# HEC11: DEHYDRATION OF REACTANTS FORIMPROVED ENERGY RELIABILITY (DRIER)

Department of Mechanical Engineering, UT – Tyler • Senior Design Project 2026–2027
Danyon Attaway • Logan Booke • Alexander Gonzalez • Lucas Mancuso • Lino Sandil
Sponsor: Dr. Kerrigan Cain NASA & TSGC • Advisor: Dr. Mohammad Biswas

## Background

NASA's regenerative fuel cell produces hydrogen and oxygen with residual liquid water. On the lunar surface, that water can freeze during storage, obstruct flow paths, and reduce energy reliability. DRIER develops a passive first-stage separator: a catch can for the hydrogen stream and a vortex chamber for the oxygen stream. The system is designed for lunar gravity, high pressure, and extreme temperatures without moving parts or continuous electrical power.

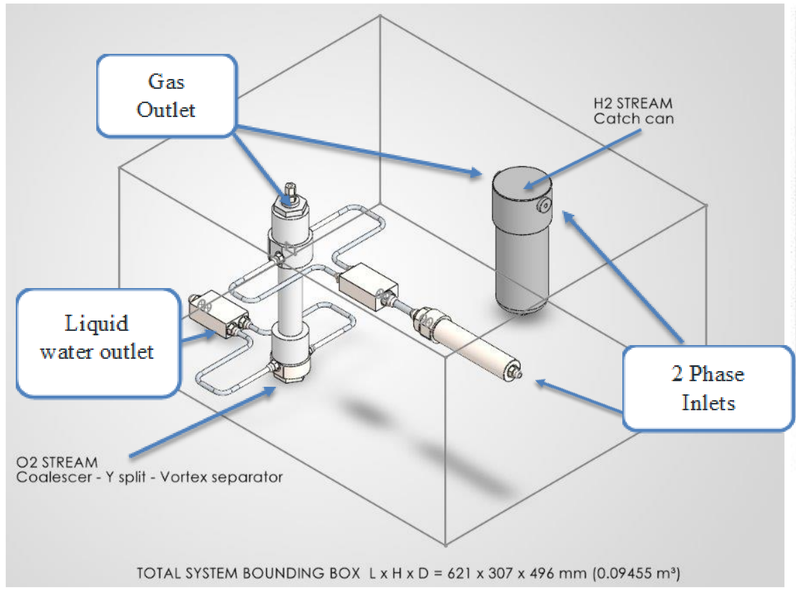
## Concept Statement

Design and assemble a first-stage phase separator that removes liquid water from hydrogen and oxygen streams in a regenerative fuel cell—preventing ice formation and improving the reliability of lunar energy storage.

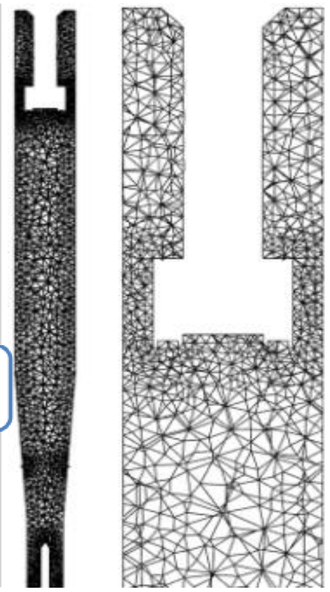
## Design Specifications

| Specification | Requirement |
|---|---|
| Total separator mass | Maximum 30.0 kg |
| Bounding-box volume | Less than 1.0 m³ |
| Power consumption | Less than 1.0 kW |
| Projected service life | Greater than 4,500 operating hours |
| Outlet water concentration | Maximum 6,033 ppmv |
| System liquid flow rate | Maximum 3.0 L/min |
| $O_2$ / $H_2$ liquid flow | Maximum 3.00 / 0.06 L/min respectively |
| $H_2$ and $O_2$ gas flow | Maximum 26 g/hr / 200 g/ hr respectively |
| Operating pressure | Maximum 2,500 psia |

