



# NATRIUM

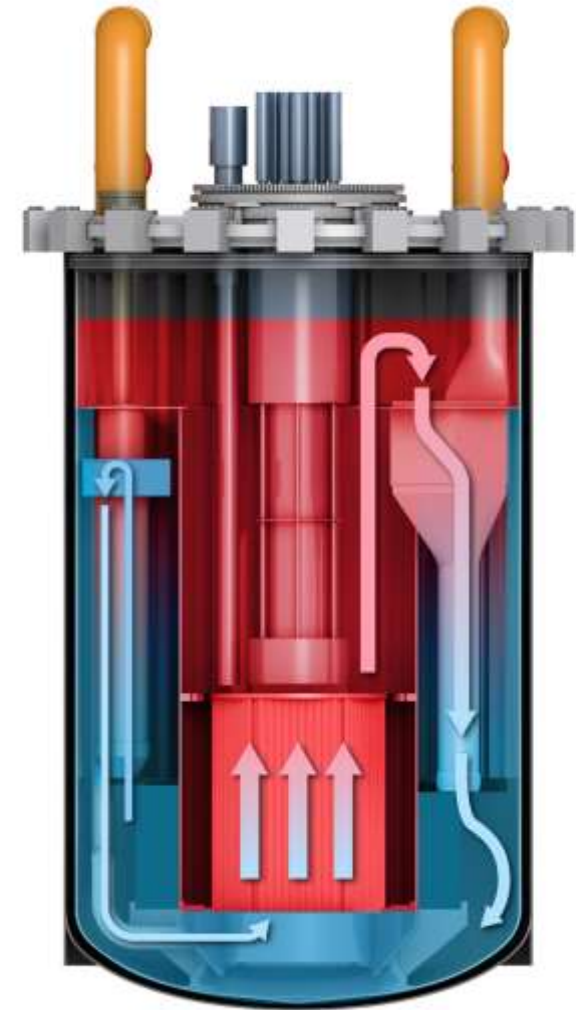
a TerraPower & GE-Hitachi technology

**Utilizing the Past to Realize the Future**

# What's Different?

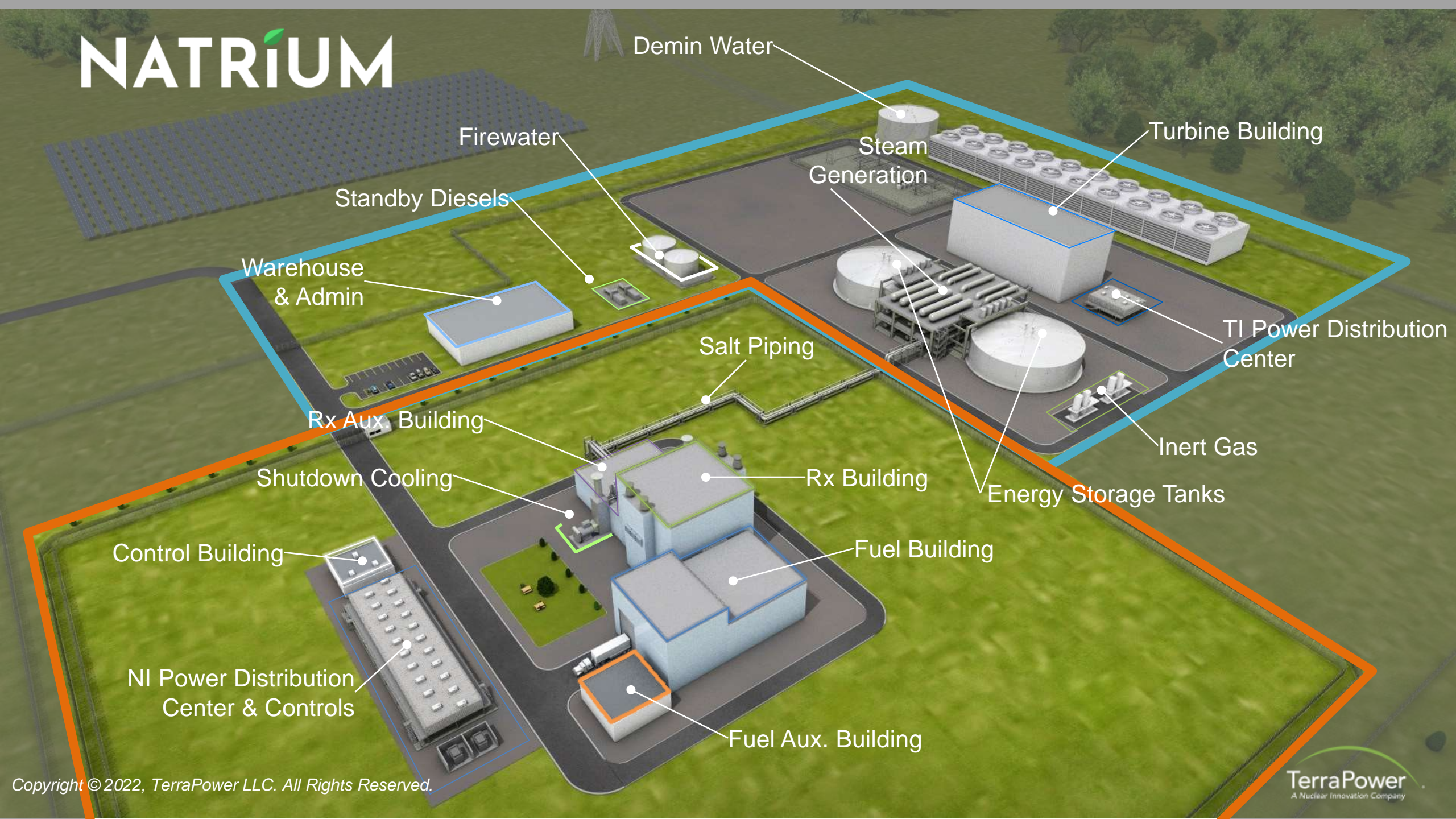
Leverage inherent features: drive down cost

