



The 18th 2010 WiN Global Annual Meeting

**Modularization Design of the
Radioactive Liquid and Solid Waste
Management Systems**

Presented By Maha Aziz

13th of May, 2010

New Approach

- Discuss mobile (skid mounted) liquid and solid waste processing technology provided by USA suppliers
 - *Diversified Technology Services (DTS)*
 - *EnergySolution[®] Systems*
- Discuss how mobile (skid mounted) systems are integrated into radioactive waste management systems
 - Design Requirements
 - Applications

USA Regulations Related to Radioactive Waste Management System

- 10 Code of Federal Regulations 50, Appendices A and I
 - General Design Criteria
 - Shielding and dose
- 10 Code of Federal Regulations 20, Appendix B
 - Effluent release concentrations
- Regulatory Guidance 1.143
 - System, structure and component design requirements
- ANSI 18.1, 55.1, and 55.6
 - Source term definitions
 - Equipment design requirements
- Others
 - Advanced LWR Utility Requirements Document by EPRI
 - EPRI 2005.1011724, *“ANP LLW Management Review: Mobile Processing and Treatment Systems.”* Final report, August 2005
 - ANSI/ANS-40.37-2009, *“American National Standard for Mobile Radioactive Waste Processing Systems.”*
 - Client preferences

Mobile Processing Systems

Definition per ANSI/ANS 40.37 (2009)

“American National Standard for Mobile Low-Level Radioactive Waste Processing Systems”

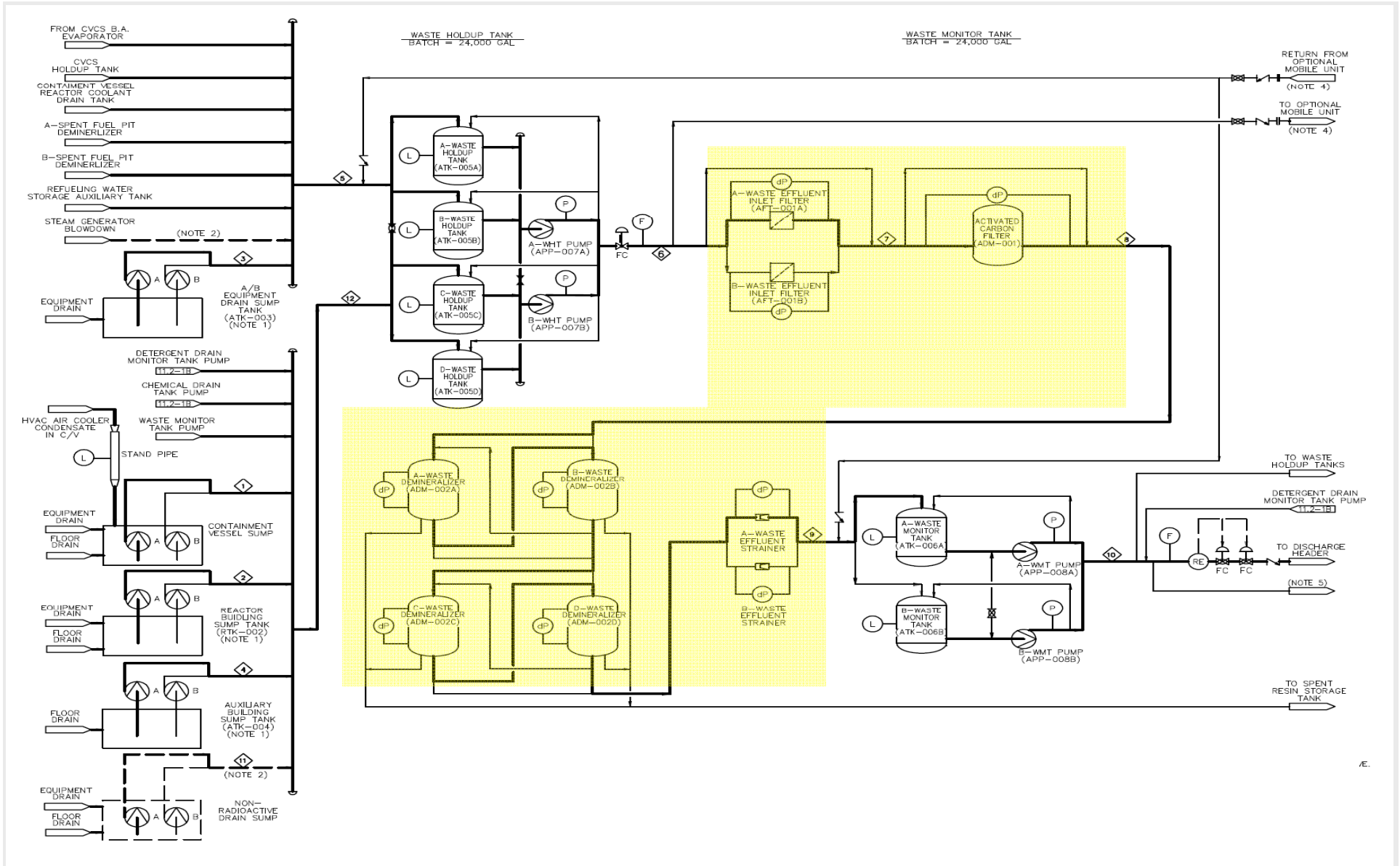
Any radioactive waste processing system or component that is designed to be transportable and that is not permanently installed as used in Regulatory Guide 1.143 “Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants”.