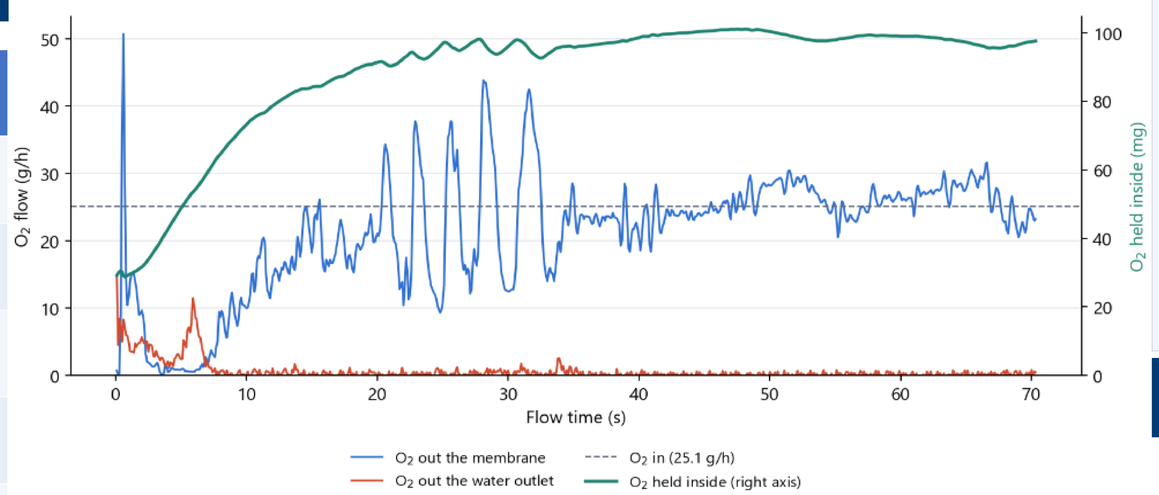
## Total System Design



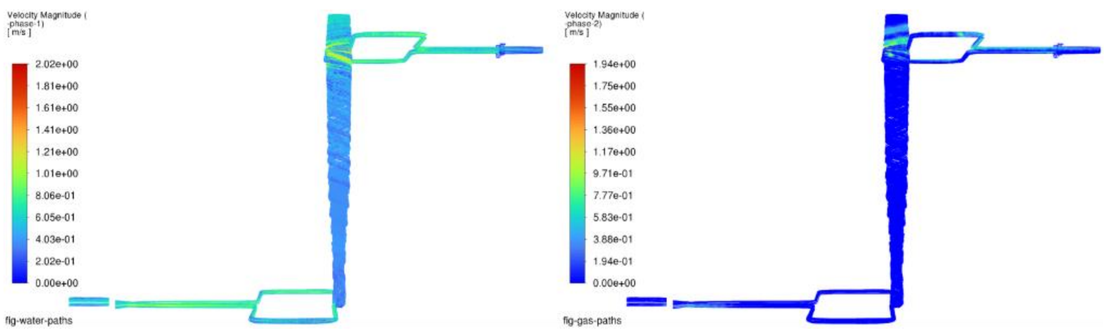

## Mesh



## Chart of O2 Against Time




## Gas Path in O2 Stream




## Catch Can — $H_2$ Stream

**99.9%**
Liquid retained in all three CFD operating cases

**779–2,749 ppmv**
Predicted $H_2$ outlet moisture — below the 6,033 ppmv requirement

**292 mL**
Catch-can liquid capacity; 307–1,208 seconds of hold-up

## Vortex Chamber — $O_2$ Stream

**Less than 1%**
Predicted oxygen loss through the liquid drain

**0.16–1.56 psi**
Predicted pressure drop from low to maximum flow

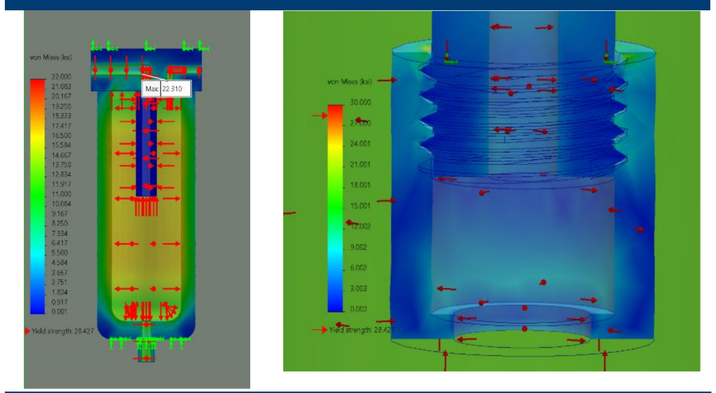
## Conclusion and Next Steps

**Passive Separation**
Two-stage system removes water from $H_2$ and $O_2$ without moving parts or continuous electrical power.

**Performance**
CFD predicts full catch-can liquid retention, zero oxygen loss through the drain, and low pressure drop under lunar-gravity conditions.

**Structural Safety**
Initial FEA shows acceptable stress in most components at 2,500 psia; refinement continues toward the 5,000 psi burst target.

## Catch Can FEA Analysis



## Acknowledgments

Team DRIER thanks Dr. Biswas for his guidance; Dr. Barakat, Dr. Rizvi, and Dr. Abdur-Razzak for their feedback; and Dr. Kerrigan Cain from NASA for providing this project opportunity.

**For Questions: Team DRIER**