# Radioactive Waste Management for U.S. EPR

*WM 2008 Conference*

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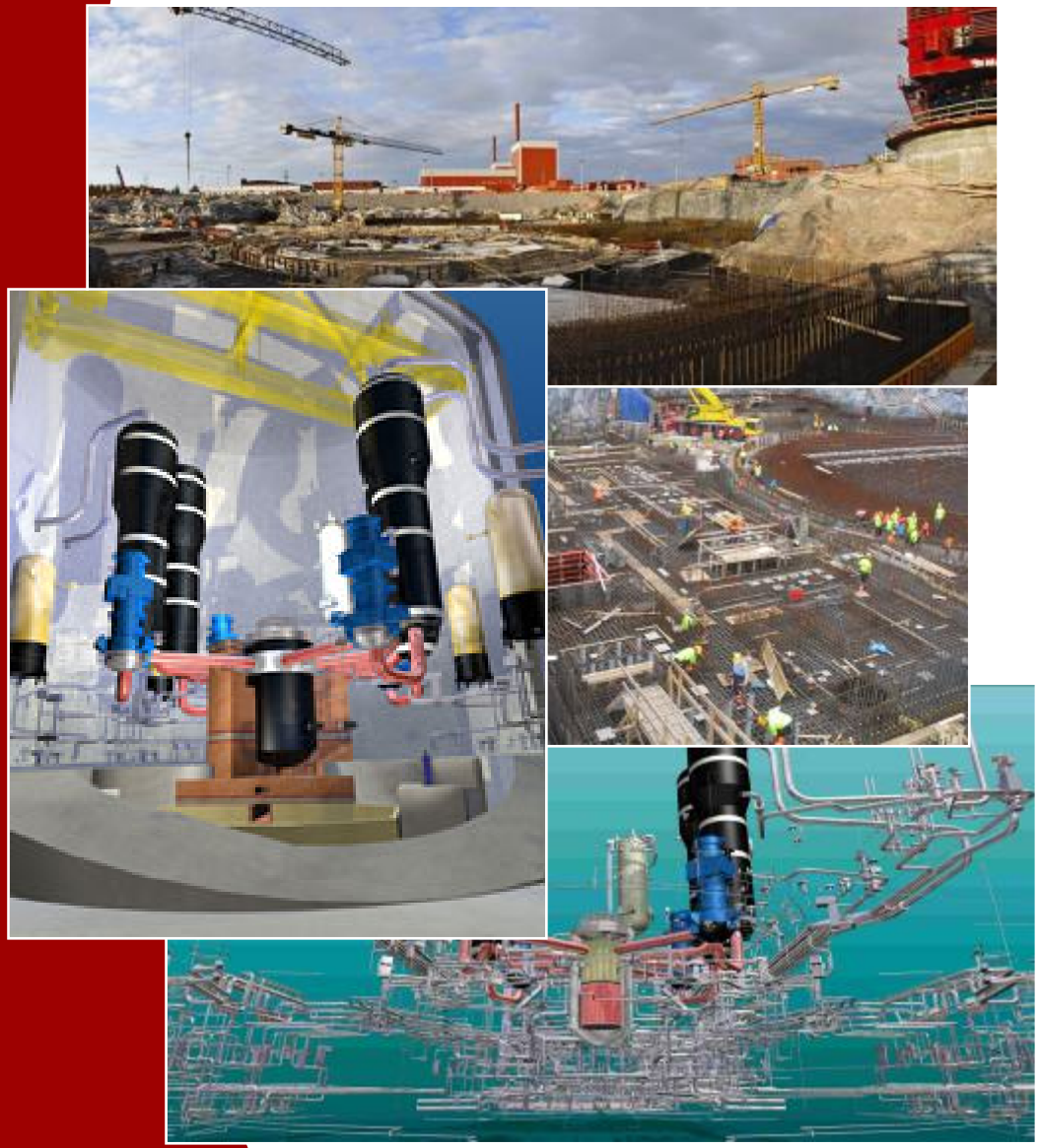
AREVA NP

Treatment of Solid, Liquid and Gaseous Radioactive Waste

# EPR: An Advanced Nuclear Power Plant



- **Proven Nuclear Power Technology**
- **60-Year Design Life**
- **Robust, Secure Design:**
  - Four independent safety trains in separate buildings
  - Greater design margins
  - Double-walled containment protects against external hazards
- **Increased Plant and Public Safety**
- **Lower Operating Cost ($/MWh)**
- **Low Thermal Discharge to Environment (Normalized)**
- **Significant Local Content**

