

## 1. 2 year Project (\$2M)

## 2. Component Development to enable \$2/kg-H2 by reducing capital cost by 30%

1. Cell/Stack
2. Steam Ejector Fuel Loop

## 3. Project

1. System Modeling
2. CFD/Performance Simulation
3. Experimental (Steam Ejector)

## 4. Deliverables

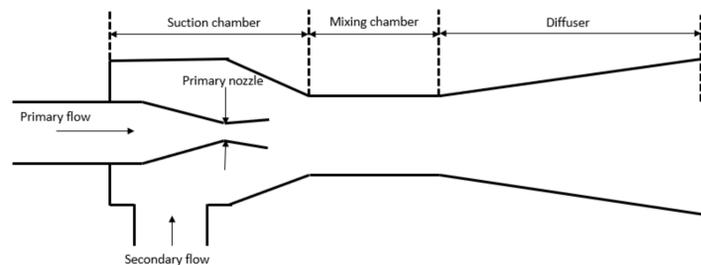
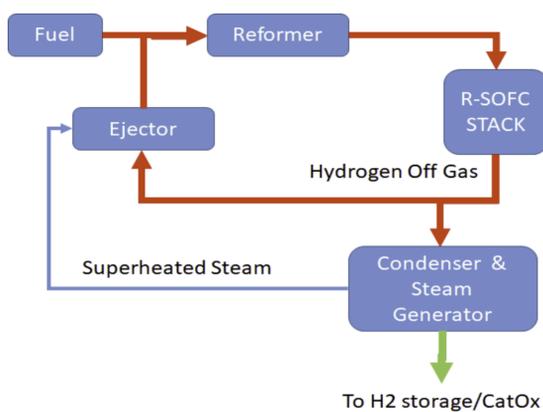
### Phase 1

1. New Cell Design
2. Steam Ejector Design/Test

### Phase 2

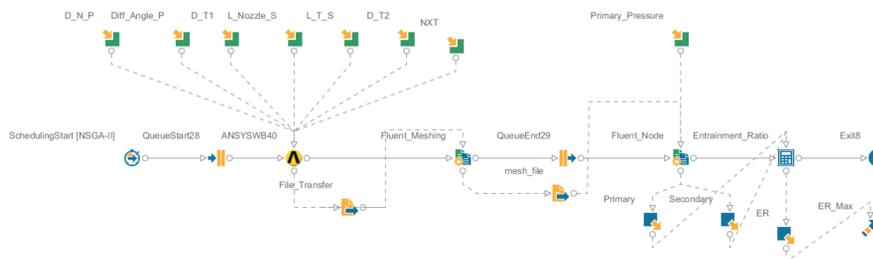
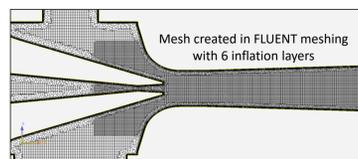
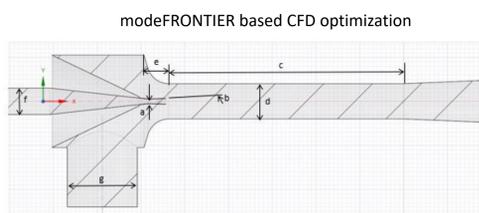
1. Prototype Cell Substrate
2. Steam Ejector Demonstration in hot fuel loop experiment

## Steam Ejector Concept Design

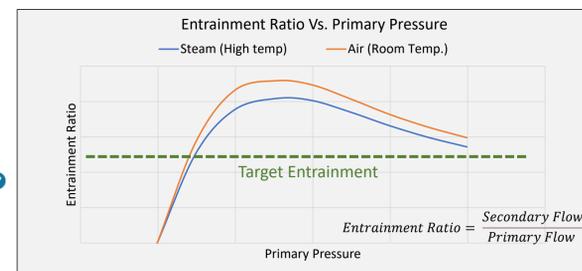


- Eliminates the need for all the hydrogen and fuel gas going through heat exchangers
- Water for steam generation is derived from the non-recirculated off gas slip stream
- Eliminates the fuel blower and reduces system piping
- **Large reduction in cost vs traditional blower approach**
- Improved system efficiency with less parasitic and heat losses
- Improved reliability with no moving parts in the hydrogen/fuel loop

