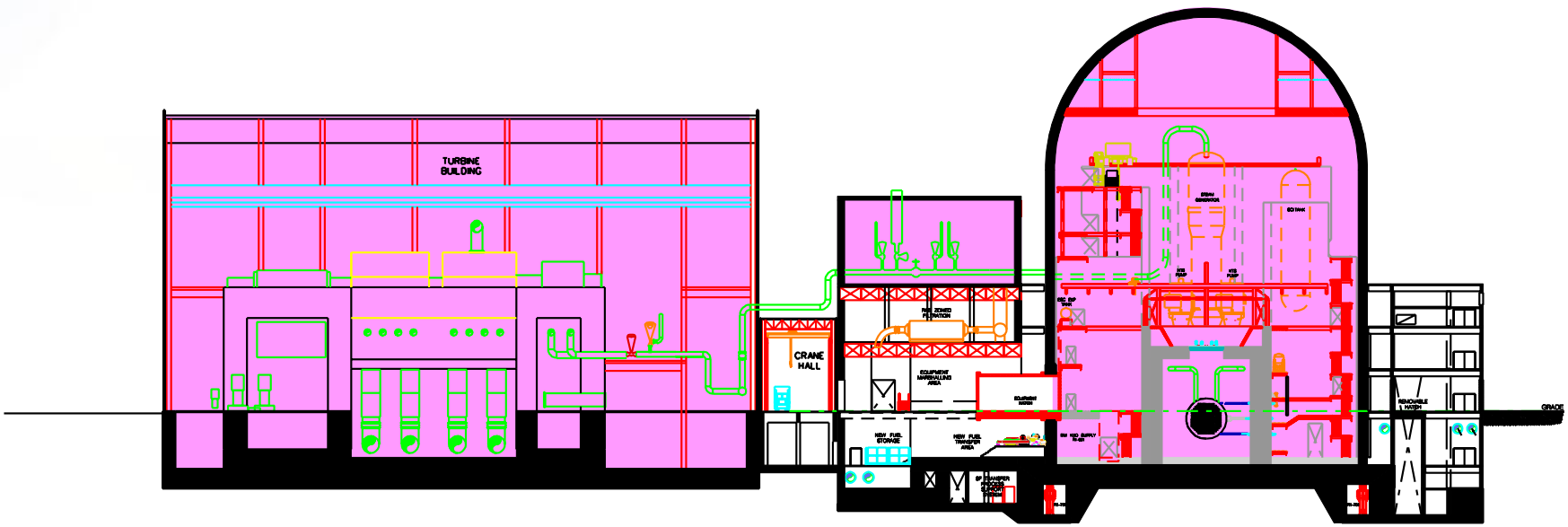


Plant Areas Subject to Harsh Environment

ACR Plant Layout

Safety Design Guide 003: Environmental Qualification

- **High Energy systems**
  - **Compartmentalized within RB**
  - **Rooftop line routes outside RAB from RB to TB**
  - **RAB roof hardened to protect RAB from MSL pipewhip**
  - **Tornado protection capable for MSL from RB to MSSV Enclosure**



B-D SECTION – Harsh Environment Buildings & Areas

ACR Plant Layout

Safety Design Guide 004: Separation of Systems and Components

- **Concept of system separation is used throughout**
- **System Division concept limited to:**
  - **RSW**
  - **RCW**
  - **LTC**
  - **Electrical Power Distribution**
- **6m minimum separation or physical barrier where fire hazard exists**
- **2m minimum separation between divisions with no fire hazard**
- **1m minimum separation between safety related systems with no hazard**

ACR Plant Layout

Safety Design Guide 005: Fire Protection

- **ACR is designed to meet requirements of the fire protection CSA standard**
  - **3 hour ratings between NSP buildings**
  - **3 hour fire separation between divisions**
  - **1 hour separation within divisions**

ACR Plant Layout

Safety Design Guide 006: Containment

- **Redundancy provided on automatic containment isolation systems**
  - **Provide adequate space allocation and access for periodic inspection and maintenance**

ACR Plant Layout

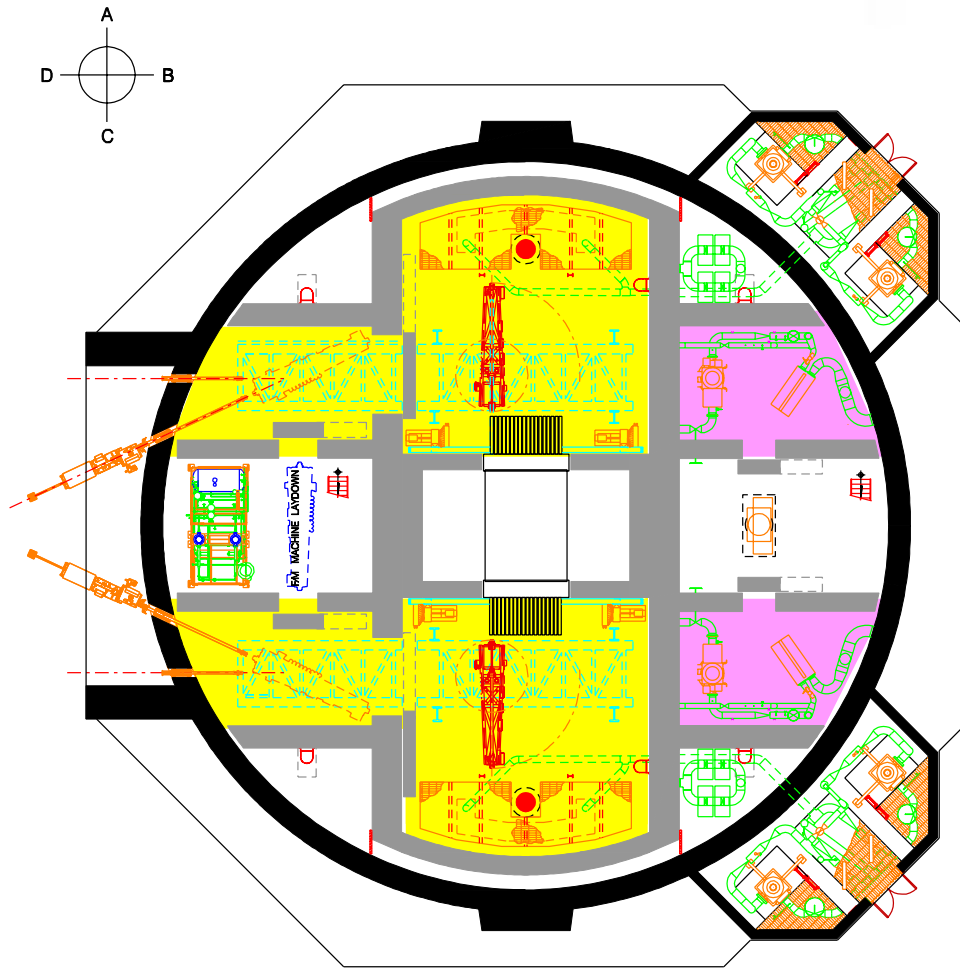
Safety Design Guide 007: Radiation Protection

