

## Senior Design Project Description

<b>Company Name</b>	<i>Schweitzer Engineering Laboratories Inc.</i>	<b>Date Submitted</b>	07/08/2020
<b>Project Title</b>	<i>Comparative Evaluation of a Modern Substation with Conventional and Digital Secondary Systems (SEL EVAL)</i>	<b>Planned Starting Semester</b>	Fall 2020

### 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:

<b>Discipline</b>	<b>Number</b>	<b>Discipline</b>	<b>Number</b>
Mechanical		Electrical	3
Computer	1	Systems	
Other ( )			

### Company and Project Overview:

SEL invents, designs, and builds digital products and systems that protect power grids around the world. This technology prevents blackouts and enables customers to improve power system reliability and safety at a reduced cost. A 100 percent employee-owned company headquartered in Pullman, Washington, SEL has manufactured products in the United States since 1984 and now serves customers worldwide. Our mission is simple: to make electric power safer, more reliable, and more economical.

### Project Requirements:

Digitization of the power grid is inevitable. There are clear financial and technical benefits of replacing copper cables in a substation with optical fiber cables. In a conventional substation, copper cables are used to connect protective relays with current transformers, voltage transformers, and circuit breakers. In a modern substation, optical fiber cables are used for secondary systems. Two digital secondary systems solutions are available; point-to-point fiber connection, and IEC 61850-9-2 Sampled Values (SV) based ethernet network connection. Each solution has its own benefits and challenges. A substation with digital secondary system can also bring complexity in implementation and day-to-day operation.

The objective of this project is to carry out comparative evaluation of two digital secondary system solutions against the conventional system. The project team shall investigate various aspects like financial benefits, technical benefits and challenges, operational complexity, etc. The team shall use some form of standard metrics when comparing these solutions. Finally, a recommendation to



UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING

replace a conventional system with a specific digital secondary system shall be provided.

**Expected Deliverables/Results:**

- Acquire a complete set of engineering drawings for an existing distribution substation. Tabulate the number of devices used and total length of copper cables used for secondary system. Calculate the total cost.
- Document the working principle of two available digital secondary system solutions. Identify the strength and challenges of each solution.
- Design a solution to replace copper cables in the existing distribution substation with point-to-point based digital secondary system. Tabulate the number of devices uses and total length of fibers used. Calculate the total cost.
- Design a solution to replace copper cables in the existing distribution substation with Sampled Values based digital secondary system. Tabulate the number of devices uses and total length of fibers used. Calculate the total cost.
- Evaluate the reliability of each system for loss of one or multiple equipment using fault tree analysis. Evaluate the operation speed of three systems by applying faults on three different protective relays.
- Final Report

**Disposition of Deliverables at the End of the Project:**

To be given to Supporter at the conclusion of the Expo.

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

- Electromagnetic Devices