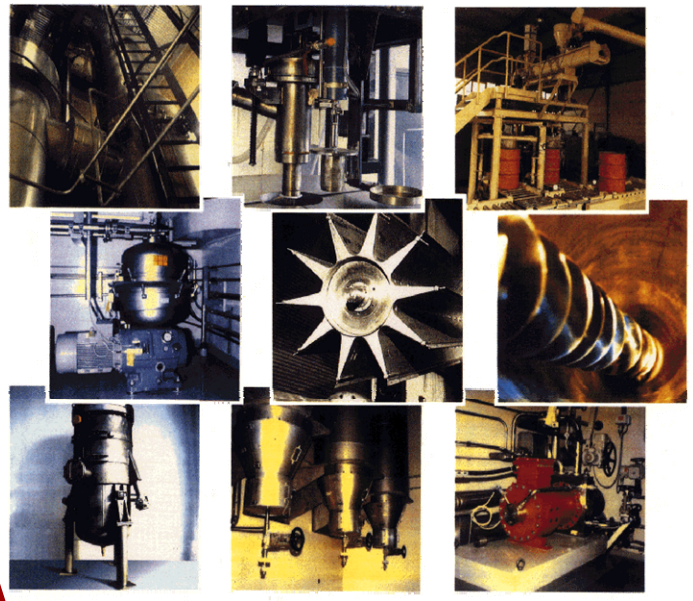
# 1st EPR Construction Project: ***Olkiluoto 3***

**Olkiluoto 3 Project: January 2008**

# 2nd EPR Construction Project: ***Flamanville 3***


**Flamanville 3 Project: January 2008**

# AREVA
# Radwaste Technologies



**1 Liquid Waste Treatment**

**2 Solid Waste Treatment**

**3 Gaseous Waste Treatment**

# *Wastewater Segregation*

**Liquid waste is generated in the controlled areas during power operation, overhauls, and refueling. It is accumulated and collected in groups.**

- ***Group I Waste has minimal solid content and consists mainly of boron containing wastewater with a high contamination level***
- ***Group II Waste has high solid content and comprises wastewater with a low contamination level***
- ***Group III Waste is typically generated in the steam generator blow-down demineralizer system and is normally not radioactive***

# US EPR Liquid Waste Processing System

Goals of the Liquid Radwaste Processing System**:**

- **Minimize Wastewater Generation**
- **Minimize Radioactive Discharges**
- **Optimize Operation**
- **Minimize Dose Rate (ALARA-Principle)**

Applied Technologies:

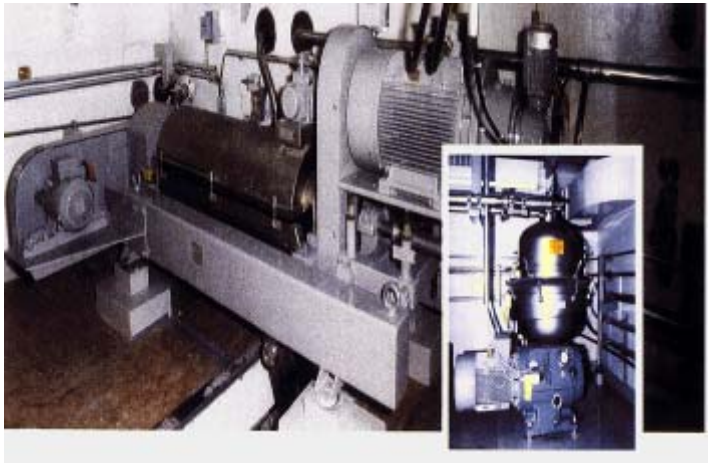
- **Evaporation**
- **Centrifugation**

Potential Vendor Applications:

- **Ion-Exchange (Demineralizers)**
- **Mechanical Filtration**
- **Reverse Osmosis**

Advantages & Features:

- ☒ **High Decontamination Factors**
- ☒ **Less Maintenance**
- ☒ **High Volume Reduction**
- ☒ **Compact Design**
- ☒ **High Efficiency**



