Bechtel Marine Propulsion Corporation
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West Mifflin, PA

Sensitivity of an Operating Supercritical Carbon Dioxide Brayton Cycle to Compressor and Turbine Inlet Temperature

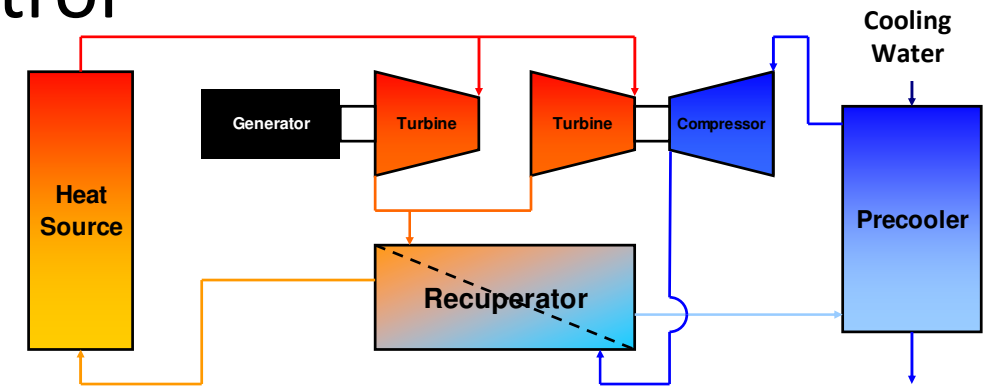
Eric Clementoni

Presentation Summary

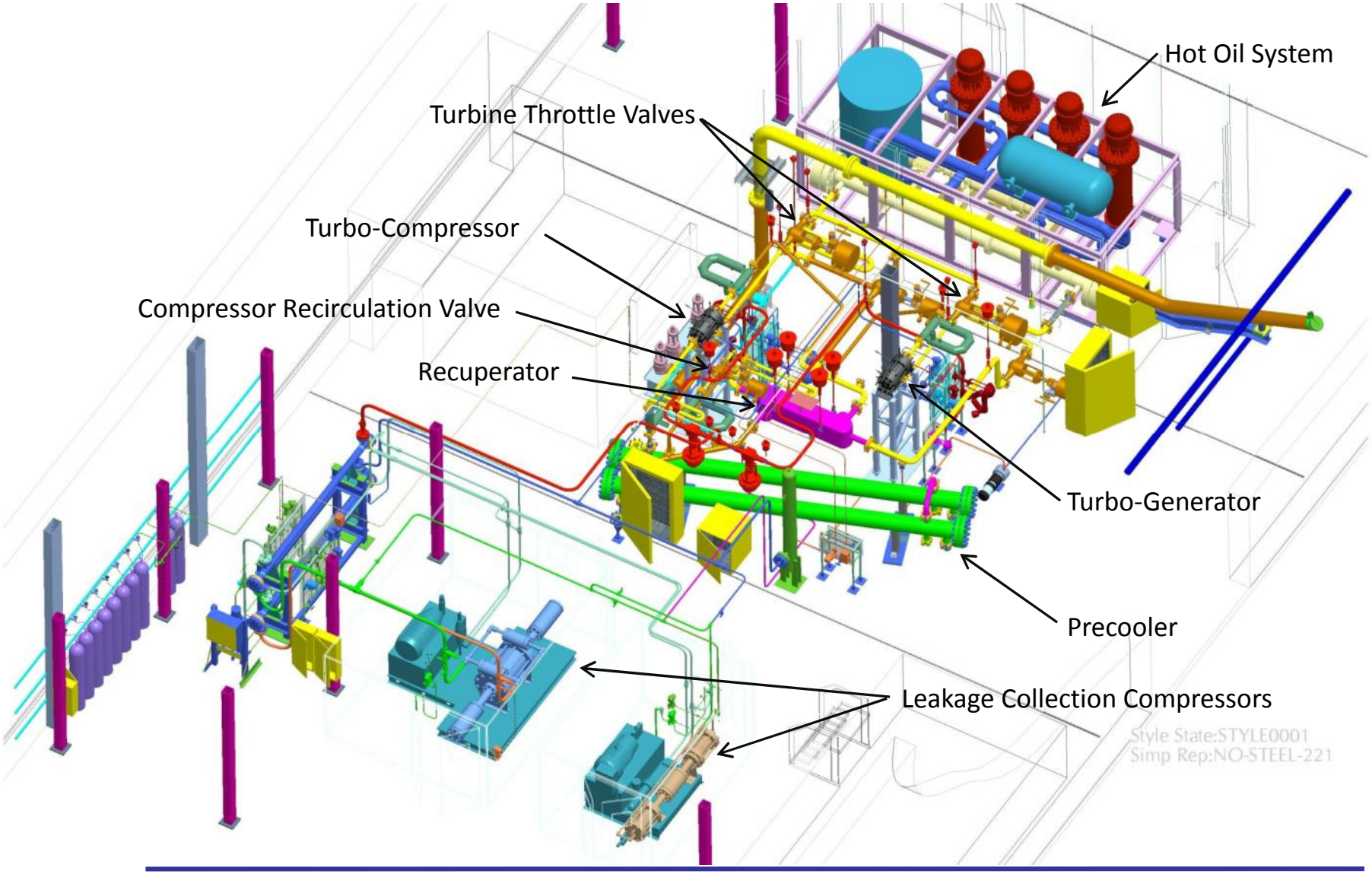
- sCO_2 Brayton Cycle Integrated Systems Test (IST) Overview
- Compressor Inlet Temperature Sensitivity
  - System Control
  - Test Results
- Turbine Inlet Temperature Sensitivity
  - System Control
  - Test Results