Application of Mobile Processing Systems for Nuclear Plants

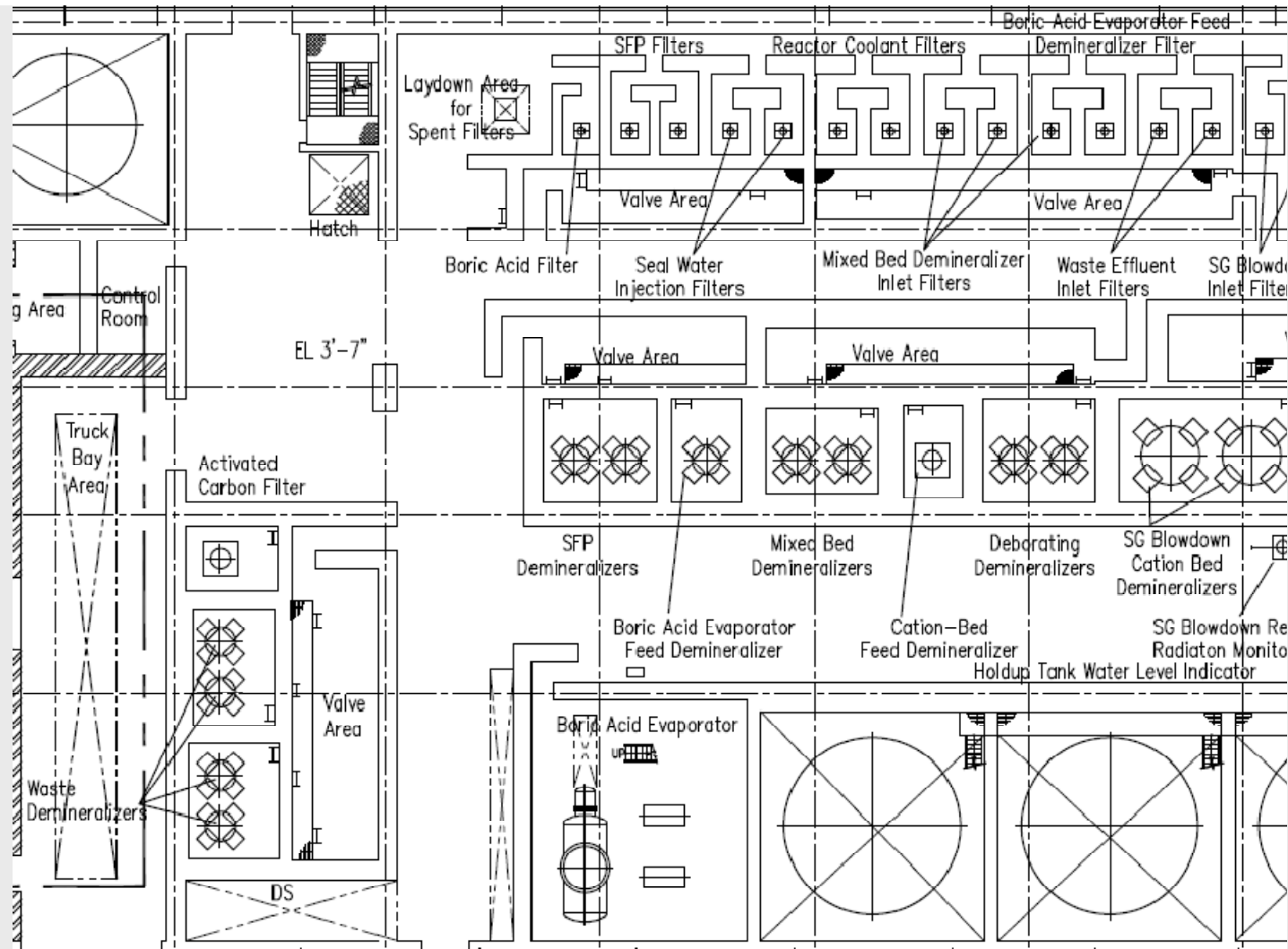


- Liquid Waste Management System
 - Equipment drain treatment subsystem
 - Floor drain treatment subsystem
 - Detergent drain treatment subsystem
- Solid Waste Management System
 - Dewatering subsystem (including drying)
- Integration with the liquid radioactive waste collection tanks and sample tanks and solid radioactive waste tanks e.g., spent resin tanks
- Design layout of treatment subsystems

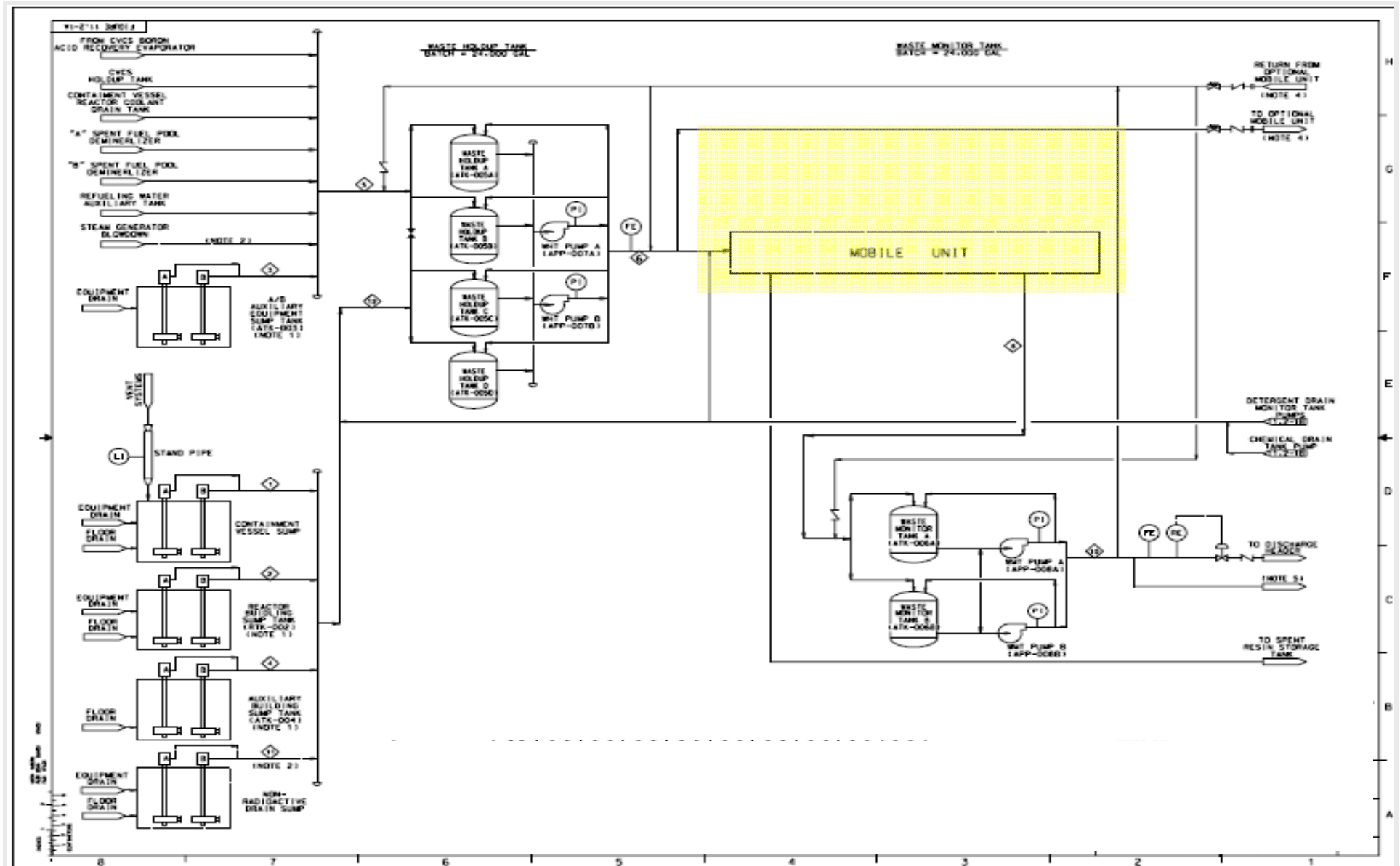
Traditional Radioactive LWMS Process Design



