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Developing a Waste Treatment Center for PWR New Builts

PWR Prague

Wolfgang SCHUCH

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Introduction

- During operation of a nuclear power plant (NPP) radioactive waste (radwaste) is generated
  - Solid waste
  - Liquid waste
  - Gaseous waste
- Each country has strict regulations for the acceptance of radwaste into the final repository or release of cleared waste streams
- Waste treatment and conditioning is therefore mandatory for each NPP
- A Waste Treatment Center is required and usually errected at the site of a NPP

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Waste treatment chain



Waste Water

Treatment

Cleaned water

Radiological Measurement

Free release into the environment

Sludge/ Concentrate/ Resin

Conditioning

Radiological Measurement

Packaging

Interim/Final Storage

Free release

Radiological Measurement

Solid Waste

Reduction of solid waste (esp. Metal) by means of decontamination

Volume Reduction of solid waste (esp. Metal) by means of shredding or (super)compaction

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Waste boundary conditions

Waste Generation at NPP

- Waste volumes per fuel cycle during operation
- Waste volumes per outage during operation (flushing, rinsing)
- Waste types and properties
  - Liquid waste (contaminants, degree of contamination, toxicity, organic content, density…)
  - Solid waste (material, degree of contamination, compressible, combustible, moisture…)

Waste Acceptance criteria by Regulator

- Limit values for release
- Waste acceptance criteria for final repository
  - Waste package (drum, stell container, concrete container, shielded cast iron container)
  - Conditioning method (solidification, drying, cementation, grouting)
  - Required properties (free water, compressive strength, leaching, temperature resistance…)

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Examples of Technology

Waste Water Treatment

Evaporator units

Centrifuge systems

Ion-exchangers

Mechanical filters



Solid Waste Treatment

Compactors

Super-compactors

Sorting systems

Shredders

Devices for handling, transport and packing



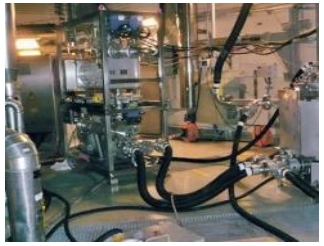
Decontamination

Decontamination Booth

Small Booth

Ultrasonic Bath

Several hours of operation for AMDA



Conditioning Systems

In-Drum Drying Systems

Cementation systems

Bituminization Systems

Drying Systems for Sludge and Resins



R&D

Micro Waste Systems

Innovative Membrane

Robotics

Mobile Cementation

Mobile Systems



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Waste water treatment

References:

42 Evaporator units

13 Centrifuge systems

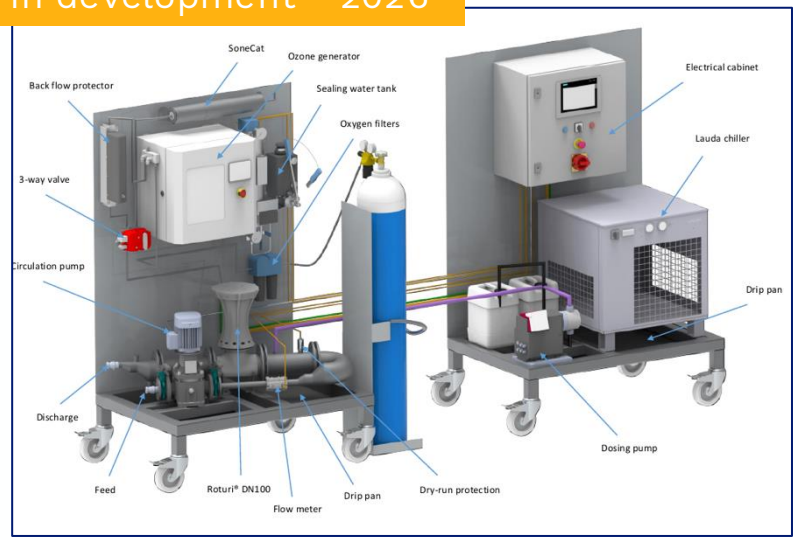
39 Ion-exchangers

25 Mechanical filters



Steam compressor

In development - 2026



Ozone treatment (laundry waste water)



Decanter

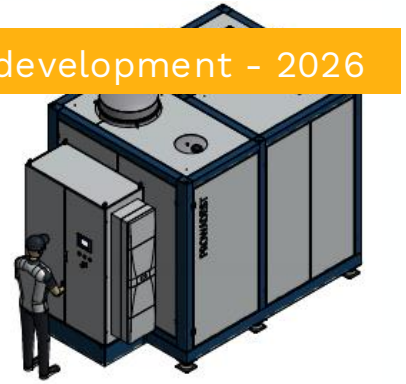


Separator



Evaporator column

In development - 2026



Mobile evaporator

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Solid Waste Treatment

References:

22 Compactors

3 Super-compactors

9 Sorting systems

5 Shredders

> 50 devices for handling, transport and packing



Sorting box and pre-compaction



Super compactor

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Decontamination

References:

