



Company Information

Company Name	<i>Duke Energy</i>	Date Submitted	<i>04/28/2023</i>
Project Title	<i>LRT200 Tap Changer Remote Reset Design (DUKE_REMOTE)</i>	Planned Starting Semester	<i>Fall 2023</i>

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	3	Electrical	1
Computer	1	Systems	
Other ()			

Company and Project Overview:

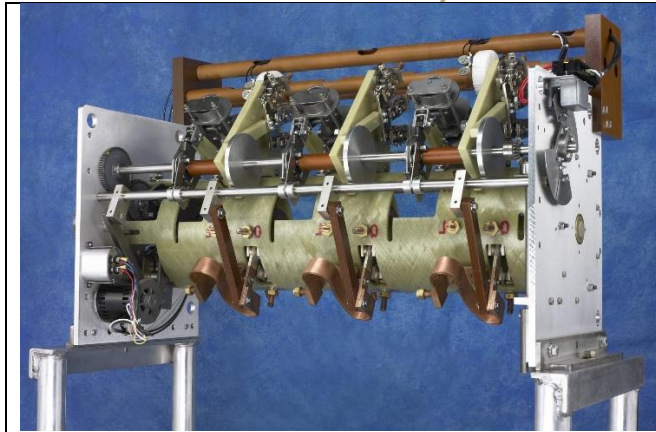
Duke Energy, a Fortune 150 company headquartered in Charlotte, N.C., is one of America’s largest energy holding companies. The company’s electric utilities serve 8.2 million customers in North Carolina, South Carolina, Florida, Indiana, Ohio and Kentucky, and collectively own 50,000 megawatts of energy capacity. Duke’s natural gas unit serves 1.6 million customers in North Carolina, South Carolina, Tennessee, Ohio and Kentucky.

On August 8th, 2011, the Kissimmee Utility Authority experienced a transformer explosion resulting in 2 employees being severely burned along with the death of another employee. At the time of the event, the employees were troubleshooting a transformer tap changer featuring vacuum interrupters. Lessons learned from this event led to changes to Duke Energy’s safety practices in order to prevent Substation Technicians from performing work on tap changers with vacuum interrupters while the transformer is energized.

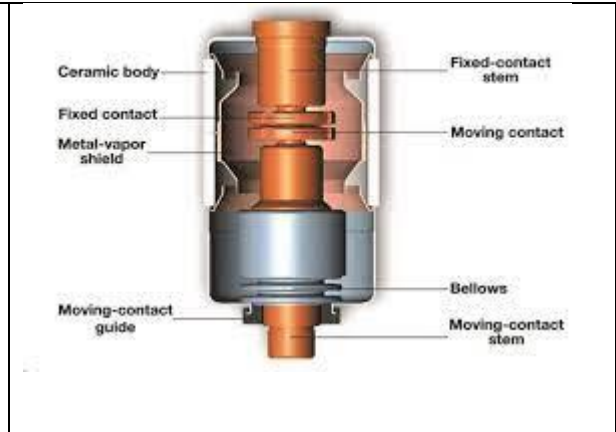
Duke Energy uses 118 LRT-200 transformer tap changers that are protected by a vacuum interrupter failure monitoring system.



INDUSTRIAL SOLUTIONS LABORATORY



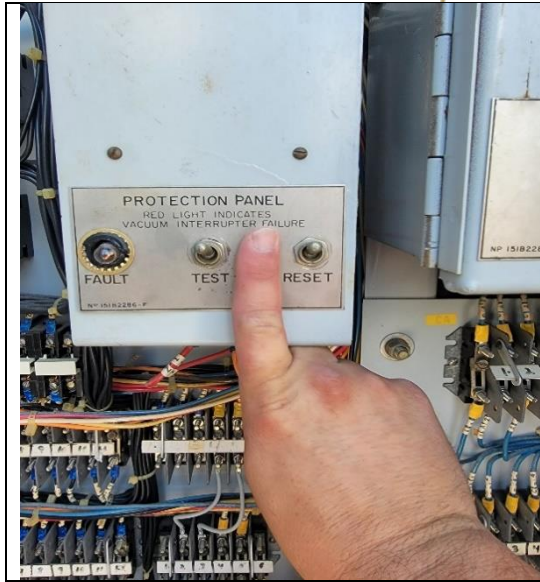
LRT-200 Transformer Tap Changer



Vacuum Interrupter

If the system reaches an alarm state, it will prevent the tap changer from operating to avoid the potential of a vacuum bottle failure that may result in an explosion. Often when adjacent transmission lines operate causing a momentary outage to the transformer, the system may fault due to the sudden inrush current upon re-energization. Once this happens the tap changer protection system will lockout preventing the transformer from having the ability to regulate the output voltage. The first step to troubleshooting the system is to manually reset the system using a momentary toggle switch located on the protection panel within the transformer control cabinet. Upon resetting the switch, the system will reinitialize and retest to determine if the vacuum interrupter is in a faulted state. Due to safety precautions that must be taken to avoid the potential for injury, we are unable to complete this reset while the transformer is energized. At dual bank stations this can be accomplished by switching load to the other transformer to allow a short duration outage for the reset; however, at single bank stations we must install a mobile substation which costs over \$200,000 in O&M.

This project proposes a solution to remotely operate toggle switches on the LRT-200 control panel so that the apparatus can be reset when energized by technicians standing at a safe distance. The proposed solution may also be used to operate other types of apparatus remotely to improve field worker safety.



Picture of Toggle Switch

Project Requirements:

The proposed solution would be to utilize a remotely operated device that would attach to the protection panel and be remotely controlled from a safe distance.

- Device must be lightweight and adhere to the panel.
- Device must be reusable.
- Device must be adjustable to allow it to attach to different types of control panels.
- Device must allow for the toggle switch to return to center after a downward press.
- Device may be powered by battery or 120v AC.
- A wireless connection will be needed between the remote device and a control panel or cell phone app.
- A video camera should be included on the remote device to allow the technician to remotely confirm operation of the switch.

Expected Deliverables/Results:

The team will deliver a prototype solution that meets the project requirements above. The device will include the remote operator that attaches to the apparatus and a control panel solution or app that allows the apparatus to be reset remotely via wireless control (at least 75 ft away). The solution will include an imaging system that allows visual confirmation of the switch's operation.

Disposition of Deliverables at the End of the Project:

The hardware and software developed by the project team will be turned over to the project sponsor after the SD2 expo.



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

- No specific skills beyond expected technical knowledge of senior engineering students in the various specialties.
- May need to travel to Duke sites to see the equipment involved.
- ECGR4123 Analog and Digital communications for EE students