

# Westinghouse AP1000

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## AP1000 Approach to Radwaste Processing

### Waste Management 2008

*Tim Meneely*

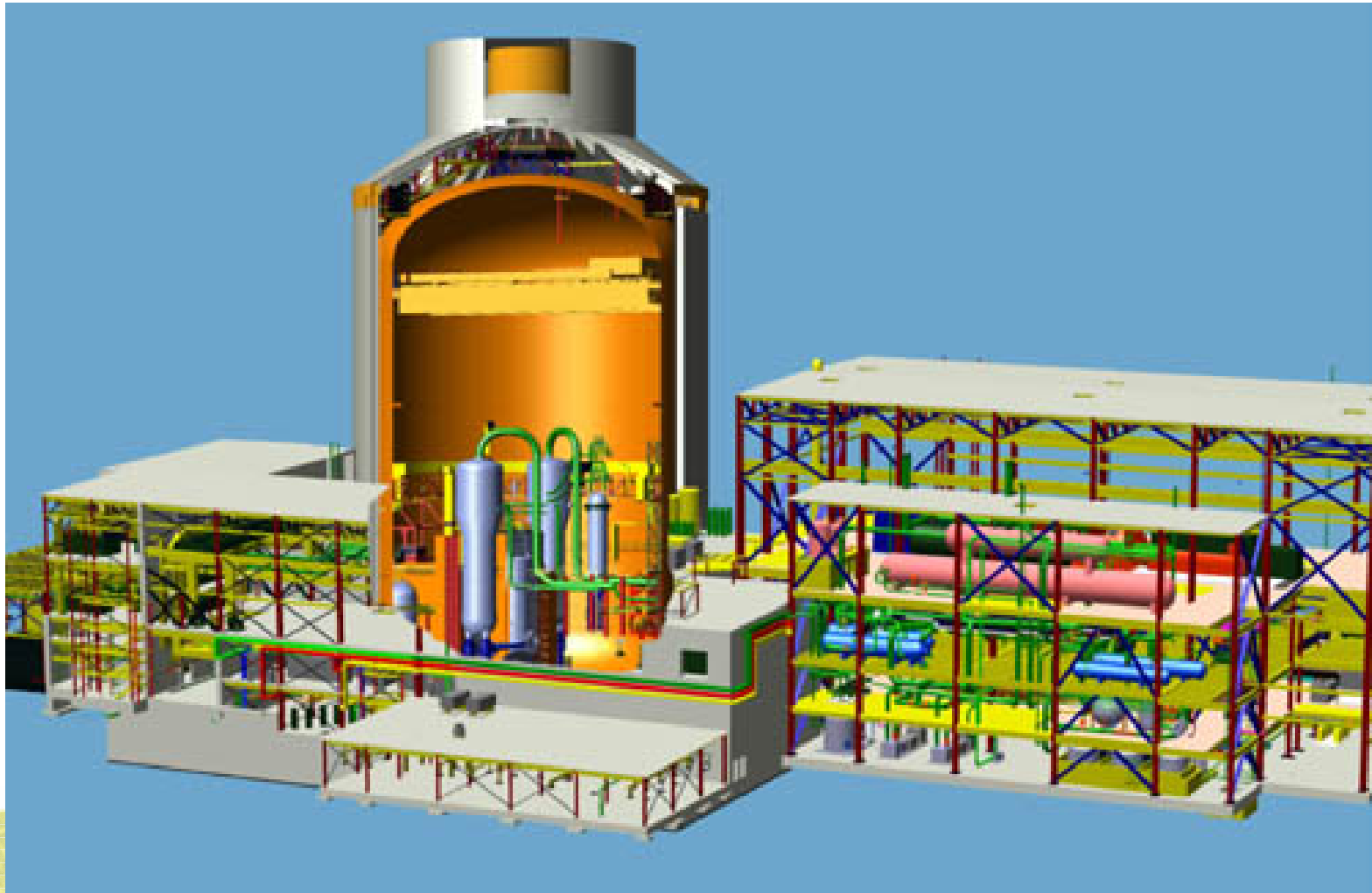
*Westinghouse Electric Company LLC*



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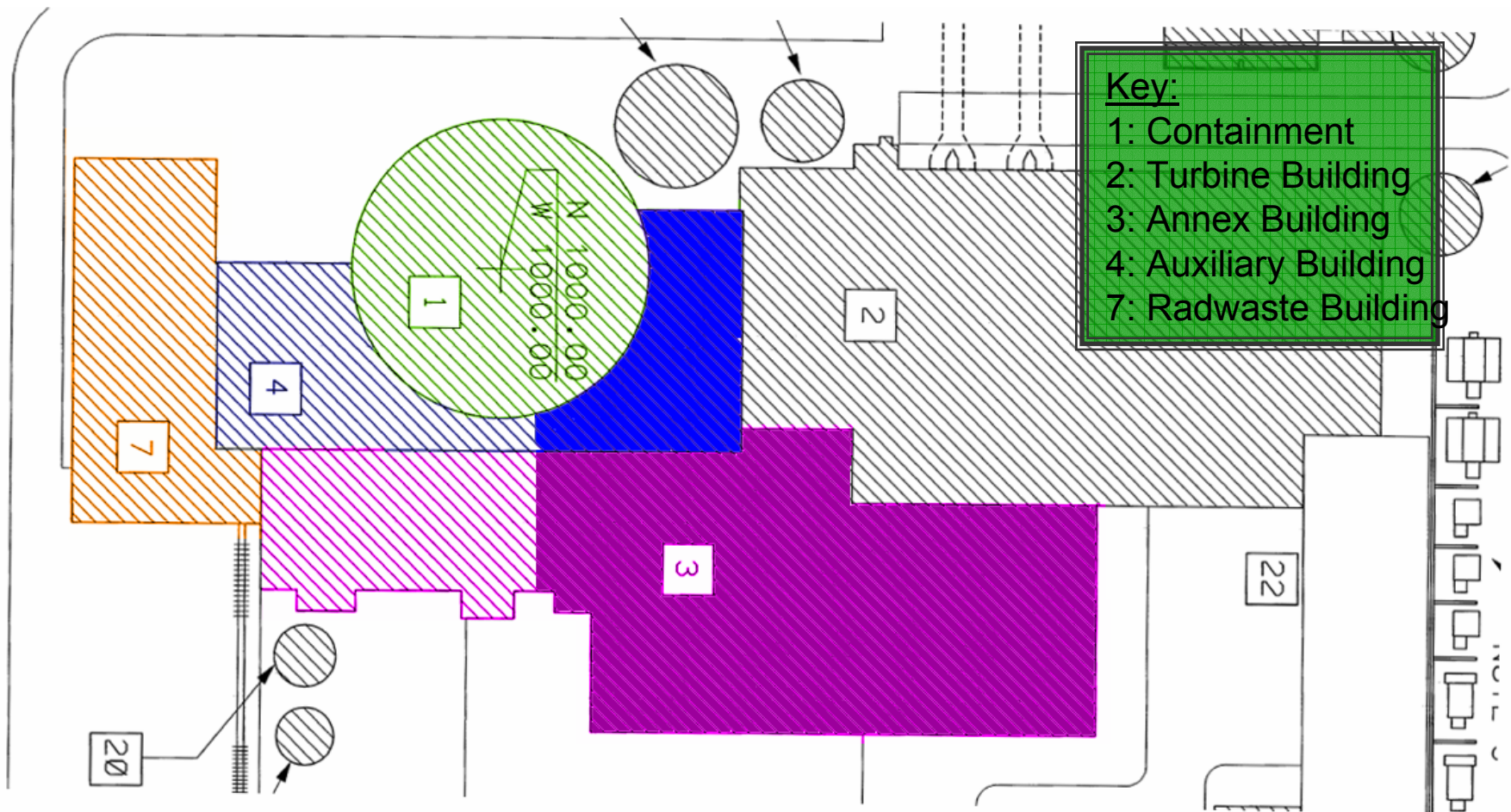


