ETU 1.0 Lessons Learned

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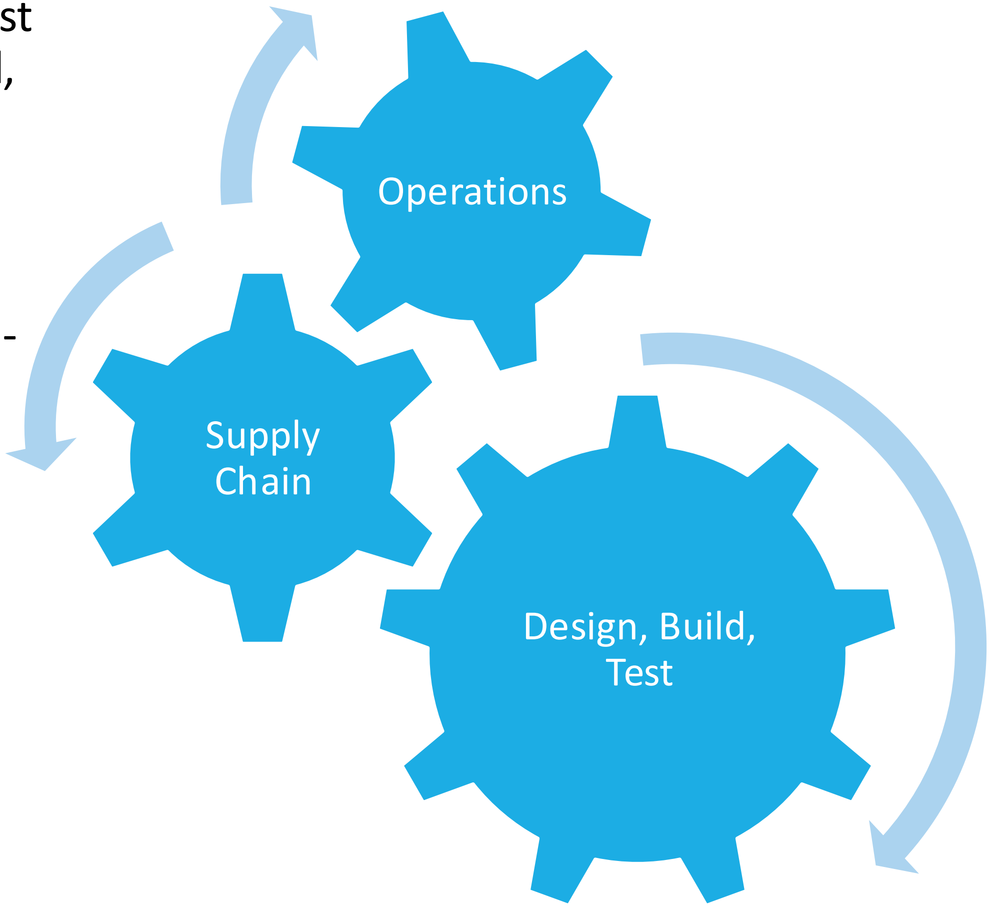
Kairos Power's mission is to enable the world's transition to clean energy, with the ultimate goal of dramatically improving people's quality of life while protecting the environment.

In order to achieve this mission, we must prioritize our efforts to focus on a clean energy technology that is *affordable* and *safe*.

The Engineering Test Unit (ETU) 1.0

- **What?**
  - A non-nuclear, un-enriched, Flibe-wetted and isothermal integrated test for principal Systems, Structures and Components (e.g., Reactor Vessel, Primary Salt Pump, Pebble Handling and Storage System, Control Rod Drive Mechanisms, etc.)
- **Why?**
  - Design, Build, Test: Demonstrate design and integration of principal KP-FHR technologies
  - Operations: Accelerate operating experience base of large-scale Flibe facility and initial plant operations
  - Supply Chain: Initiate and exercise supply chain for KP-FHR specialized components and materials. Gather data on lead times and inform vendor selection for future iterations.



