

## Objective

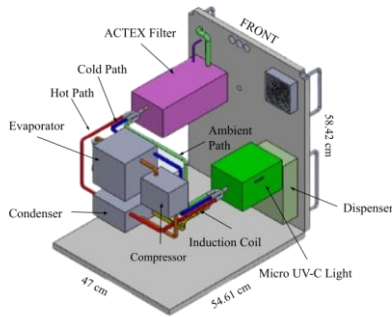
The EPWD provides future astronauts with on-demand hot and cold water for daily food and beverage needs from a single system. By emphasizing safety, efficiency, throughput, minimal waste, and minimal cleaning, the EPWD fits within NASA's vision for sustained explorations of the Moon and eventually Mars.

## Solution

Hybrid heating elements and a miniature refrigeration cycle regulate water temperature between 4 and 93 °C. Water is filtered and disinfected by an ACTEX filter and micro UV-C light, while an integrated command and data handling system supports an enhanced user interface.

### Key Specifications

Mass	30.623 kg
Cost (Flight Unit)	\$2.6 Million
Peak Power Draw	~488 W



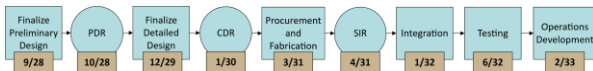
## Safety

Multiple sensors within the system monitor the internal temperature, ready to shut down the system once temperature limits are reached. Additional safety features include an abort button, a fire port, and rad-hard electronics.

## Budget

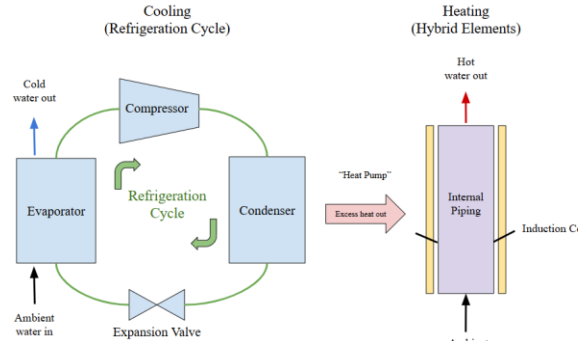
Expected Flight Unit Cost: \$2.60 Million (USD)  
 Total Expected Program Costs: \$35.26 Million (USD)

## Implementation Plan



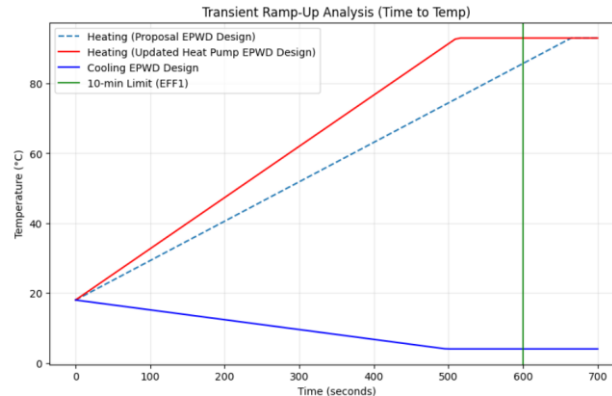
## Temperature Control

The EPWD utilizes an integrated heat pump architecture that pairs non-contact induction heating with a miniature refrigeration cycle via a Brazen Plate Heat Exchanger. By recovering 157.3 kJ of condenser waste heat to pre-heat the water line, this design reduces cycle energy consumption by 35%, slashes ambient cabin heat emissions by 81%, and accelerates the thermal ramp rate to safely deliver 4°C and 93°C water within 8.5 minutes.



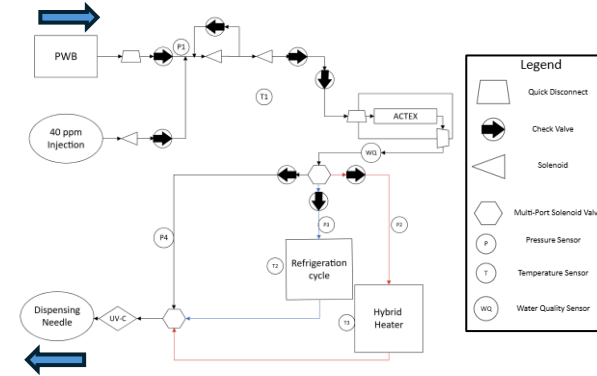
## Thermal Analyses

Process	Cooling	Heating	Combined
Energy Consumption [Wh]	10.9	145.9	156.8



## Fluid Flow

The Fluid Transporting System uses 265 cm of 6.35 mm diameter 316L stainless steel tubing, selected for its durability, smooth surface, and compatibility with iodine disinfection to minimize biofilm formation. Driven by a 230–280 kPa pressure gradient from the upstream Water Recovery System, the design eliminates pumps and achieves an estimated flow rate of 756 mL/min, a 9.24% improvement over the current system.



## Fluid Analyses

Water Temperature	Cold	Hot	Ambient
Throughput [mL/min]	756.0	765.3	754.7