- **Provide adequate shielding of radioactive systems and components to facilitate on-power access**
  - **Integrate Civil internal structures with shielding requirements as possible.**
  - **Provide localized shielding as necessary**
- **Provide for atmospheric isolation or flow control as required to support on-power access**
  - **Moderator D_2O recovery air dryers for tritium control**
  - **Reactor and F/M vault isolation to limit airborne radionuclide release to accessible on-power areas**

ACR Plant Layout

Safety Design Guide 007: Radiation Protection

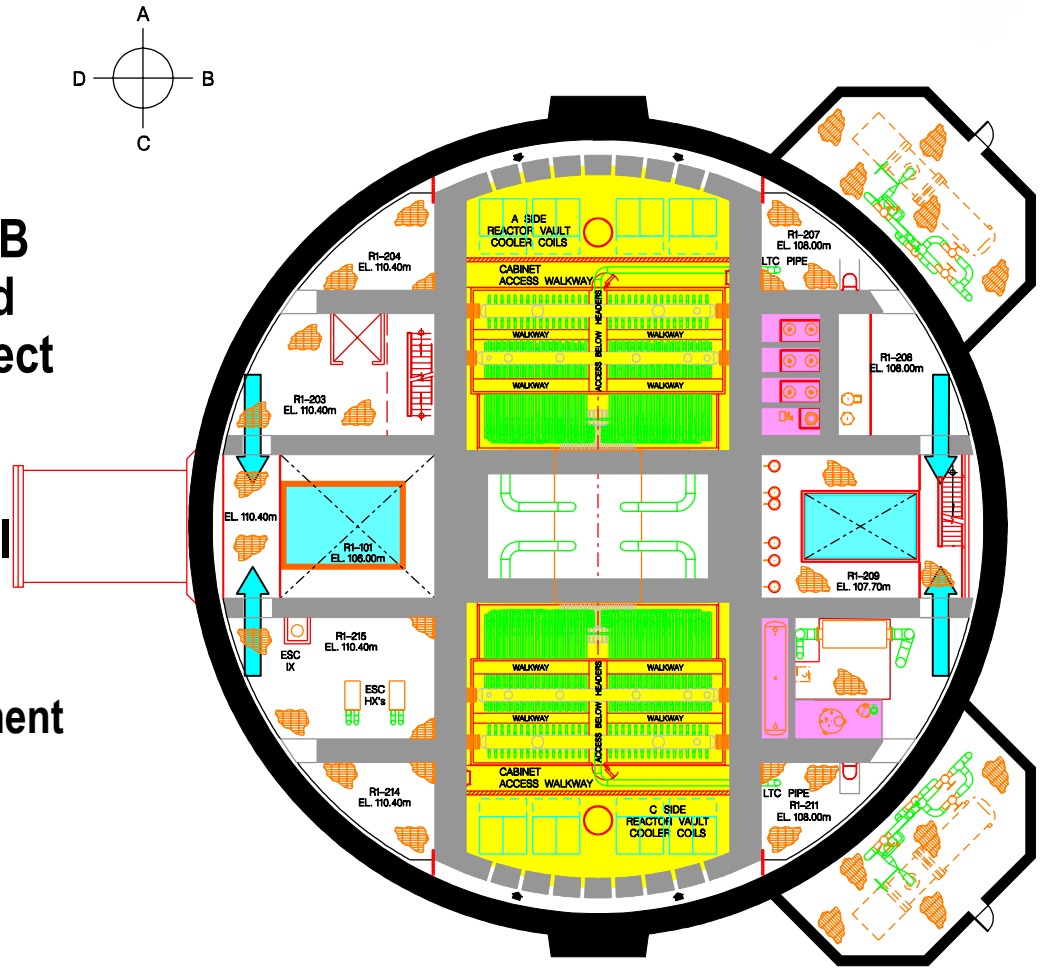
- **Atmospherically controlled areas**
  - **Main Moderator on the B Side**
  - **F/M Fuelling Vault & Machine Maintenance Locks, A, C and D Side**
- **Reactor and Fuelling Machine vaults integrate civil internal structures with shielding requirements**
- **Moderator system rooms integrate civil internal structures with shielding requirements**