IST Overview

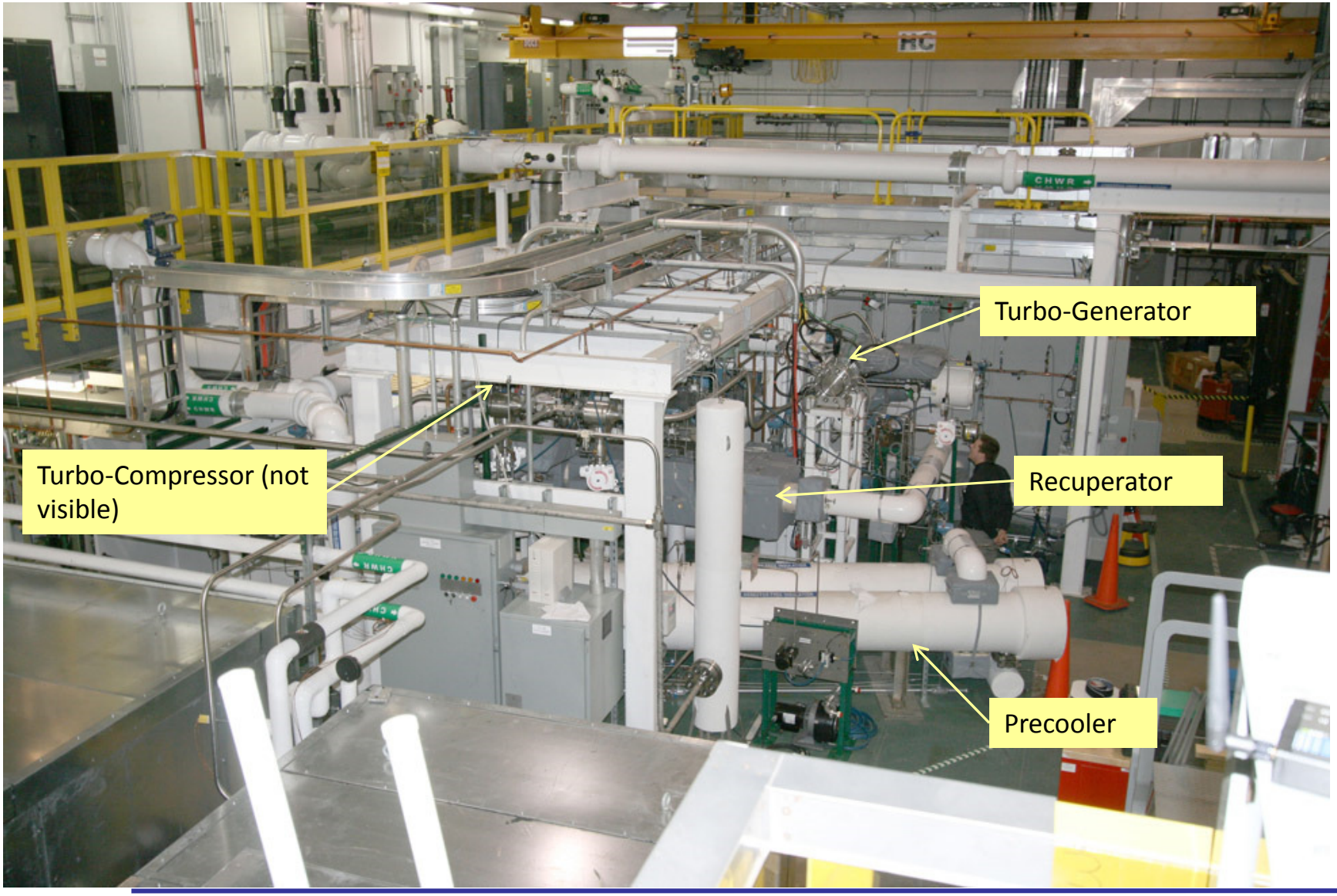
- 100 kWe IST has been main sCO_2 development focus of BMPC
- Simple Brayton cycle
  - Single variable speed turbine-compressor
  - Single constant speed turbine-generator
  - Single recuperator
- Focus on system control
  - Rapid startup
  - Power changes
  - Shutdown



