FLEXENERGY
SOLUTIONS

# GT1300S COGENERATION

## UTSR 2019 GAS TURBINE INDUSTRIAL FELLOWSHIP PROGRAM

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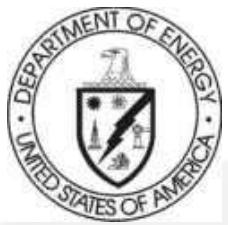


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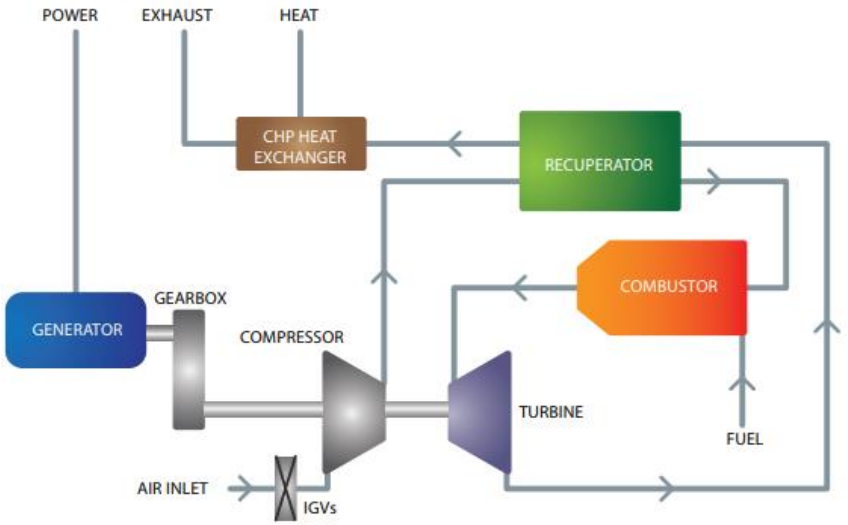
# INTRODUCTION

- FlexEnergy Solutions
  - Engineers and manufactures highly efficient Ultra low emissions recuperated gas turbines and compact high-temperature heat exchangers
- Flex Turbine GT1300S
  - 1.3 MW power output with a LHV electrical efficiency of 33% at ISO conditions
- Market Areas
  - Oil & Gas, Combined Heat & Power (CHP), Landfill Gas Renewable, and Biogas–Renewable CHP