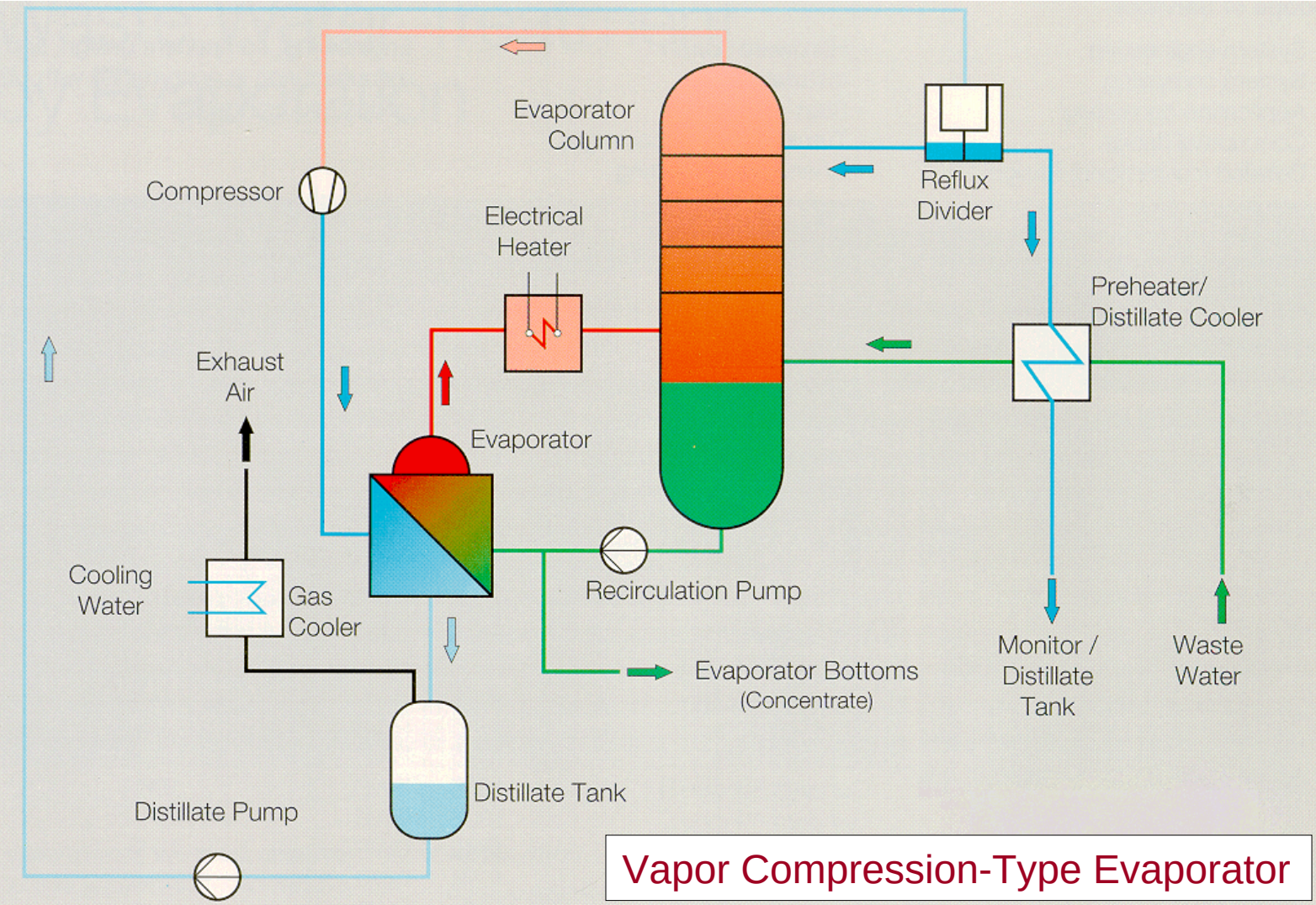
# *Liquid Waste Processing System*

- **The US EPR Liquid Waste Processing System is designed to address current and future radwaste processing needs**
- **The US EPR technologies are proven and will be operational before your EPR waste design decisions are required**
- **Current US EPR design has significant flexibility including portable vendor systems and/or technologies such as evaporation and centrifugation**

# Systems Used in the US EPR

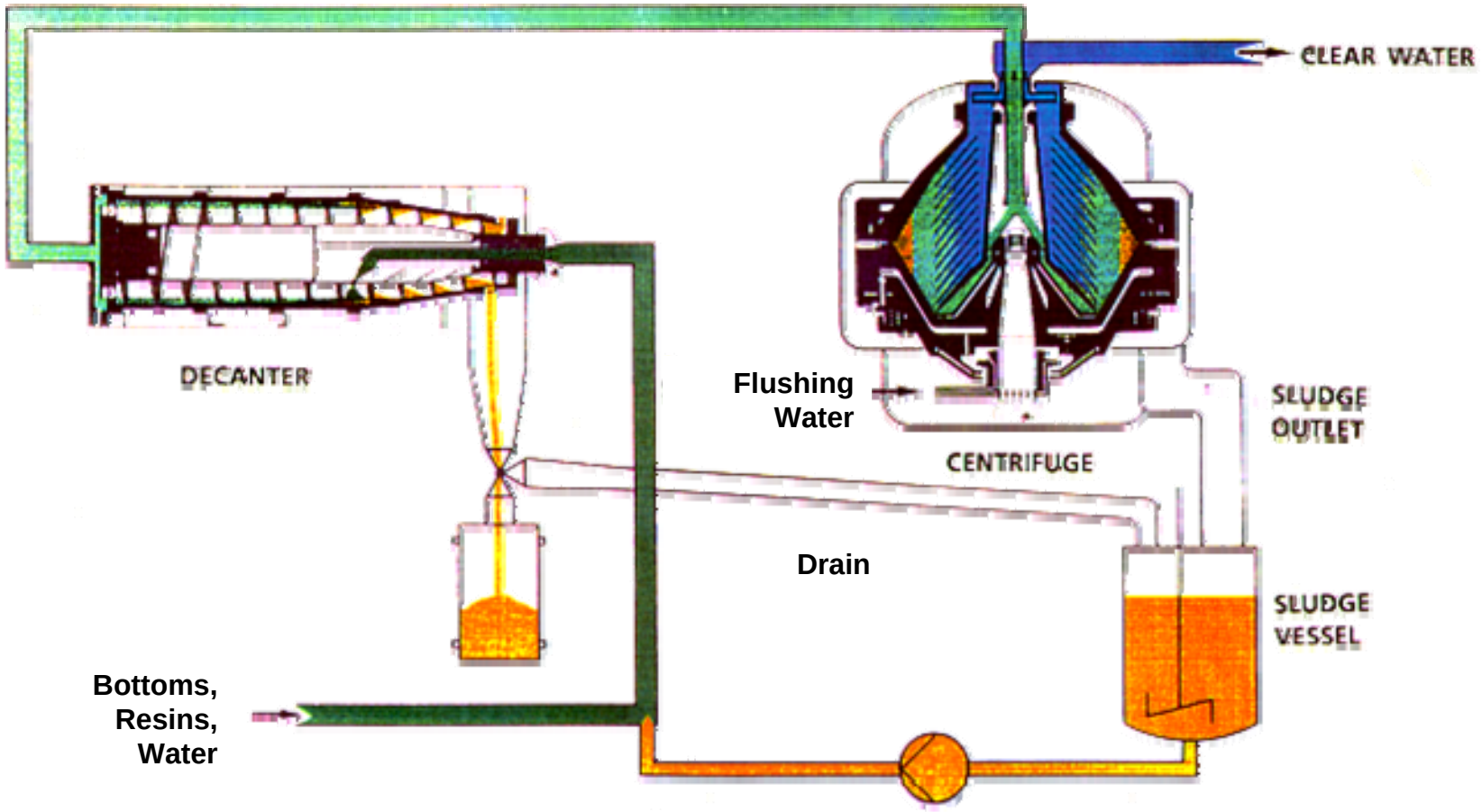
- ***Evaporator System –***
  *Typically treats Group I Waste*
- ***Centrifuge System –***
  *Typically treats Group II Waste*
- ***Vendor-Supplied Demineralizer System –***
  *Treats both Group I and Group II Waste*

