U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

SOLAR ENERGY TECHNOLOGIES OFFICE

SETO CSP Program Summit 2019

Oil-Free, High-Temperature Heat Transfer Fluid Circulator

Mohawk Innovative Technology, Inc.
Award # DE-EE0008374
09/01/18 – 11/31/18
01/09/2019 Date

James F. Walton II, Vice President & Program Manager

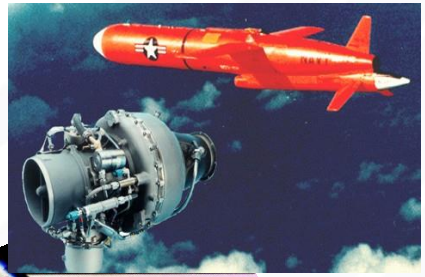
MITI Oil-Free Machinery

25 YEARS OIL-FREE

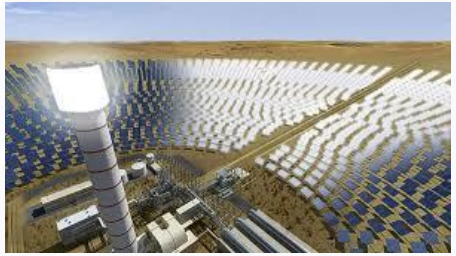
Aerospace
Air Cycle Machines

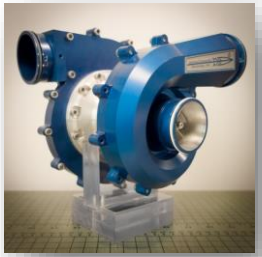
Industry
Air Compressors

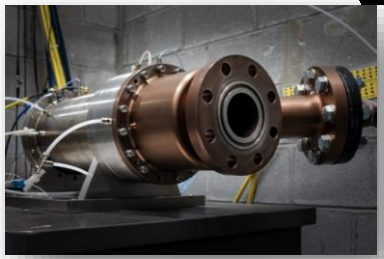
Defense
Gas Turbine Engines

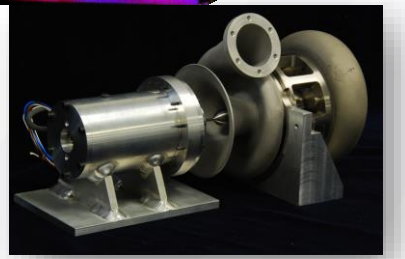


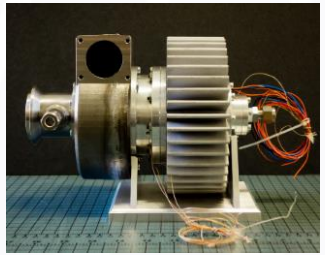
Energy
Turbomachinery











Project Objectives

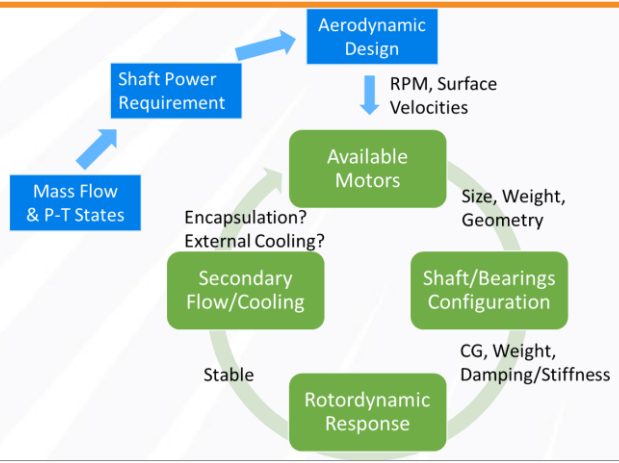
- Develop High-Temperature Heat Transfer Fluid (HTF) Circulator for Gas Phase Pathway CSP Systems
  - 1.5 MWth Thermal Load Prototype HTF Circulator
    - Pressure Rise 1 or 5 to ~50 Bar
    - Inlet Temperature ~550°C w/ potential to 700°C
    - Inlet Pressure 73 to 90 Bar and/or 125 Bar to ~240 Bar
    - Scalable to 100 MWth Commercial System
  - Proof Test
  - Potential Demonstration at DOE Site under Phase III