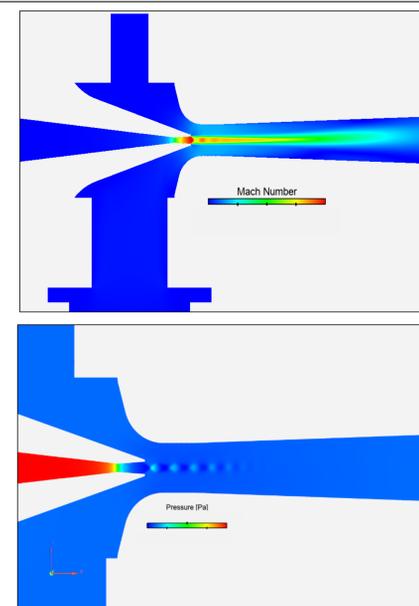
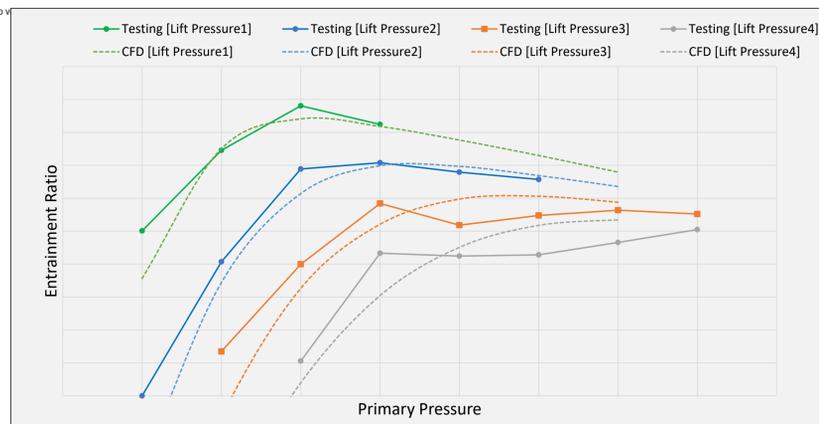
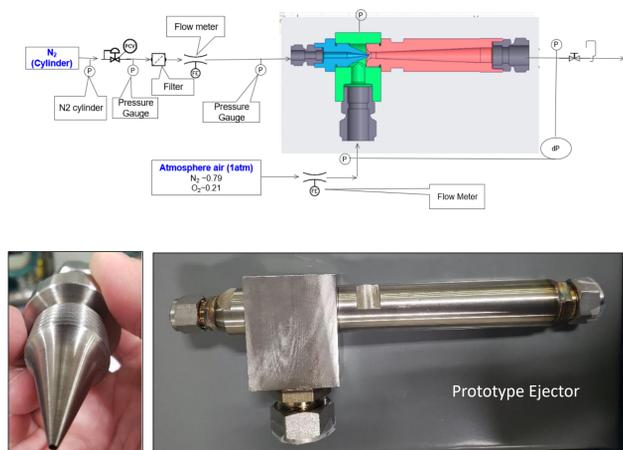
## Automated CFD Methodology



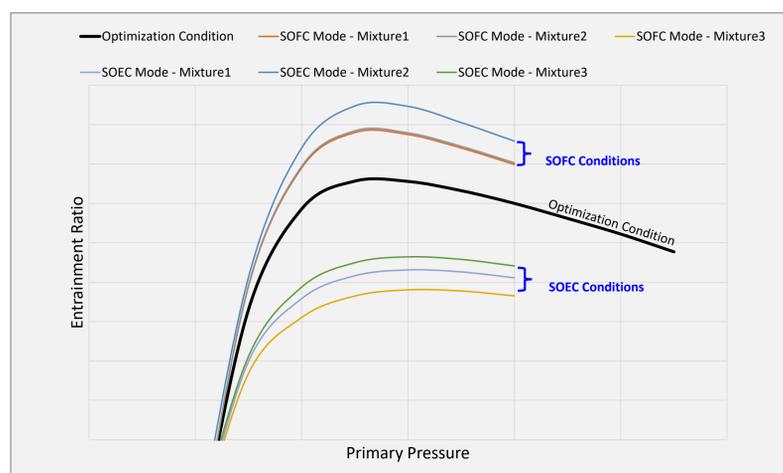
- FLUENT 2022R1
- Mesh count ~ 2.5 million
- Poly hex-core meshing approach is used
- Ideal-Gas density treatment
- Turbulence model (Realizable k-epsilon ) with scalable wall functions
- Coupled Solver with second order discretization scheme for variables
- Compute resources : 192 CPUs on Cummins Internal Server



## Ejector Test Loop & Validation



## Understanding Ejector Operation in Reversible Mode



## Summary

- Efficient use of an automated CFD workflow for design optimization
- Close agreement between CFD model and experimental data
- Key geometric parameters, operating conditions, meshing guidelines, solver setup etc. identified for designing & testing steam ejectors
- Unique experimental setup to validate the design with air & nitrogen at room temperature conditions
- Work in progress to test ejector in high temperature environment integrated with steam generation components