ACR Plant Layout

Safety Design Guide 007: Radiation Protection

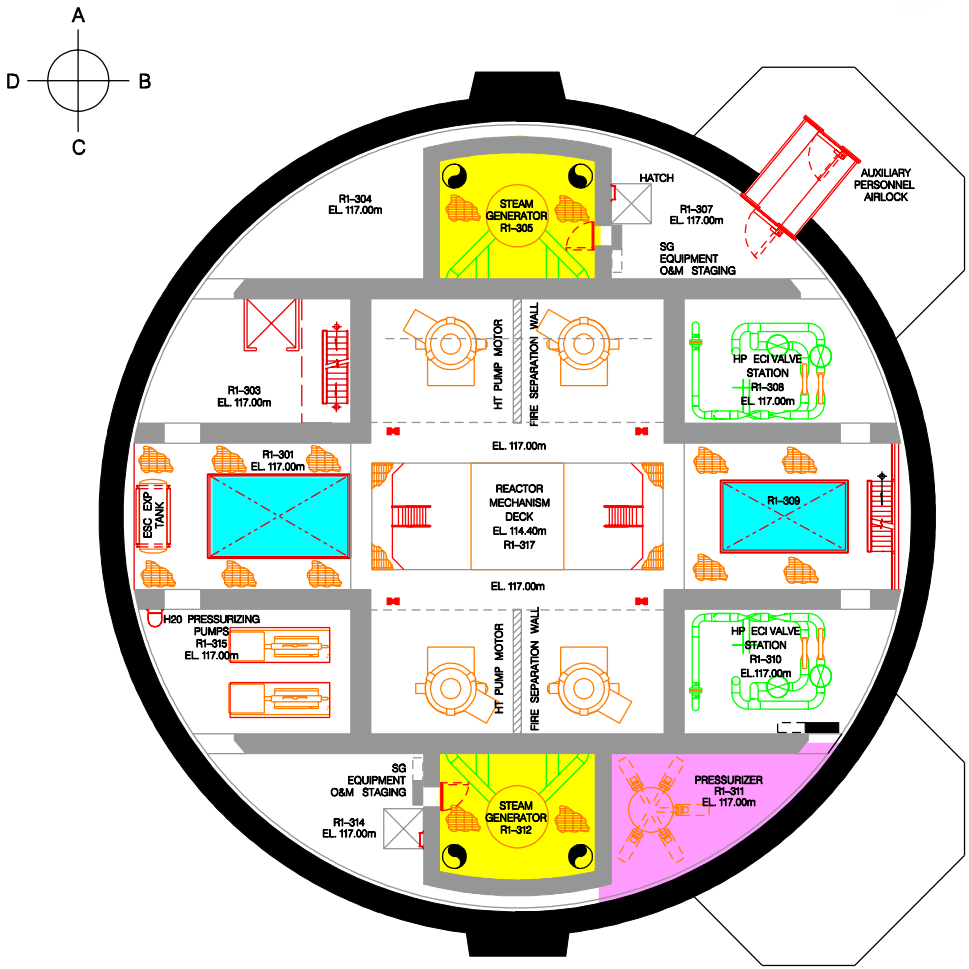
- Atmospherically controlled areas
  - Main Moderator on the B Side
  - Upper Feeder Cabinets, A and C Sides
- Major equipment hoistway, up from B side 100 elevation over RM Deck and down D side to 106 elevation connnect all system compartments through horizontal access openings.
- Access from compartment to central hoist area defined
  - Major stair and service elevator located on D side with main equipment airlock



ACR Plant Layout

Safety Design Guide 007: Radiation Protection

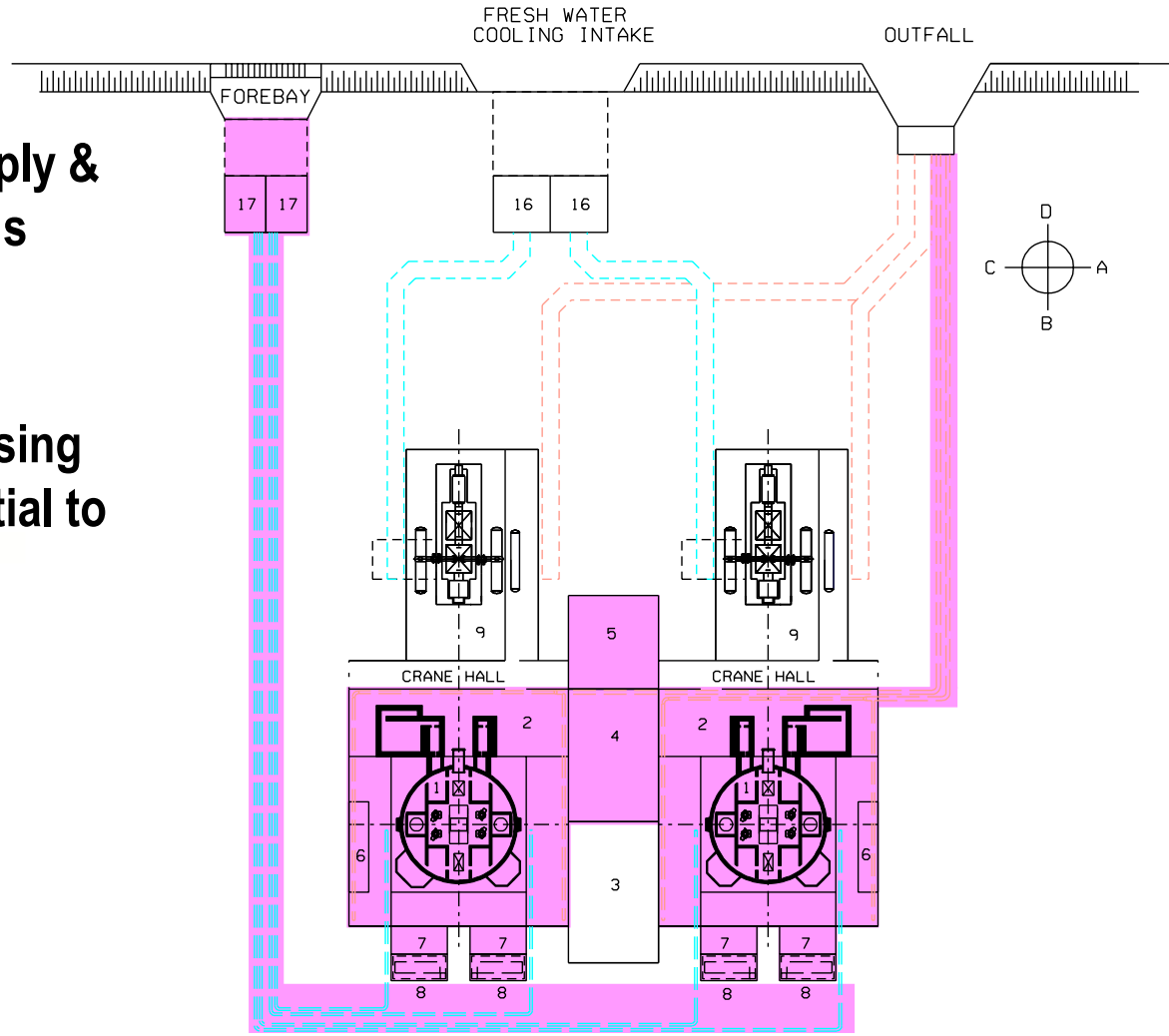
- **Atmospherically controlled areas**
  - **SG enclosures**
- **Restricted on-power access area**
- **Major equipment hoistway, up from B side 100 elevation over RM Deck and down D side to 106 elevation connecting all system compartments through horizontal access openings.**