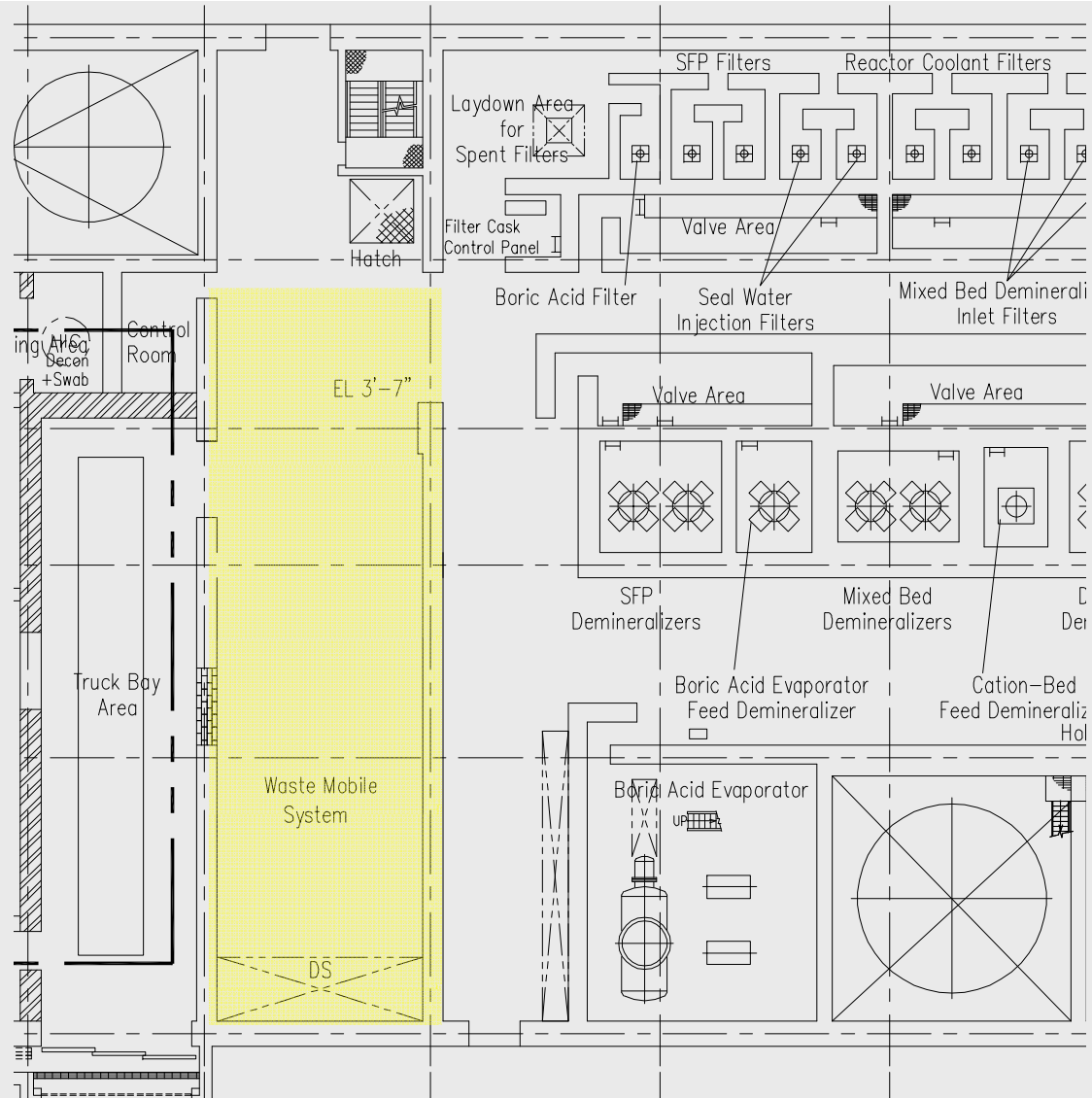
Traditional Radioactive Waste Equipment Layout