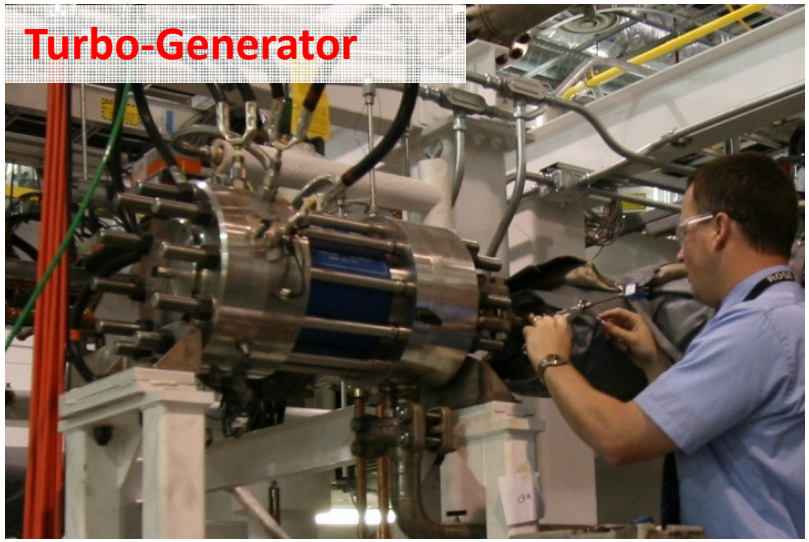
IST Physical Layout



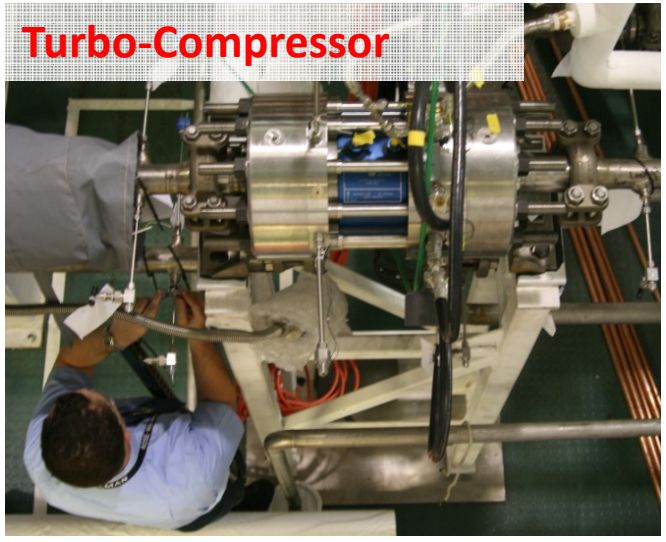
IST Physical Layout

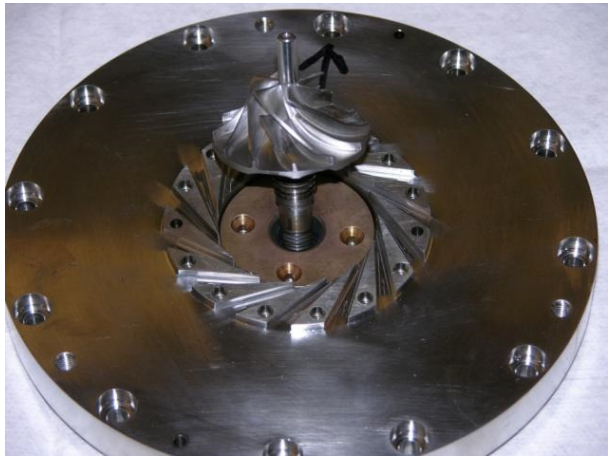


IST Turbomachinery

