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Liquid Cooling System for Battery/Electric Testbed

Richard Hainey[1], Leighton Gay[1], Josiah Worch[1], Kerry Sado[2], H.J Fought[2], Austin R.J. Downey[1], Jamil Khan[1]

[1]University of South Carolina, Department of Mechanical Engineering

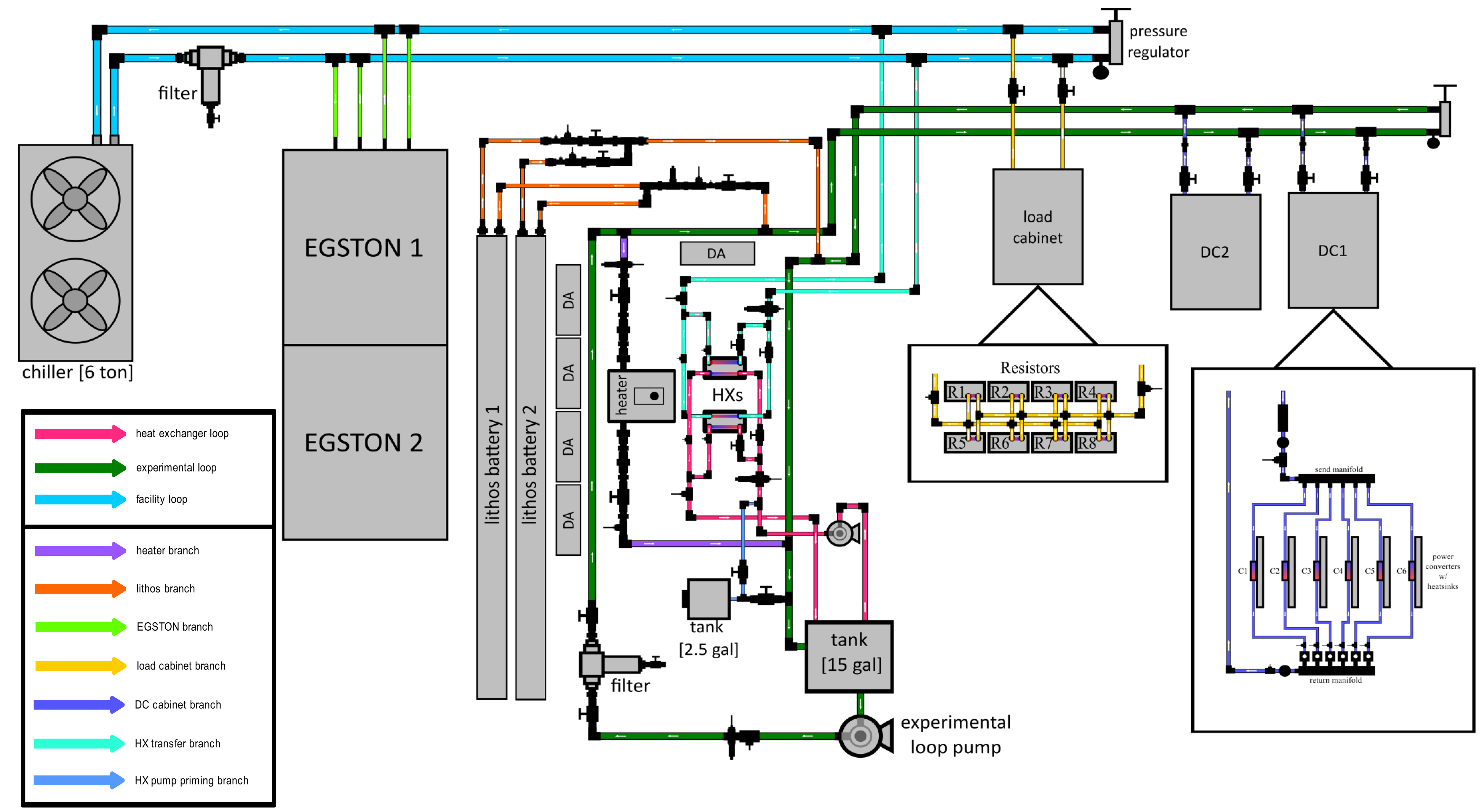
[2]University of South Carolina, Department of Electrical Engineering

