

ET Summit 2023

Presented by



A Near-Zero GWP Heat Pump System for All-Electric Heating & Cooling in California

EPC-19-014

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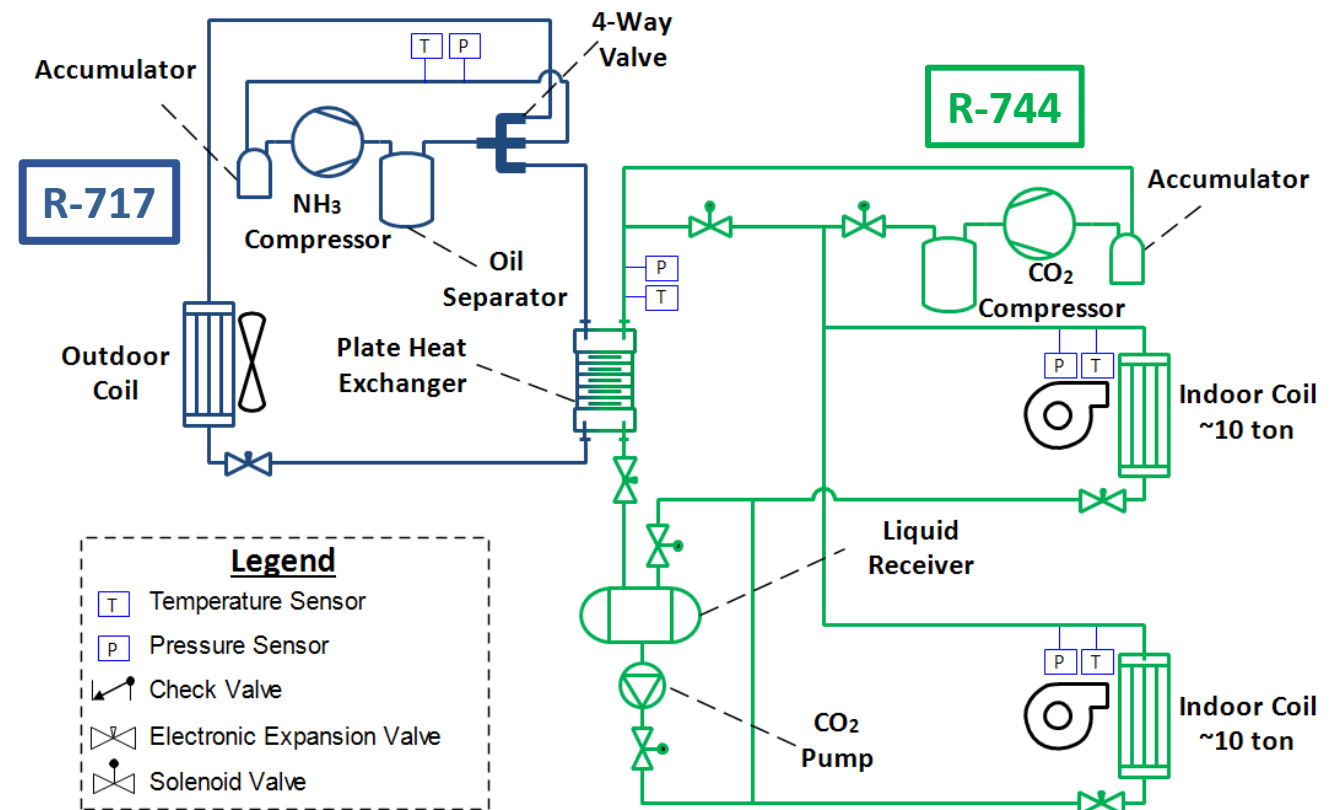


Project Goal & Objective

- Goal
 - Demonstrate the performance and cost effectiveness of a novel NH₃ / CO₂ reversible heat pump for small commercial and multi-family applications
- Objectives
 - Design, optimize, and evaluate a prototype of the heat pump in the lab
 - Deploy production units in California climate zones
 - Conduct measurement and verification of the field units for at least **9** months of operation