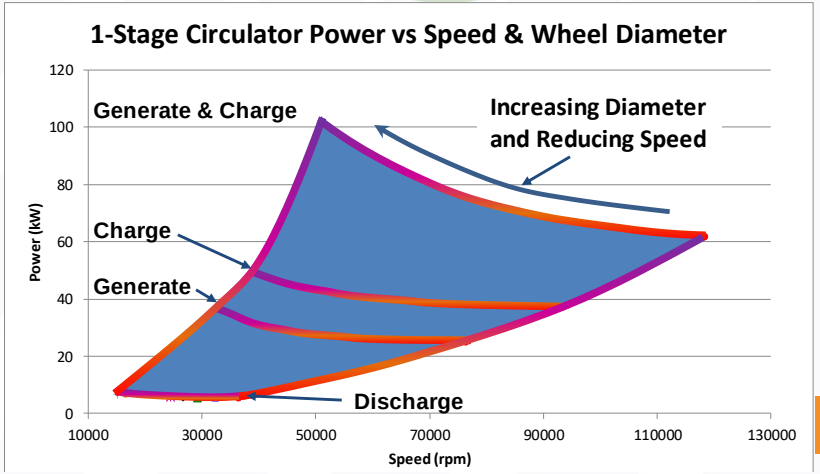
Key Technical Challenge

- Operating Conditions (High Pressures & Temperatures)
  - Accommodate Disparate Operating Conditions
    - High Inlet Temperature and Pressure
    - Inlet & Discharge Pressures Vary 2:1
    - Speed Ratio: 2:1
  - System Design
    - Aero Efficiency/Windage/Bearing Losses
    - Thrust Balance Due to High Pressure
    - Drive System Thermal Management

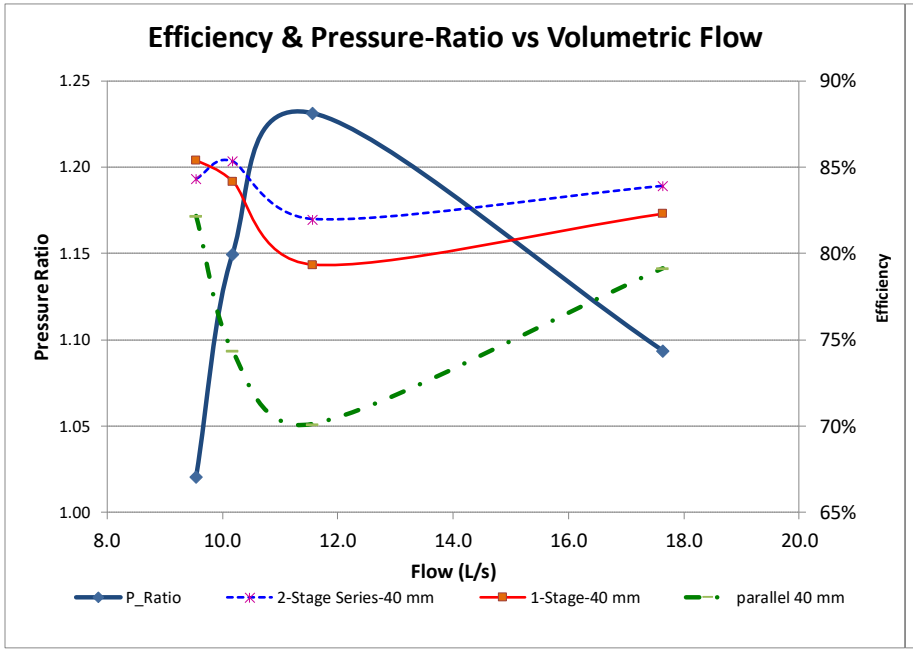
Key Technical Challenge – Solution Approach