# Evaporator System

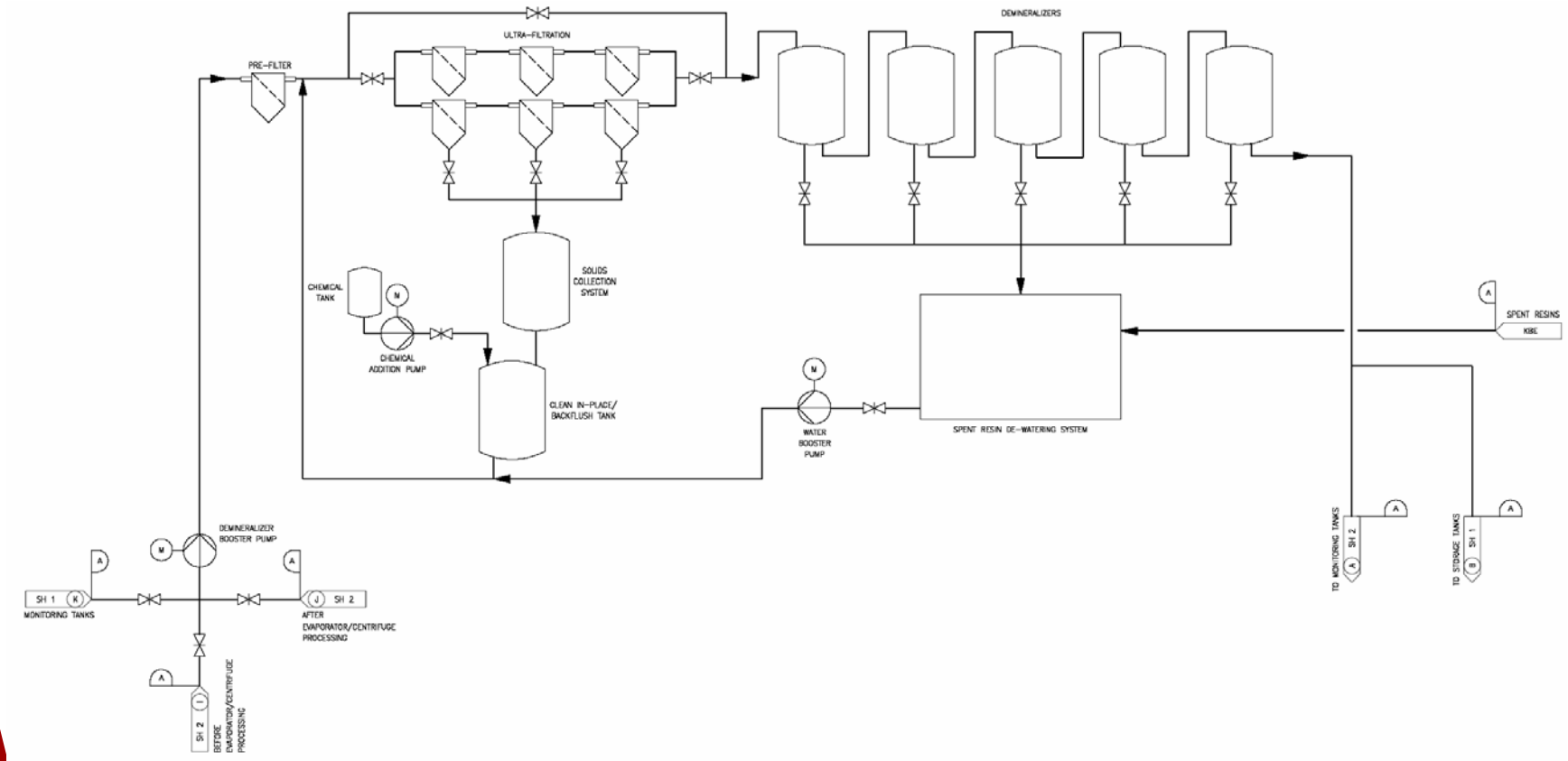



Vapor Compression-Type Evaporator

# Centrifuge System



# Demineralizer System



# US EPR Solid Waste System

## Goal of the Treatment

- **Minimize Waste (Volume reduction)**
- **Minimize Secondary Waste**
- **Generate Stable and Safe Products**
- **Minimize Man-Rem**
- **Safe Storage**