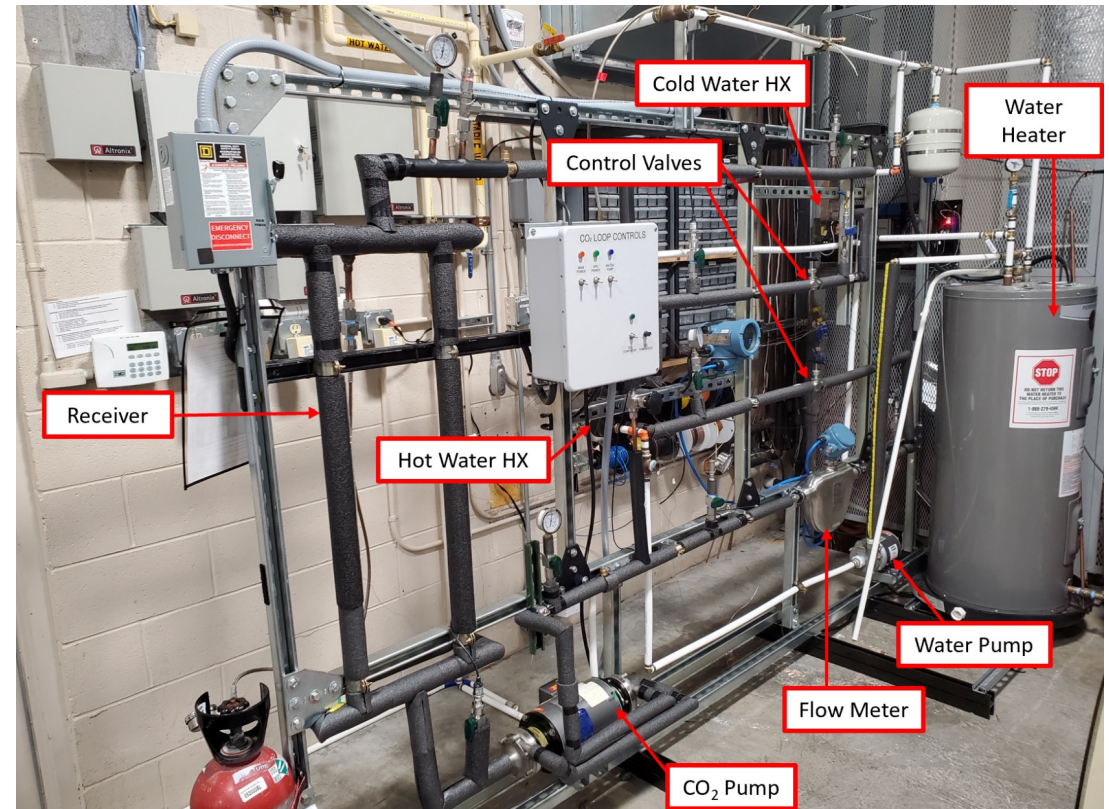
System Schematic

- R-717 (NH₃) must be isolated outdoors
- R-744 (CO₂) is efficient in cooling but has challenges in heating
 - Supercritical fluid
 - Low lift, lower efficiency