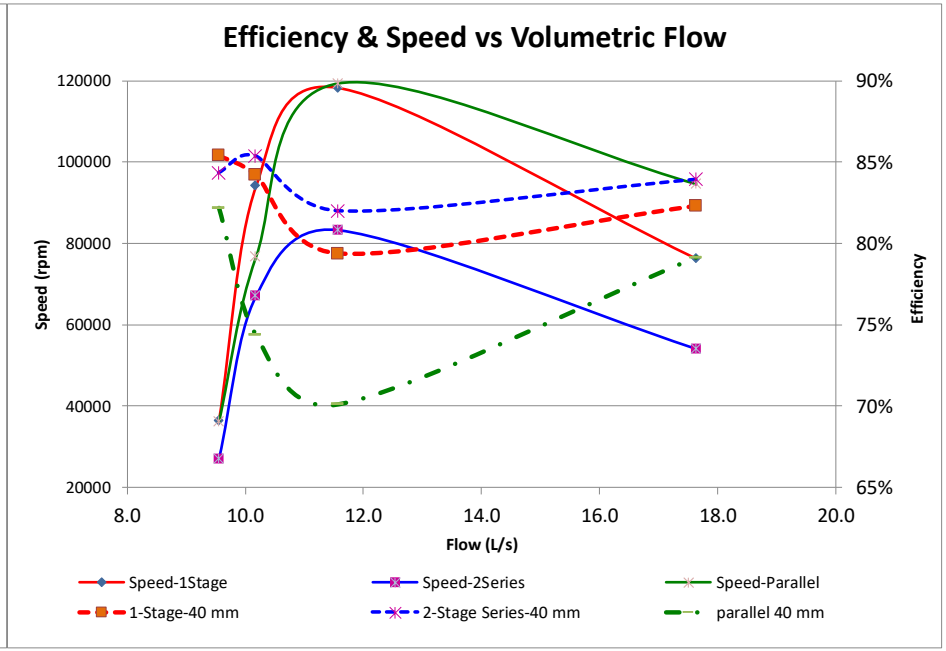
- Holistic System Design
  - Aerodynamic Design
    - Single & Multi-Stage
  - System Tradeoffs
    - Impeller Efficiency
    - Windage Losses
    - Motor Speed & Power
  - Thermal Management
    - Isolate Motor from Hot HTF
  - Thrust Balance Due to High Pressure