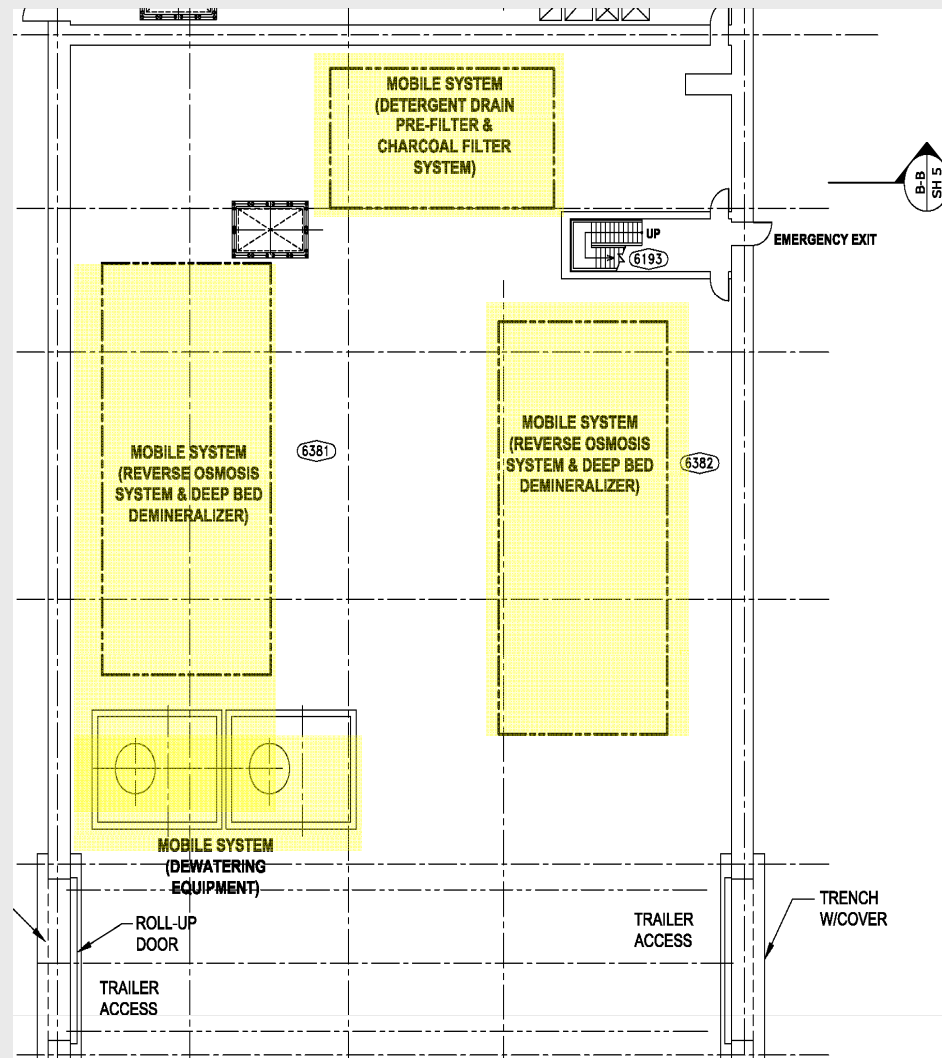
Mobile System Integration



Equipment Layout with Mobile Unit



Equipment Layout with Modularization (Skid-Mounted) Units



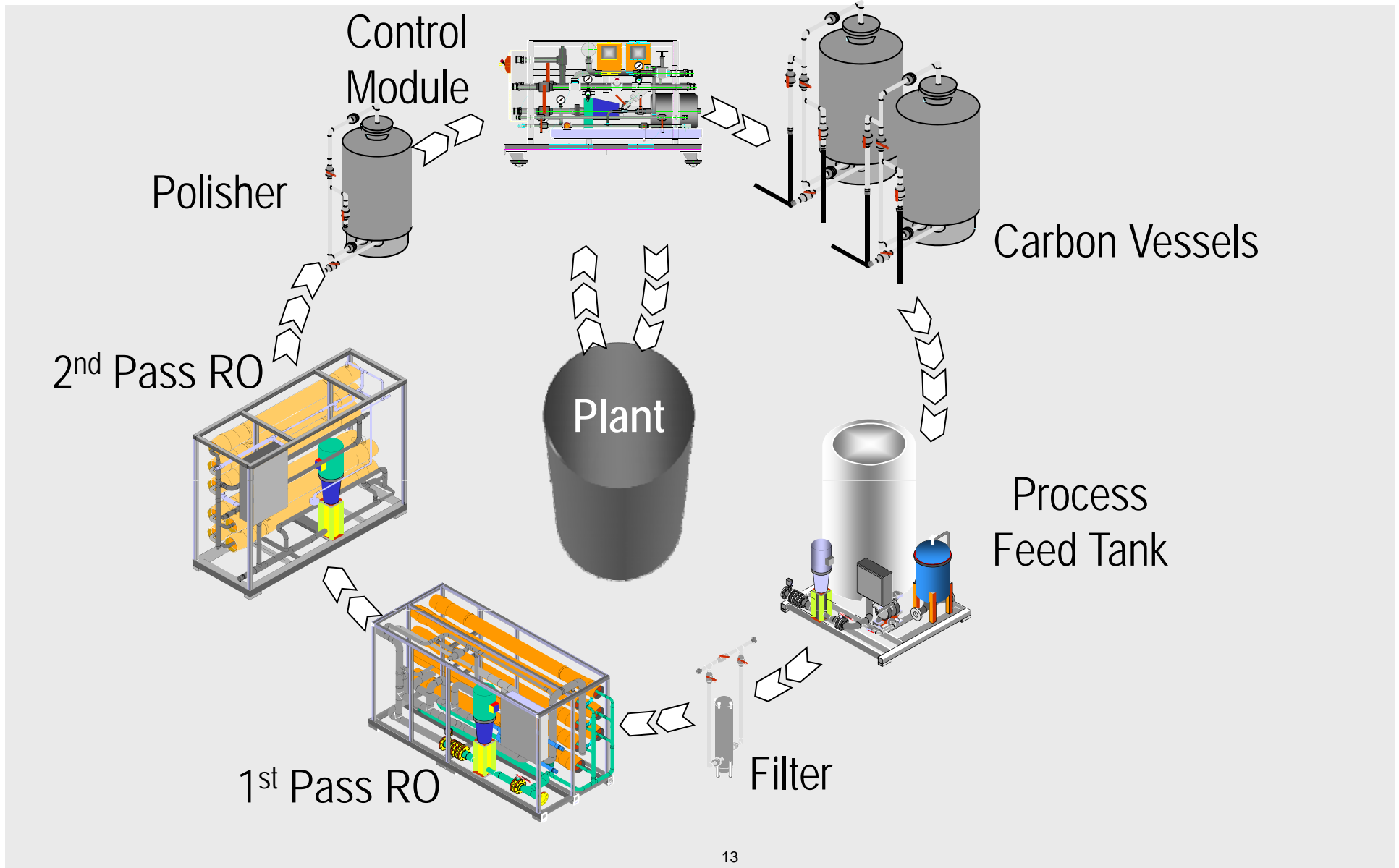
RG 1.143-Design Requirements-Table 1- Codes and Standards for the Design of SSC in Radwaste Facilities