ETU 1.0

Characteristics

- **ETU 1.0 Characteristics:**
  - Vessel close to Hermes in scale
  - 30,000 solid graphite pebbles
  - One shutdown element, one control element
  - One primary salt pump
  - Single pebble insertion and extraction line
  - Included Inert Gas, Chemistry Control
  - ETU 1.0 constructed in place
- **Operation & Commissioning**

Engineering Test Unit

Albuquerque, NM

Graphite Reflector Installation

Entrant Training

Control Room

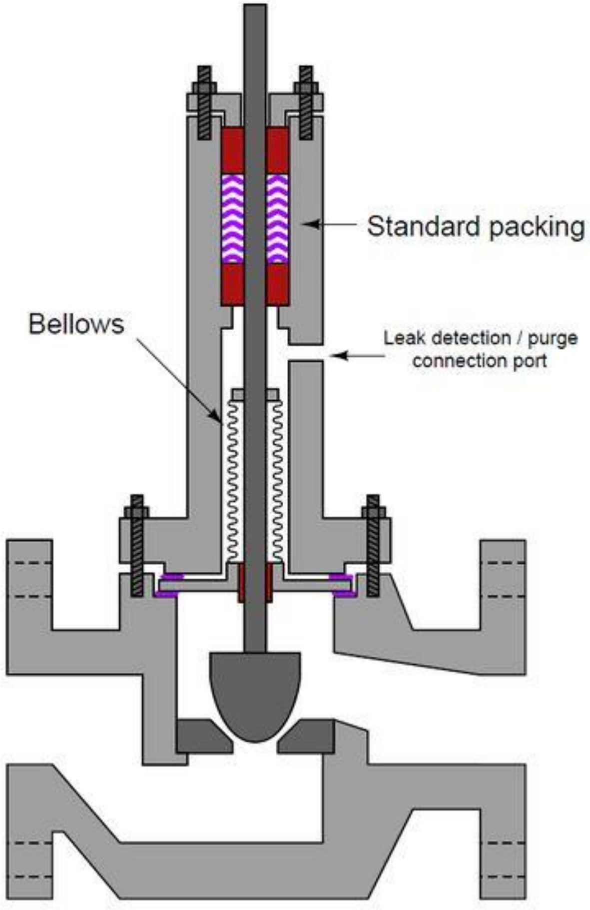
Commissioning

Mechanical Salt Valves

- Commissioning opportunities
  - Verify component/system functionality prior to Flibe operations
  - Supported by parallel lab testing

- Mechanical salt valve
  - Reliability challenges
  - Needed for fast actuation times
    - e.g., halting a siphon

- Galling/Self-welding
  - Diffusion bonding
  - High temperature, high contact stress
  - Seat/plug or stem/backseat



Representative Valve

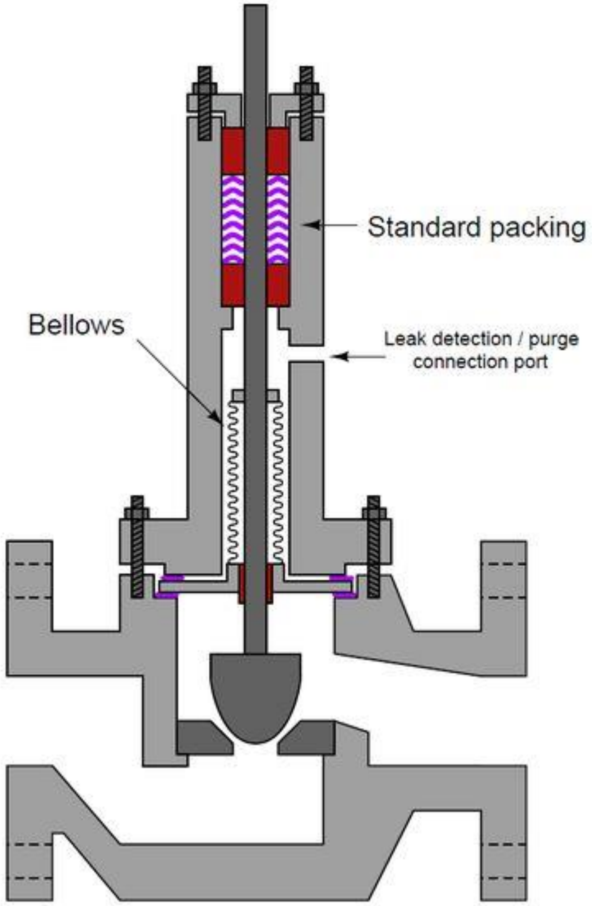
Commissioning

Mechanical Salt Valves

- Identified as a risk going into ETU 1.0

- Self-welding/galling factors
  - Material selection (avoid similar materials)
    - seat, plug, stem
  - Time
  - Temperature
  - Contact Stress

