UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	Duke Energy	**Date Submitted**	June 19, 2017
Project Title	Meter and Device Placement in Duke Circuit Model – Phase 2 (DUKE_METR2)	**Planned Starting Semester**	Fall 2017

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. 250 hours are expected per person. Complete the following table if this information is known, otherwise the Senior Design Committee will develop based on the project scope:

Discipline	Number	Discipline	Number
Mechanical		Electrical	3
Computer	2	Systems	
Other ( )			

Project Overview:

Increased electrical energy usage and network intricacy has mandated a change in how electric utilities model and monitor their system. A transition from manual modeling using paper maps to electronic Geographic Information Systems (GIS) to keep accurate models of the transmission and distribution networks has been needed to keep up with this complexity. Telecommunication improvements and implementation of Smart devices have given the utilities increase in data from the devices and control of the devices using Supervisory Control and Data Acquisition (SCADA) software. The leveraging of GIS data and communication and control of devices on a distribution network has given rise to applications to help observe and operate the grid optimally called Distribution Management Systems.

A relevant application of advanced Distribution Management Systems (DMS) is their use in managing voltages in distribution feeders with high penetration of utility-scale distributed photovoltaic (PV) sources. Specifically, this project will investigate applicability of using Integrated Volt/Var Control (IVVC) strategies to mitigate voltage variations caused by high PV penetration. The objective will be to define the monitoring and control devices needed, and where in the system they should be placed, in an attempt to minimize number of monitoring points (and data accumulation) while maximizing system visibility to achieve IVVC for voltage management.

Another application is Fault Locating, Isolation and Service Restoration (FLISR). By leveraging the fault data from the field devices and the power flow algorithms, you can identify the location of the fault and automatically switch around the fault to isolate the outage and restore service where possible. This reduces the outage time by not only minimizing the number of customers

that have an extended outage, but also reduces the time the crew spends looking for the problem. As devices are added to the grid, an engineering study must be performed to determine where those devices should be placed. This project will develop an algorithm to identify the optimal placement of new FLISR devices that are being added to the circuits. The will provide the engineers with a tool that can be leveraged in their designs.

This project is a follow-on to the "Duke Meter and Device Placement for Vol/Var Control in Distribution Systems" project that was completed in May 2017.

Initial Project Requirements:

Scaling the work on the campus feeder in DMS and SCADA interfacing with RTDS simulator to a Duke Circuit model and developing a DMS based control with optimal meter placement. The team will implement and adjust/modify the strategy developed by the previous team for an actual Duke circuit, given its specific characteristics.

Expected Deliverables/Results:

1. Interfacing SCADA interface with eTerra distribution, developing a SCADA platform for the Duke Energy model and integrating eTerra control with this architecture.
2. Integrating the full scale RTDS model for PV farms and implementing the IVVC architecture
3. Developing an optimal meter placement algorithm considering PV dynamics and working in close loop with LVM based on sensitivity.
4. Create an algorithm for optimal placement of FLISR devices using the 4-3-2 rule.
    - Place reclosers every 400 customers or 3 miles or 2 MW on each feeder.
    - Would like to automate this in some way to determine device placement for normally closed and normally open devices.

Disposition of Deliverables at the End of the Project:

Provide all project output to Duke Energy technical reps after the completion of the Expo

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

- Power system background and software background math and control preferred.