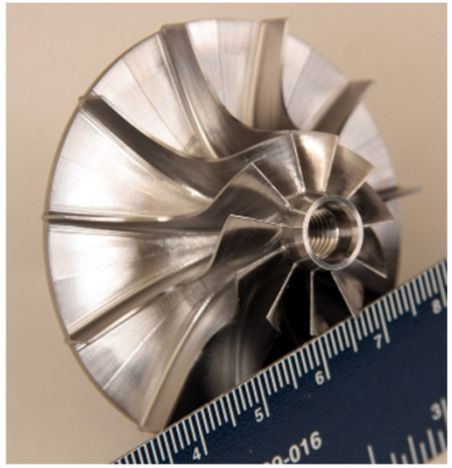


Thrust Bearing



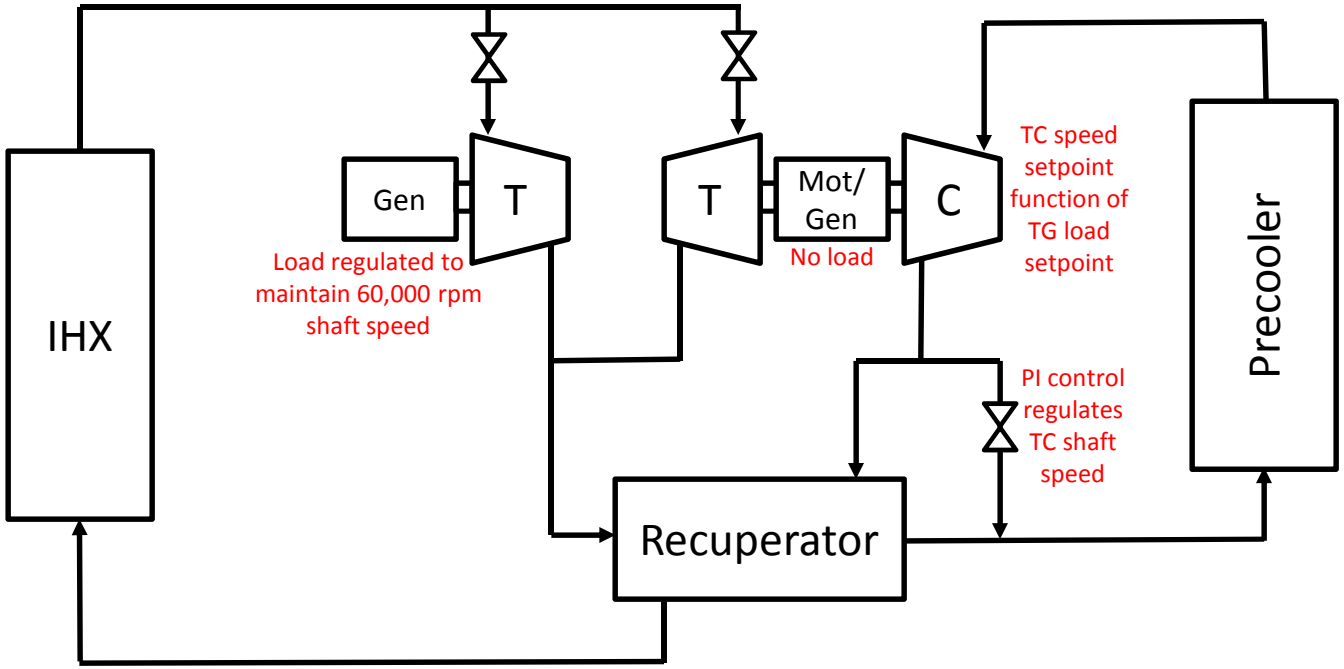


Compressor/Diffuser

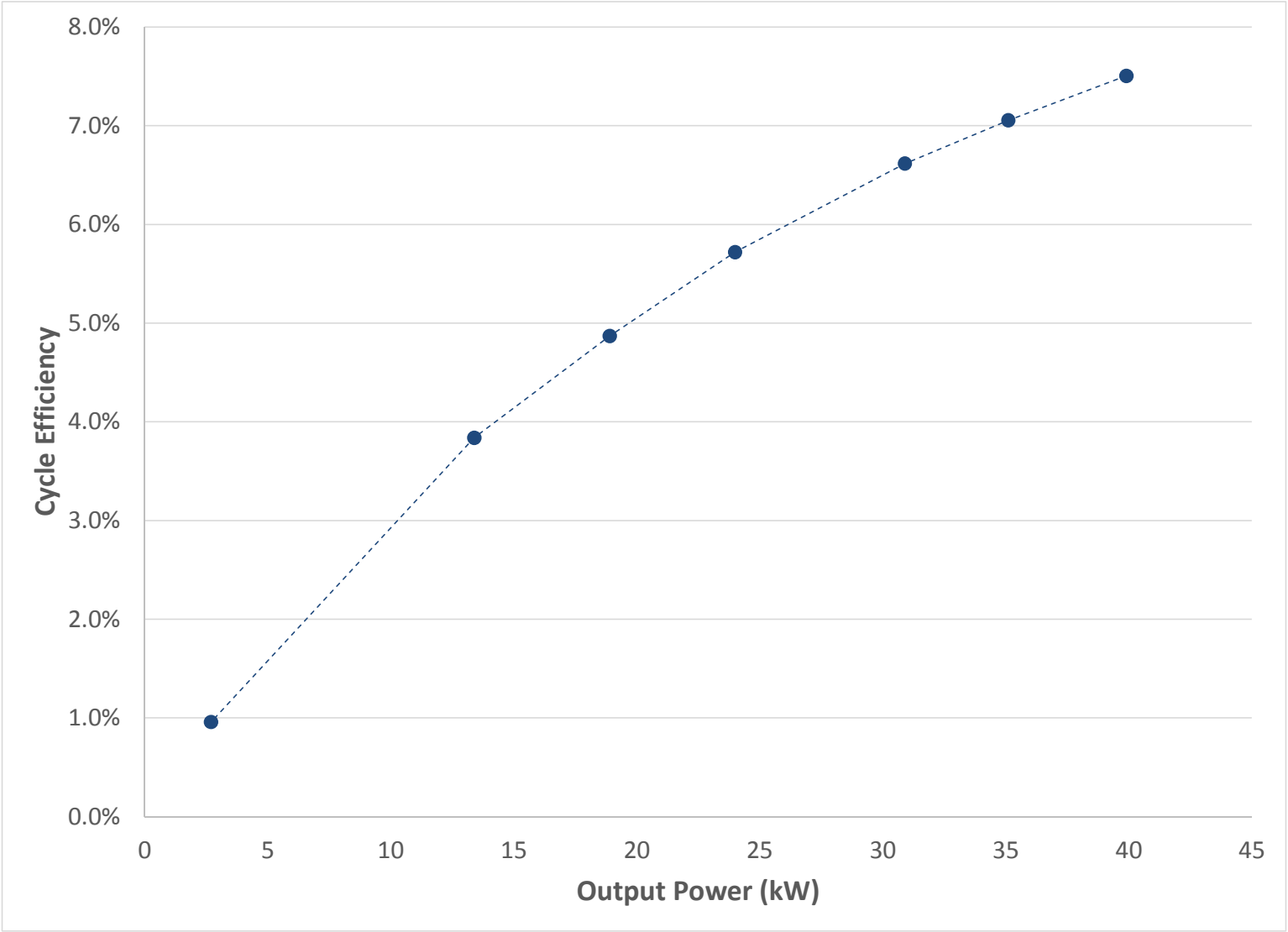


Turbine

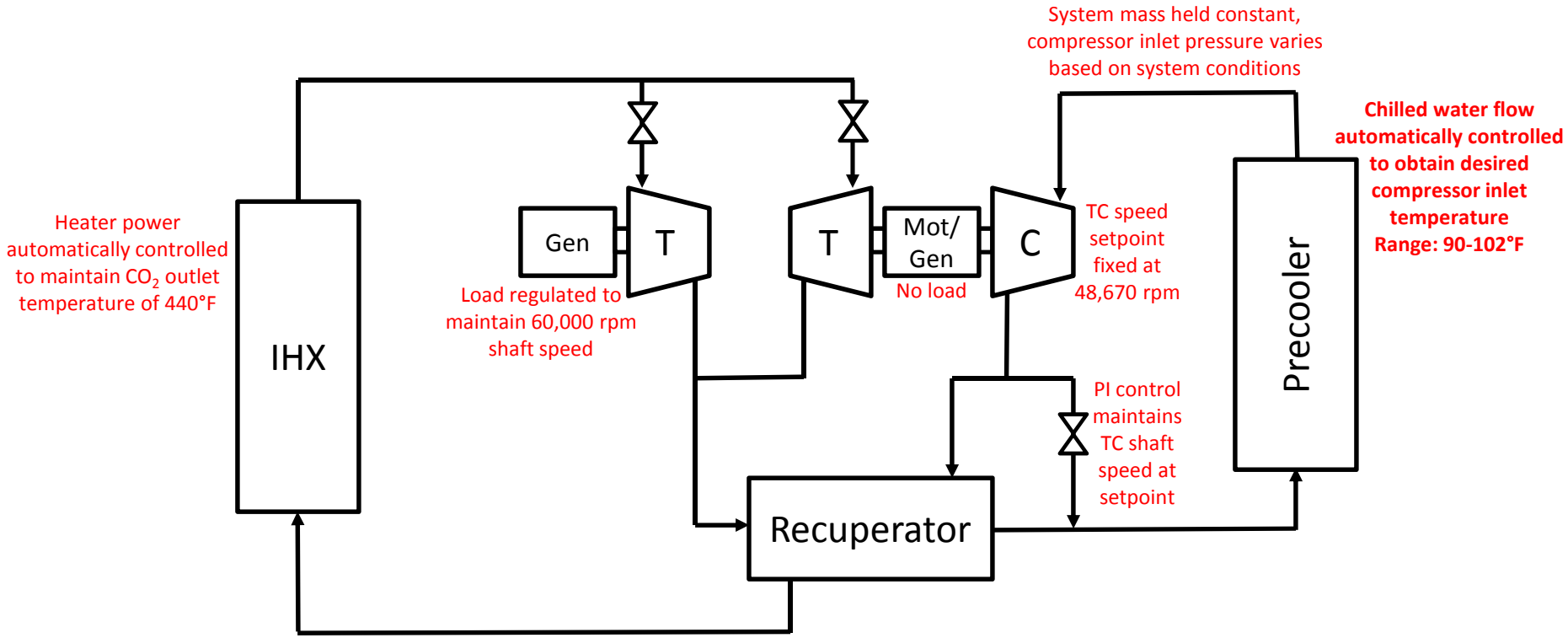