# AP1000





# AP1000 Plant Arrangement



# AP1000 Fundamental Design Objectives

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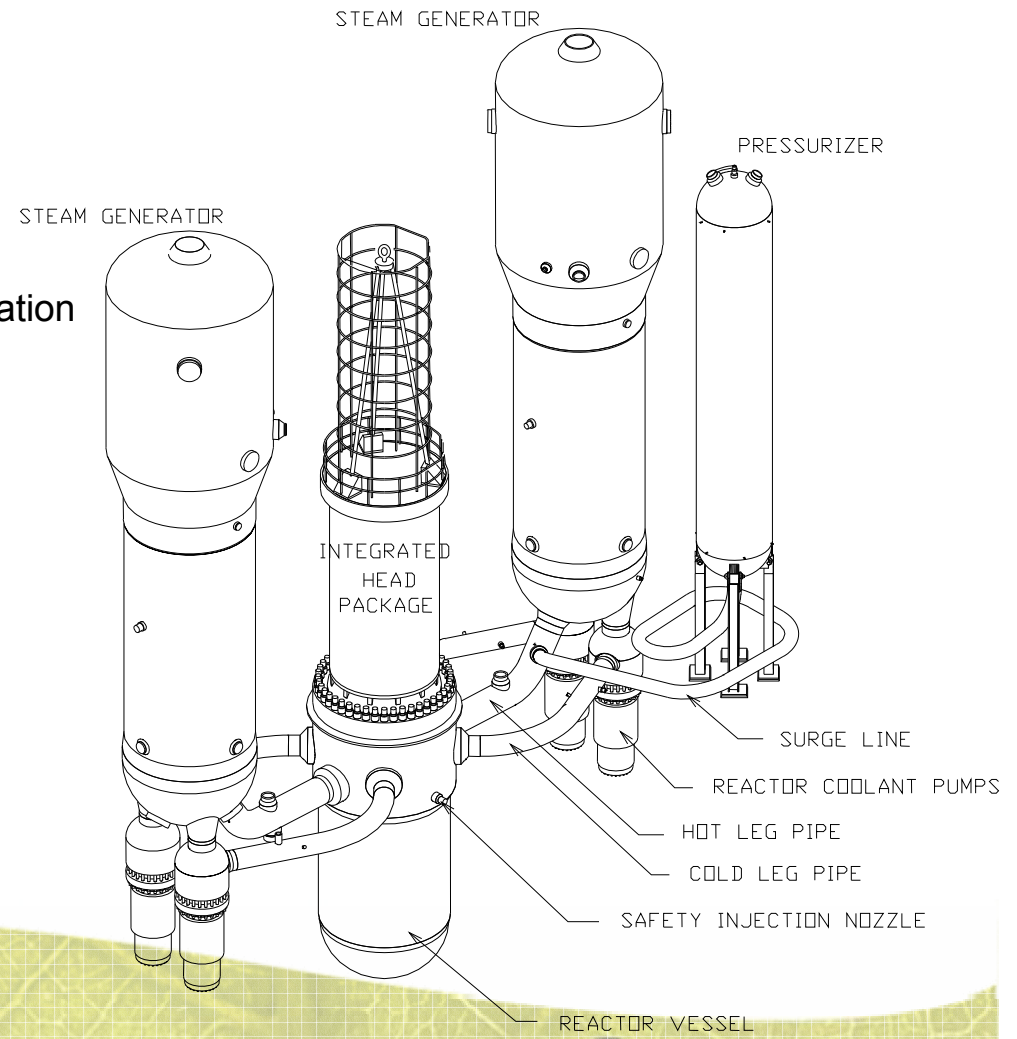
- Compliance with ALWR Utility Requirements Document
  - (Rev. 8)
- Increased Operation and Safety Margins
  - Design Basis Accidents, PRA (core melt prevention & mitigation)
- Licensing Certainty
  - NRC Final Design Approval / Certification
- Greatly Simplified Plant
  - Simplified Design Simplifies Construction, Maintenance, & Operation
  - Competitive Cost of Power
  - Extensive Use of Modular Construction
  - Short Construction Schedule
  - Improved Availability, Maintenance, Inspection, & ORE
- Integrated Power Plant Design
  - Pre-Engineered / Pre-Licensed Standard Design
  - Standard nuclear island, turbine island, annex & radwaste buildings
  - Strict limits on site-specific variations



# AP1000 Simplification – Primary Loop & RCS



- Fuel, Internals, Reactor Vessel
  - Integrated head package
  - No bottom-mounted instrumentation
  - Improved materials - 60 year life
- Steam Generators
  - Similar to large Westinghouse (CE) in operation
- Reactor Coolant Pumps
  - No shaft seals
- Simplified Main Loop
  - Reduces welds by 67%, supports by 90%
- No Boron Changes for Load Follow
  - Gray control rods
  - Boron changes limited to:
    - Burnup dilution
    - Shutdown boration