ACR Plant Layout

Examples

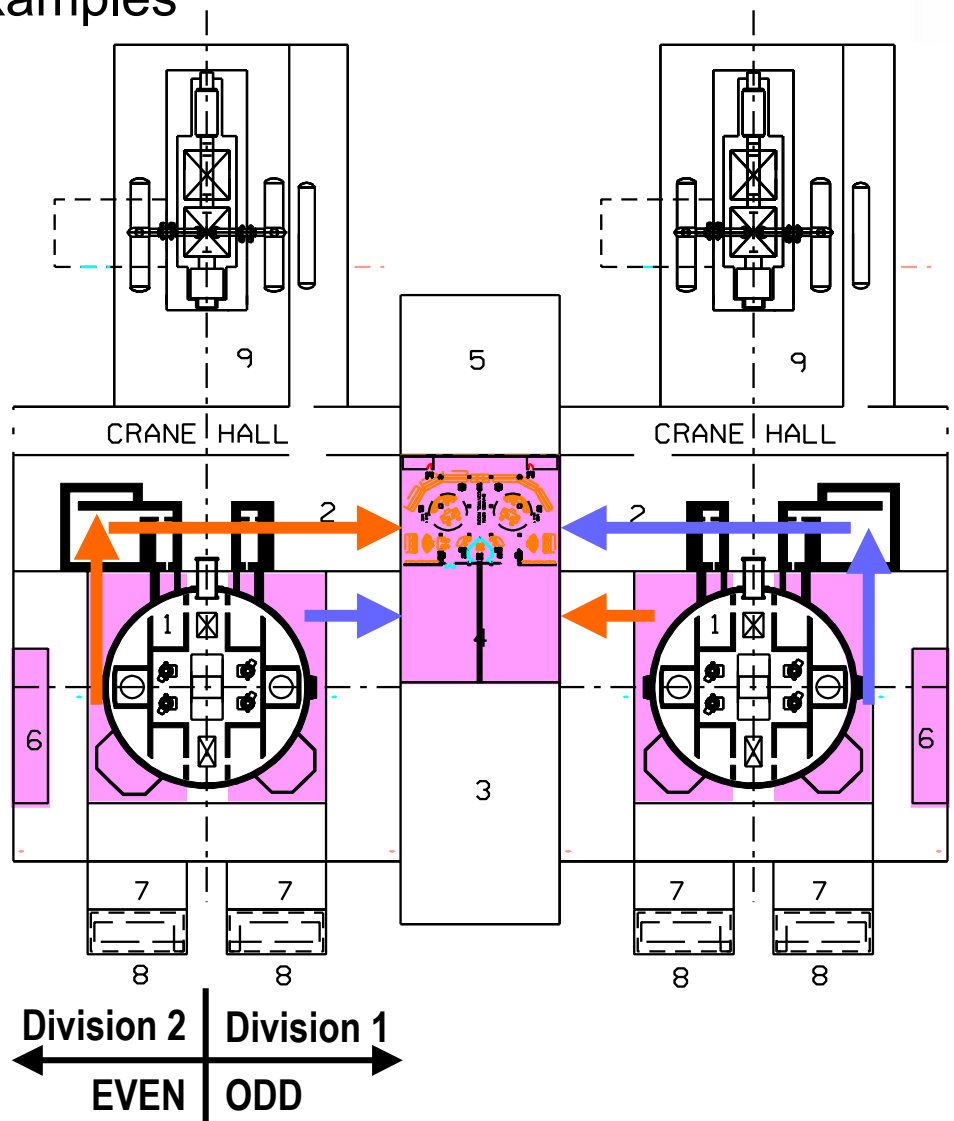
- **Seismic Qualification**
  - **RSW Pumphouse and supply & return routes to/from RAB's**
  - **Nuclear Steam Plant RB, RAB, MCB, DG1 to 4**
  - **Maintenance Building housing active systems with potential to contaminate surroundings**