- Compact systems, less “nuclear sprawl”
- Low pressure
- Efficient heat transfer
- Pool design with large coolant inventory
- EI/Ni Separation
- Modularity
- Parallel Construction
- Emergency Planning Zone Reduced



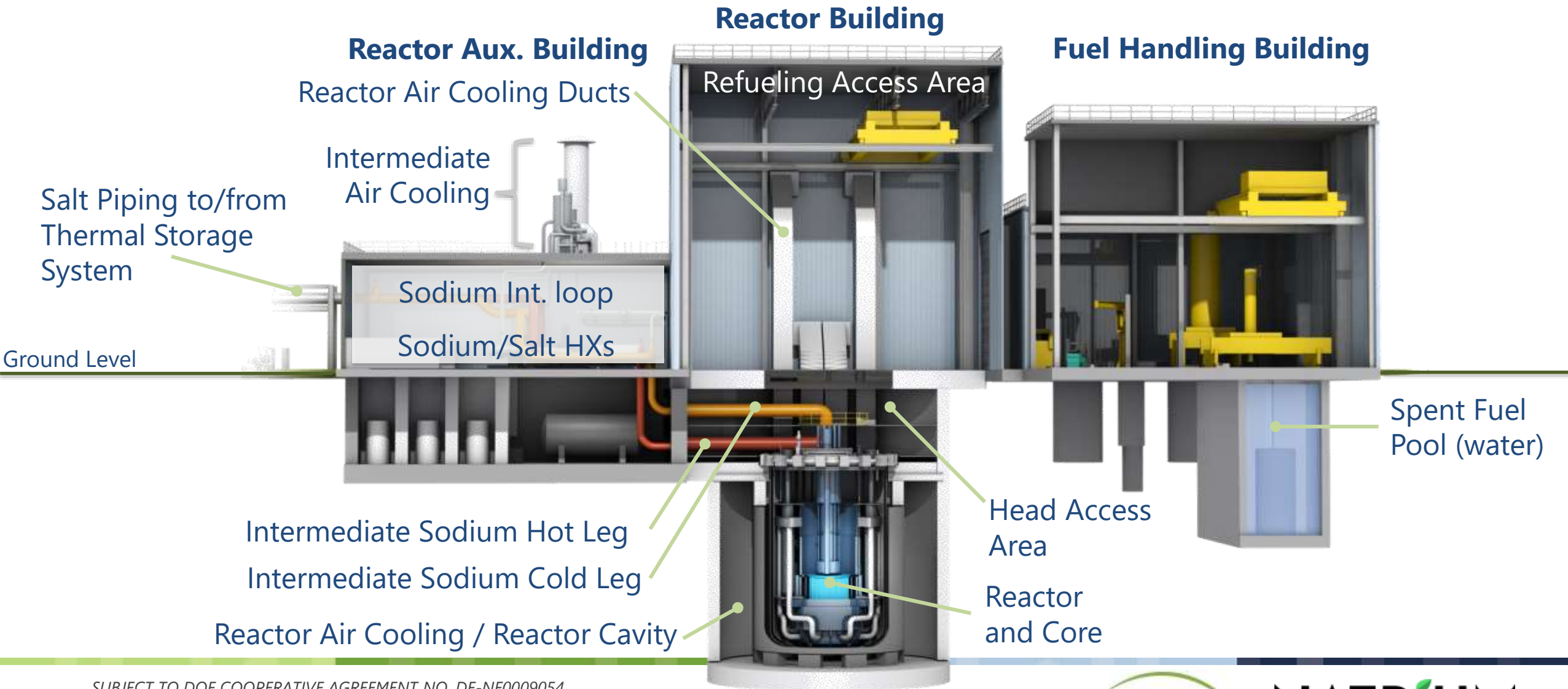


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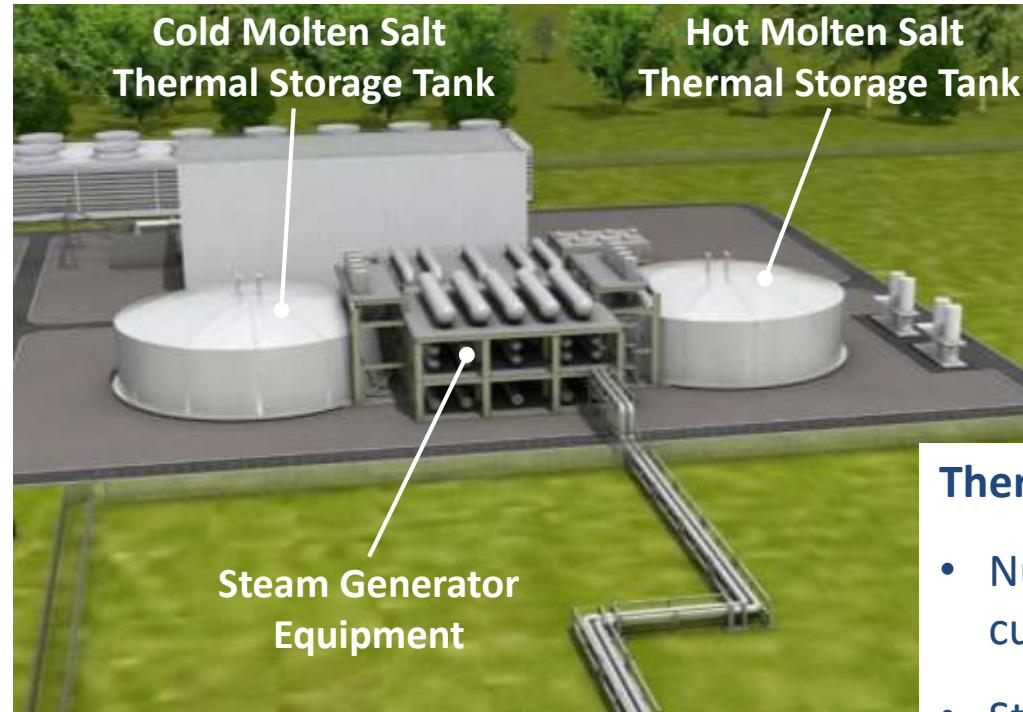
# Plant Overview