Normal Thermal-Hydraulic Control



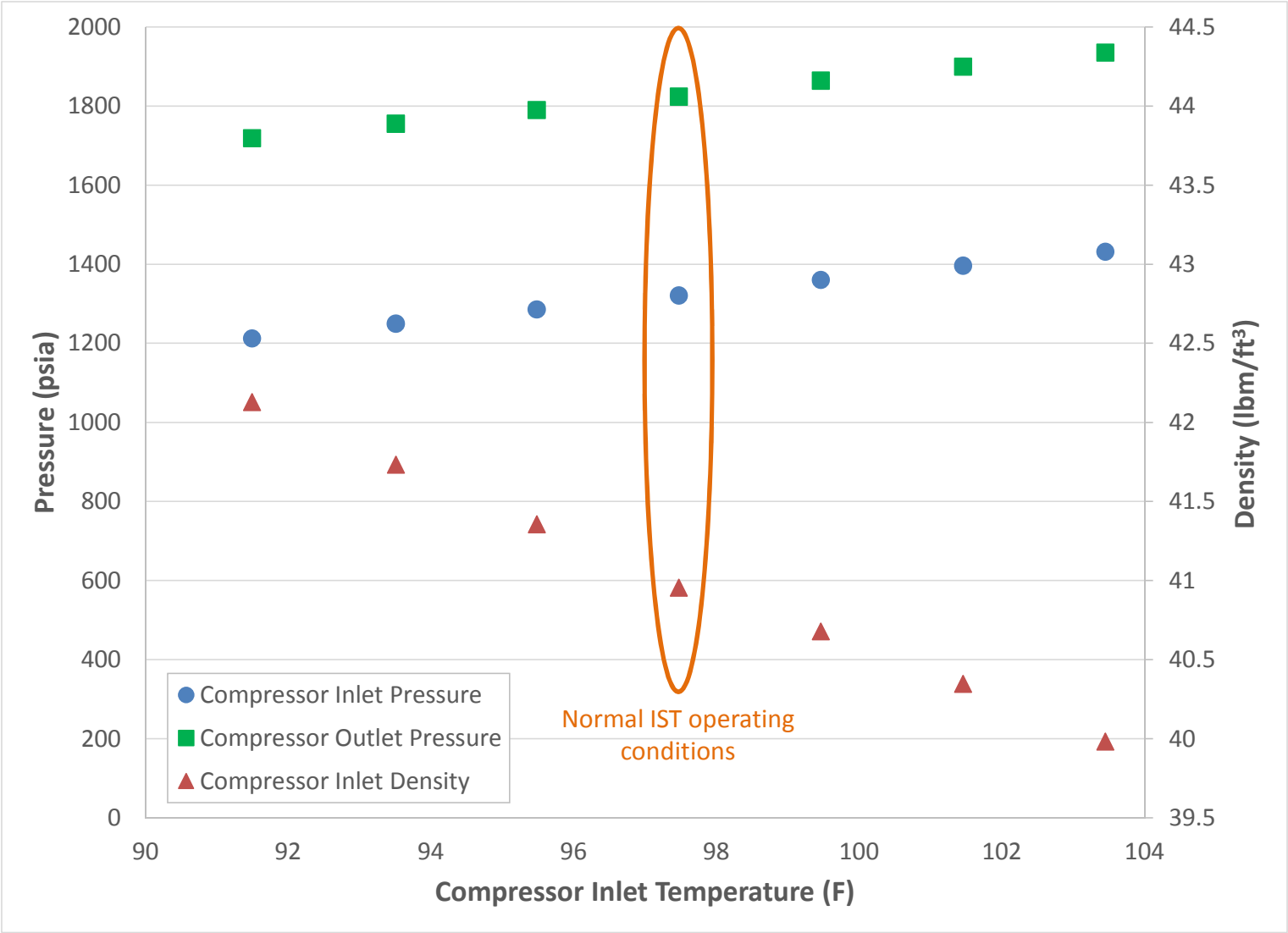
IST Efficiency vs. Power



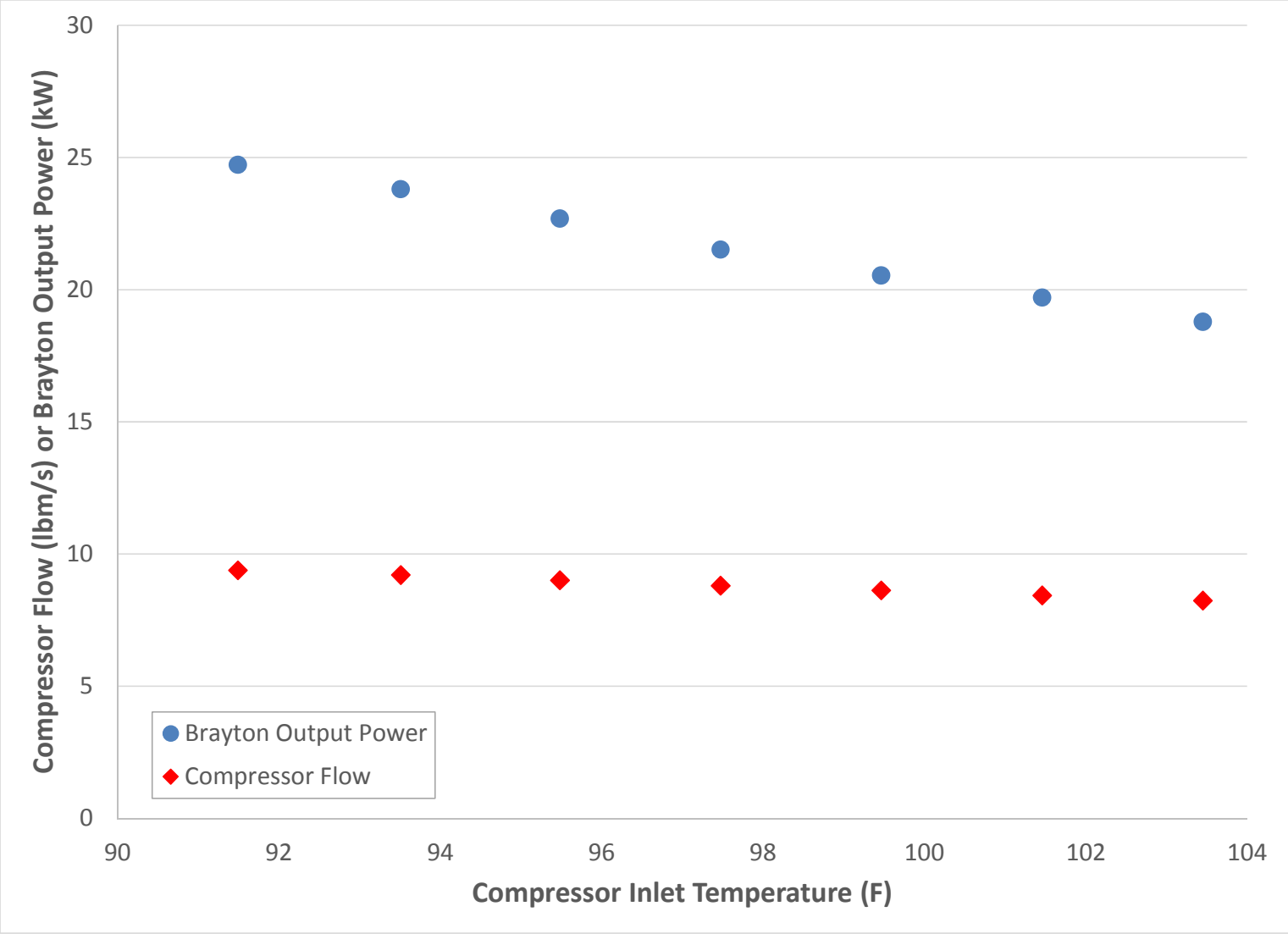
Compressor Inlet Temperature Sensitivity Overview