ACR Plant Layout

Examples

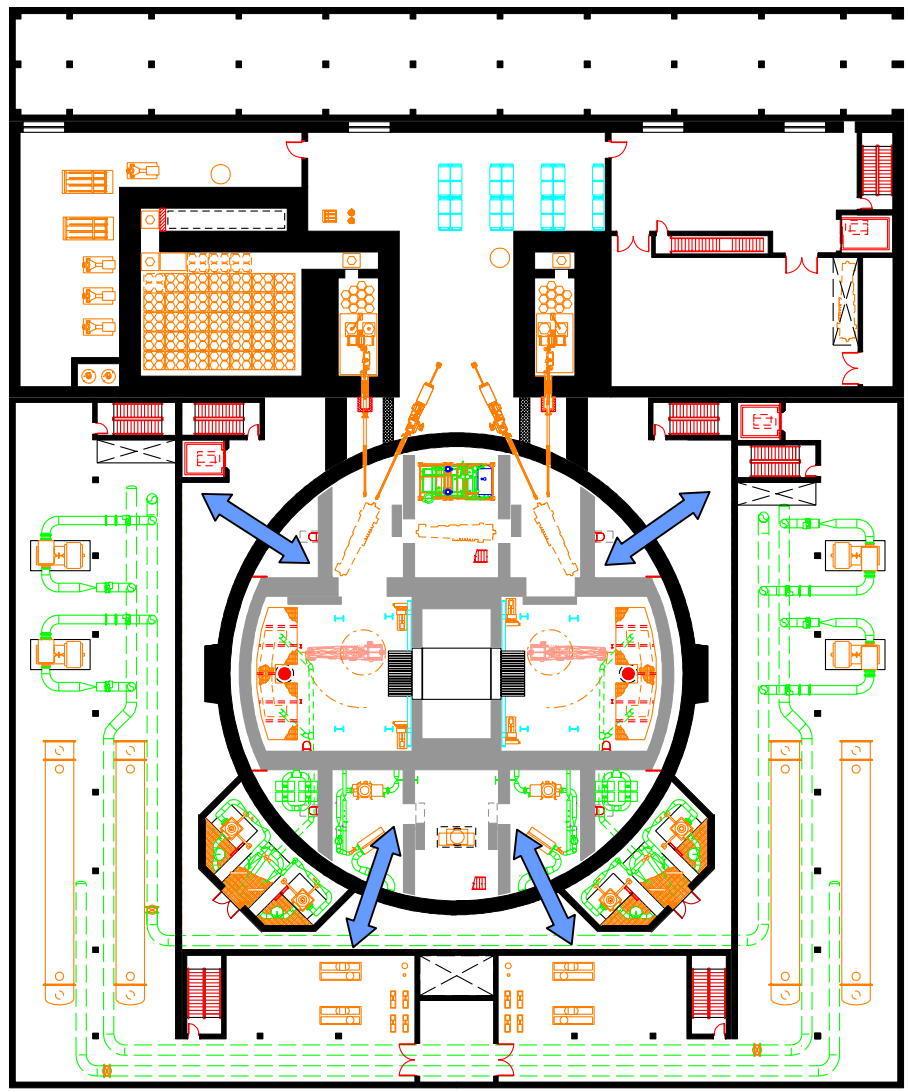
- MCB & SCA
  - RB between Main and Secondary Control Centers
  - Independent cable routes within & between Units
  - Access route from MCB to SCA's within SQ structures



ACR Plant Layout

Examples

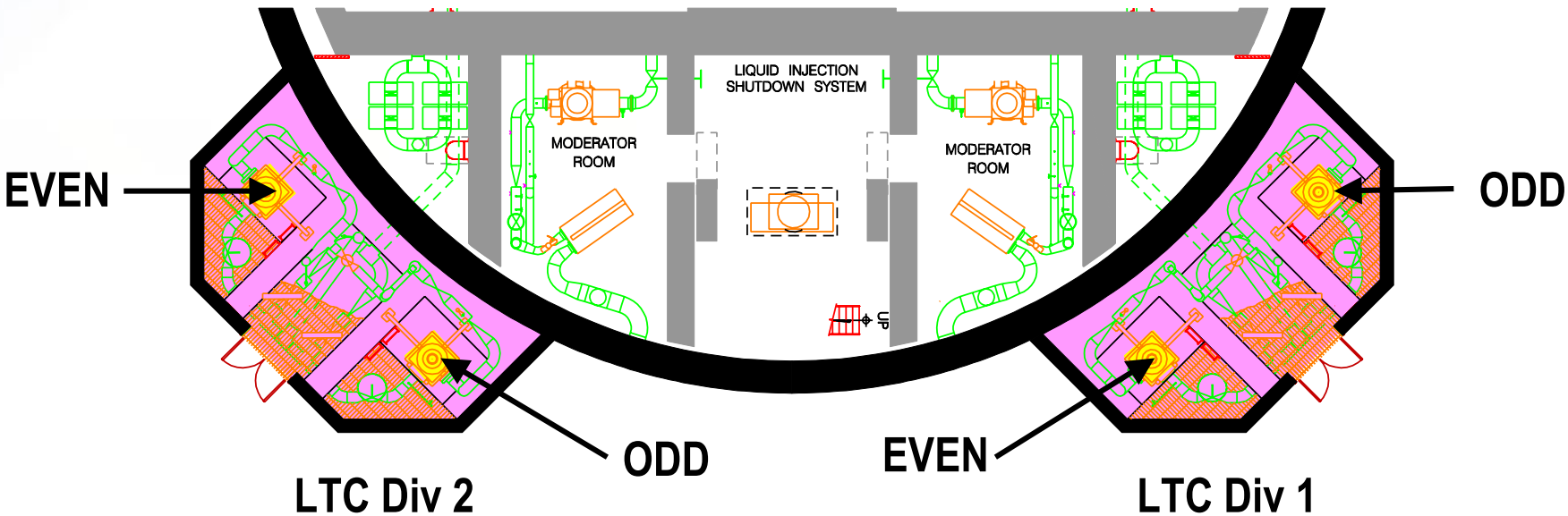
- RCW outside RB
  - 2 x 100% divisions
  - Independent interface penetrations with RB
  - 6m Separation between motors within Divisions



ACR Plant Layout

Examples

- LTC in RAB
  - Extension of containment boundary
  - Division 1 & 2 Separated
  - 6m separation of pumps within divisions
  - Enclosure provides shielding and atmospheric isolation