SCEPTER LAB Cooling Network

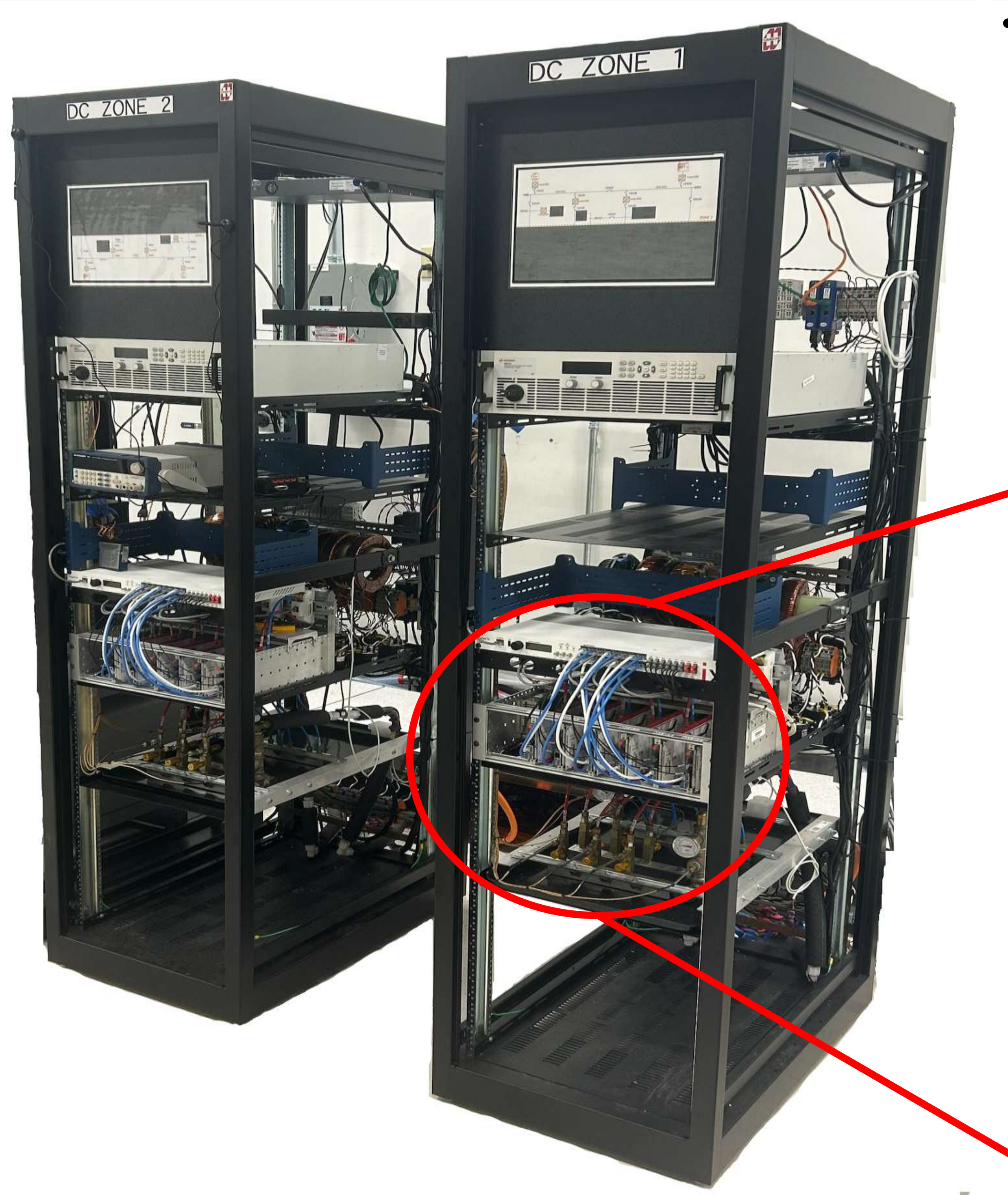
- The SCEPTER [South Carolina Energy and Power Testbed for Engineering Research] lab cooling system is a collection of interconnected cooling loops designed to maintain the effective cooling of the equipment in the lab.
- The system consists of three cooling loops: experimental, facility, and heat exchanger.
- **Experimental loop**:
  - ❑ Supplies coolant [propylene glycol water mixture] to power electronics within the DC cabinets.
- **Facility loop**:
  - ❑ Supplies coolant to EGSTON power amplifiers, load cabinet, and equipment not used in experiments.
- **Heat exchanger loop**:
  - ❑ Circulates coolant from experimental loop through heat exchangers to transfer heat to the facility loop.
  - ❑ From here heat is expelled out to the local atmosphere through liquid to air heat transfer.