Efficiency Comparison for Three Configurations





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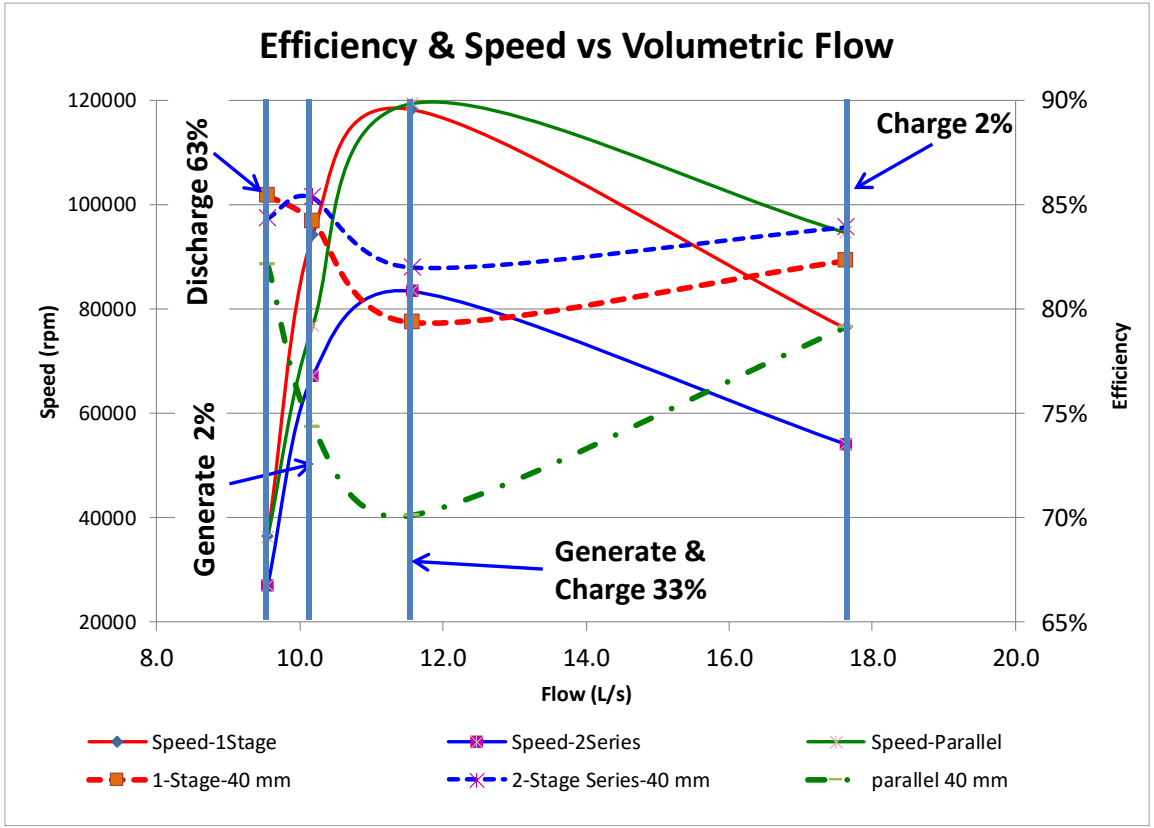
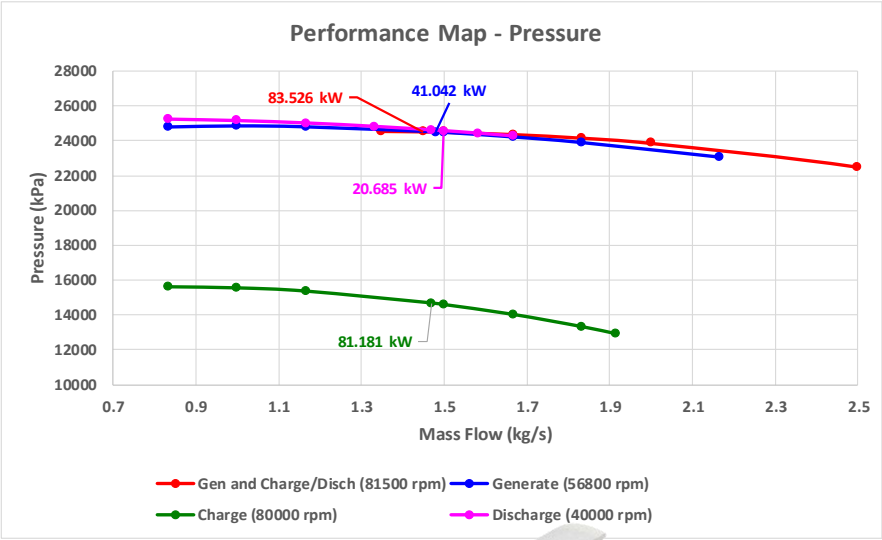
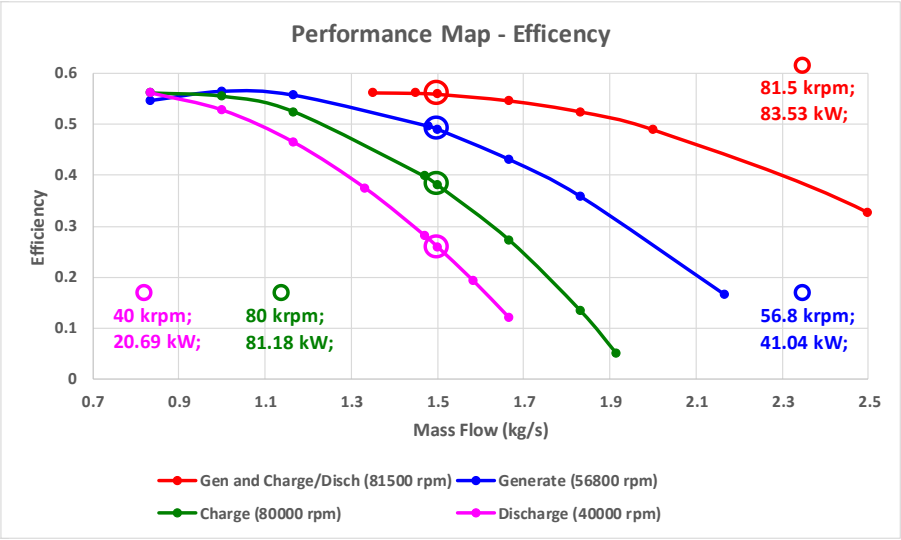


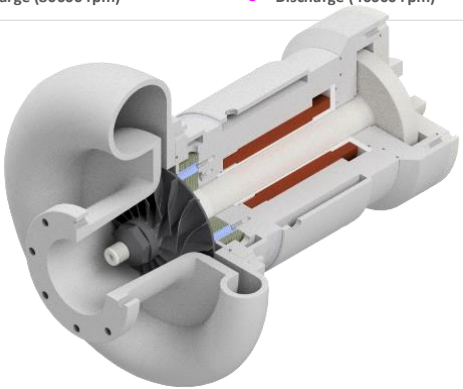
IPLV	Efficiency
2-Stage Series	83.6%
1 Stage	83.3%
2-Parallel	78.0%

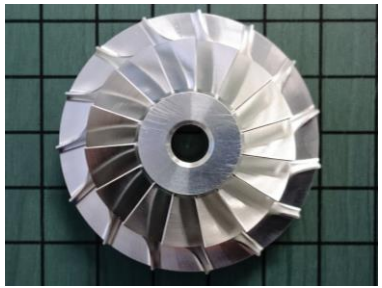
Without Windage. Bearing or Electromechanical Losses