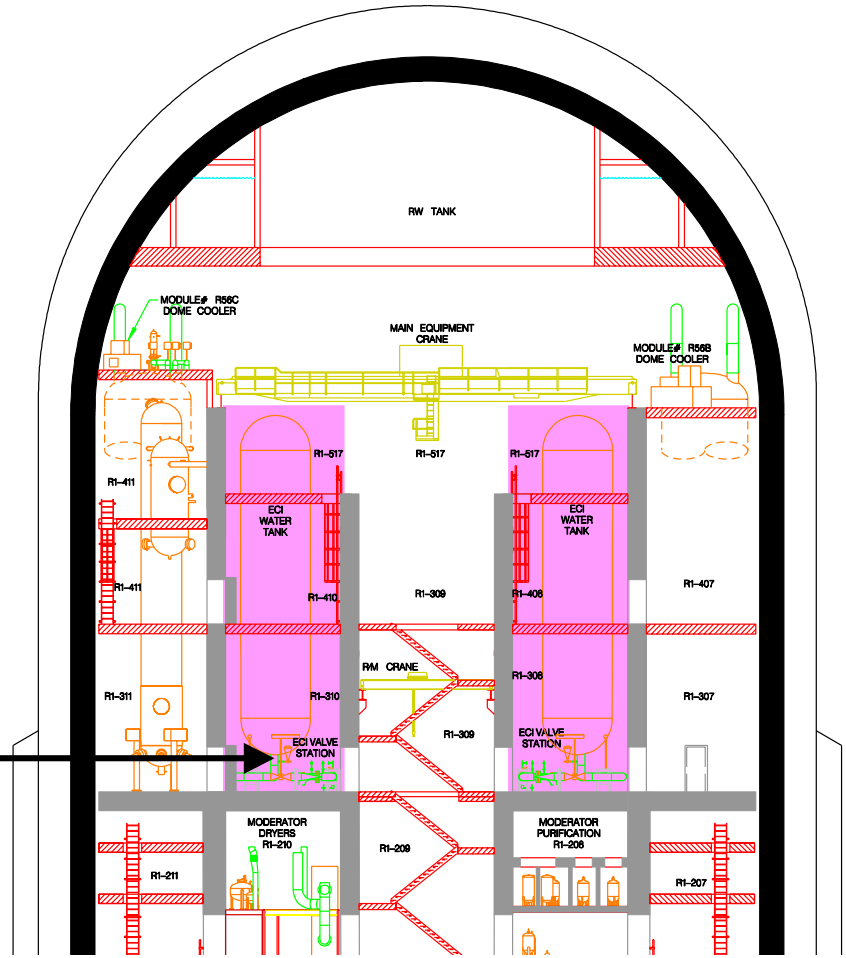


ACR Plant Layout

Examples

- **ECI Accumulator Tanks**
  - **Tanks housed within individual enclosures (Compartmentalized)**

