UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	*EPRI*	**Date Submitted**	*12/1/2020*
Project Title	*Design of Test Frame base on the Results of EPRI_FEM Project* **(EPRI_FEM2)**	**Planned Starting Semester**	*Spring 2021*

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	2	Systems	
Other ( )			

Company and Project Overview:

The Electric Power Research Institute (EPRI) conducts research, development, and demonstration projects for the benefit of the public in the United States and internationally. As an independent, nonprofit organization for public interest energy and environmental research, we focus on electricity generation, delivery, and use in collaboration with the electricity sector, its stakeholders and others to enhance the quality of life by making electric power safe, reliable, affordable, and environmentally responsible.

Project Requirements:

For electric utilities to manage the flow of power over the electric grid, they employ switches; similar in purpose to a household wall switch but significantly different in size and operation. These switches can be located on transmission line structures or in switchyards. They must be insulated from ground which is normally done with porcelain post insulators. The porcelain post insulator must withstand both static and dynamic mechanical forces. Those forces are dependent on each switch's design but can be one or more of the following:

- Compression
- Tension
- Cantilever
- Torsional

If the forces exerted on the porcelain post insulator exceed the design margin it can fail. However, there has been little research into the actual forces transferred to the porcelain post insulator during switch operation and especially on aged switches. The EPRI Phase 1 team (Spring 2019) had as a

project objective to create a FEM to analyze the magnitude and type of mechanical force exerted onto the porcelain post insulator during switch operation with and without the added friction that simulates an aged switch. A drawing of an example switch along with its operation parameters was provided to the Phase 1 team for the development of the FEM. Figure 1 is an example of a typical switch.

Figure 1
An example of a switch in a switchyard.

The objective of this project is to use the results of an FEM analysis performed by the Senior Design team of 2019 (EPRI_FEM) to initiate a two phase project. Phase 1 is to design a test frame capable of applying torsion and compression to a porcelain post insulator simultaneously. The two loads need to be independently controlled to follow load profiles using a feedback loop. The frame

needs to be designed to withstand more force than is needed to break the insulator and need to allow testers reasonable ease of installing the test samples. Optional to the design for this project is a way to permit a variety of mounting holes for the variety of insulator designs that exist. All the previous FEM work and supporting drawings are available to support the design phase.

Phase 2 is to build a scaled down working version of the test frame designed in Phase 1 as a proof of concept. The proof of concept should be able to apply two forces as specified by an input load profile simultaneously and measure the applied forces for record and control feedback.

Expected Deliverables/Results:

- Design drawings in Solidworks or compatible file format
- Design parameters tabulated in a spreadsheet
- Electrical schematics of the control circuit
- Parts list
- Working proof of concept at reduced scale

Disposition of Deliverables at the End of the Project:

Hardware developed is the property of the Industry Supporter. The work product is displayed at the last Expo then immediately handed over to the supporter unless arrangements have been made to deliver at a future date.

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

- Interest in energy transmission design
- Control theory
- Circuit design
- Statics and dynamics