Component	Design and Construction	Materials ¹	Welding	Inspection and Testing
Pressure Vessels and Tanks (>15 psig)	ASME Code Section VIII, Div. 1 or Div. 2	ASME Code Section II	ASME Code Section IX	ASME Code Section VIII, Div. 1 or Div.2
Atmospheric Tanks	API 650	ASME Code Section II	ASME Code Section IX	API 650
0-15 psig Tanks	API 620	ASME Code Section II	ASME Code Section IX	API 620
Piping and Valves	ANSI/ASME B31.3 ^{4,5}	ASME Code Section II ⁶	ASME Code Section IX	ANSI/ASME B31.3
Pumps	API 610; API 674; API 675; ASME Section VIII, Div.1 or Div.2	ASTM A571-84 (1997) or ASME Code Section II	ASME Code Section IX	ASME Code ² Section III, Class 3
Flexible Hoses and Hose Connections for MRWP ³	ANSI/ANS-40.37	ANSI/ANS-40.37	ANSI/ANS-40.37	ANSI/ANS-40.37

RG 1.143-Design Requirements-Table 1- Codes and Standards for the Design of SSC in Radwaste Facilities

- 1. Manufacturer's material certificates of compliance with material specifications may be provided in lieu of certified material test reports as discussed in Regulatory Position 1.1.2 of Regulatory Guide 1.143
- 2. ASME Code stamp, material traceability, and the quality assurance criteria of ASME BPVC, Section III, Div.1, Article NCA are not required. Hence, these components are not classified as ASME Code Section III, Class 3.
- 3. Flexible hoses are used in conjunction with Mobile Radwaste Processing Systems (MRWP).
- 4. Class RW-IIa and RW-IIb Piping Systems are to be designed as category "M" systems.
- 5. Classes RW-IIa, RW-IIb and RW-IIc are discussed in Regulatory Position 5 of Regulatory Guide 1.143.
- 6. ASME BPVC Section II required for Pressure Retaining Components.

Typical Mobile System Equipment Modules



Typical Mobile (Skid Mounted) Radioactive Waste Processing Equipment Modules and Functions

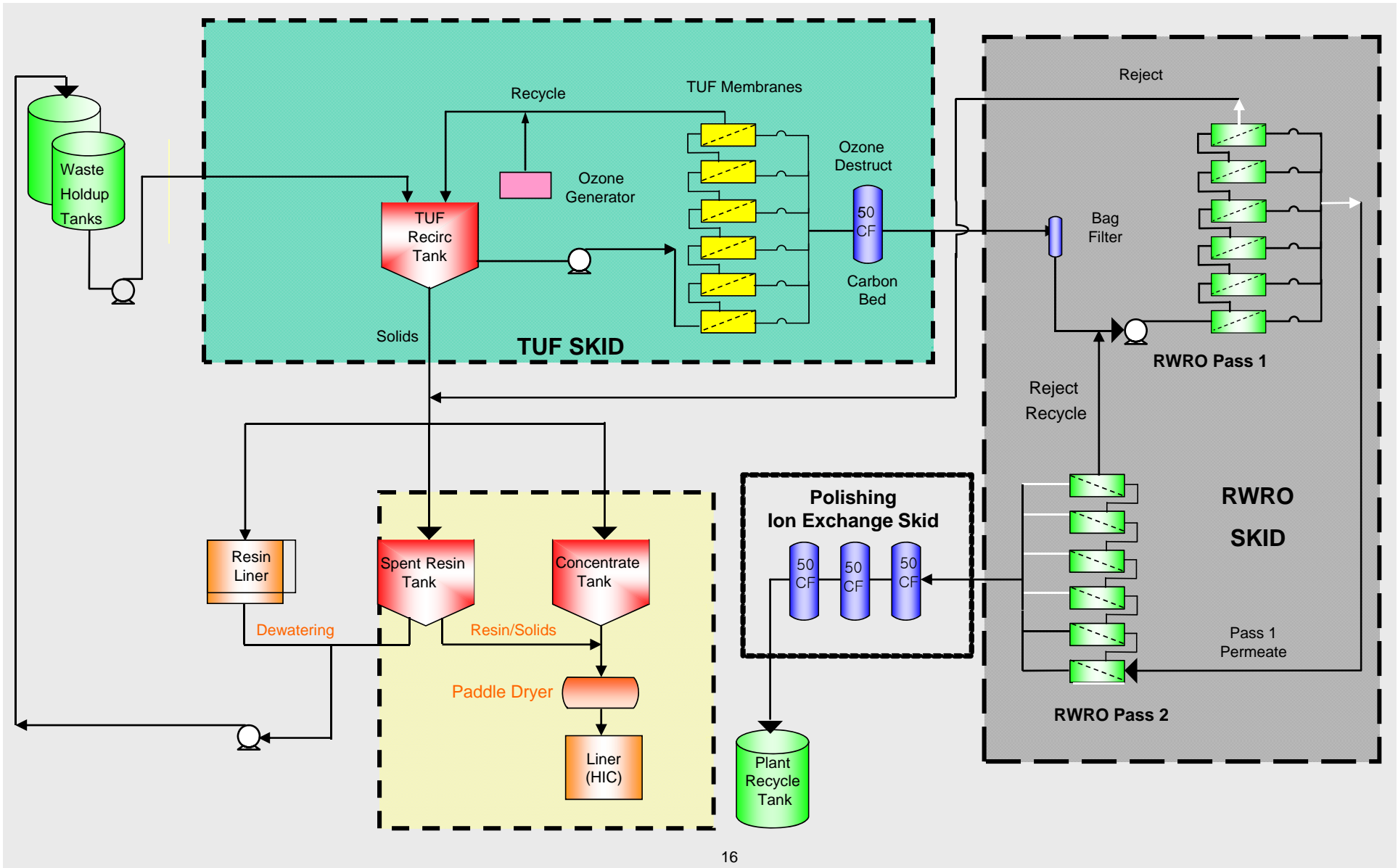
Typical processing modules:

