UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE of ENGINEERING

Senior Design Project Description

Company Name	Siemens Energy, Inc.	**Date Submitted**	May 8, 2018
Project Title	Generator Rotor Blocking Improvement (SIEM_BLOCK)	**Planned Starting Semester**	Fall 2018

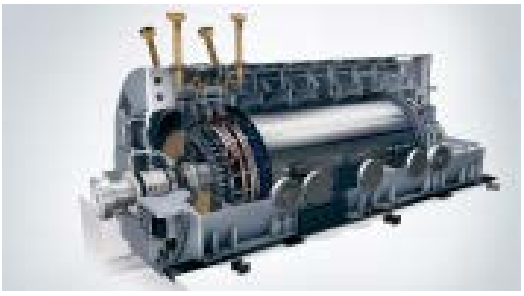
Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. 250 hours are expected per person. Complete the following table if this information is known, otherwise the Senior Design Committee will develop based on the project scope:

Discipline	Number	Discipline	Number
Mechanical	4	Electrical	
Computer		Systems	
Other (Industrial/Mfg)		Material Science	

Company and Project Overview:

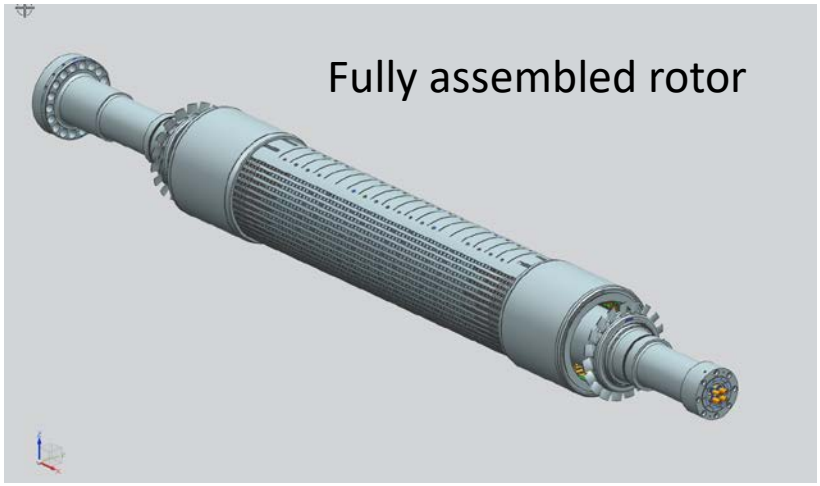
The Siemens Charlotte Energy Hub is the company's worldwide hub for 60 Hz power generating equipment. Opened in 1969, the facility has manufactured and serviced generators and steam turbines for the power generation market for decades. In November 2011, the facility celebrated the opening of a new expansion, 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.