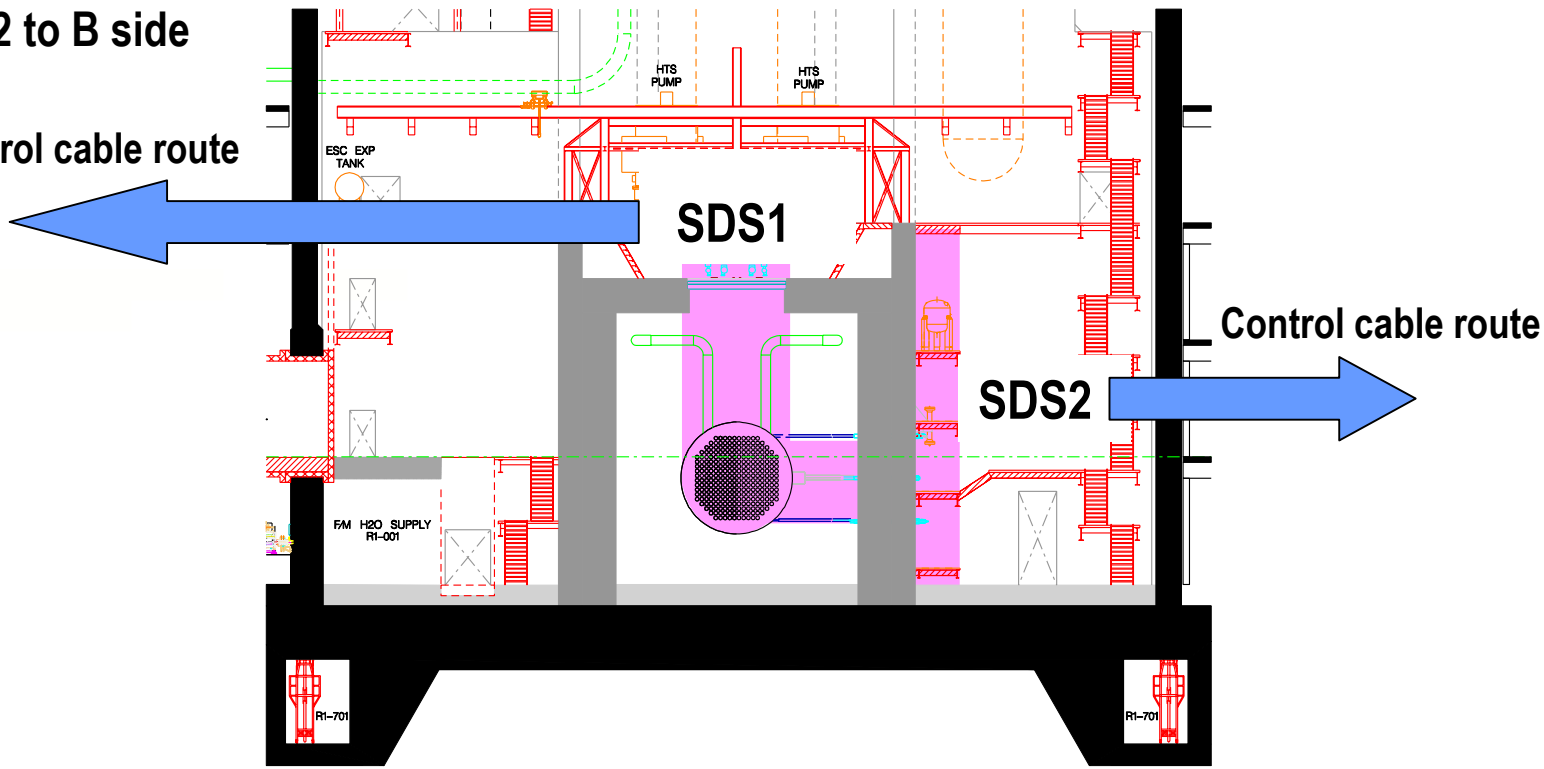
ECI Valve Station



ACR Plant Layout

Examples

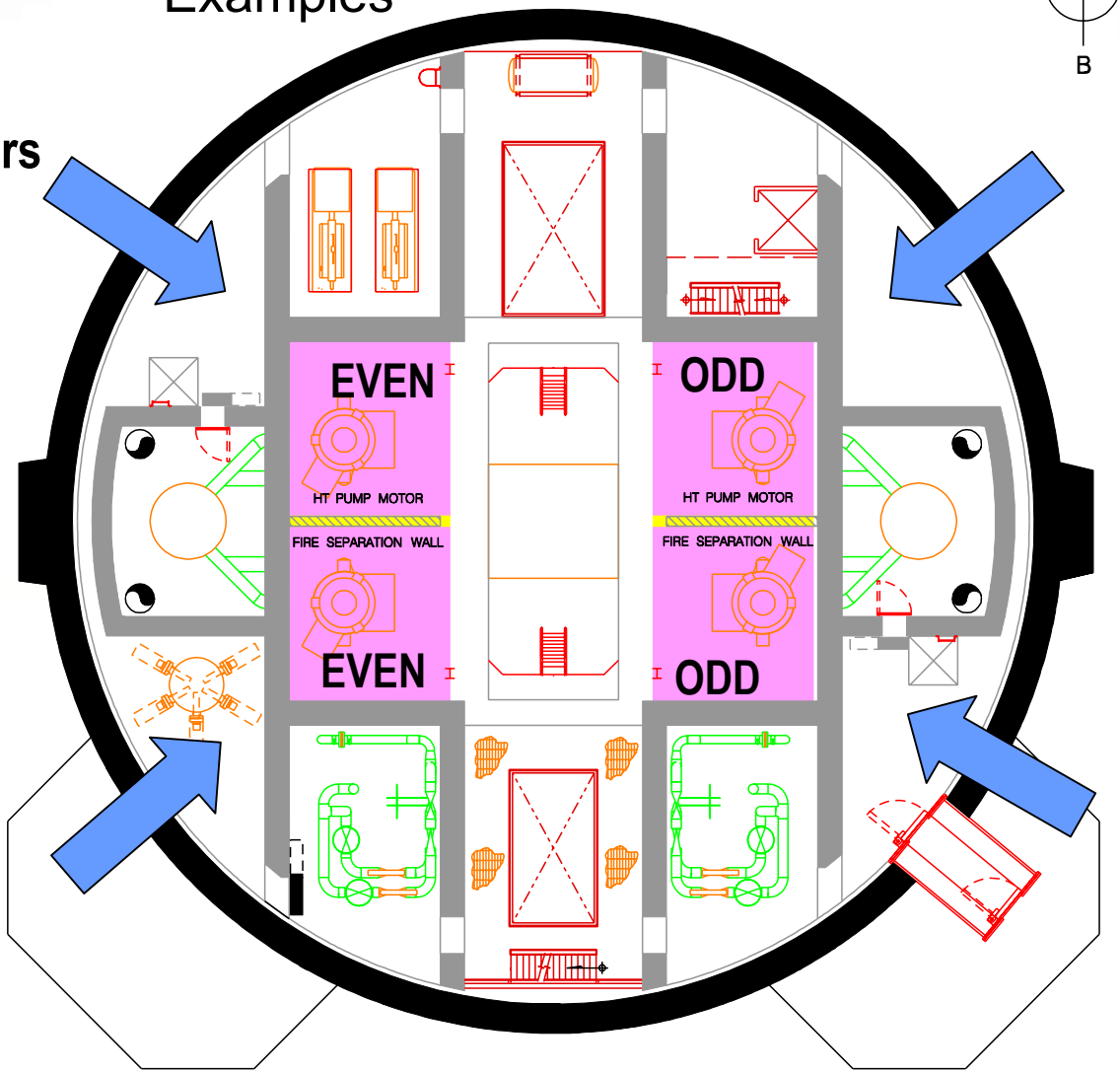
- **SDS1 & SDS2**
  - **Separated by 90 Degrees**
  - **Independent cable routes**
    - **SDS1 to D side**
    - **SDS2 to B side**



ACR Plant Layout

Examples

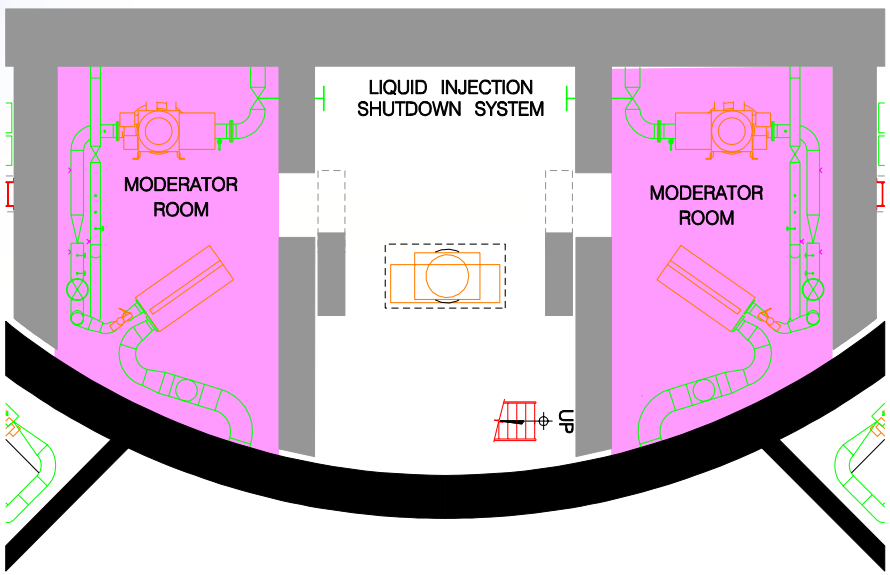
- **HTS Pump Motors**
  - **Separated by Fire Barriers**
  - **Individual Power cable routes**



