INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*Duke Energy.*	**Date Submitted**	*07/17/2025*
Project Title	*Improved Maintenance Tools for Switchgear Breakers and 24KV Disconnects (DUKE_CREW)*	**Planned Starting Semester**	*Fall 2025*

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	6	Electrical	0
Computer	0	Systems	

Company and Project Overview:

Duke Energy is one of the largest electric power holding companies in the United States, providing electricity to 7.7 million retail customers in six states. We have approximately 51,000 megawatts of electric generating capacity in the Carolinas, the Midwest and Florida – and natural gas distribution services serving more than 1.6 million customers in Ohio, Kentucky, Tennessee and the Carolinas. Our commercial business owns and operates diverse power generation assets in North America, including a portfolio of renewable energy assets. We are transforming our customers' experience, modernizing our energy grid, generating cleaner energy and expanding our natural gas infrastructure to create a smarter energy future for our customers.

McGuire Nuclear Station (MNS) is located on Lake Norman in Huntersville NC. There are two pressurized water reactors on site that started operation in 1981. Station capacity is 2,386 megawatts.

Project Requirements:

McGuire maintenance crews identified the need for improved tools to resolve problems caused by tools.

1. McGuire's switchgear breakers, 13.8KV, 7KV and 4KV are mounted on a track to ensure electrical contacts for the breaker controls always align properly. The breaker came with a racking tool which uses a 1/2 horsepower motor to drive the breaker into place. The racking tool doesn't have a clutch or other means to prevent over torquing which has caused damage to breaker guide pins. Due to the high cost of repair and limited supply of nuclear safety grade breakers, maintenance now manually cranks the breakers into place.
2. McGuire's 24KV disconnect switches are used to isolate the generator circuit breaker from the main step-up transformer and the generator bus to allow for generator breaker maintenance while the 24KV bus is energized to power plant loads. Silver plated "fingers" under spring tension carry current between the stationary 24KV bus and the prime mover of the disconnect switch. If the springs are not evenly compressed, the fingers don't distribute the 15,000A of current equally resulting in overheating, pitting of the bus work and potential catastrophic failure. The OEM tensioner tool is a flexible rod which requires the user to measure the amount of deflection when put under load. Differences in how techs hold the tool have caused inconsistent results.

Expected Deliverables/Results:

Project 1:-

- Evaluate the process of racking in breakers to determine potential common failure modes between the breaker and track system.
- Develop mitigations for any identified failure modes.
- Improve racking tool to prevent over torquing components.

Project 2:-

- Develop a spring tension tool which includes a tension gauge and ensures repeatable measurements.
- The tool needs to have a place where a tether can be installed to mitigate the issue of dropping the tool down the bus duct.

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. It is also a mandatory part of this Program that the Industry supporter attend the 2 expos to grade their team's performance. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

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

- Tools must use off-the-shelf components or pieces which can be fabricated in a standard metal shop.
- Blueprints and a complete bill of materials for the tools will be submitted.
- Changes to the switchgear breaker or the disconnect fingers are not feasible due to Nuclear Regulatory Commission which is only allows qualified nuclear engineers to evaluate changes in design function.
- Due to Nuclear Security Requirements, students need to be US Citizens or US Permanent Residents.