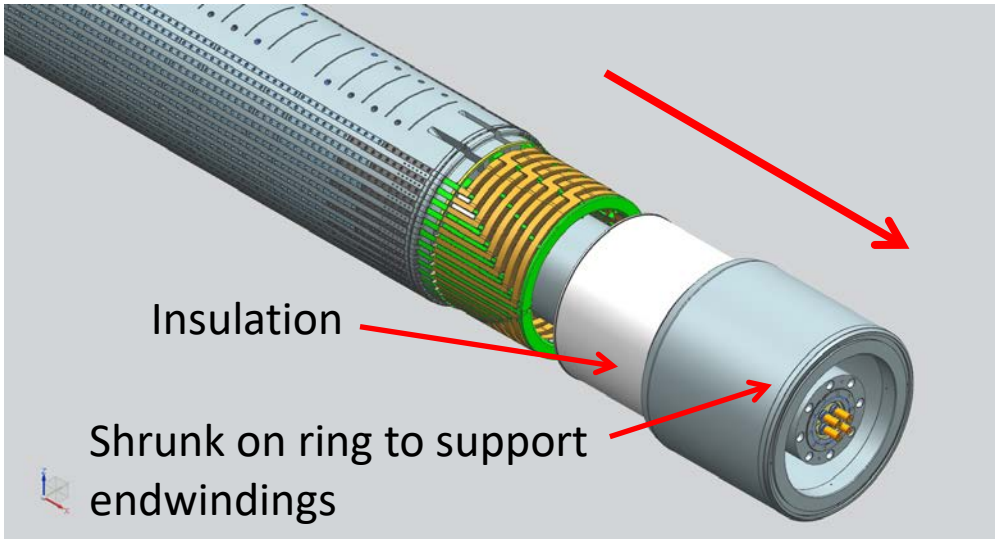


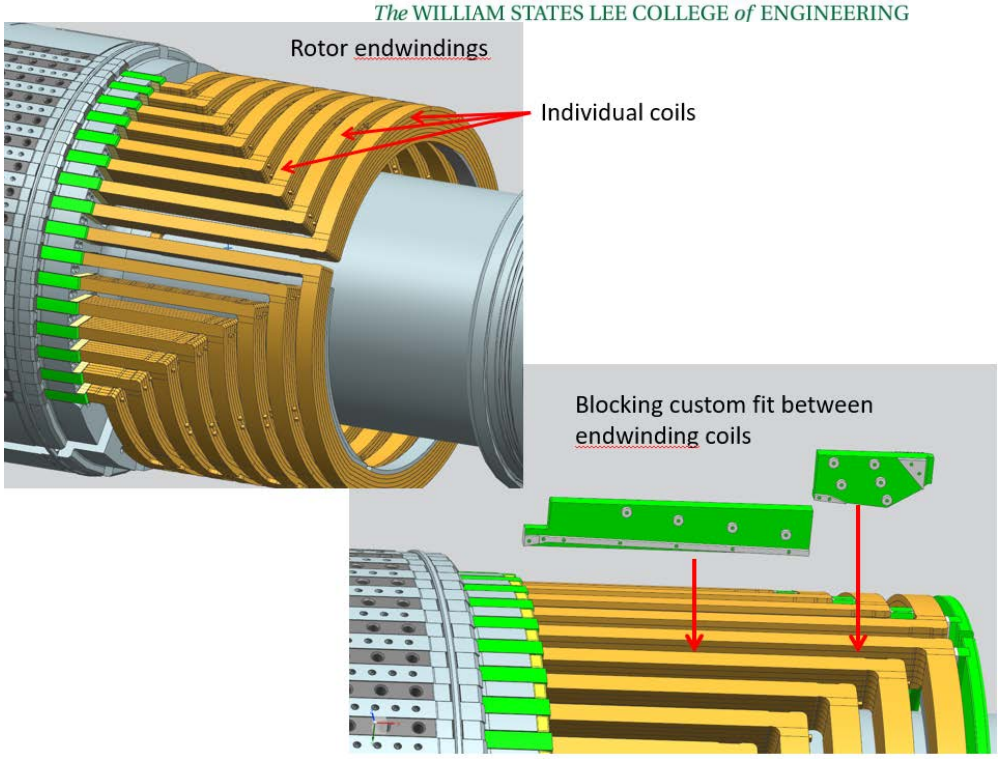
The project is sponsored by the Siemens Generator Engineering department in Charlotte NC with a goal to improve the robustness and cost effectiveness the rotor end winding blocks of typical Siemens generators.

Project Requirements:

Provide an alternative to the present rotor blocking assemblies considering increased robustness and cost position. See the following pictures that describe the blocking material and its arrangement in a rotor





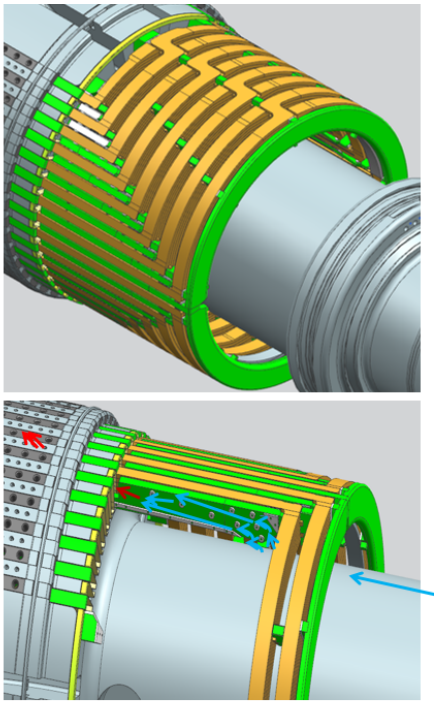


Endturn Blocking Functional Requirements:

1) Support endwindings to prevent excessive deformation
2) Support coils to prevent axial migration
3) Keep coil stack aligned radially for support due to rotation
4) Electrically insulate coils from each other
5) Provide ventilation path

Endturn Blocking Design Requirements:

1) Non conductive
2) Non abrasive to copper
3) Withstand 4320 rpm
4) Perform at 155° C for 20 years (@3600 rpm)
5) Accommodate variations in coils/straps (formable/Sandable/grindable)
6) Strong enough to provide support to coils (compression/bending/shear)
7) Manufacturable
8) Price- comparable or lower than existing



Specific functional requirements of the blocking are as follows:

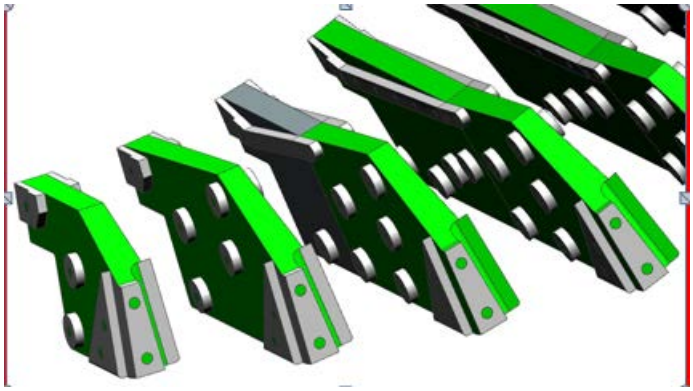
- Provides mechanical spacing and support between rotor coils for life the generator
- Provides a ventilation path for cooling gas from the inner plenum of the end winding to the

axial rotor tooth bores

Boundary conditions:

- 10,000 start/stop cycles between standstill and operating speed (3600 RPM)
- 2 minute at 120% overspeed (4320 RPM)
- Thermal resistance to Class F temperatures (155C) continuous operation.
- Assembly of blocks into the generator requires adjustability (current procedure is the "peel" layers of Nomex until block is fit.

Present configuration is a G11 glass block with Nomex pads/seal strips that are pinned and glued each side of the block. The block is inserted between rotor coils. Fit as required. Known failure modes to date are displaced Nomex pads/seal strips.



Expected Deliverables/Results:

- Technical report including
  - Executive summary of the project goals/approach/deliverables and achieved results
  - Overview of options considered in designing new blocks.
  - Design matrix for choosing a preferred candidate
  - Prototype design, manufacturing, and testing (mechanical/thermal)
  - Cost Analysis compared to traditional blocks.
  - Recommended Next Steps
- Manufacture and Test prototype
  - Test fitting block in Generator.

Disposition of Deliverables at the End of the Project:

Provide report and prototype to Siemens technical representative at the conclusion of the demo.

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

- Interest in Material Science
- Interest in applying Mechanical Engineering and Material science to a design improvement project related to Generator manufacturing.