## Applied Technologies

- **Sorting**
- **Shredding**
- **Drying Radioactive Concentrates**
- **Drying Solid Waste**
- **Compaction**
- **Handling Devices**

## Advantages & Features

- ☒ **High Volume Reduction**
- ☒ **Compact Design**
- ☒ **Reliable Constructions**
- ☒ **Low Maintenance**
- ☒ **Easy and Unattended Operation**
- ☒ **High Automation**

# Systems Used in the US EPR

- *Radioactive Concentrates Processing System*
- *Solid Waste Processing System*
- *Solid Waste Storage System*

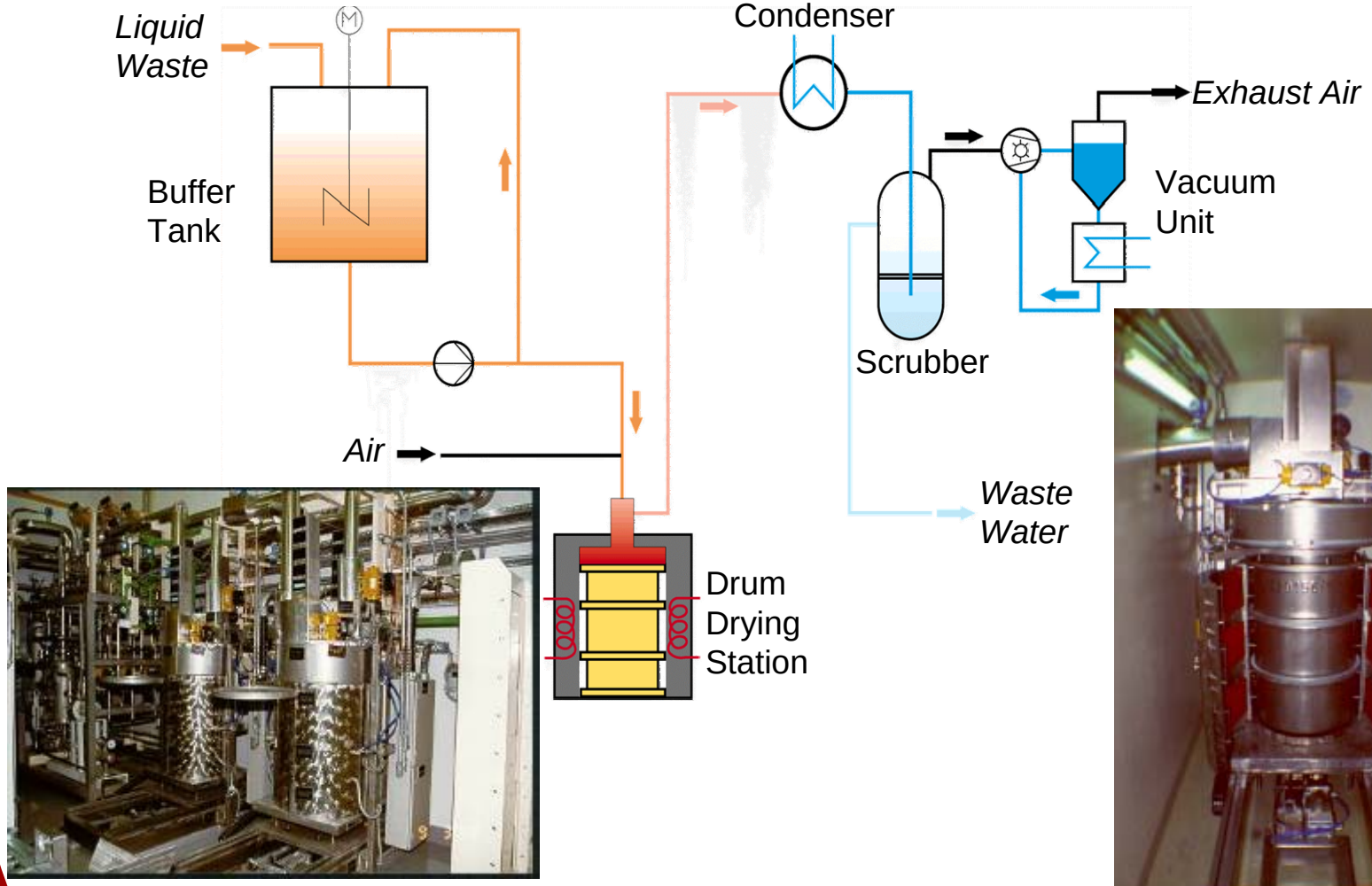
# Radioactive Concentrates Processing System

***Examples of Radioactive Concentrates are:***

- *Evaporator Concentrates*
- *Liquid Waste Storage Tank Sludge*
- *Spent Resins from the Fuel Pool Purification and Coolant Purification Systems, and the Radwaste Demineralizer, if used.*