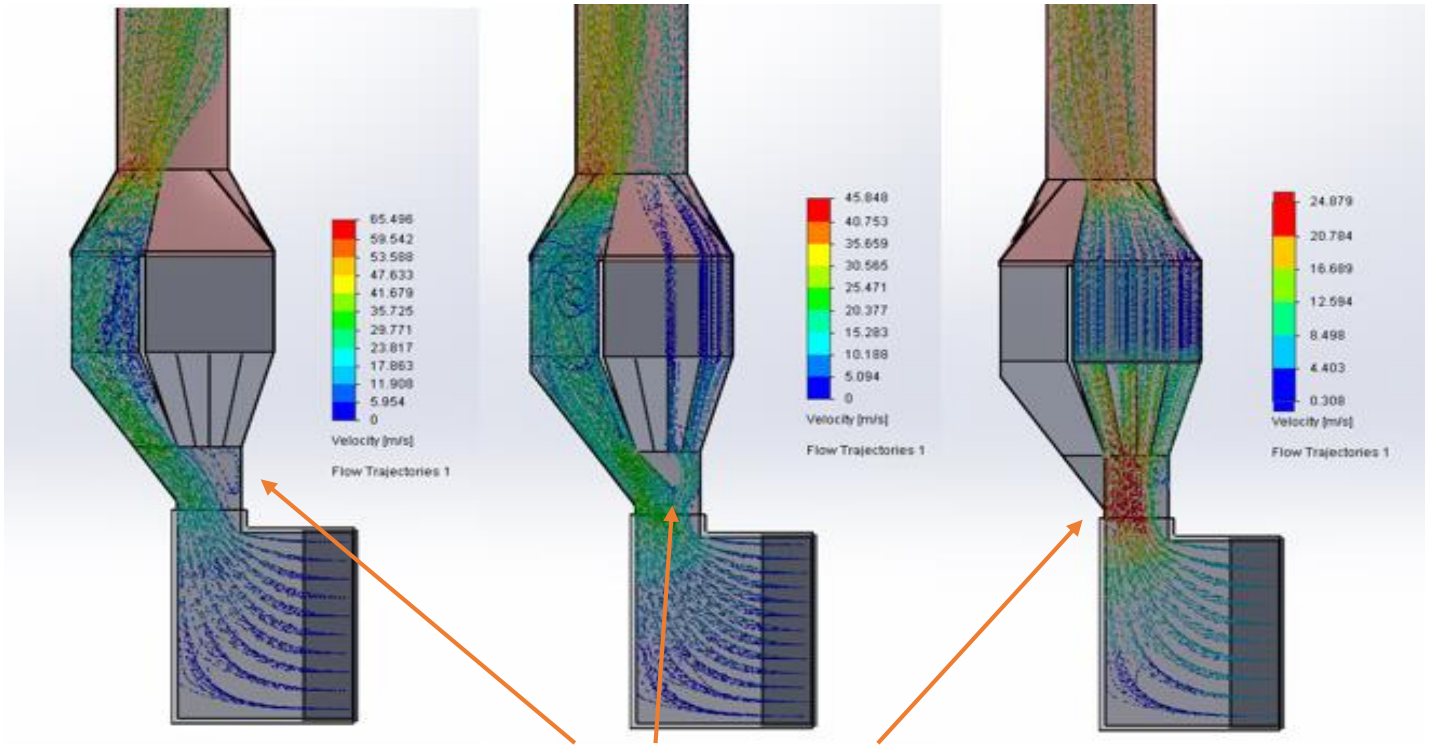
# OBJECTIVE

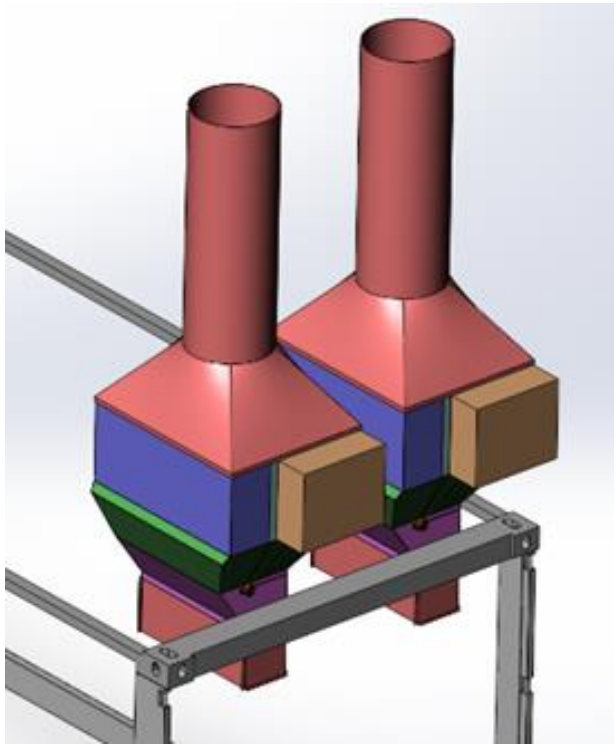
- The Fellowship focused on GT1300S cogeneration application and engine airflow management through simulations
  - Incorporate a multi-pass gas-liquid CHP heat exchanger into the GT1300S package
    - Maximize use of proven FlexEnergy technology
    - Minimize turbine back pressure
    - Customer liquid temperature controllable
    - Mechanically actuated
  - Engine airflow for 4 GT333S turbines
    - Noise reduction engine inlet air duct
    - Low inlet face velocity for reduced particulate ingestion
    - Minimize pressure drop to engine inlet