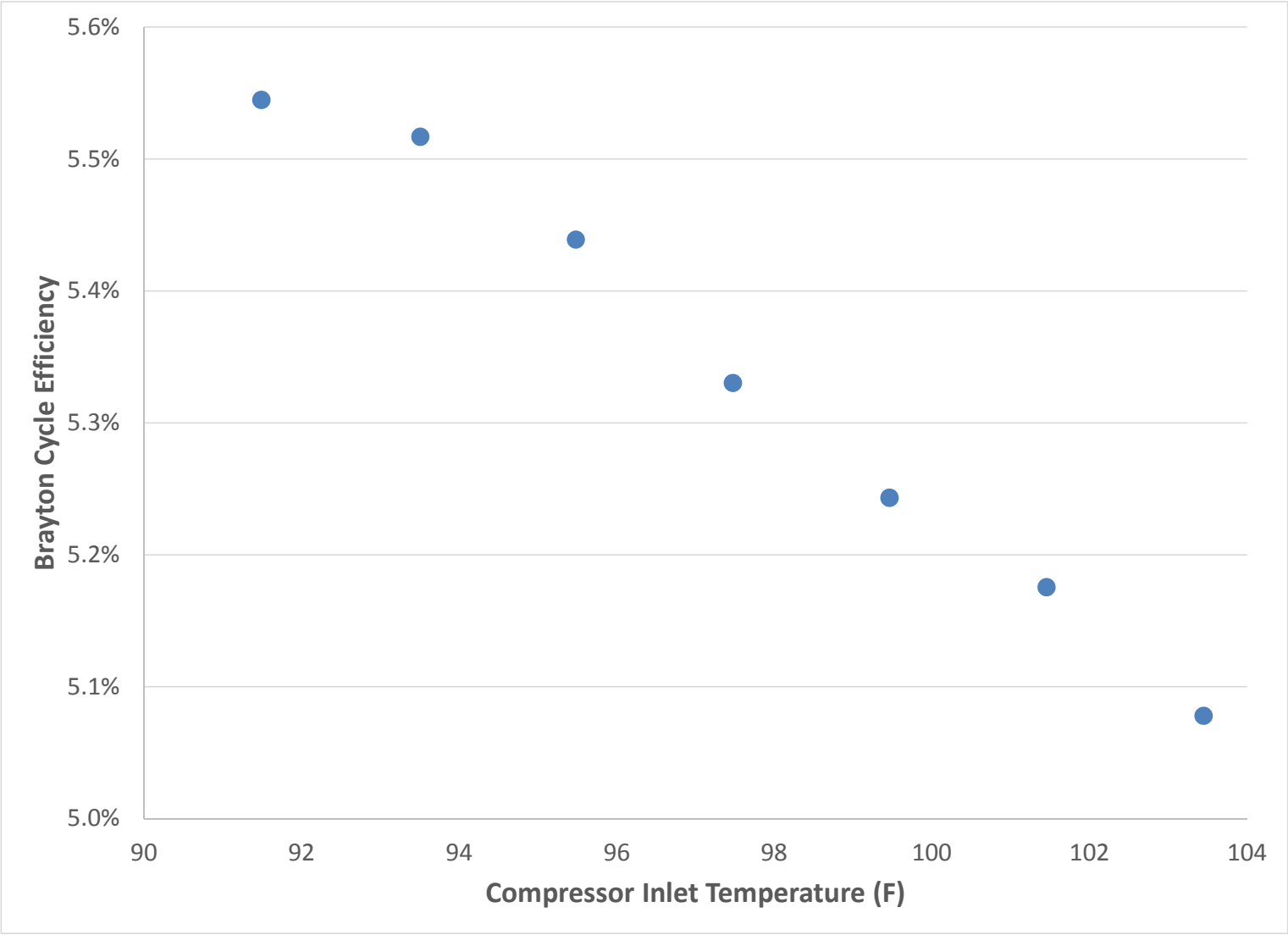
Compressor Inlet Conditions



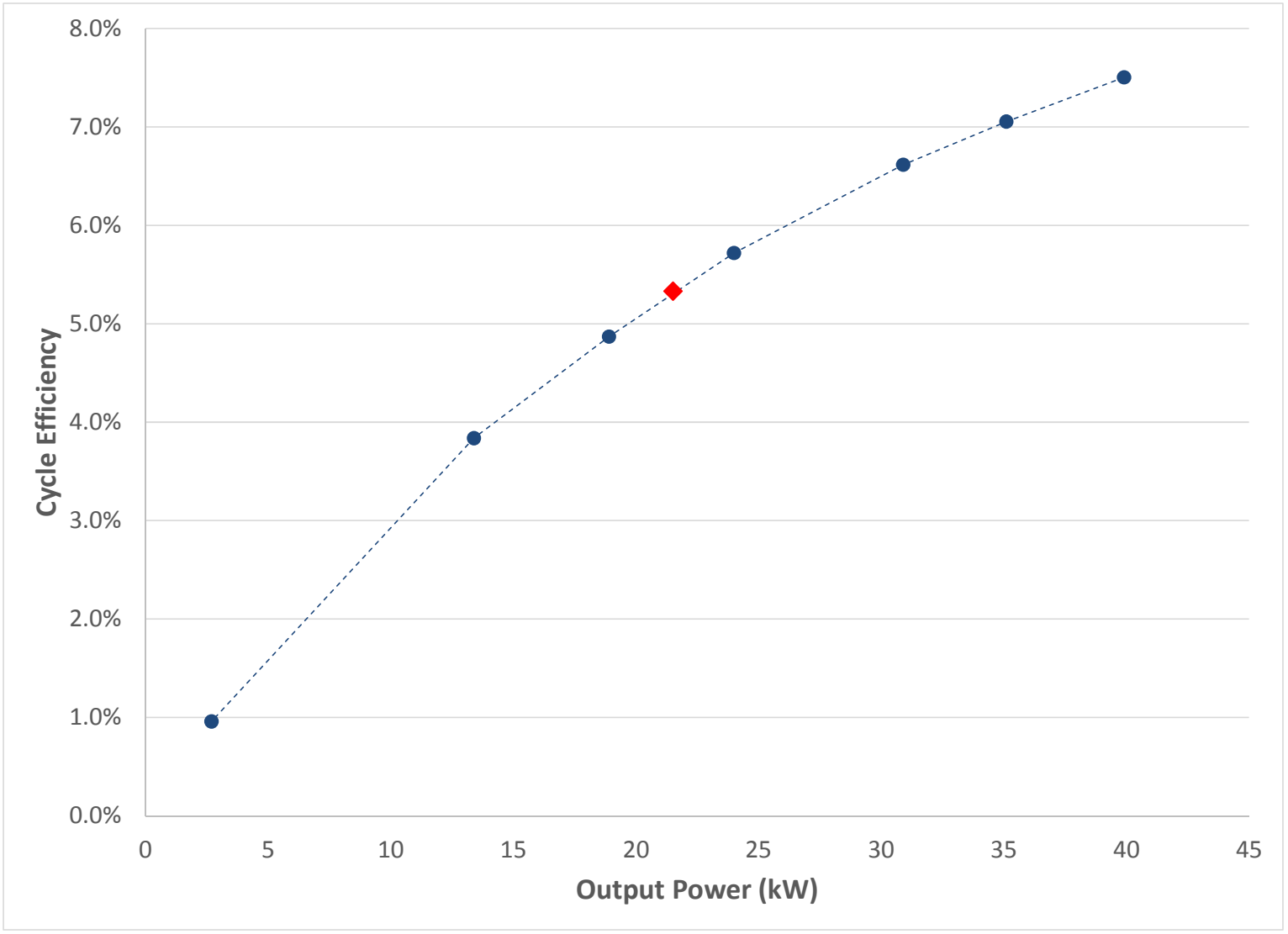
Compressor Flow & Brayton Power



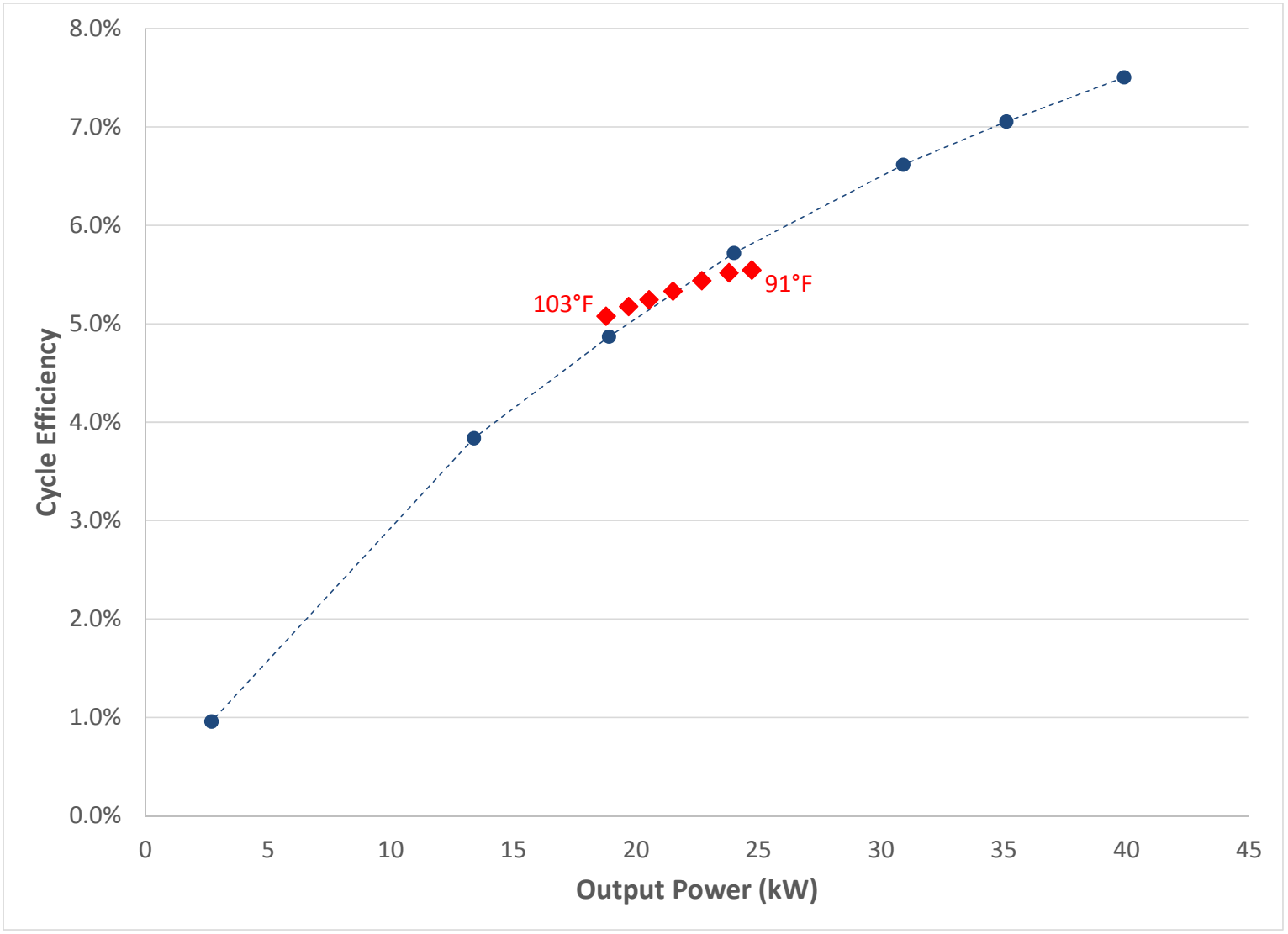
Cycle Efficiency



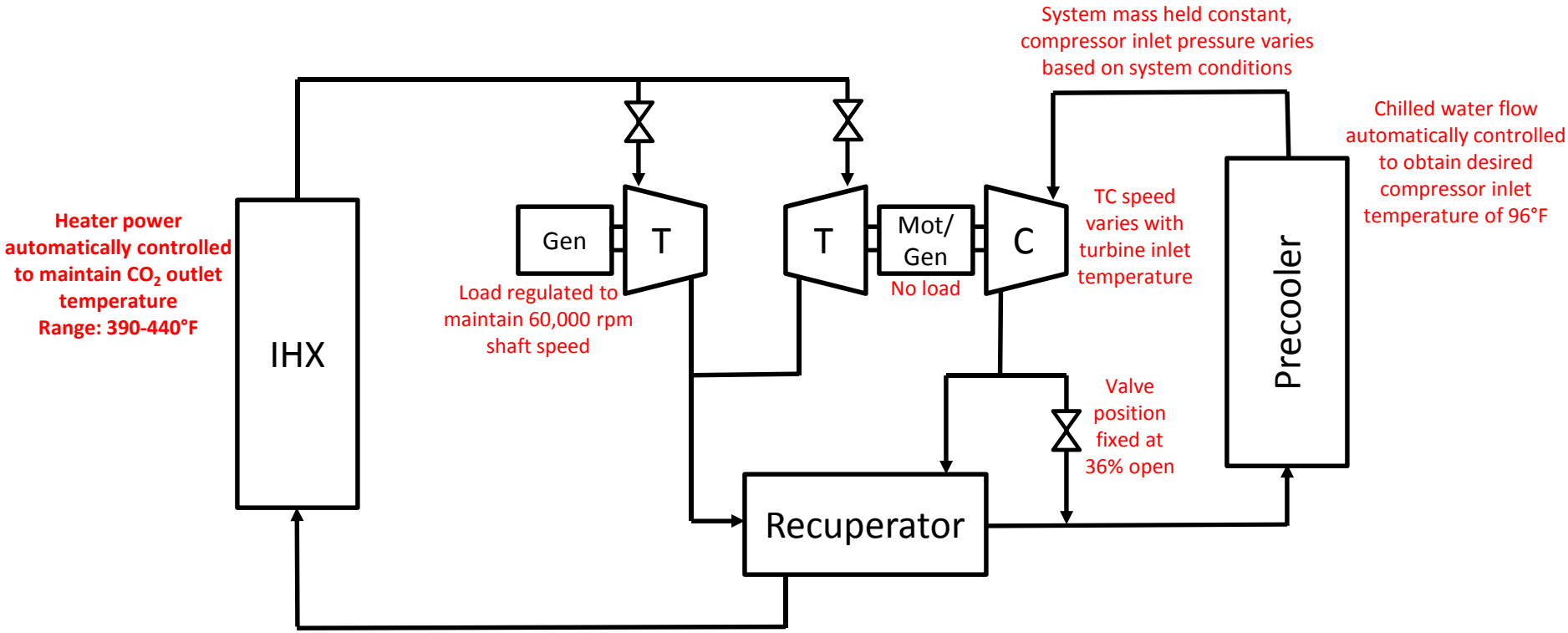
Cycle Efficiency



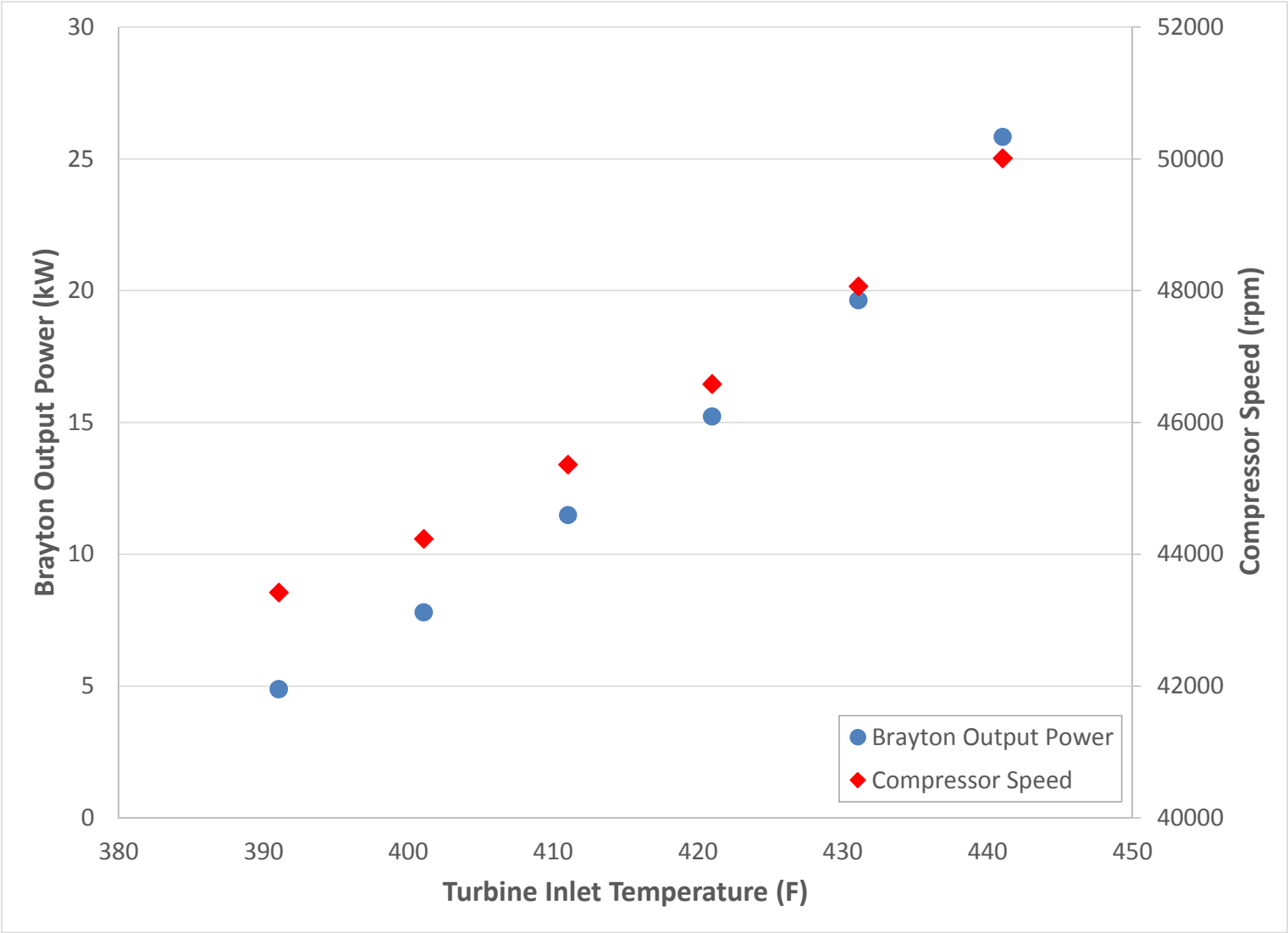
Cycle Efficiency



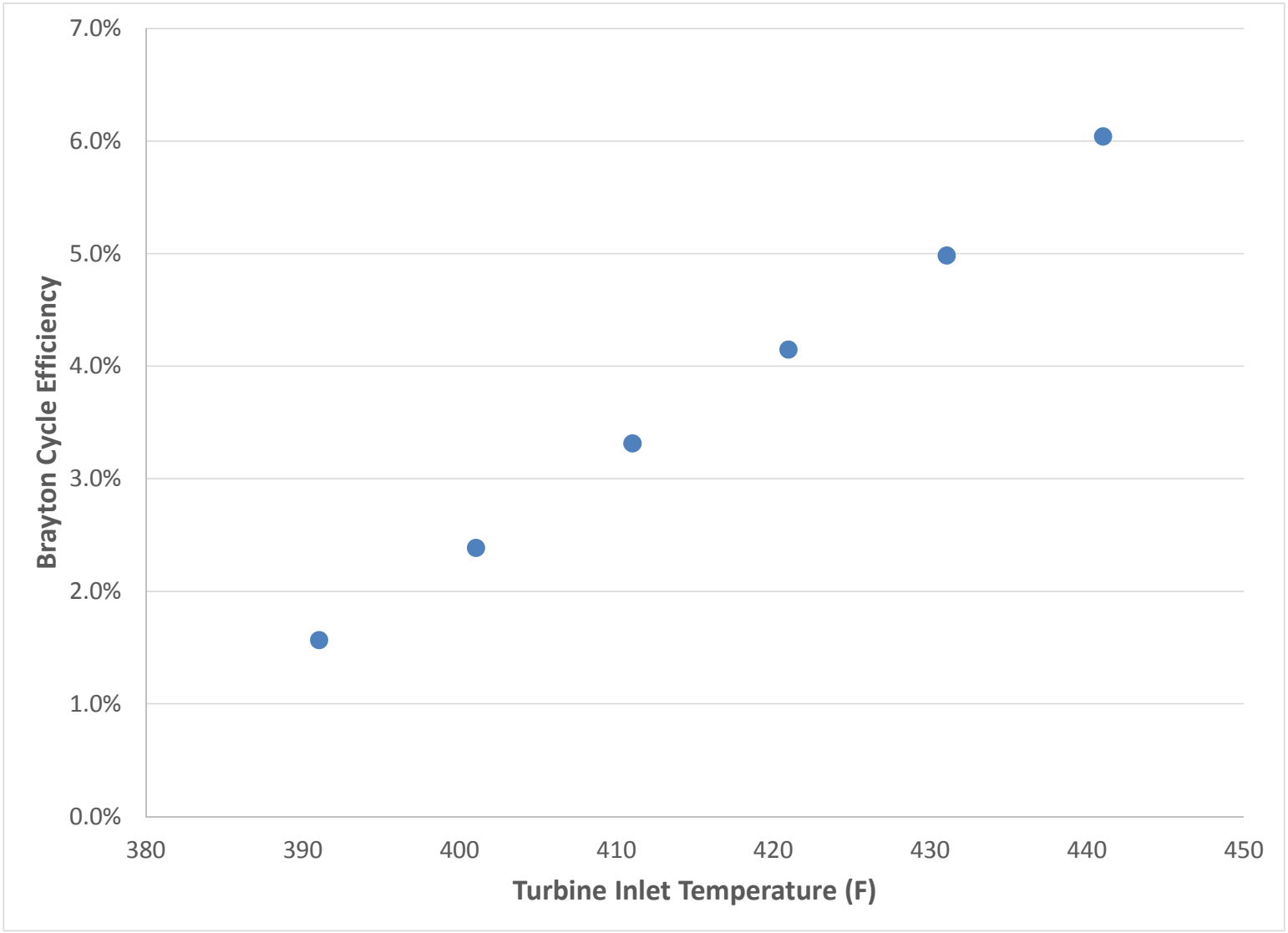