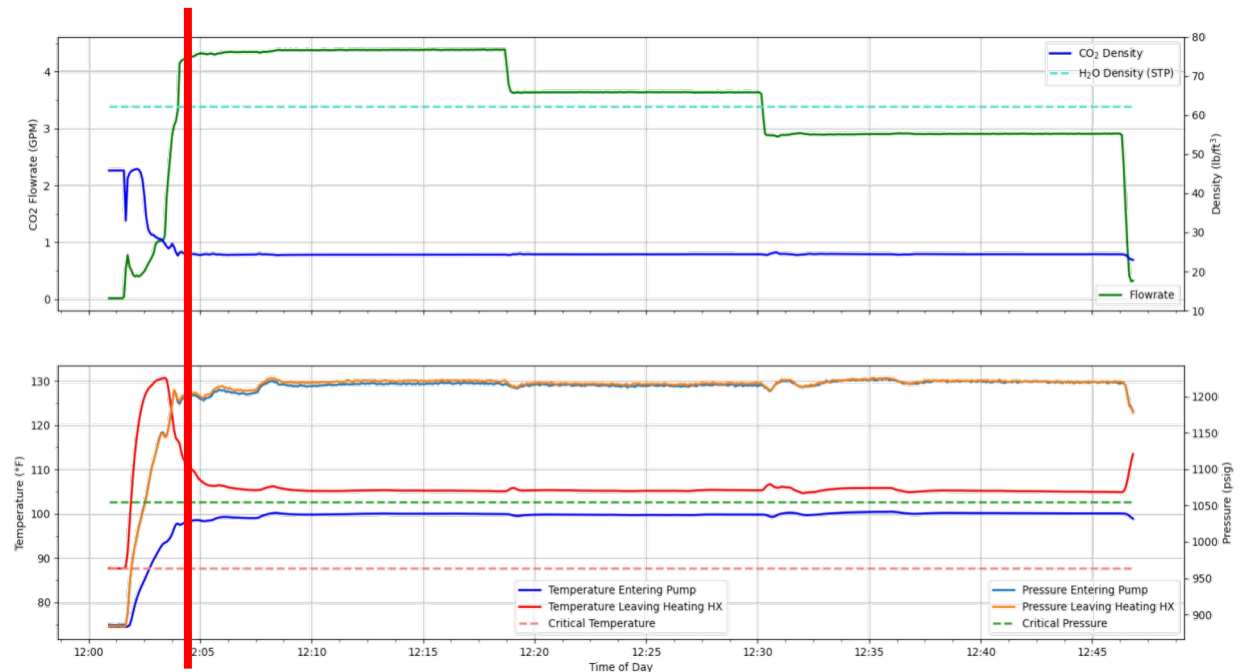
“Pumping” Supercritical CO₂

- Mimic heating mode of heat pump
- CO₂ pump is rated to handle high pressures
- Needle valves and heat exchangers act together for heat transfer and pressure drop



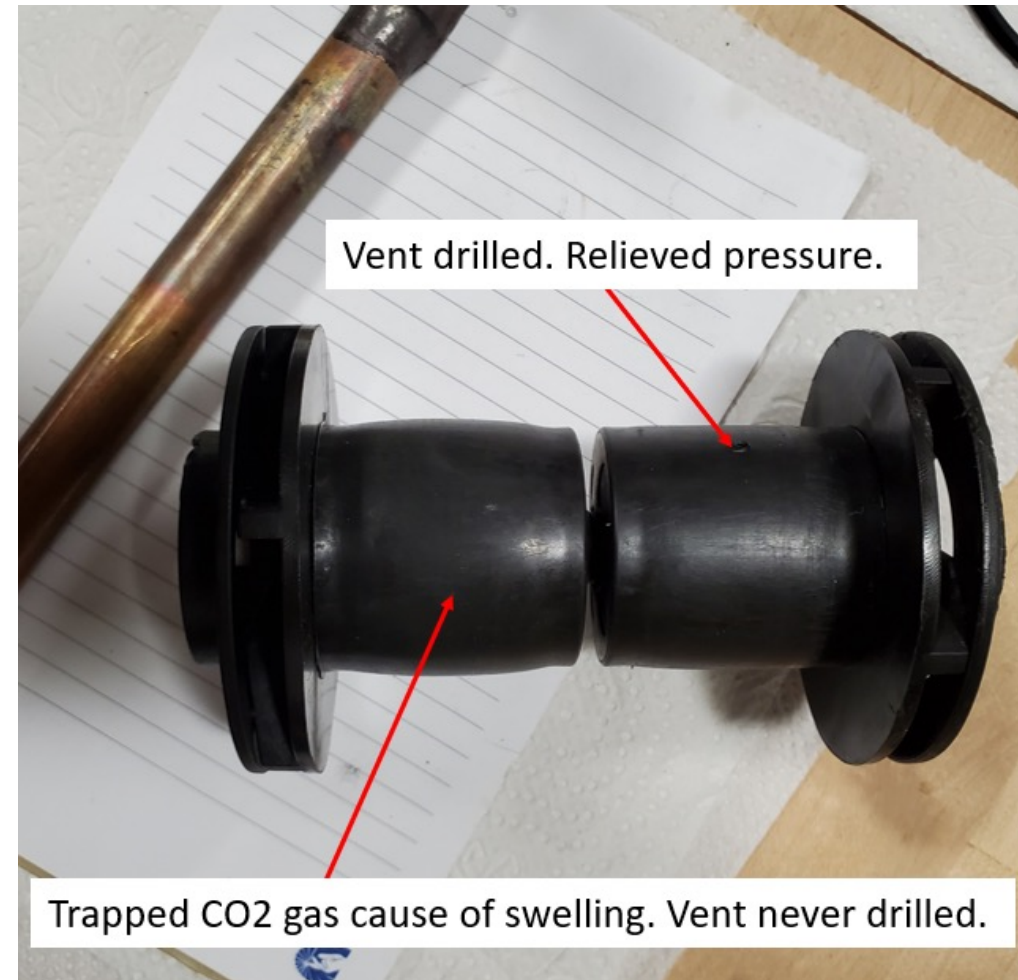
Learnings on Pumping Supercritical CO₂

- Pumping of supercritical CO₂ was successful
- Moving about 7 kW_t (2-ton) at 150 W_e to 200 W_e
 - 6.5 kW_e average rated power for CO₂ compressor
 - Need 70.3 kW_t (20-ton) for the heat pump