- Carbon filtration or Ozonation for organic removal
- Advanced filtration technology-ultrafiltration, microfiltration for removing suspended solids (0.05 microns). Cartridge filters (with non-metallic filter elements) are used for detergent drains
- Reverse Osmosis-double pass for removing ionic impurities e.g., Ca, Mg and carbonates
- Deep bed ion exchangers for polishing (< 0.01 micro-mho)
- In-container Dewatering System

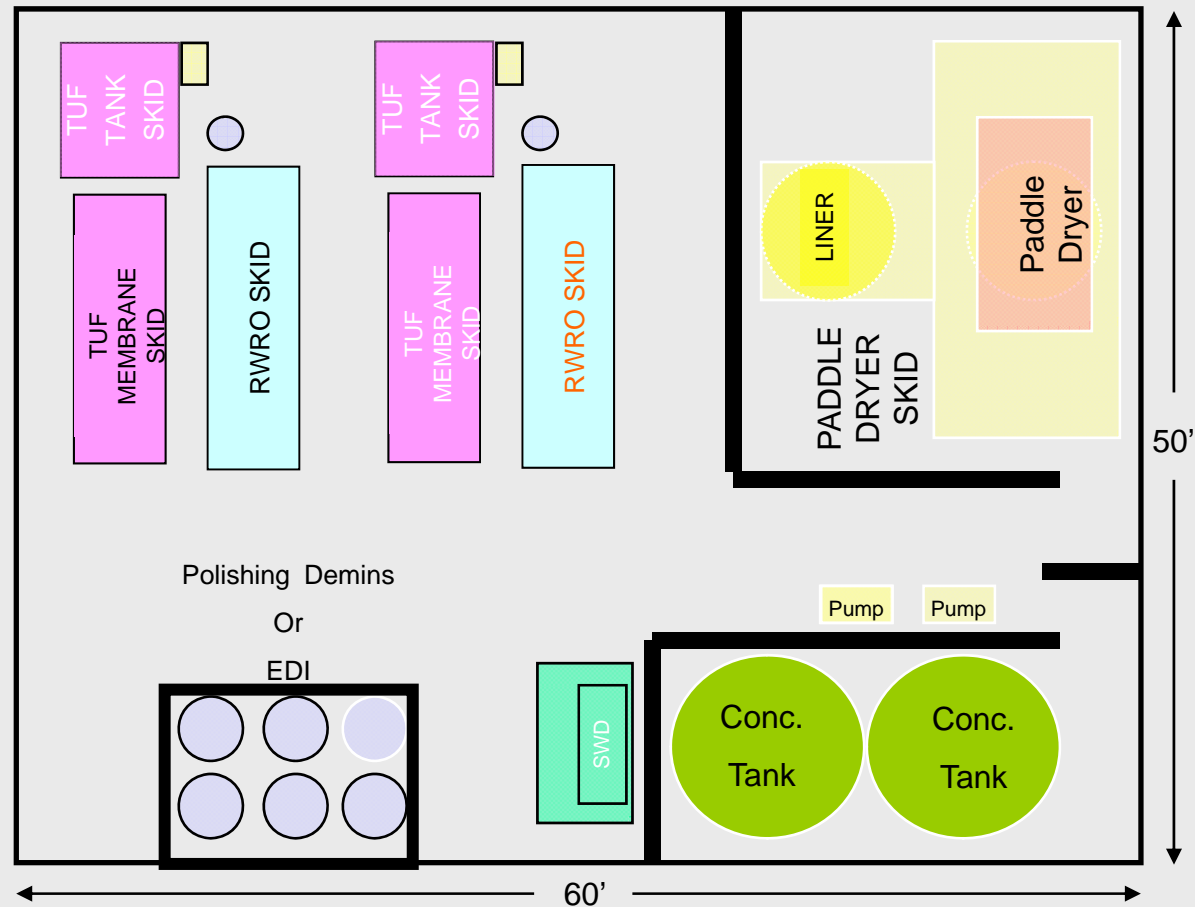
Equipment of the Mobile (Skid Mounted) Radioactive Waste Processing Systems By USA Suppliers

- *Diversified Technologies Services (DTS) Waste Processing Mobile System:*
 - Zero System
 - Tubular Ultrafiltration (TUF) with ozonator
 - Reverse Osmosis Units (RO)
 - Ion Exchange Vessels (IX)
 - Drum/Paddle Dryer
 - High Velocity Vacuum (HVV) Dewatering
- *EnergySolutions® Waste Processing Mobile System:*
 - Thermex™ for BWR waste
 - Granular Activated Carbon Beds
 - Filters
 - Reverse Osmosis Units (RO)
 - Ion Exchange Vessels (IX)
 - Self-Engaging Dewatering System

Typical Process Flow Diagram (DTS)



DTS 150 GPM LRW System Layout (2 Trains)