- Initiated lab test campaign to evaluate factors across a wide range
  - Cycling of valve in Flibe
  - > 3,000 valve strokes
  - Varying closure times
  - Friction force calculated
  - Leak check for seat integrity



Representative Valve

Commissioning

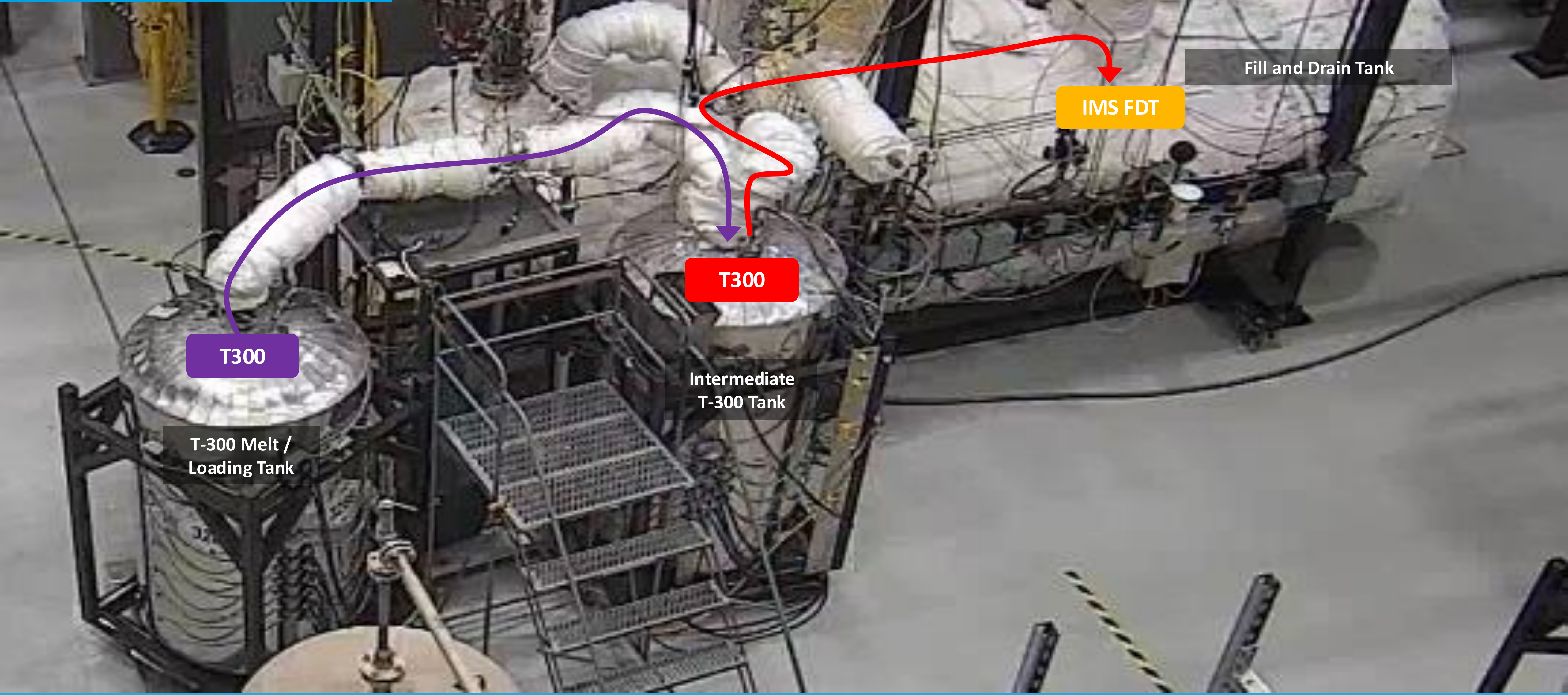
Mechanical Salt Valves

- Received a set of recommendations for optimal valve configuration
    - Adjusted actuator pressures in-field, during commissioning
    - Implemented a protocol for regular cycling of valves
    - Implemented procedures for allowable operating temperatures for valves
- Some sticking behavior encountered during operation
    - But no permanent self-welding observed
- Improvements being made for in-house mechanical salt valves in ETU 2.0
    - Health monitoring program