Learnings on Pumping Supercritical CO₂

- Trapped gas within impellers expanded and deformed when venting
 - Vents are added on components
- No noticeable damage to impellers after testing
 - Long-term testing needed



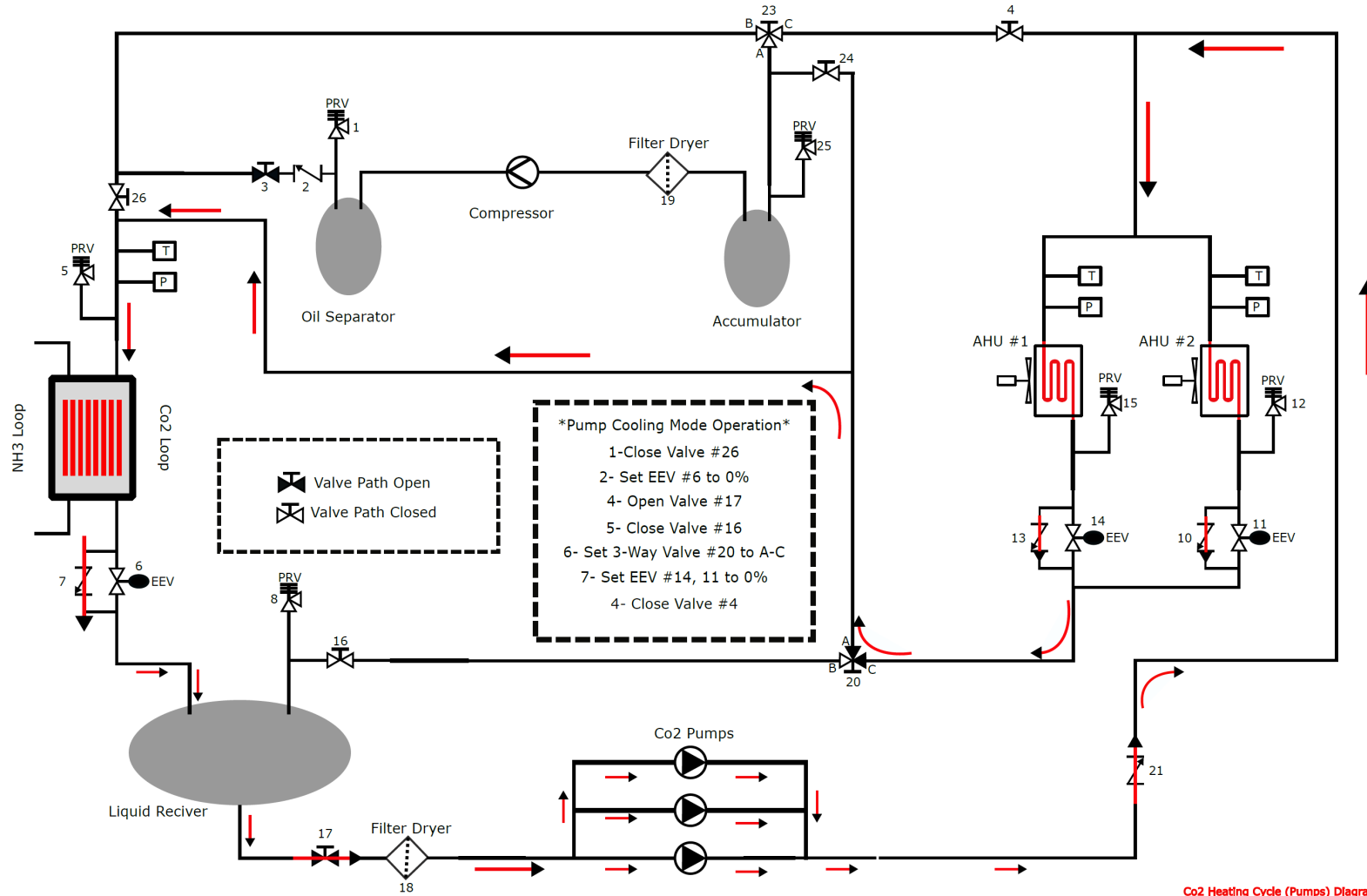
Hysave comments on O-rings

Laboratory Prototype

- Constructing 20-ton prototype in laboratory



Laboratory Prototype (Pump Mode)



Co2 Heating Cycle (Pumps) Diagram

Next Steps

- Field demonstrations
- Optimizing CO₂ loop heating capacity
 - Increasing temperature difference
 - Overspeed CO₂ pump
 - Adjust CO₂ charge

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