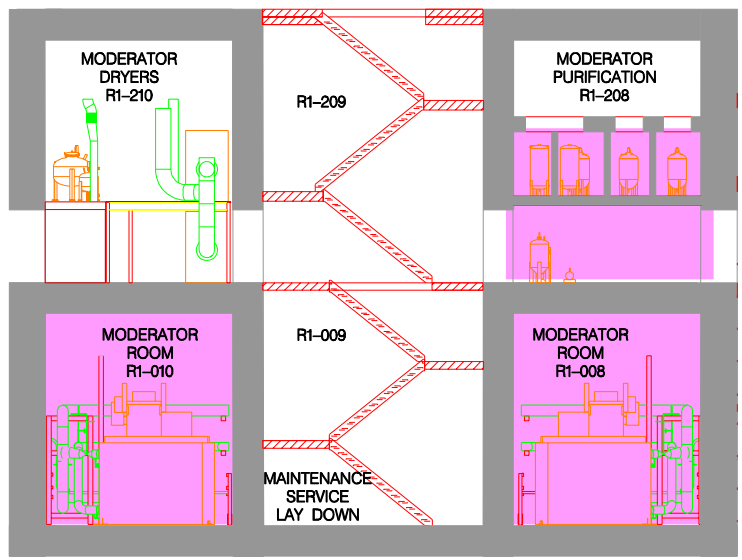
ACR Plant Layout

Examples

- **Moderator System**
  - **Physical system separation**
  - **RCW division separation**
  - **Atmospheric Isolation**
    - **Moderator rooms & purification system connected to D2O Vapor recovery dryers under negative pressure**



Moderator Plan, Elev. 100

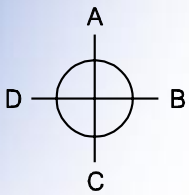


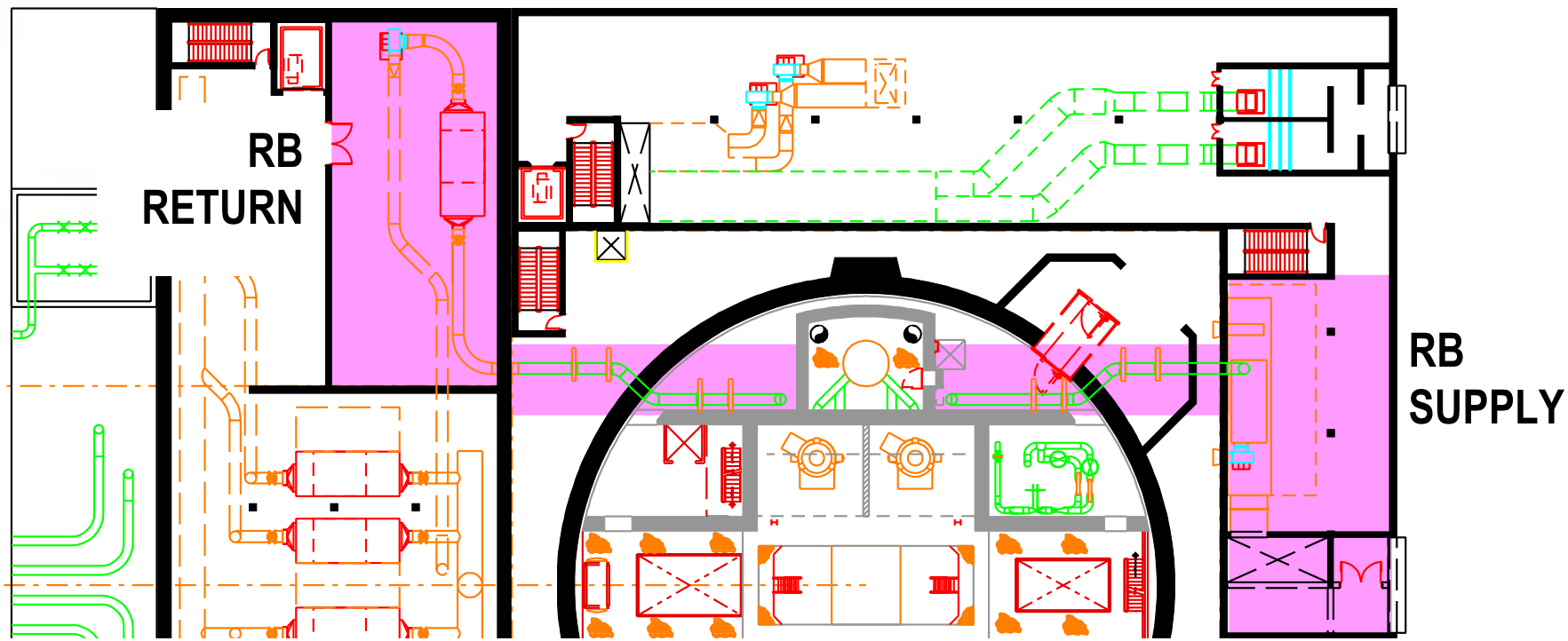
Moderator Section

ACR Plant Layout

Examples

- **Containment Isolation**
  - **Opposite Ventilation S & R penetrations**
  - **Isolation Valve redundancy**
  - **Tornado Protected RB air supply vent opening**





ACR-700 Plant Layout
Summary

- Requirements outlined in SDG's and other high level documents exported into Design Requirement documents
- Plant layout embodies requirements outlined in SDG's and system DR's as part of the overall conceptual development and organization of the site, plant and building layout in 2D space allocation drawings
- Plant layout SA drawings utilized by 3D CADDS development team
- 3D model files embody requirements outlined in Safety and other Design Guides and concepts outlined by plant layout SA drawings for:
  - Safety
  - Civil structures
  - O&M equipment removal routes
  - Human Factors personnel access pathways


AECL
EACL