UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	*EPRI*	**Date Submitted**	*11/08/2018*
Project Title	*FEM Analysis of High Voltage Switches* **(EPRI_FEM)**	**Planned Starting Semester**	*Spring 2019*

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	4	Electrical	
Computer		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 objective of this project is 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 will be provided for the development of the FEM. Figure 1 is an example of a candidate switch for analysis. The actual chosen switch may change at the time of project execution.

The focus on the FEM is mechanical forces on the porcelain post insulators, the necessary forces calculated on the switch to that end are ancillary to the problem. It is there acceptable to simplify the switch geometry to improve calculation time so long as it does not affect accuracy.

Using the data from the FEM, a set of design parameters and restrictions will be developed that can be used in the development of test frame to mimic the in-service mechanical forces. For example, the parameters may be the minimum force required by a mechanical actuator to mimic the switch forces or the minimum and maximum torsion stress expected on the support beam where the porcelain post insulator is to be mounted.

Figure 1
An example of a switch in a switchyard.

Expected Deliverables/Results:

- The FEM model of the switch in question in the original and a SolidWorks compatible format.
- The visual of the force magnitudes overlaid on the porcelain post insulator in the FEM provided as JPEG files.
- A table of results (in Excel or equivalent) describing the simulation parameters, the maximum force calculated on the porcelain post insulator, and location of the maximum force.
- Provide a list of force parameters for test frame such as described above in Excel or equivalent.
- A PowerPoint presentation describing
    - the problem,
    - the objective,
    - modeling technique,
    - assumptions,
    - results of each scenario.

Disposition of Deliverables at the End of the Project:

No hardware is planned to be developed. Soft copies of the interim results can be delivered at any time during the project and final results delivered no later than at the end of the Expo.

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

- 3 of the 4 ME students must have taken MEGR 3225 (Intro to Finite Element Analysis)
- Statics and dynamics interest and fluency