2 Decontamination booth

2 Small booth

2 Ultrasonic bath

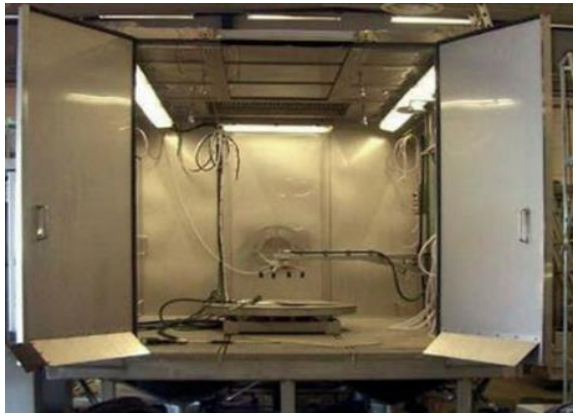
Several hours of operation for AMDA



Ultrasonic bath



AMDA



Decontamination booth



Small booth

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Conditioning

References:

8 In-drum drying systems

7 Cementation systems

2 Bituminization systems

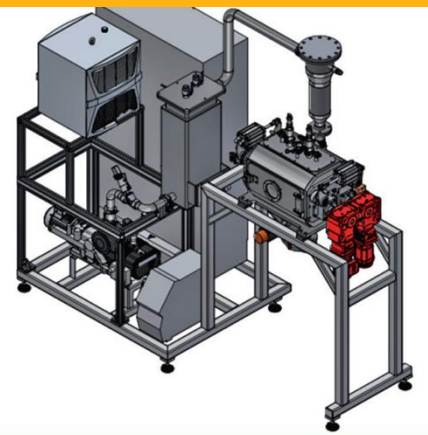
7 Drying systems for sludge and resins





In drum drying

In development - 2026



Rotating drum drier



Cementation



Continuous flow mixer



In-drum mixer



Destruction of spent resins and organics

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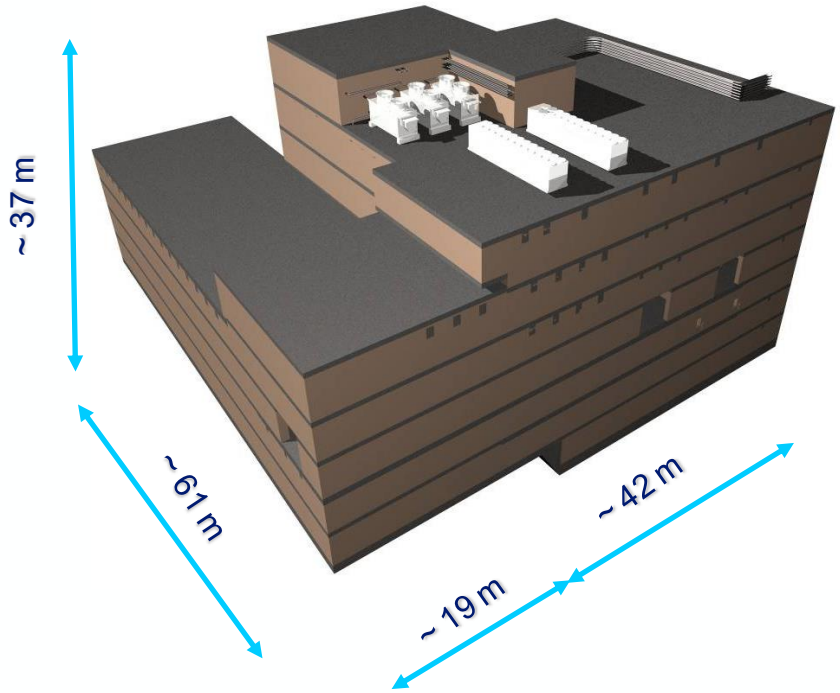
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Stages of planning a Waste Treatment Center

- **Design**
  - Process design of the waste streams
  - Layout design of the Waste Treatment Center / Waste Building
- **Engineering**
  - Civil engineering of the Waste Building
  - Mechanical engineering of components and piping
  - Electrical Engineering
  - I&C Engineering
  - Radiological and radiation protection consideratons
- **Construction**
- **Commissioning**
- **Operation Support**
  - Partnership does not end at hand-over. Framatome has

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Examples for a waste treatment center design



Example of 3D Model of WTC
with Storage Building



Example of 3D Model of WTC
(components and piping)

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Approach for SMR

- Small modular reactors (SMR) are fully equipped NPPs at smaller sizes with amodular approach
- SMR also require radwaste treatment
- Depending on the NPP site (single unit against multiple units) different approaches are possible
    - Singe unit: the waste treamnet needs to be included in the SMR
    - Multiple units: a separated waste treatment center serving all units can be established
- Smaller reactor sizes generate smaller waste volumes (not proportionally)
- Hence, smaller waste treatment systems are required