Testbed Coolant Network Diagram

- **Heat exchange between cooling loops**:
  - ❑ After heating, coolant within the experimental loop [dark green] returns to the 15 U.S gallon tank featured in the right-side diagram.
  - ❑ This heated coolant then travels through the heat exchanger loop [pink loop]. Here it enters two 24k BtuH brazed plate heat exchangers.
  - ❑ Heat transfer occurs between this loop and the HX [blue green] branch. This branch connects into the facility loop.
- **Heat removal from testbed:**
  - ❑ Heat is expelled from the testbed via the, six-ton cooling capacity, chiller into the local environment.
- **Heat addition into testbed:**
  - ❑ Heat is added to the testbed via the heater, DC cabinet converters, load cabinet, EGSTONs, and centrifugal pump via impeller inefficiencies.

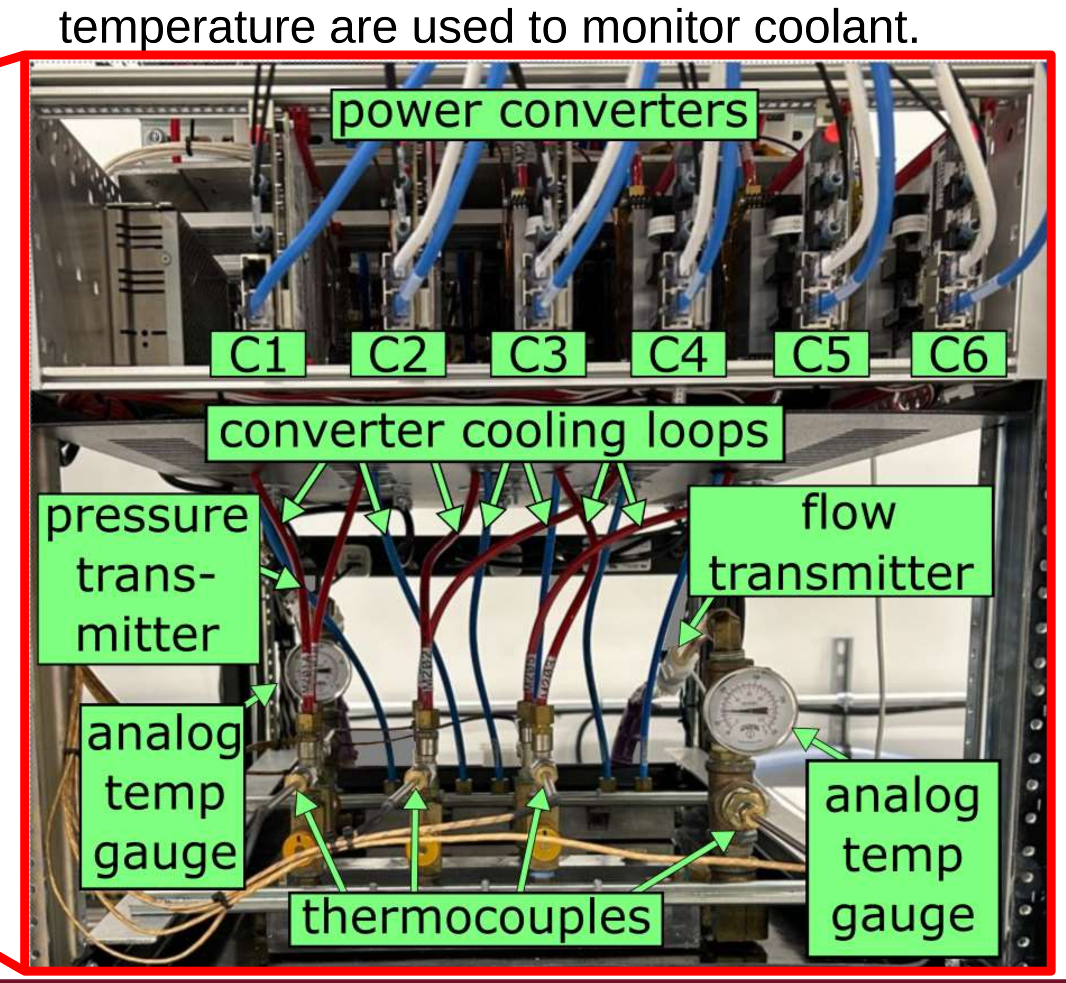


DC Cabinets

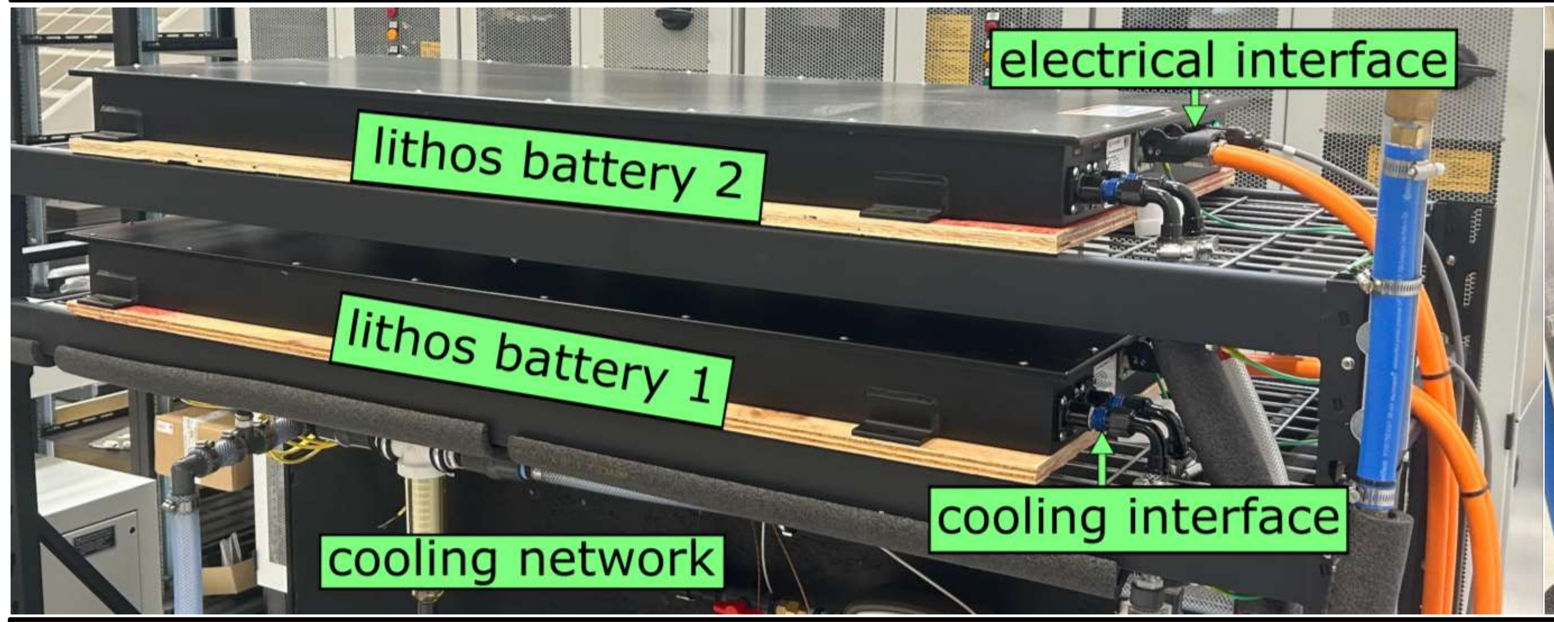