1-Stage Impeller Compression Power vs Speed & Diameter









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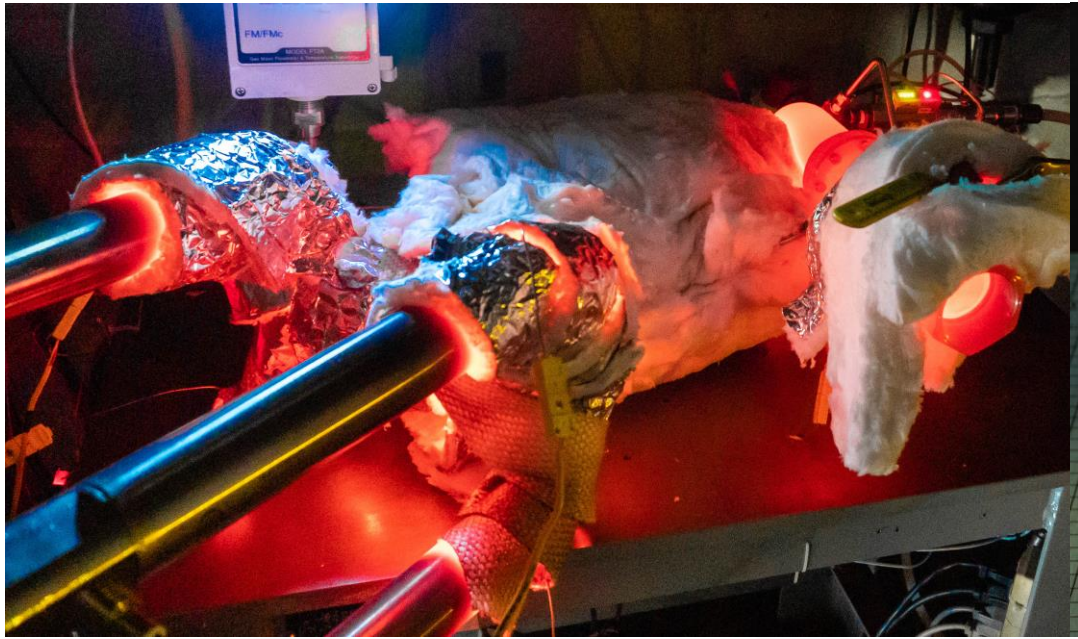
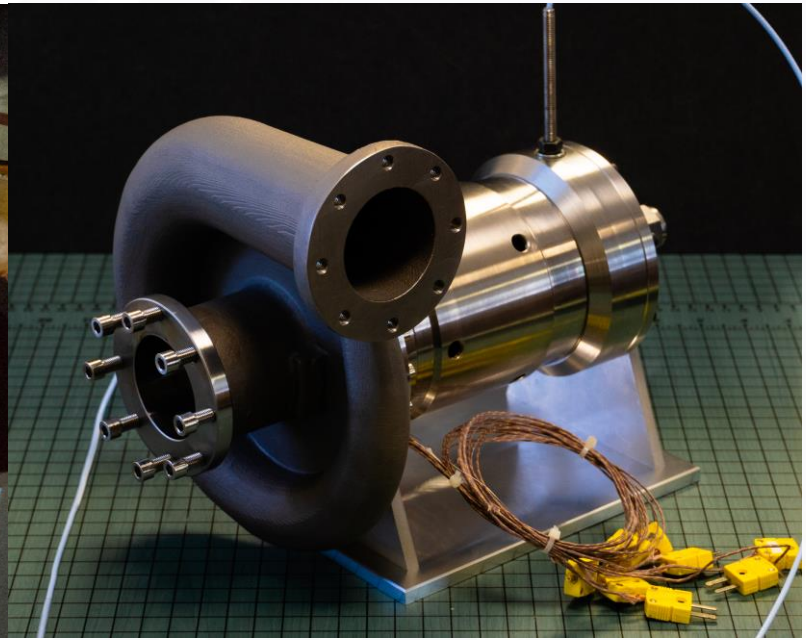
Thermal Management





High Temperature Recycle Blower with 700^{o}C Inlet Air

Successful Project Impact

- High Temperature Circulator/Compressor Developed
  - Enabler for CSP Gen3 Gas Phase Pathway
  - Sized for Pilot Demonstration System
  - Spiral Developments/Applications
    - Other DOE Solar and SCO2 Power Systems
    - High Temperature Recycle Blowers For SOFCs
    - Syngas Processing
    - Kiln Drying (Cement Plants, Wood, etc.)
    - Food and Pharmaceutical Applications