Turbine Inlet Temperature Sensitivity Overview



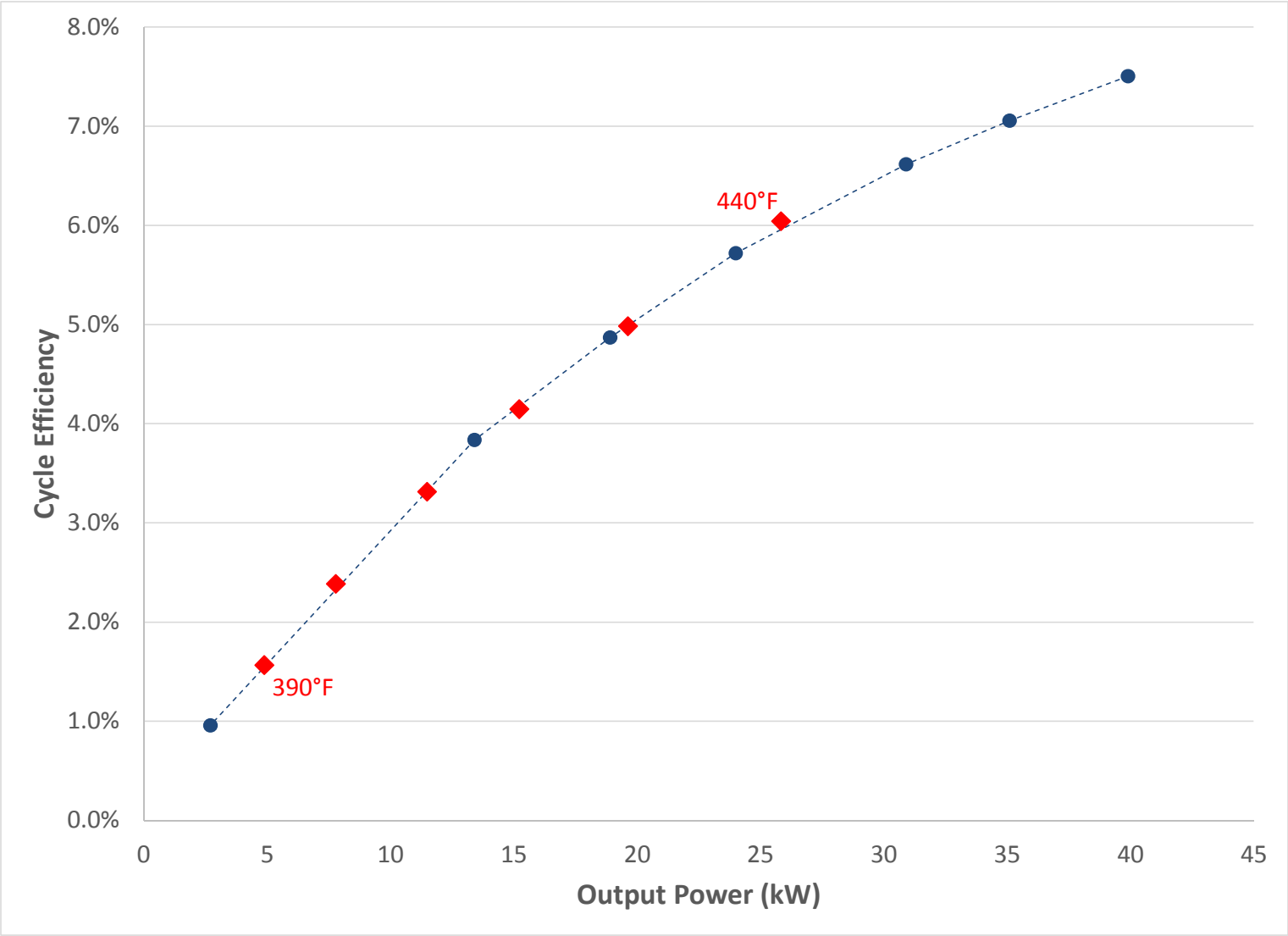
Power and Compressor Speed



Cycle Efficiency



Cycle Efficiency



Summary

- IST response to varying compressor and turbine inlet temperatures consistent with most expectations
  - Cycle efficiency benefit from reducing compressor inlet temperature diminished in a fixed mass system
  - Cycle efficiency vs. output power appears to not be strongly influenced by turbine inlet temperature

Acknowledgements

- This presentation summarizes work that has been performed a number of devoted engineers, scientists, technicians, and support personnel at the Bechtel Marine Propulsion Corporation and our subcontractors. This paper would not be possible without the efforts of this team.