# Energy Island Thermal Storage

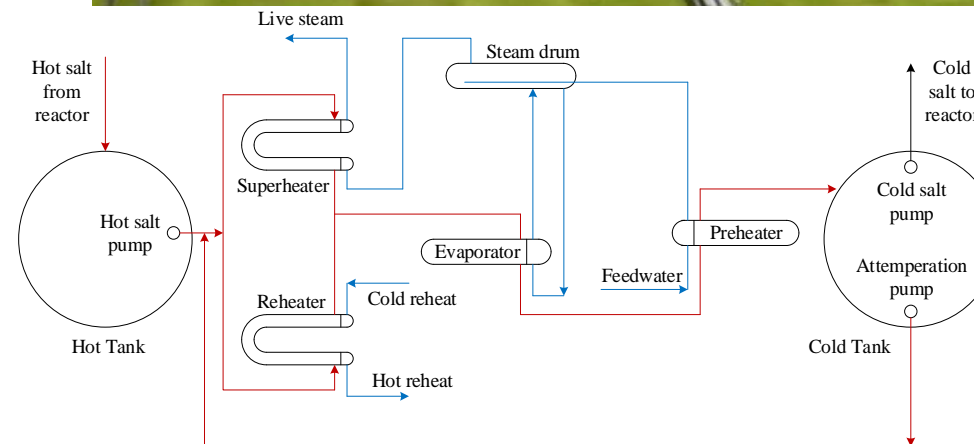


Above picture is of a Solar Salt Plant



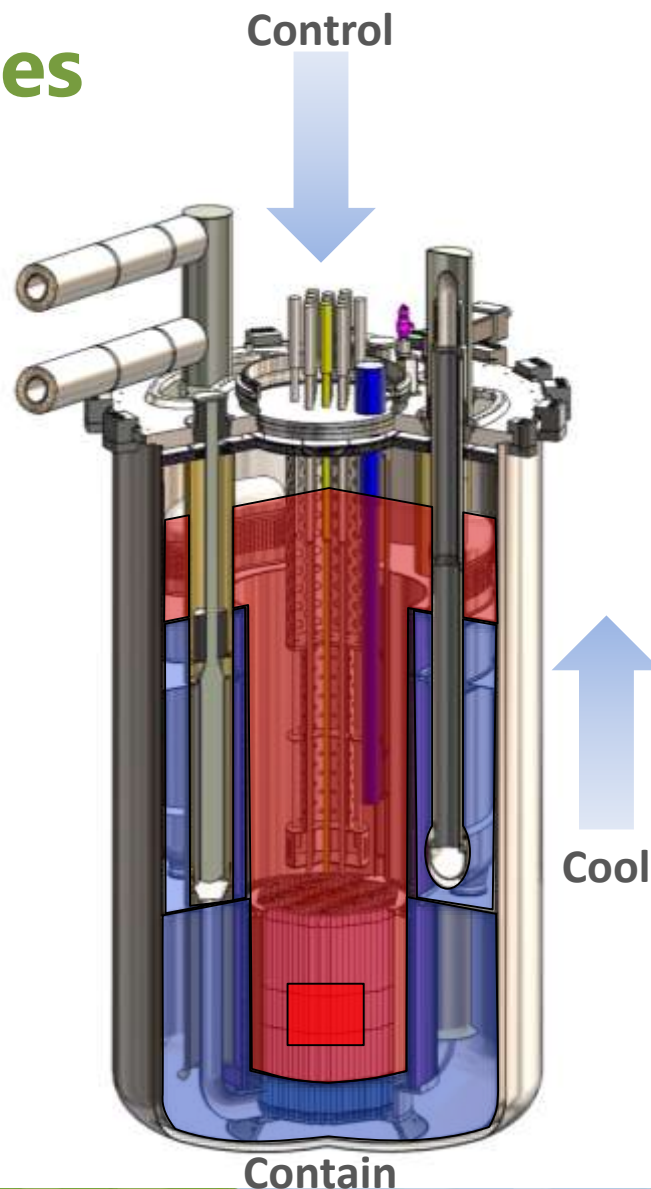
## Thermal Storage

- Number of tanks based on customer's energy need
- Steam generator trains based on size of turbines
- Turbine size based on customer's power need
- Proven Technology



# Sodium™ Safety Features

- Pool-type Metal Fuel SFR with Molten Salt Energy Island
  - Metallic fuel and sodium have high compatibility
  - No sodium-water reaction in steam generator
  - Large thermal inertia enables simplified response to abnormal events
- Simplified Response to Abnormal Events
  - Reliable reactor shutdown
  - Transition to coolant natural circulation
  - Indefinite passive emergency decay heat removal
  - Low pressure functional containment
  - No reliance on Energy Island for safety functions
- No SR Operator Actions or SR AC power required for Safe shutdown
- Technology Based on U.S. SFR Experience
  - EBR-I, EBR-II, FFTF, TREAT
  - SFR inherent safety characteristics demonstrated through testing in EBR-II and FFTF



