



UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING

Senior Design Project Description

Company Name	<i>Siemens Energy, Inc.</i>	Date Submitted	<i>9/10/18</i>
Project Title	<i>Generator Stator Core Pressing Leak Prevention and Height Metrology Project (SIEM_PRES)</i>	Planned Starting Semester	<i>Spring 2019</i>

Personnel

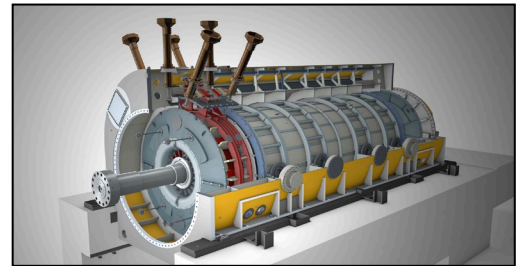
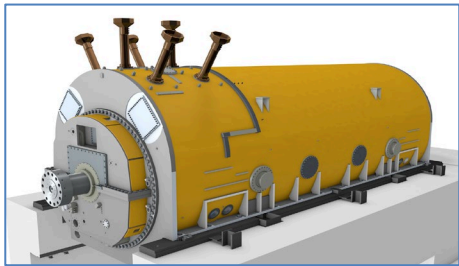
Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

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	5	Electrical	
Computer		Systems	
Other ()			

Company and Project Overview:

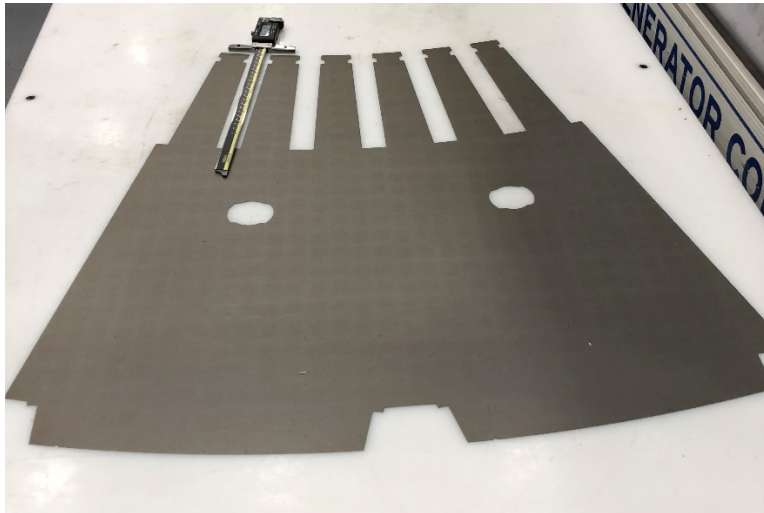
The Siemens Charlotte Energy Hub is the company's worldwide hub for 60 Hz power generating equipment. Opened in 1969, the facility has manufactured and serviced generators and steam turbines for the power generation market for decades. In November 2011, the facility celebrated the opening of a new expansion, 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 with a goal to Change the hydraulic stator core pressing and metrology operation to eliminate a failure mode possibility.

Project Requirements:

A generator stator core is made up of thousands of individual laminations each stacked together.



During the manufacturing of a stator core, these laminations are individually stacked to form stator packs (subassemblies of stacked laminations).



Robotic core stacking of individual laminations or core punchings (stack of laminations on pallet being delivered to robot cell)

These packs are then stacked on each other to form the stator core. The stator pack assembly area is shown on the left and the stator core assembly is on the right:



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Individual laminations being stacked by robots

Fully stacked generator core

Typical access point for core vertical measurement

During the stacking process to create the stator core, numerous in-process height measurements must be taken at various locations along the diameter to ensure that the top surface is flat and not leaning. It is imperative that the height of the stator core is maintained as flat as possible throughout the core building cycle. To accomplish this, as each row of stator lamination packs are loaded, various intermediate hydraulic pressing processes are performed using jacks mounted at the top of the core. Measurements are taken of the vertical distance from the bottom of the core to the top. Measurements are made in multiple sectors of the cylinder and at three locations from the inside of the core to the outside. There are tolerances that must be held for each row in the core stack. Core stack height and diameters vary by the generation configuration for each production model. Adjustments to core “lean” are then made using filler materials to ensure the continuation of the build does not lean to one side or another.



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The hydraulic jacks are shown at the top of this picture. (They are the yellow and green devices).

Typically to accomplish these measurements one is able to access the bore of the core via the bottom of the core under the stand. See below photo:



The measurement device is moved through the three positions in the lamination and measurements made with reference to the bottom of the core.

There is concern about the possibility of a hydraulic jack leaking hydraulic fluid during the



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pressing operation. Leaking hydraulic fluid would run down the core and weep into the individual lamination stacks. This would require costly disassembly or scrapping of the core laminations.

The focus of this project is to how to change the process to eliminate the potential for hydraulic fluid to leak down the core and also improve the measurement methodology to improve measurement accuracy to the process tolerances. As the core is pressed and grows taller, the inside and outside of the core become higher than the interior. This “cupping” effect must be considered for the measurement device and the means to attach given the fact that there is a slight downward curve from the inside core location to the middle and the same from the outside core.

Expected Deliverables/Results:

Deliverables include:

- Develop a solution to eliminate the risk of hydraulic leak contamination of the core stack.
- Process definition: Define a process for taking the core height measurements given the constraints mentioned in the description. This includes selecting the type of technology to be employed.
- Validation dataset: Perform the new measurement process during an actual core build and obtain actual data and compare this data to data taken using the current process in order to study and validate the capability of the new process.
- Final documentation: Document the new process in a manner where this information can be used as a training document for employees who will need to perform this process in the future.

Disposition of Deliverables at the End of the Project:

Hardware to be handed over to the supporter at the conclusion of the Expo.

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

- Familiarity or interest in metrology technology