# SIMULATION RESULTS

- Flow Trajectories

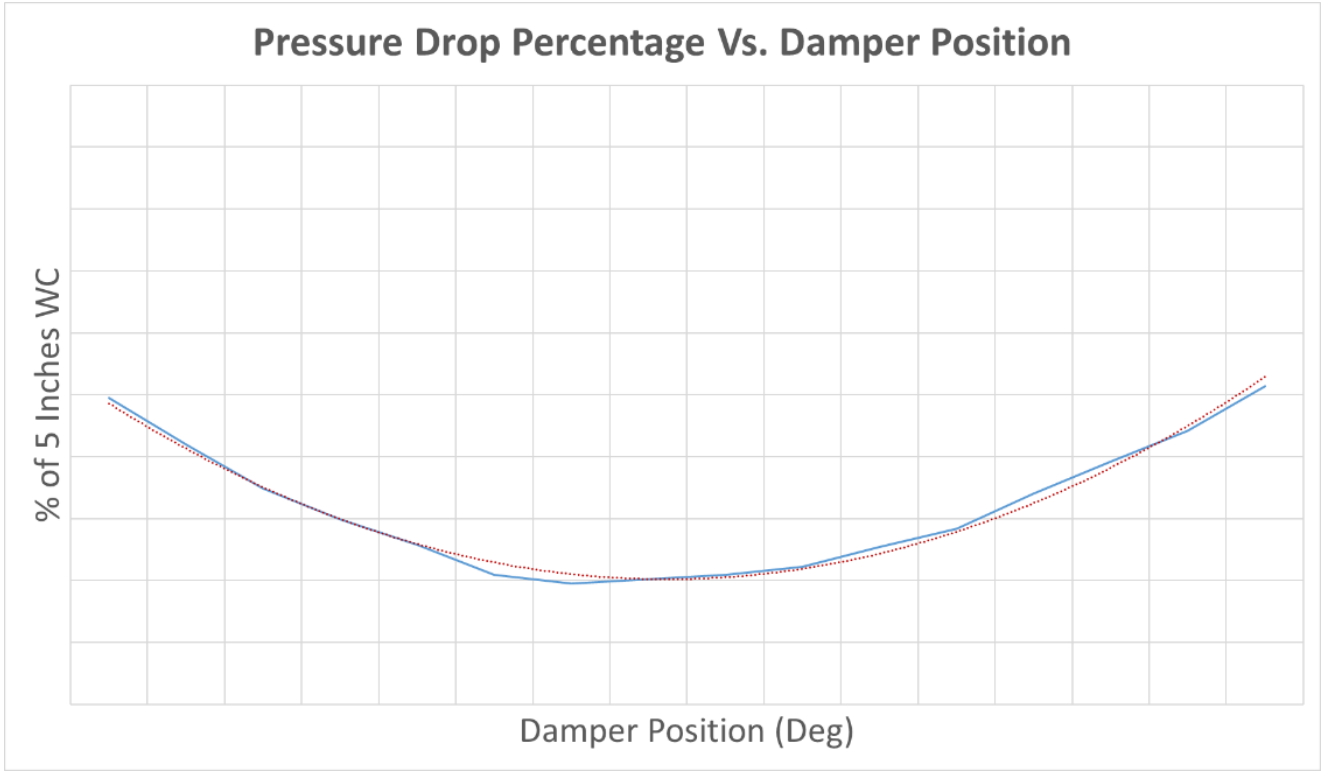


- Damper Position of 0, 45, and 90 degrees respectively

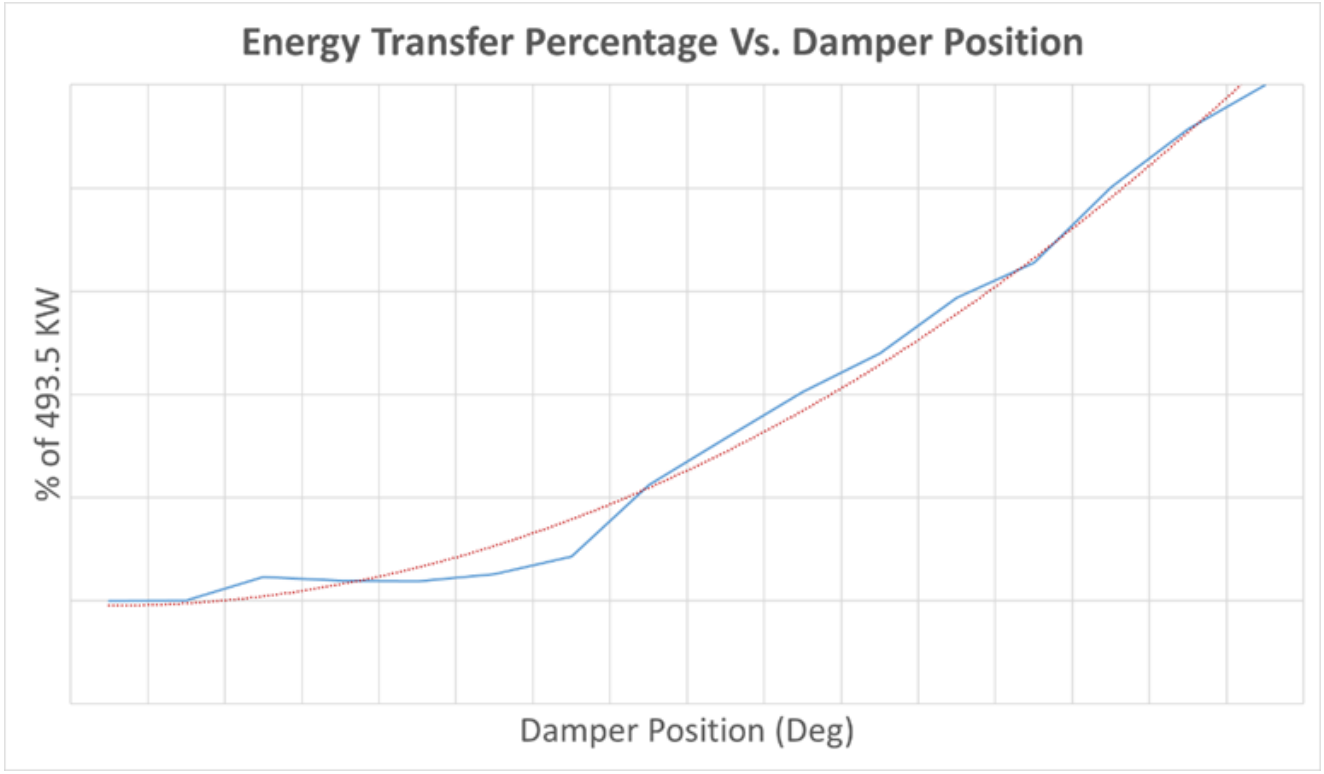
# SIMULATION RESULTS

- Simulation: Data Analysis
  - Pressure drop was calculated from exit of the recuperator to exhaust duct for each damper position
  - A 34.5% reduction in back pressure was achieved resulting in 0.185% reduction in turbine inlet temperature and an anticipated increase in the creep life by 14.6%