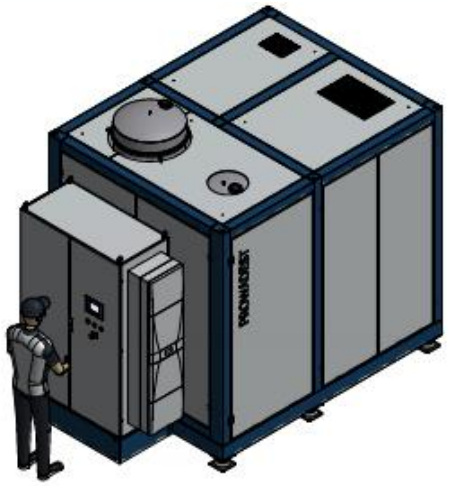
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Approach for SMR – Modular Waste Systems

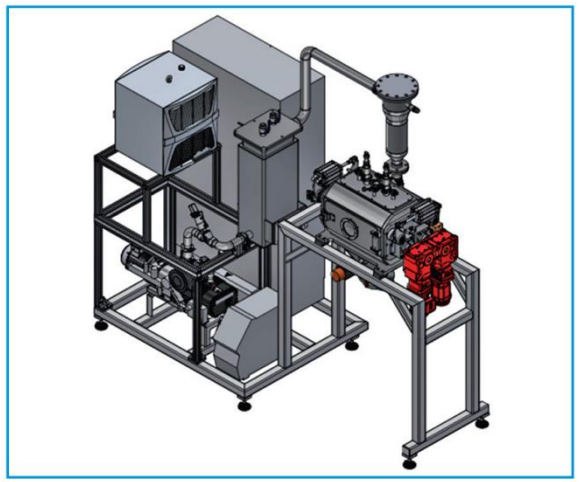
Evaporator module

- Small size evaporator for capacity of up to 1000 l/h
- Fits in a small frame, perfect for modular approach



Rotating drum drying module

- Small size dryer for evaporator concentrates
- Fits in a small frame
- Solidifies by producing powder



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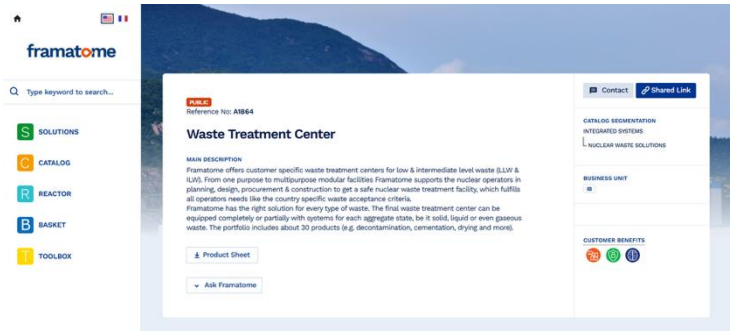
Conclusion

- Waste treatment is a complex engineering task and shall be included in the early design stages
- A holistic approach considering waste production and final repository requirements is recommended
- Planning a full waste treatment center instead of techno bricks reduces the amount of design interfaces and brings the benefit of synergies
- Framatome has experience in the planning, design, engnieering, construction and commissioning of complete waste treatment centers
- For SMR a waste treatment center is also required
- Small modular waste treatment systems shall be preferred for a SMR

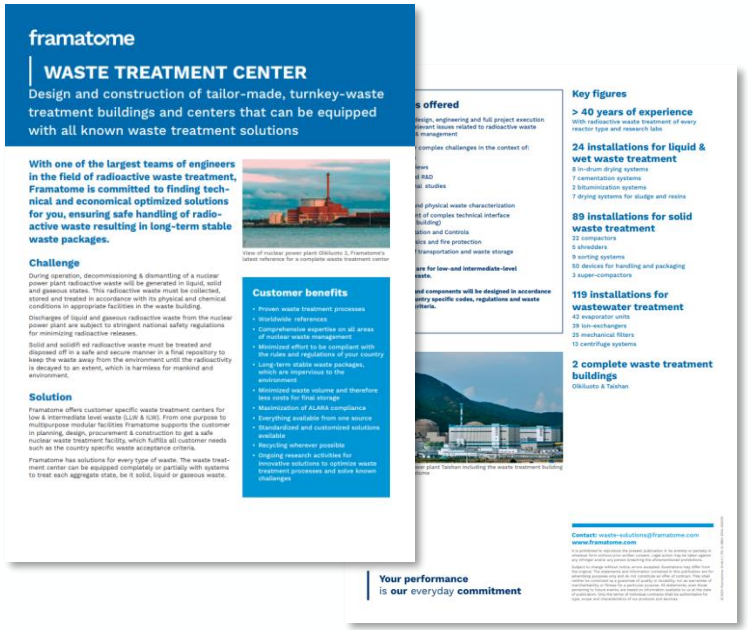
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Further Information

Solutions portfolio:
[Waste Treatment Center | Framatome.com]



Product sheet: [PS-G-1864-ENG-202410-Waste Treatment Center]



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