

Senior Design Project Description

Company Name	<i>Siemens Energy, Inc.</i>	Date Submitted	<i>06/01/2020</i>
Project Title	<i>Generator Rotor Coil FEA model Validation - Phase 2 (SIEM_FEA2)</i>	Planned Starting Semester	Fall 2020

Personnel

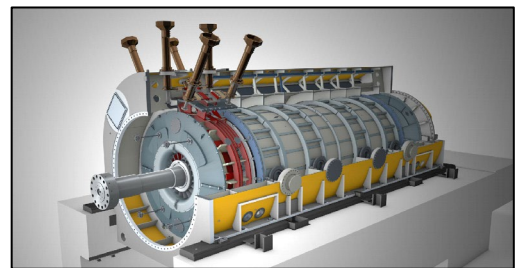
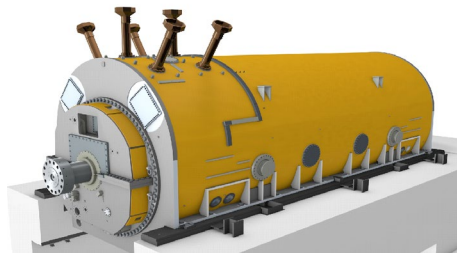
Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	4	Electrical	
Computer		Systems	
Other ()			

Company and Project Overview:

The Siemens Charlotte Energy Hub is the company's worldwide hub for 60 Hz power generating equipment. Opened in 1969, the facility has manufactured and serviced generators and steam turbines for the power generation market for decades. In November 2011, the facility celebrated the opening of a new expansion, adding gas turbine production and service capabilities. The new Gas Turbine facility was designed based on LEAN manufacturing principles and certified for U.S. LEED Gold green building standards, making it the most advanced gas turbine production plant in operation. The expansion represents a \$350 million total investment in Charlotte, adding 1,000 jobs. With its current workforce of 1,500 and more than one million square feet of space under roof, Siemens Energy in Charlotte has become the largest manufacturer in the city and the second largest among the 250+ Energy companies based in Charlotte.



The project is sponsored by the Siemens Generator Manufacturing department in Charlotte NC. The project will analyze the stress experienced on the copper windings on a generator rotor and suggest an analysis method that simulates these stresses. This is a Phase 2 project which follows on the work of the Fall 2019 Phase 1 project.



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Project Requirements:

See photos below of the copper windings found with a rotor for a utility scale generator:



These windings are held secure during the operation with a large metal ring before the rotor enters service:



As the rotor spins at 3600 rpm (60 Hz systems) there is a significant amount of heat from the electron flow and air friction. This cause thermal stress to the copper coils. Given the tight spacing of these coils, it is very important to understand the thermal stresses that can build up in these coils. Siemens has developed a sophisticated FEA model of the rotor coils to predict the thermal stresses and the mechanical impact. The objectives for this project will be to review testing equipment from last semester's class (SIEM_FEA), determine if changes are required, measure strains on one or more rotors, and develop a simplified analysis approach that correlates with test data. As you can see from the pictures, space is tight, the rotor is rotating and the environment is challenging.

Team must thoroughly understand the mechanics of the coil design, the FEA model predictions and then develop a methodology to take reliable data in this challenging operational environment.

Expected Deliverables/Results:

- Review Instrumentation setup created by previous Sr Design Team. Make adjustments if required
- Physical instrumentation set-up to run tests
- Implementation and testing at Siemens facility on an actual rotor in a balance facility
- Compare measurements against existing models.
- Develop simplified analysis method that represents results measured on rotor

Disposition of Deliverables at the End of the Project:

Models and report to be given to the Supporter after the conclusion of the Expo

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Energy concentration
- Interest in Finite Element Analysis
- Ability to travel to Siemens facility in Charlotte for multiple data gathering and test implementation trips
- Strain gage technology