INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*Siemens-Energy*	**Date Submitted**	*May 31, 2023*
Project Title	*Electric Generator Wedge Fixture Design for Machining* ***(SIEMENS_WEDGE)***	**Planned Starting Semester**	*Fall 2023*

Senior Design Project Description

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	

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.

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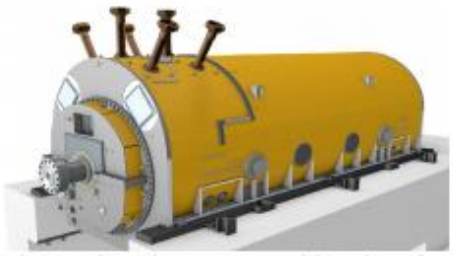

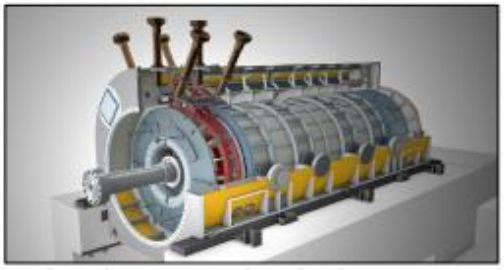

This projects is within the facility that performs machining, electrical testing and final assembly.

Project Requirements:

Copper wedges are vital for electric generators built at Siemens-Energy. Final machining of a wedge parts use rigid clamping to allow a smooth surface finish. New market conditions in productivity, quality and quantity require a new manufacturing method for wedges. The top priority of this project is to develop a new fixturing system that allows drilling, front and back chamfering with a through-tool, slotting and end cutting. One style of wedges produces requires a second operation to machine a relief area. The fixture must accommodate this. Some of the other requireements for the design are:

- An automated clamping fixture should hold a maximum number of wedges. This is expected to be between 12 to 24 parts.
- The clamps will allow for length variation. There are different side profiles, and one shape of vise jaws should fit all size wedges.
- Hydraulic or pneumatic clamping should be used to minimize repetitive human motions. A Kuka robot arm is available to load the wedges into fixtures for machining.
- The clamping or vises should allow large-shank tools to access the cutting regions to deliver heavy torque and precision. Dimensions of current tools will be provided. If there is an advantage in Fixture Design that requires a change of tools, that can be considered.
- The fixture will fit the weight, size and movement limitations of a 5 Axis Mazak Milling machine.
- Tangential Cutting and Drilling torque calculations should be compared to wet-friction holding power of the clamps.
- Microfractures in the copper due to machining pressure must be avoided. The wedges are eventually installed in rotors that are several feet in diameter and spin above 3,000 rpm. The centrifugal forces require full integrity of the metal parts to be maintained during the machining process. This means the clamping process is key to preventing damage to wedge products during machining.
- The fixture should be able to flip the part and hold it without changing clamping jaws.

Expected Deliverables/Results:

Fall Semester 2023:

- CDR: Design alternatives with cost estimates should be presented with a recommended approach.
- 8th Week: Report the maximum and minimum sizes of wedges that can be used on this fixture. Identify the dimensions where the wedge part family will be divided into small or large. Identify overlap of sizes that could go on both large and small wedge fixtures.
- 12th Week: 3D Model of fixture assembled with largest and smallest wedge.
- 14th Week: Provide a report of options of fixture expenses. Discuss how fixture options will impact wedge manufacturing time, reliability, and labor. Include safety issues, tool breakage risks, error-proofing, number of machining options or operations added or saved that led to the final proposal.
- Spring Semester 2024:
- Week 4: Complete assembly of fixture
- Week 5: Test run
- Week 8: Redesign and optimize.
- Week 12: Install new design.
- Week 13: Test final design

Disposition of Deliverables at the End of the Project:

Fixture will be displayed at the Senior Design expo, they arrangements made within 7 days to transfer the fixture to Siemens-Energy, Charlotte who will keep and use the fixture.

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

- CAD 3D Modelling,
- Calculation of machining forces,
- interact with industrial specialists for machining fixtures.
- Precision manufacturing