## Control

- Motor-driven control rod runback
- Gravity-driven control rod scram
- Inherently stable with increased power or temperature

## Cool

- In-vessel primary sodium heat transport (limited penetrations)
- Intermediate air cooling natural draft flow
- Reactor air cooling natural draft flow – always on

## Contain

- Low primary and secondary pressure
- Sodium affinity for radionuclides
- Multiple radionuclides retention boundaries

# Knowledge Transfer

There are three methods for effective knowledge capture employed on the Natrium project:

1. Utilizing personnel who have previous SFR experience
2. Reviewing previous SFR design documentation, OE, and Lessons learned
3. Strategic Partnerships



# Personnel with SFR experience (Current and Past)

- Denny Newland –
  - SFR Experience: Started as Operations Engineer after College at FFTF. Moved up to Shift Operations Manager, Assistant Operations Manager, Program Manager, Assistant Plant Manager, Plant Manager, and the LMFBF Program Manager.
  - Natrium: Assisted in the development of the operational concepts and programs for the Natrium plant.
- John Truax –
  - SFR Experience: Started at Westinghouse on Sodium System designs for FFTF. Joined FFTF as an Operations Supervisor and shift testing leader for commissioning. Shifted to a leadership role as a Technical Support Manager managing plant chemistry, systems analysis, and the experiment review committee. Later become the Outage manager in charge work planning and execution and the refueling group and was the dry cask program owner. Later helped to established decommissioning plant
  - Natrium: Assisting in refueling system development and input into several operational programs including commissioning.
- Dave Lucoff –
  - SFR Experience: 40 years of experience in Sodium Fast Reactors including Core Manger for FFTF and worked at Handford Site as Core designer, safety tester, and Operations Manager.
  - Natrium: Assisting the development of the Natrium Fuel program and systems.
- Craig Smith –
  - SFR Experience: Operator at FFTF, learned and studied all the sodium systems and maintained the plant during decommissioning phase.
  - Natrium: Training Program owner responsible for developing Natrium training.
- Owen Nelson –
  - SFR Experience: Reactor Operator at FFTF operating the reactor plant systems while in operation
  - Natrium: Assisting in development of Re-fueling systems in Natrium plant.



# Knowledge Transfer

- Knowledge from these SFR experts is transferred through:
  - Mentorship
    - Direct transfer to a Jr engineer
  - Direct input into design
  - Documentation
    - Document strategies used from previous SFRs that apply to Natrium

# SFR Historical Documents

- TerraPower has a database of historical SFR documents:
  - FFTF
  - EBR-II
  - Prism
  - CRBR
  - Fermi-1
  - Phenix
  - SuperPhenix
  - SNR-300
  - Monju
- This includes Design documents, Operating Experience, and Lessons Learned.



# SFR Historical Documents

- Prior to beginning work on Natrium System design or program development Natrium Engineers review historical reference repository related to their system.
  - Provides good basis for design
  - Provide past problems and their resolved solutions
  - Includes Operating Experience and Lessons Learned that can be utilized in current project
- This historical information is key to ensuring the design is based on solid data and provides the ability to better model the systems.

