UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	*CAPER*	**Date Submitted**	*May/22/2019*
Project Title	*Mini D-VAR modeling and Analysis* **CAPER_DVAR**	**Planned Starting Semester**	Fall 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		Electrical	4
Computer	1	Systems	
Other ( )			

Company and Project Overview:

CAPER Overview

The Center for Advanced Power Engineering Research (CAPER) is a membership driven consortium among several universities and industry partners in the Southeast region of the US. The main mission of the center is to develop and demonstrate grid modernization technologies and enhance the educational experience for students in electric power engineering. With an aging infrastructure, rising demands for cleaner electricity and extreme weather conditions, the nation's utilities are working to meet these operational and planning challenges while maintaining a resilient and reliable grid.

As a collaborative effort, CAPER will develop research and demonstrate advanced technologies to meet the operational and expansion needs under uncertainties with an increased penetration of distributed renewable generation. Its Industry Advisory Board (IAB), composed of numerous industry partners, meets twice per year with CAPER researchers and students to conduct business and to engage in discussions about the Center's research and education activities. The project results will be presented at the CAPER conference in each semester at the location to be determined by the CAPER Board. These two events are excellent networking and educational opportunities for the student team.

Project Requirements:

High penetration of distributed energy resources (especially solar farms) on distribution feeders causes operational challenges associated with voltage and VAR management due to the intermittency of generation of solar farms. In order to improve volt/VAR management on the feeders with high penetration of solar farms, Duke Energy installed mini D-VAR device, which is power electronics based device that provides or absorbs the reactive power in sub-cycle time in order to mitigate the voltage changes caused by the solar farm intermittency. The unit operates based on the smart inverter volt/VAR control curve. As such, this device cannot distinguish between the voltage changes due to transient sags and swells vs. voltage changes due to the feeder faults.

The objective of this project will be to use the generic model for Mini D-VAR device (which will be provided in MATLAB/Simulink), and then convert the model to RTDS equivalent model. Once this has been completed, simulation must be done in order to ensure that two models are very similar in terms of response. Following, feeder model in CYME will need to be imported into RTDS software, and mini D-VAR model will need to be added to the feeder. Once this has been completed, fault current analysis should be done for different types of faults (LG, LL, LLG and LLLG), and this simulation should be done without mini D-VAR device first to get the baseline data and then with mini D-VAR device. The main objective is to understand if mini D-VAR can result in creation of undesired islanding condition within faulted area.

Expected Deliverables/Results:

Duke Energy to Provide:

- Generic model of mini D-VAR device
- Feeder model in CYME
- Guidance for fault analysis

Fall Semester Deliverables:

- Receive the mini D-VAR model in MATLAB/Simulink and CYME model
- Converter the mini D-VAR model to RTDS
- Converter the CYME model to RTDS

Spring Semester Deliverables:

- Perform the baseline fault current analysis without mini D-VAR and record the analog values for voltages, currents, frequency, frequency change, voltage shift, etc…
- Perform the baseline fault current analysis with mini D-VAR and record the analog values for voltages, currents, frequency, frequency change, voltage shift, etc…
- Write a report and make conclusions based on the simulation data

Disposition of Deliverables at the End of the Project:

Report and all files to be delivered at Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested

(If none please state none):

- Strong interest in the Power Generation field
- Knowledge of Mat Lab, Cyme and Open DSS Software
- Ability to travel to status meetings that will be held off-campus. Presence is required at ALL off-campus meetings.
- CAPER has two conference meetings each year. On in the Fall and one in the Spring. The locations of the conferences will be in NC or SC. Past meetings have been held at Clemson (either main or Charleston campus), NCSU or UNC Charlotte, but meeting locations may be anywhere in the Carolinas. The student team is required to present their results to the full CAPER organization each semester. ALL STUDENTS FROM THE TEAM MUST ATTEND AND PRESENT AT EACH OF THE TWO MEETINGS. THIS IS NOT OPTIONAL, ATTENDANCE AND PRESENTATION BY EACH STUDENT IS A REQUIREMENT OF THE PROJECT AND COURSE. FAILURE TO MEET THIS REQUIREMENT WILL ADVERSELY AFFECT THE INDIVIDUAL GRADES. Travel costs will be covered by the team's project budget.
- Faculty mentor must also attend the student presentations at the CAPER conferences