**In the US EPR, these radioactive concentrates are treated using the Drum-Drying method**

# Radioactive Concentrates Processing System








## Drum Drying System

# *Radioactive Concentrates Processing System*

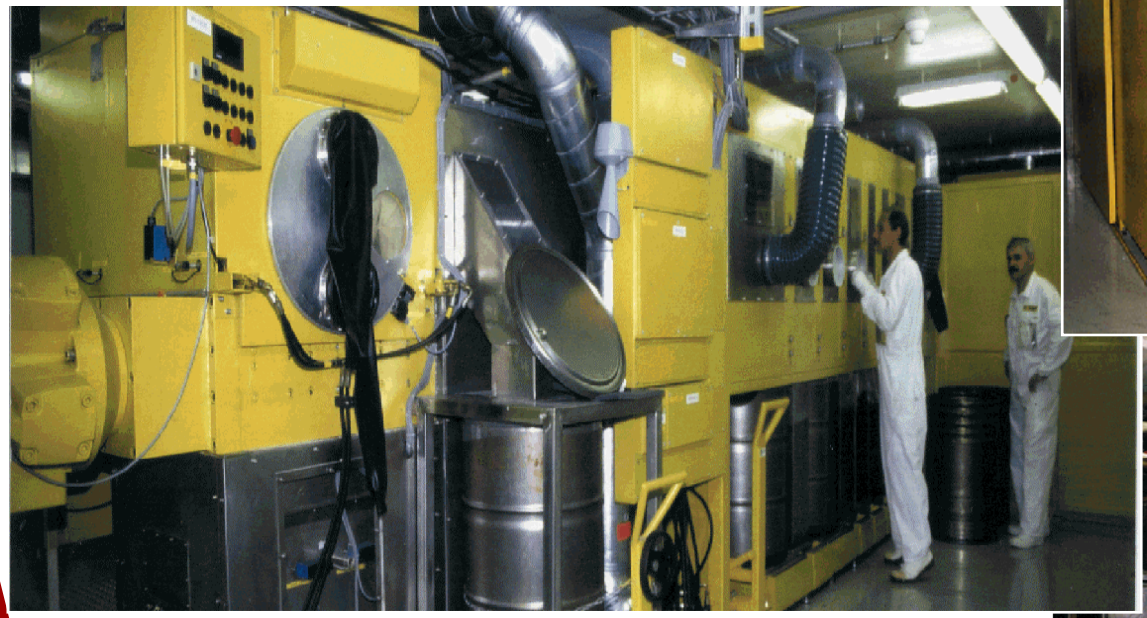
Example for embedding in 55-gal drums (used in Europe)

- ***Insertion of the 30-gal drum into 55-gal drum***
- ***The space between 55-gal drum and 30-gal drum is filled with ready-mixed concrete***

***30-gal Drum in 55-gal Drum, or as agreed on by the depository – cemented waste package***

# Solid Waste Processing System

## Sorting Box, In-Drum Compactor and Shredder



# Proven Radioactive Waste Management Experience

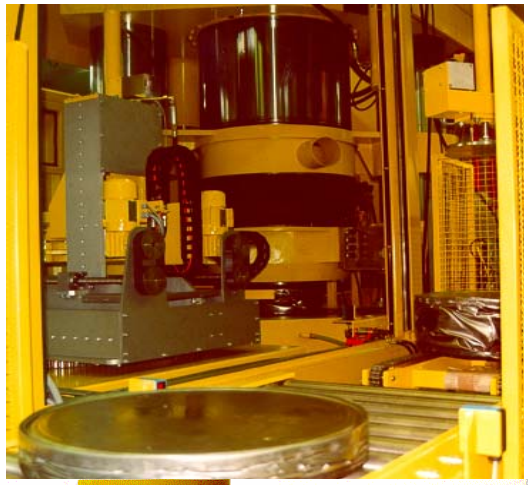
Experience and References Collected During 40 Years of Activities in Waste Management:

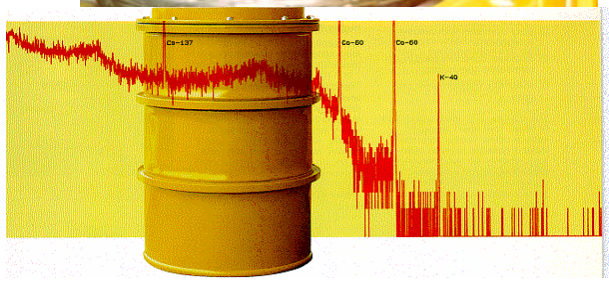
*Liquid Radwaste Processing Systems*

- ***29 Liquid Waste Treatment Systems***
  - **39 Evaporators**
  - **11 Centrifuges**
  - **39 Ion-Exchange Plants**
  - **22 Mechanical Filters (plate, bag, cartridge filters)**

*Solid Radwaste Processing Systems*

- ***25 Solid Waste Treatment plants***
  - **7 Drum-Drying Systems**
  - **5 Cementation Plants**
  - **7 Drying Systems for Sludge and Resins**
  - **20 Compactors, 1 Super Compactor**
  - **5 Sorting Devices**
  - **3 Shredders**
  - **1 Incineration Plant**
  - **More than 25 Devices for Handling and Transport**