# Phenix IHX Leak and Changes

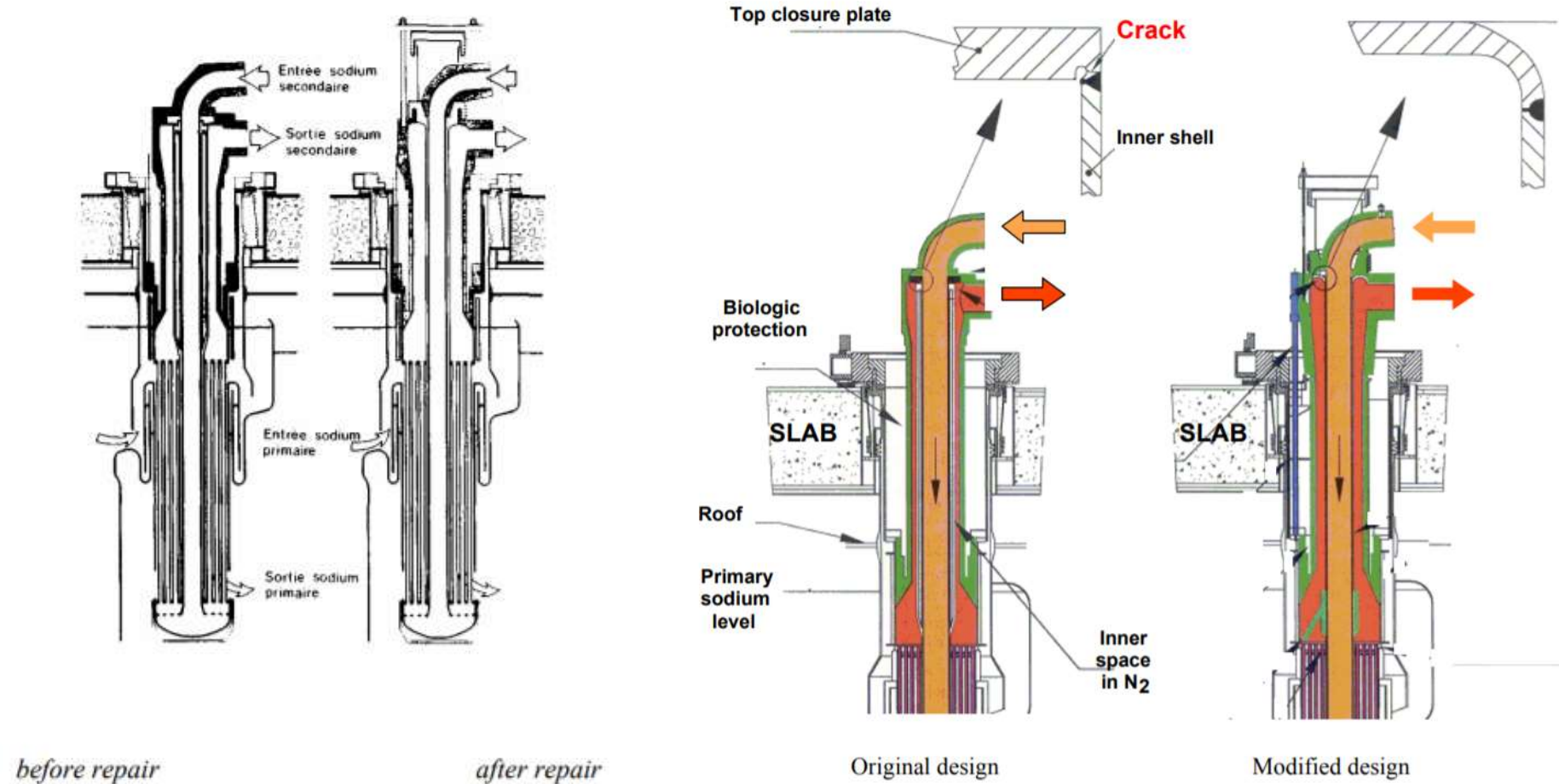
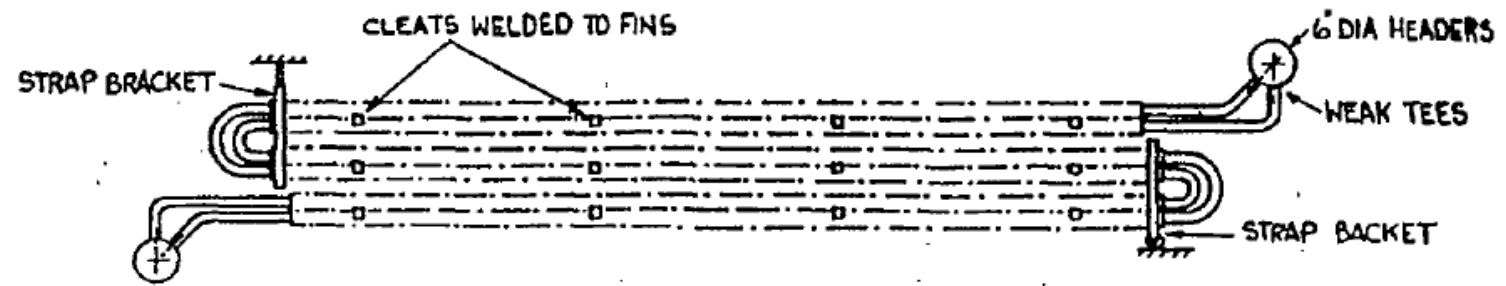