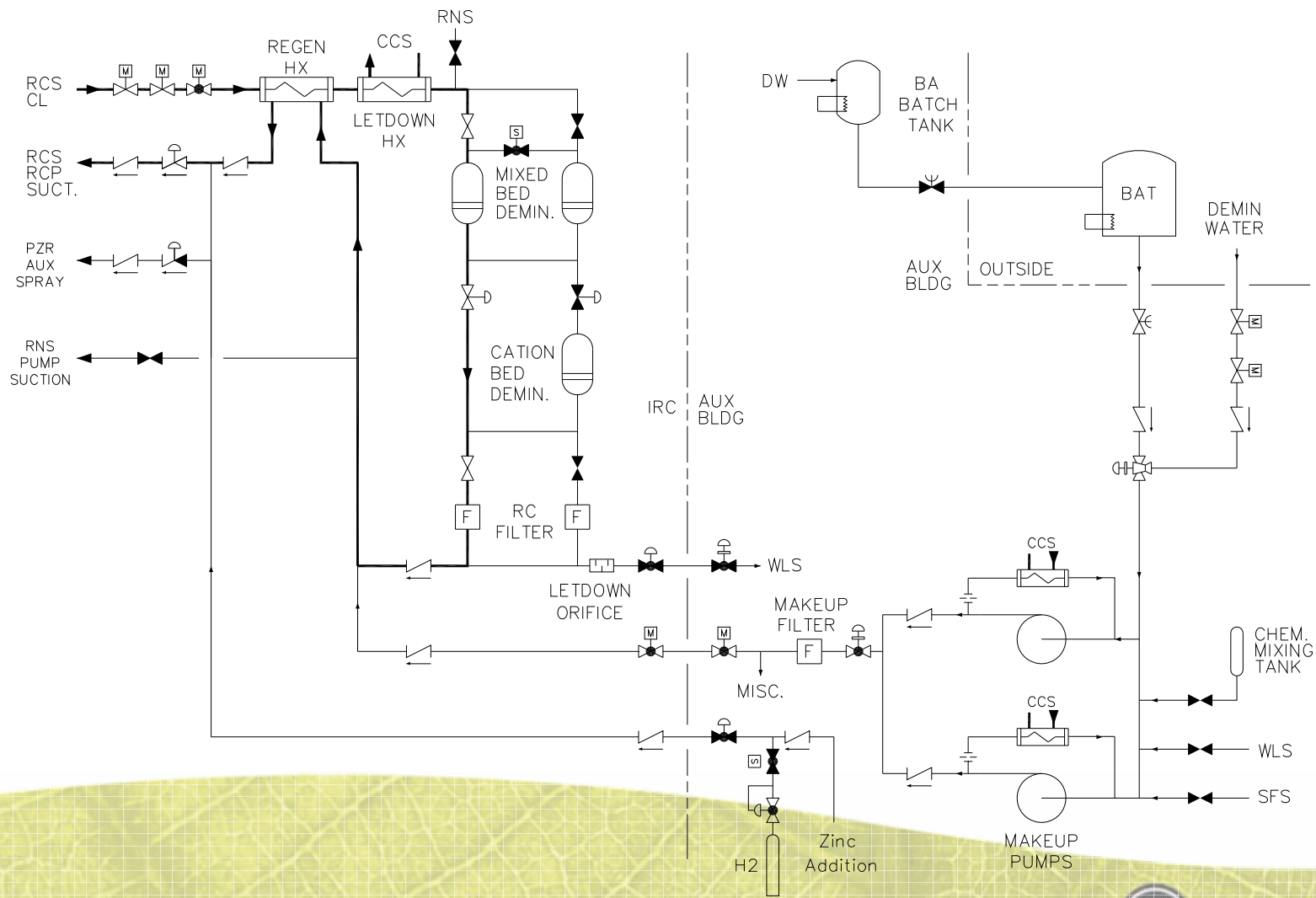


# Radwaste Design Approach

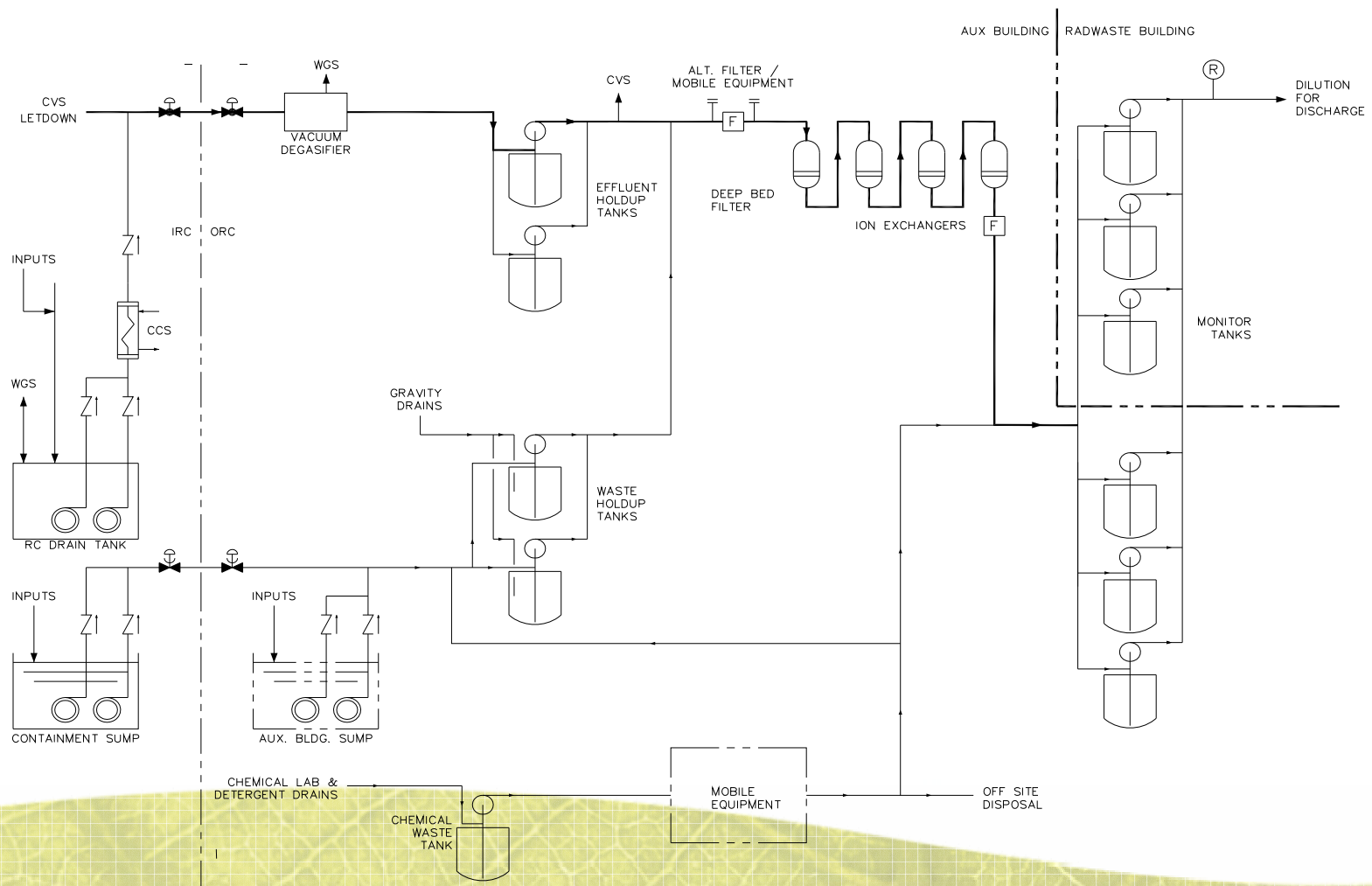
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- Design for plant simplicity
  - Chemical & Volume Control System
    - Gray control rods – minimal effluents
    - No safety injection functions
  - Liquid radwaste:
    - Ion exchange – no evaporators
  - Gaseous radwaste
    - Charcoal delay beds – no compressors
  - Solid radwaste (USA)
    - High integrity containers (HIC) – no solidification
    - Take advantage of US infrastructure: Mobile equipment, off-site processing
- Allow for long-term flexibility
  - Radwaste building:
    - Grade level building with multiple equipment bays
    - Pipe chases and access to & from important plant systems
  - Components / subsystems can be readily added / installed
    - Short term needs, Long term technology evolution