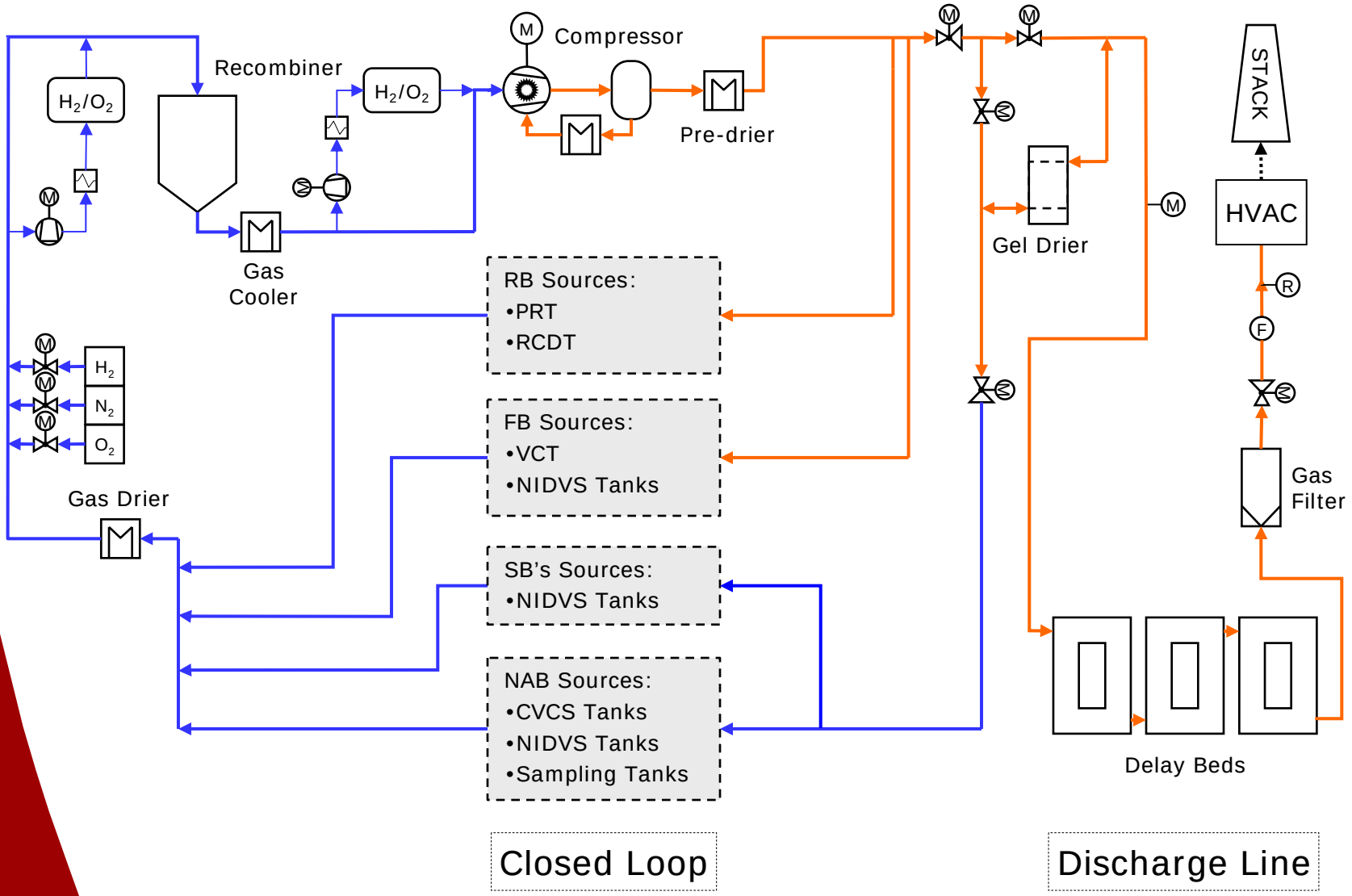





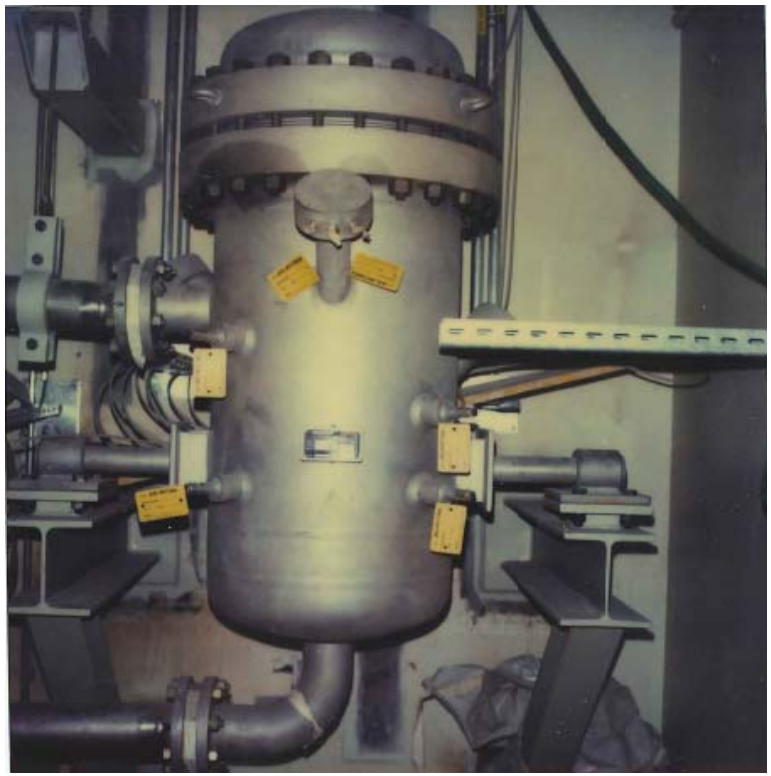
# US EPR's Gaseous Waste Processing System