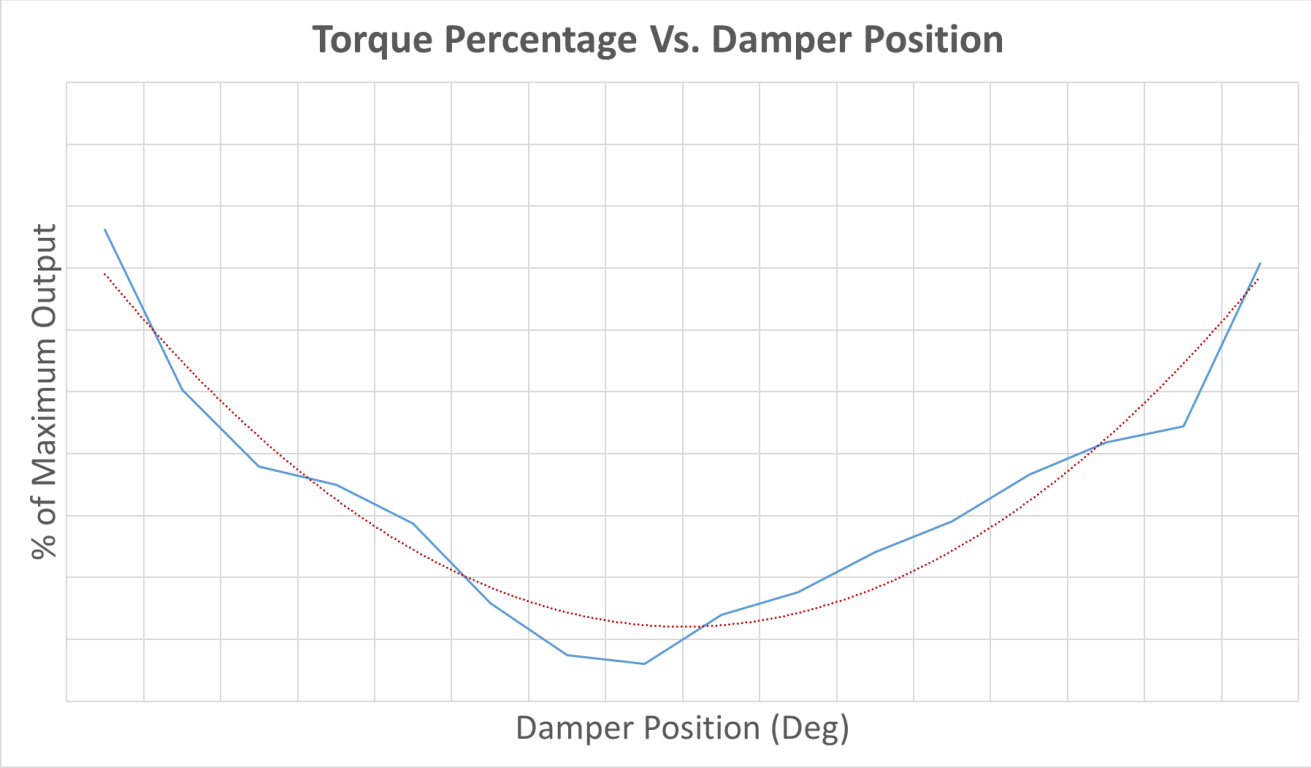


# SIMULATION RESULTS

- Simulation: Data Analysis
  - Multi-pass gas-liquid CHP heat exchanger performance at respective damper positions
  - Calculated from performance curves and scaled with mass flow directed through heat exchanger