# Chemical & Volume Control System

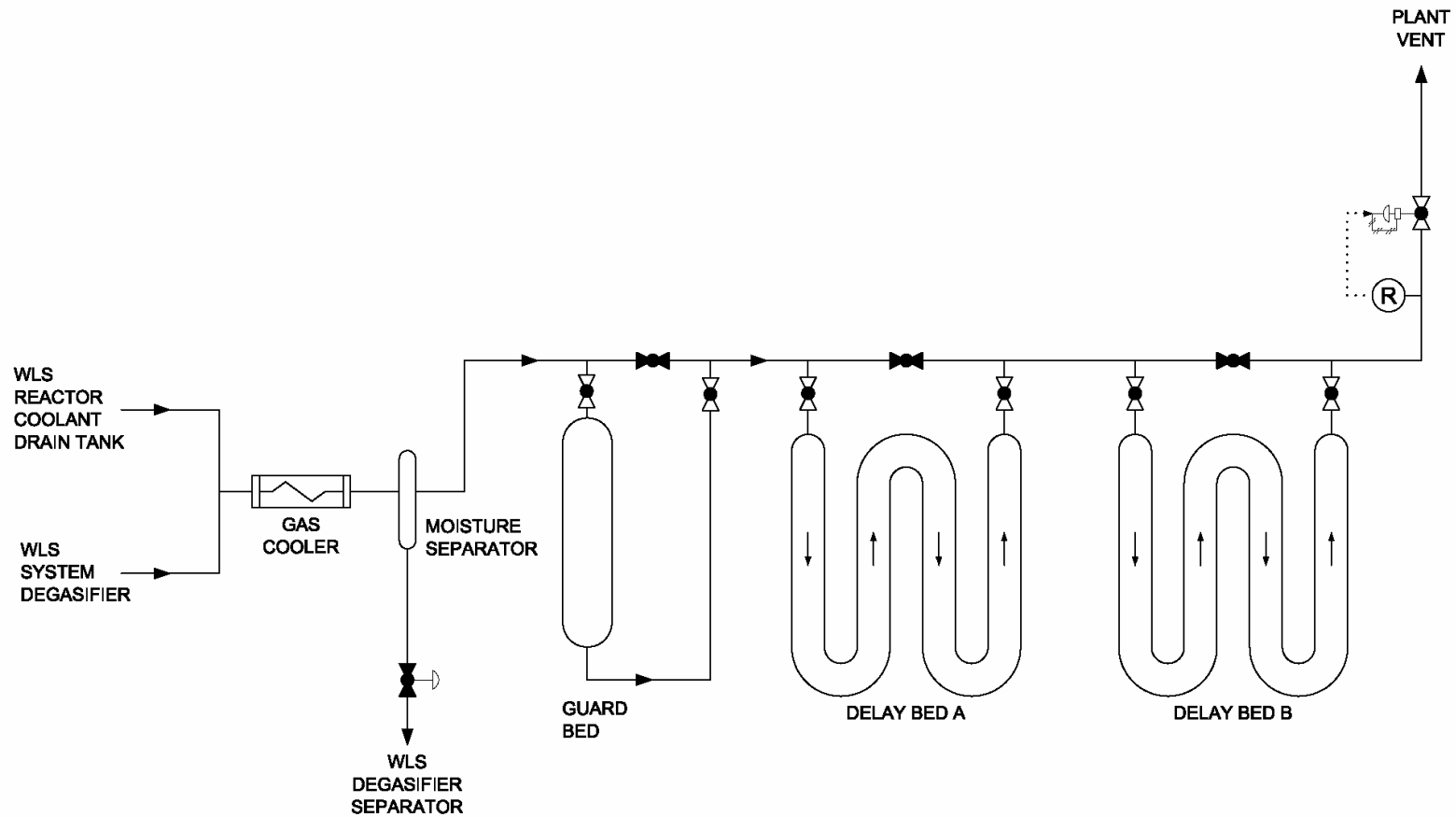


# Liquid Radwaste System





# Gaseous Radwaste System

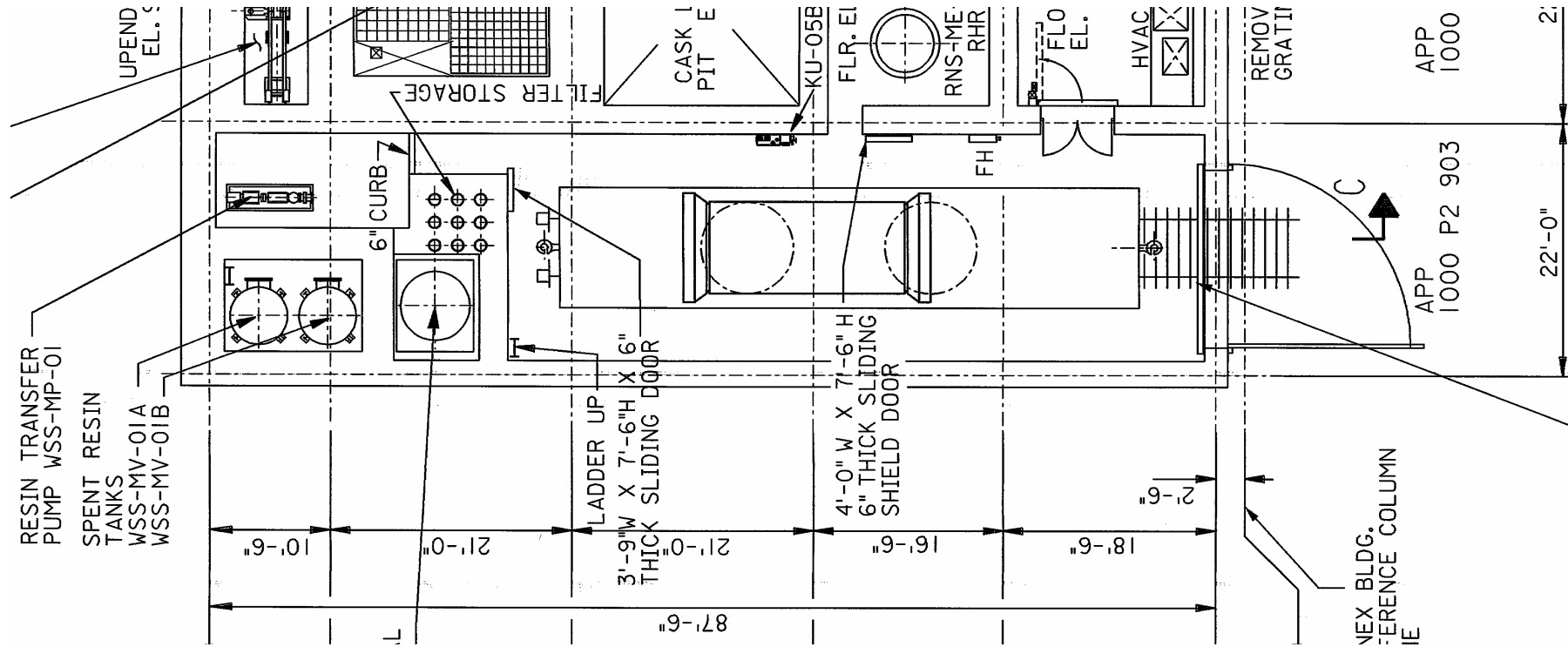


# WSS Design Approach

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- On-site accumulation – relatively short term
  - Several months for dry active waste
  - Longer term disposition is site- and owner-dependent
    - Shipping to off-site facility, or
    - Construction of shared facility (Warehouse)
- Packaging
  - Resin & filters into high integrity containers (HIC)
  - Dry active waste:
    - Ship to treatment facility
    - Alternative: Mobile Equipment to
      - Shred / compact
      - Compress into boxes, HIC, as necessary