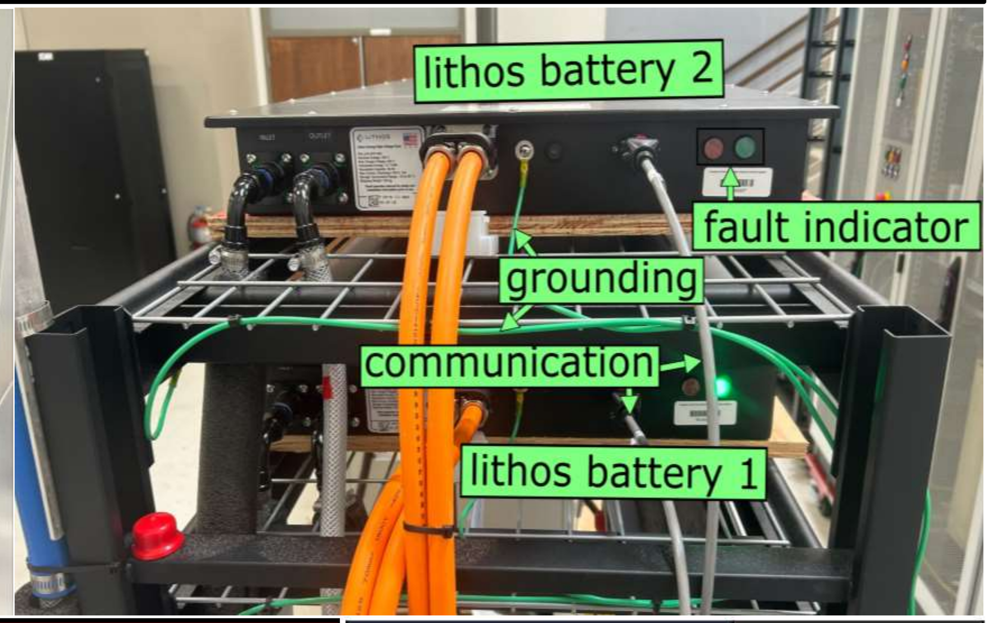
Power Converters

- **Waste heat production in converters**:
  - ❑ Waste heat generated by the power converters is removed via coolant flowing through cooling chambers within cooling blocks installed in converters.
  - ❑ Coolant distribution is controlled via the manifold network below.
  - ❑ Gauges and sensors for pressure, flow, and temperature are used to monitor coolant.



Lithos batteries





DC Cabinets/ Lithos Functionality

- The DC cabinets house the main electronic suites used during testing.
- Features six individual power converters per cabinet, for a total of 12.
- Control for these cabinets is through a nearby operations area where operators manipulate power input via generators and the Lithos batteries featured above.
- Minimum flow requirements is 0.33 gpm per set of converters.
- Waste heat generated by the power converters is removed via coolant flowing through cooling chambers within cooling blocks installed on the converters.
- Featured right is the specifications for the Lithos batteries.
- Minimum flow requirements for the Lithos batteries is one - two gpm per battery.

Nominal Voltage, V	350
Operating Voltage, V	240-403
Nameplate Energy, kWh	12.7
Nameplate Capacity, Ah	36
Cont. Discharge Current, A	150
10s Pulse Current, A	300
Std Charge Current, A	18
Max Charge Current, A	48
Cycle Life*	500
Mass (dry), kg**	100
Cooling System	Liquid Cooled
Environmental Protection***	IP67
Cell Discharge Temp, °C	-10 to 65
Cell Charge Temp, °C	0 to 65
Recommended Storage Temp, °C	-30 to 65
Maximum Storage Temp, °C	5 to 25
Passive Safety Features	Individual Cell Fuses
	Pack Fuse
	Safety Vent
BMS Features	X Form Contactor
	Pre-charge Circuit
	Passive Balancing
	Cell Temp. Sensing
	Isolation Monitor

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