Diversified Technologies Services (DTS) Mobile Waste Processing System Examples



Ozonator



RO Unit

DTS Mobile IX Module for Fort Calhoun



Thermex™ First Pass RO Skid (Energy Solutions)

URS



Thermex™ Second Pass RO Skid Rear View (EnergySolutions®)

URS



Skid Mounted Radioactive Waste Processing Systems

- Small and Large Scale Equipment
 - Selected based on specific application



5 GPM RO

85 GPM RO



Skid Mounted Radioactive Waste Processing Systems (*EnergySolutions*[®])

- IX Vessel



Typical Piping Arrangement (EnergySolutions®)



Skid Mounted Radioactive Solid Waste Management Units

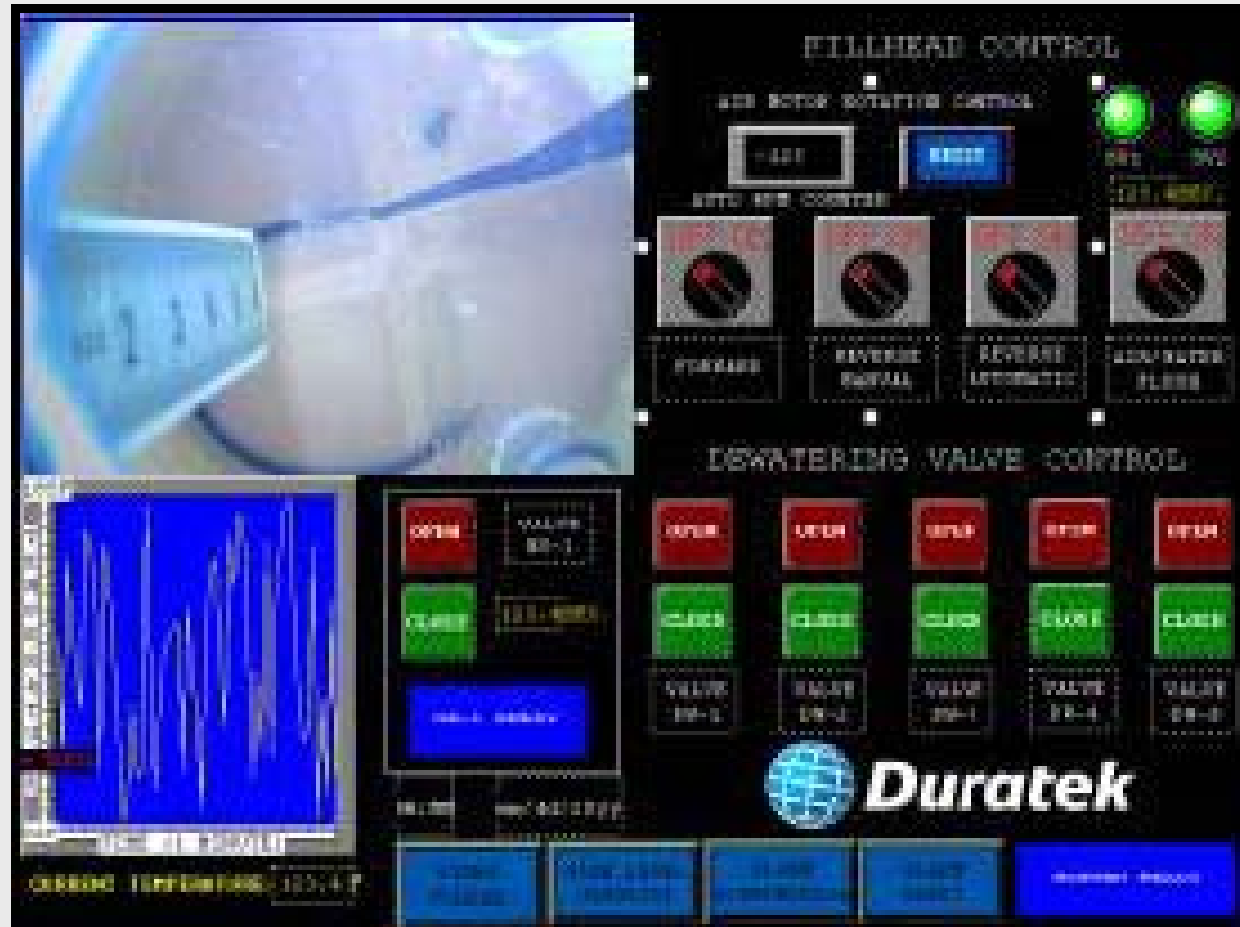


- Typical SWMS processing units (Dewatering Equipment):
 - Fillhead assembly:
 - Level detection system
 - Camera and light assembly
 - Infrared temperature measurement
 - Waste and dewatering piping connections
 - Pump skid
 - Waste control valve
 - Control console

Self-Engaging Dewatering Systems (EnergySolutions®)