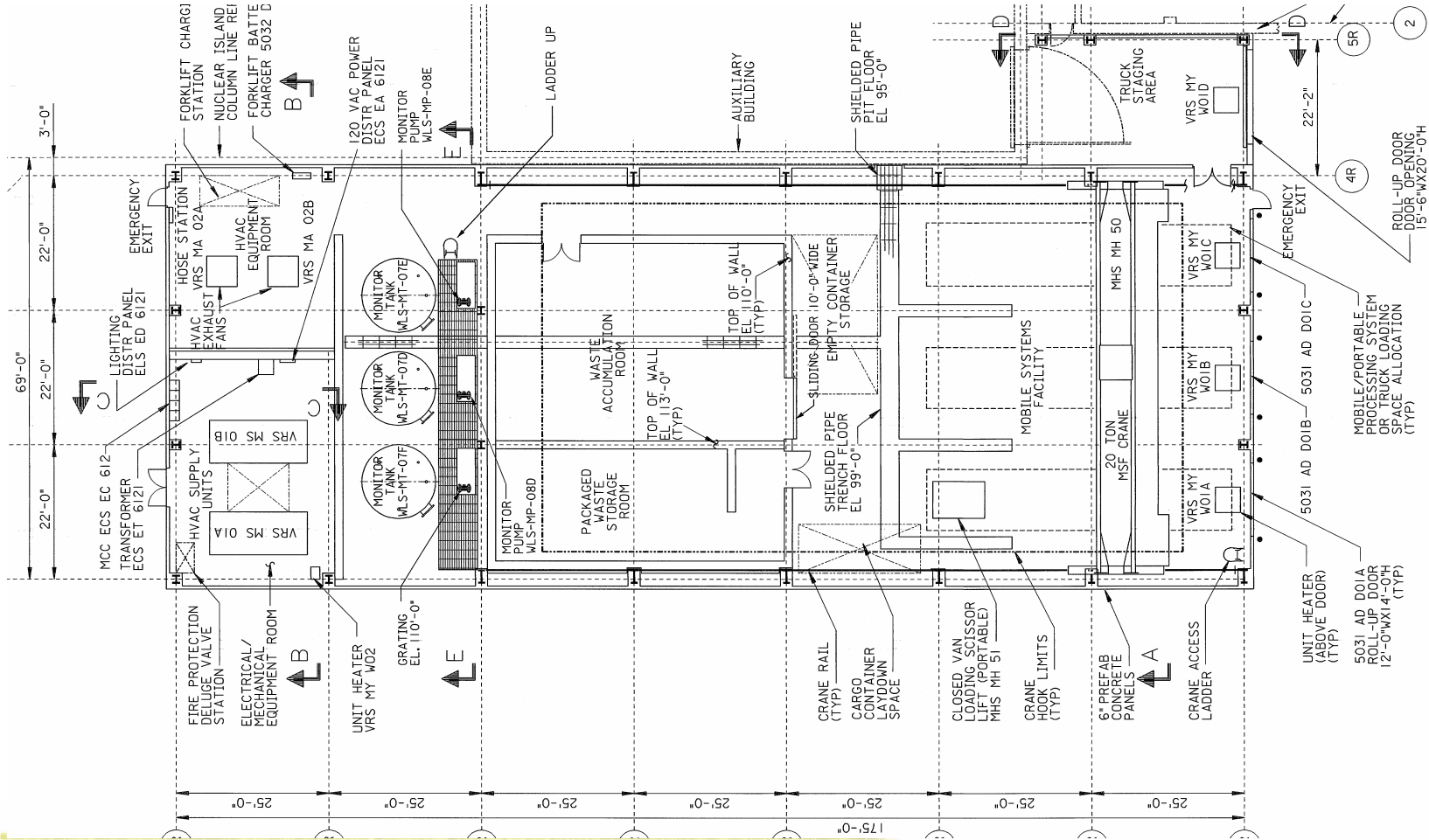
# Solid Radwaste System Auxiliary Building





# Radwaste Systems

## Radwaste Building



# AP1000 Radwaste Systems Recent & Current Initiatives

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- Ongoing emphasis on source term minimization
  - Primary component materials
  - Design details – manufacturing, finishing, shielding
  - Operating chemistry, zinc addition
- Limiting potential for spread of contamination
  - 10CFR20.1406
  - Building design details
  - Module designs - leak chases, etc.
  - System design details
- Solid radwaste detailed design
  - Primary filter housings and handling
  - Resin transport, packaging
  - Handling of HICs

# AP1000 = Standard Plant

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- AP1000 is a Single, Standard Plant Design
  - Single unit concept, minimal sharing between units
  - Standardization of design, construction, procedures
- Maintaining Standard Plant is Critical
  - Designers, Operators, Regulators, Fabricators are all resource limited
  - Divergence among deployments would be problematic
- However:  
Standardization of Solid Radwaste is a Challenge
  - Availability of support services and disposition
  - Packaging requirements
  - Licensing level of detail required



# Solid Radwaste Standardization Challenges

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- **United States**
  - Potential sites generally 2 x AP1000
  - Mobile equipment is routine
  - Significant waste handling vendor infrastructure
  - Disposal sites available
- **China**
  - Sites are 6 x AP1000
  - Mobile equipment is acceptable – if supplied with plant
  - No vendor waste handling infrastructure
  - No disposal sites assumed ~20 years
- **United Kingdom**
  - Potential sites are 1 x AP1000, 2 x AP1000 ?
  - Mobile equipment viewed with caution
  - Limited vendor waste handling infrastructure
  - Disposal site available now LLW; ILW is question
- **Republic of South Africa, Europe...**

# Solid Radwaste Directions

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- United States

- Utilities willing / able to assume strategic leadership
- AP1000 approach is generally well accepted
  - Installed gaseous, basic liquid radwaste processing
  - Open-plan radwaste building for flexibility
  - Contractor support

- China

- Central facility to support site (six units)
- Provide waste stabilization, handling, packaging, storage
- Mobile equipment (used on NI) provided with central facility

- UK

- Currently developing generic site plan
- Detailed waste strategy being defined
- Long term view: Waste arisings, packaging, storage, disposition
- Detailed design required up front
  - Identify equipment in radwaste building to support waste strategy
    - **“Fill up the shed”**