- **The primary objective of the Gaseous Waste Processing system is to collect, process, and discharge waste gases**
  - **Radioactive gases (e.g. Xenon, Krypton)**
  - **Potentially explosive mixture (i.e. Hydrogen & Oxygen)**

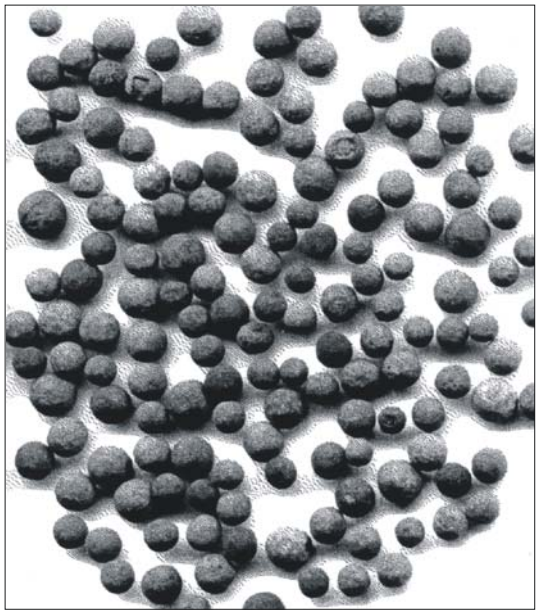
# Overview



# Recombiner



Recombiner During Installation



Catalyst

# Waste Gas Compressor

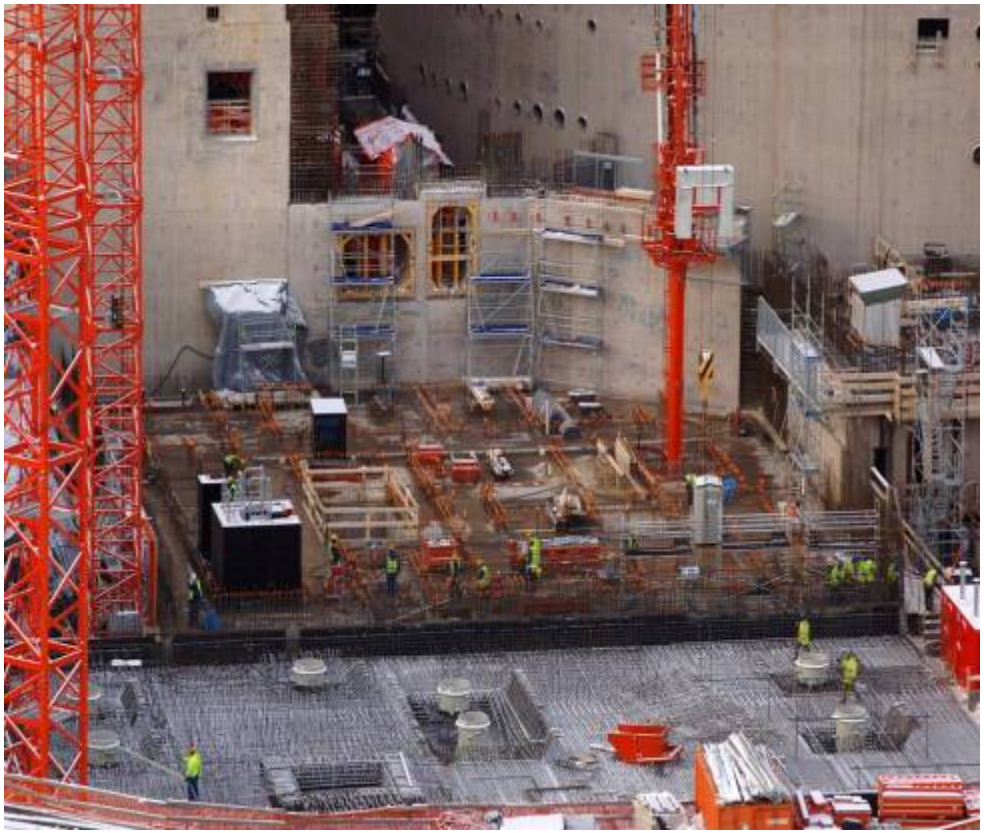
# Delay Beds

Activated Charcoal Column

Charcoal

# The EPR is Being Built Now

## Olkiluoto Waste-Processing Building



## Olkiluoto 3 Project: January, 2008