Carbon dioxide is increasingly gaining attention from energy industry as an alternate working fluid for power generation to produce low cost electricity from natural gas or synthetic gas from coal gasification while generating near zero atmospheric emissions, including full CO2 capture. Carbon dioxide in supercritical phase possesses properties that imparts it high potential to replace traditional power cycles. High density and low compressibility near critical point that is close to standard atmospheric temperature are the key drivers for carbon dioxide applications. The dramatic variation of properties like specific heat capacity, density, thermal conductivity, viscosity etc. presents challenges in further development of this cycle and invokes failure modes in the transient operations.

Dynamic modeling characterizes the failure modes and enhances the understanding of problems introduced because of the transient events. This dissertation presents a dynamic model for recuperated Brayton power cycle using Simcenter Amesim. Amesim is a commercial simulation software for the modeling and analysis of multi-domain systems developed by Siemens Digital Industries. Impact on the operation of air cooler and compressor due to varying air conditions and varying power demand is demonstrated here. Non-linear temperature distribution, reduction in compressor surge margin and high rate of mass transfer are the issues characterized during transient events. The need for controlling the mass in the closed loop is manifested here. Advanced control logic and instrumentation will be required for safe and successful transition from one state of operation to next.

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The public is welcome to attend.