Supercritical CO2 Combine Cycle Analysis & Optimization

Overview
When CO\textsubscript{2} is subjected the critical pressure of 72.9 atm and 88°F it becomes a supercritical fluid that has the diffusivity of a gas and density of a liquid. These properties of Supercritical CO\textsubscript{2} (ScCO\textsubscript{2}) in addition to low toxicity, stability, and reduced environmental impact, make it an ideal working fluid for thermodynamic cycles. Combined cycle using ScCO\textsubscript{2} is being developed in fossil fuel generation in addition to geothermal power, concentrated solar thermal and other applications.

Objectives
The objective for this project is to develop optimize power cycle using the LM6000 aeroderivative gas turbine in a natural gas combined power cycle using steam and supercritical CO\textsubscript{2}. Each cycle will be analysed using both low grade and high grade heat sources.

Approach
- Had a discussion with the Dresser-Rand point of contact to establish needs and requirements.
- Visited Dresser-Rand’s facility in Olean, NY to observe equipment being engineered.
- Performed external research on existing products and patent review.
- Created a clear description of objectives and development of scope of work.
- Compared and selected appropriate analytical software.
- Used Aspen HYSYS to develop four unique models.
- Determined the best solution by comparison of volume of working fluid used in each cycle.
- Synthesised of data to reach conclusion.
- Checked results with sponsor.

Outcomes
- Supercritical CO\textsubscript{2} is a viable option for a working fluid in a natural gas combined power cycle.
- The Supercritical CO\textsubscript{2} cycle has the ability to utilize low grade heat more effectively than steam cycles.
- Using supercritical CO\textsubscript{2} has the possibility to save the customer money because this system requires less equipment.
- This project is a substantial development in an emerging technology that has the ability to reduce the company’s impact on the environment by using waste heat and by using less material.