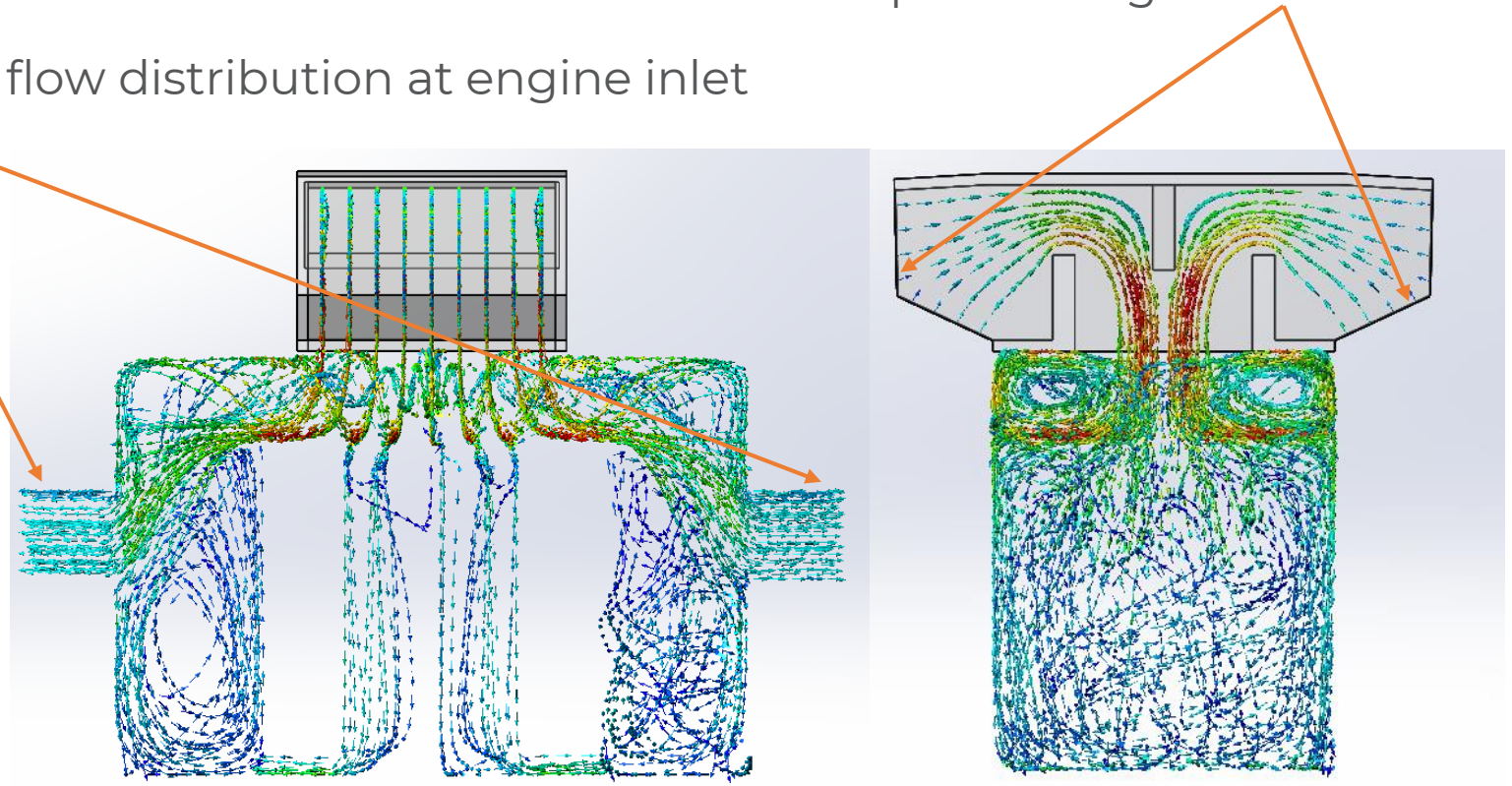
# SIMULATION RESULTS




- Simulation Data Analysis
  - Damper actuator maximum torque limit
  - CFD provided a pressure load on the damper which was turned into a torque for the various positions

# SIMULATION RESULTS

- Simulation: Data Analysis
  - GT1300S engine and electrical airflow velocity magnitude vectors
    - Targeted low inlet face velocities to minimize particle ingestion
    - Uniform flow distribution at engine inlet



# CONCLUSIONS

- A cogeneration design has been conceptualized for the incorporation into the GT1300S cycle
  - Up to 85% total efficiency
  - Reduced turbine back pressure compared to similar integration in GT333S
  - Controllable water discharge temperature
- Engine inlet duct
  - Low face velocity duct
  - Minimal pressure drop
  - Low sound ducting

# ACKNOWLEDGEMENTS


- I would like to thank FlexEnergy for selecting me for this fellowship and express my gratitude to everyone on the FlexEnergy team for their warm welcome and extensive knowledge in the gas turbine and CHP industries. I would like to give a very special thanks to Jeffery Armstrong and Dr. Chris Bolin for their many lessons and mentorship throughout the summer. I would also like to extend my thanks to those at Southwest Research Institute for putting on the UTSR program. This fellowship experience has been an unparalleled learning experience with my knowledge of heat transfer, thermodynamics, fluid mechanics, and combustion all extensively expanded upon.