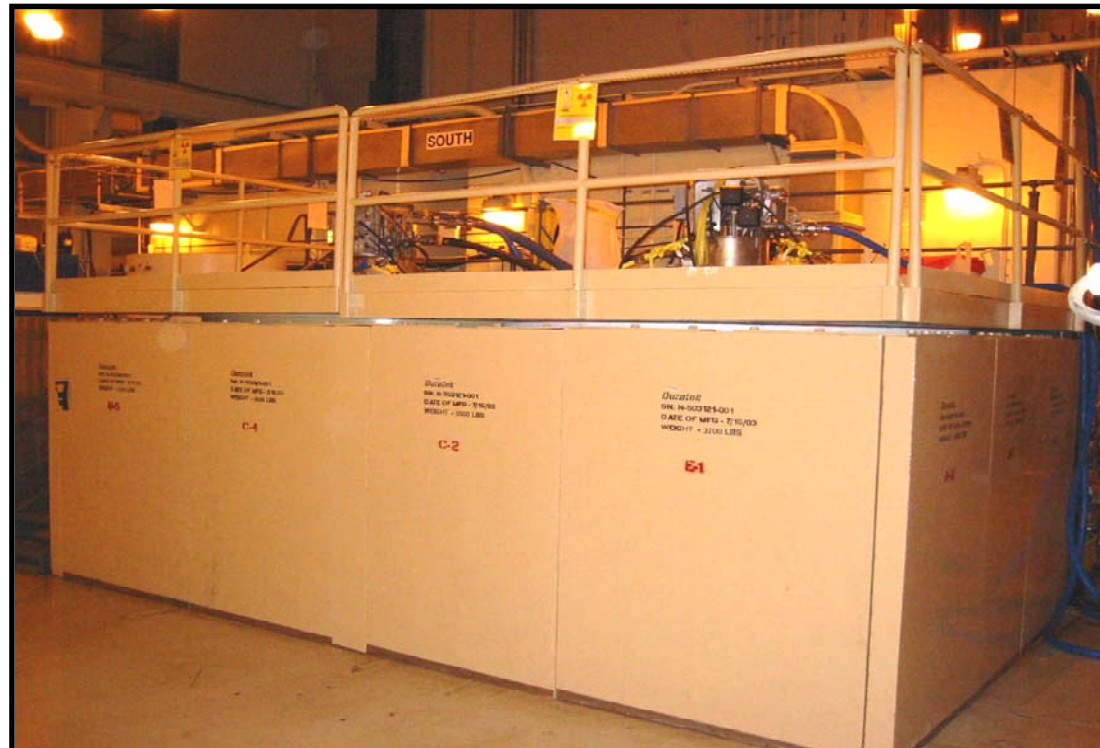


Self-Engaging Dewatering Systems Controls (*EnergySolutions*[®])



Self-Engaging Dewatering System (*EnergySolutions*[®])

Skid Mounted Radioactive Waste Treatment Systems
Courtesy of Energy Solutions
Self-Engaging Dewatering Systems



USA Suppliers Contact Information

**Information provided in this presentation is
Courtesy of *DTS* and *EnergySolutions*[®]**

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Mobile (Skid Mounted) Radioactive Liquid Waste Processing Systems

- Advantages:
 - Modules provide flexibility for easy transportation and installation
 - Flexible to modify modules, add or change equipment modules
 - Flexible to be installed permanently, brought in by truck for fast hookup, and/or both
 - Individual modules can be upgraded due to technology improvement or equipment modifications
 - Can be mobile between different plants
 - Complete processing system from one supplier

Mobile (Skid Mounted) Radioactive Waste Processing Systems Integration Considerations

- Designed to be integrated into the Waste Management Systems
 - Need to meet site specific liquid effluent specifications
 - Need to meet shipping and storage requirements for solid wastes
- Meets codes and standards as the permanently installed systems
 - Need to evaluate systems as a whole
- Integration
 - Spent resin and spent charcoal transfer and handling
 - New resin addition
 - Processing of filtration and RO rejects
 - Utility connections (service air, instrument air, flush water etc)
 - Process piping connections
 - Process alarms and operational parameters part of the Radwaste Control Room panel

Mobile Processing Systems Design Considerations (1 of 3)

- Define structural requirements: number of process units, space area, floor loading
- Define lifting requirements: maximum overhead crane capacity, crane access to processing areas
- Identify access requirements: personnel, equipment , supplies and waste movement
- Remote control and monitoring requirements: process parameters, controls, central processing control

Mobile Processing Systems Design Considerations (2 of 3)

- Designed, constructed and tested in accordance with RG 1.143 (for USA Nuclear Plants)
- Equipment and floor drain treatment subsystems are interchangeable
- Bypasses to treatment units are provided
- Designed with modular localized shielding

Mobile Processing Systems Design Considerations (3 of 3)

- All pipes connected to the skid mounted treatment subsystems are butt welded. No hose connections are utilized except where necessary e.g., dewatering fillhead
- All non-radioactive connections shall contain double isolation to prevent cross contamination
- Define applicable technology for each segregated waste stream
- Identify ALARA requirements for mobile units: shielding requirements

URS Radioactive Waste Skid Mounted Systems for USA New Nuclear Plants



- South Texas Project Units 3 and 4 (STP 3&4) Redesign Liquid and Solid Waste Management Systems for COLA with:
 - Mobile Units for Equipment and Floor Drains Systems
 - Fillhead and dewatering system for spent resin and sludge processing

- GE ESBWR Liquid and Solid Radioactive Waste System detail design
 - Using similar skid mounted systems as STP 3&4

- Comanche Peak Nuclear Power Project Units 3 and 4
 - Provide permanently installed filters and ion exchange columns
 - Provide space and piping and utility connections for future in-plant mobile system
 - Provide piping and utility connections for future off-plant mobile system

Wholly Integrated Commitment to the Nuclear Industry



Nuclear Engineering

- ◆ Radiological Dose Assessment
- ◆ Nuclear nonproliferation and national security
- ◆ Alternate Source Terms
- ◆ Radiological Protection Including Shielding
- ◆ ALARA
- ◆ Criticality and Radiological Engineering
- ◆ Safeguards and Security Management

Paul Reichert
Andy Woodruffe

Radwaste Systems Engineering

- ◆ Liquid Waste Management System
- ◆ Solid Waste Management System
- ◆ Gaseous Waste Management System
- ◆ Process Sampling System
- ◆ Radiation Monitoring System

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Noani Propst
Lisa Davies

Nuclear Decommissioning

- ◆ Closure Characterization and Planning
- ◆ Closure Engineering Requirements

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Ed Taylor

Nuclear Fuel Management

- ◆ Nuclear Fuel Management
- ◆ Spent Fuel Storage

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Rothstein
Jerry Lahti

URS
Washington Division
Nuclear Discipline
Irving Tsang

Licensing Support

- ◆ DCD
- ◆ COLA
- ◆ Regulatory Compliance and Analysis
- ◆ NRC RAI Responses

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BOP System Design

- ◆ Water Treatment Systems

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Questions and Answers

If you remember any questions later
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Thank you WiN Korea for your hospitality.