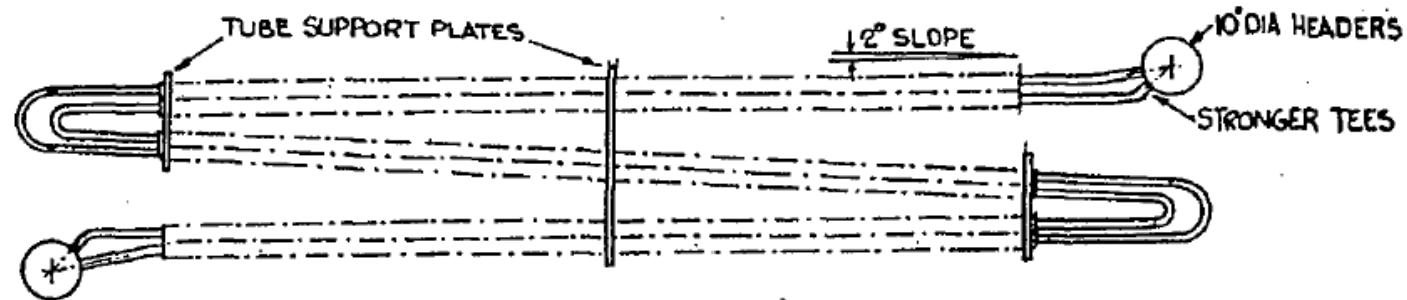
FIG. 3. PHENIX intermediate heat exchanger (IXH): places of failure, repair and modification.  
[(a)-before modification; (b)- after modification (flexible design elements and a flow-mixing device in the sodium header at the tube plate outlet)].