Self-Welding Test Stand

Salt Transfer Process

OCT. 22ND, 2023: LARGEST FLIBE TRANSFER SINCE 1969
Duration: 5:53PM – 6:31PM
Total Flibe Mass Transferred: Appx. 3,000 kg

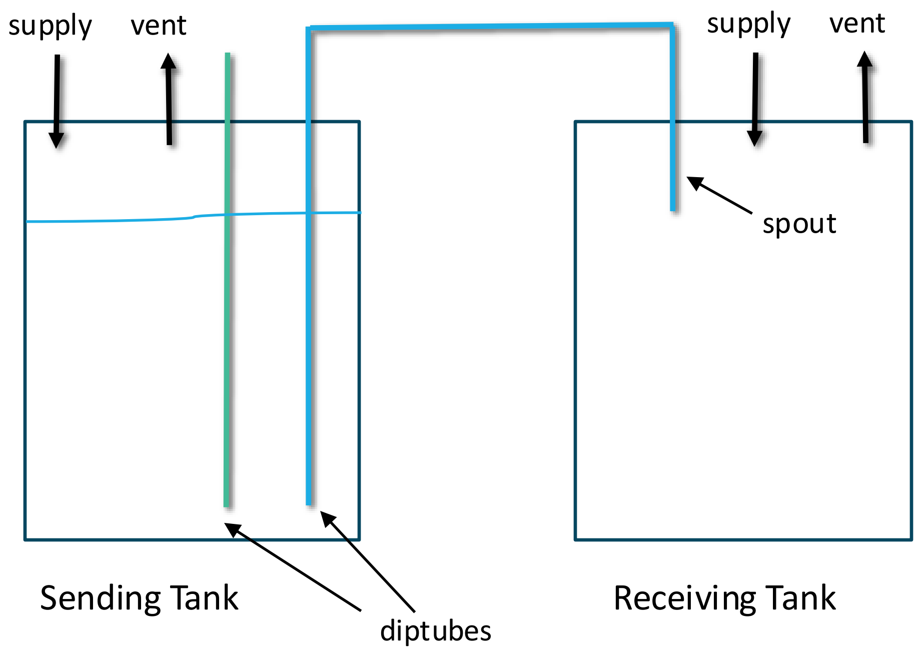


Operation

Salt Transfer Lessons Learned

- Ideal filter sizing identified
  - Salt transfer speed vs filtering capability
- Encountered some buildups in argon lines
  - Splashing and vapor deposition mitigation
- No unintended salt transfers during loading or unloading operations
  - Passive protection is ideal
- Vacuum-assisted salt transfers proved to be useful
- Anything that can become a diptube should be treated as a diptube
  - Lab testing experience

Typical Salt Transfer Setup



Operation

Freeze Valves

- Advantages
  - Avoids mechanical salt valve reliability challenges
  - Simple component, no moving parts
- Challenges
  - Need sufficient salt to remain in trap
  - Freeze valve de-priming
    - Allows gas communication between volumes
    - Requires another priming operation to correct
- Solutions
  - Freeze valve orientation & geometry
  - Salt transfer speed (argon flowrate)

ETU 2.0

The Next Iteration

- 588 OEs documented from ETU 1.0 build, commissioning, and operations
- Evaluating lessons learned
  - Lab scale testing of pebble circulation
  - Eliminating pebble jamming points
  - Testing new pebble detection methods
- Extending vertical integration
  - In-house design & assembly of mechanical salt valves
  - In-house vessel manufacturing
- Modular skid-based construction

Pebble Circulation Test