# PFR Decay Heat Removal Air Dump Heat Exchanger Design Changes



ORIGINAL AHX TUBE PROFILE

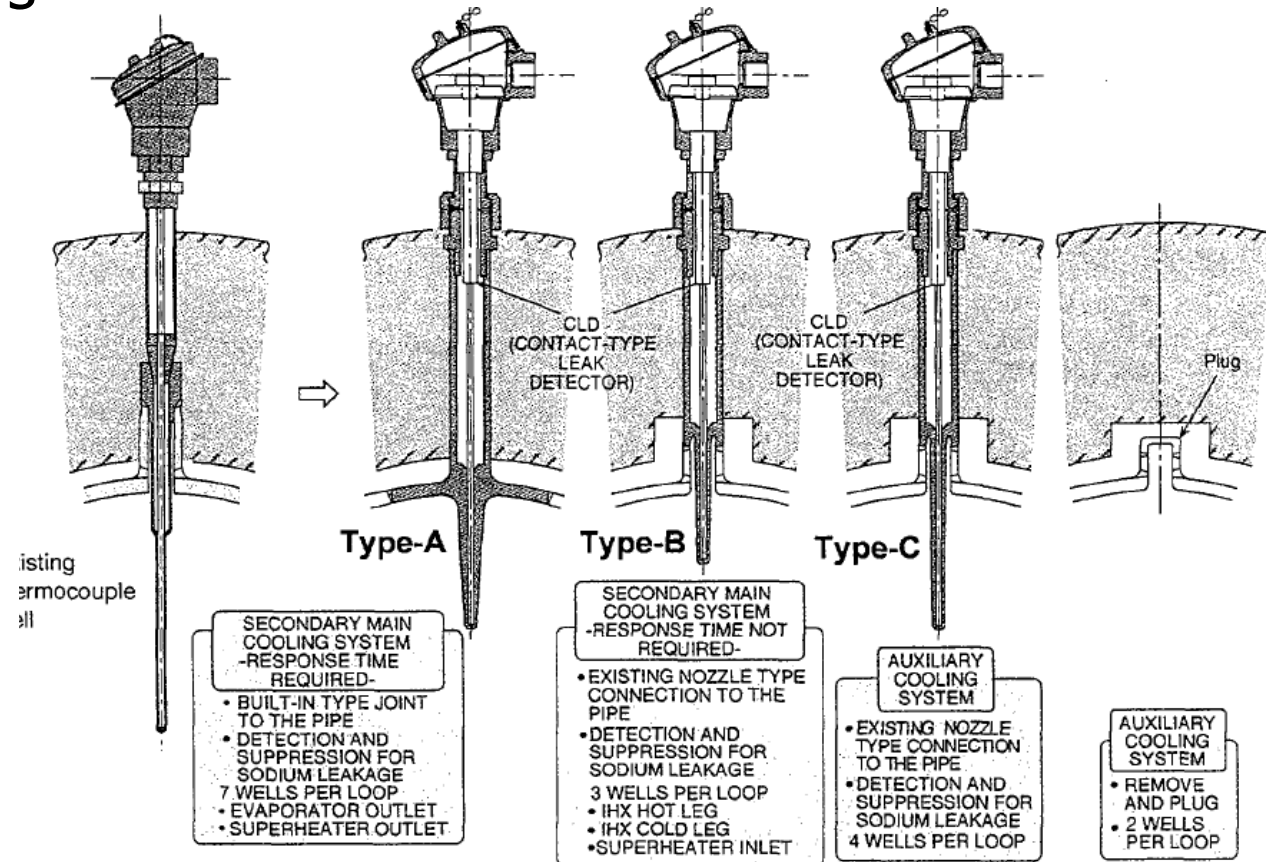
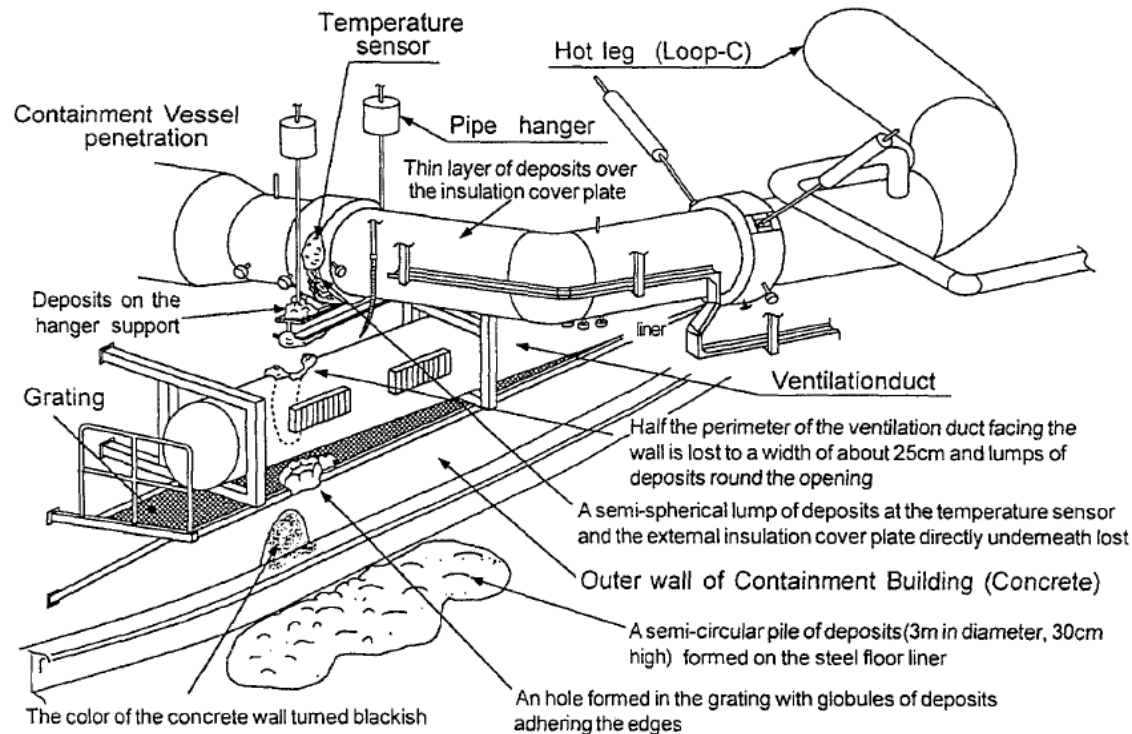


REPLACEMENT AHX TUBE PROFILE

*Figure 7.2. The Original and Replacement PFR Thermal Syphon Air Heat Exchangers*

# Monju Leak

- Flow induced vibration of a thermocouple
- Redesign of thermocouple wells





# Strategic Partnerships

- Work with PNNL and INL
  - PNNL has a contingent of SFR experts who consult on the Natrium Project
  - FFTF and EBR II historical records were retrieved from PNNL and INL to be referenced by the Natrium Project
- Work with JAEA
  - Historical Documentation sharing

# Questions?