



Company Information

Company Name	<i>Schweitzer Engineering Laboratories Inc</i>	Date Submitted	<i>06/01/2021</i>
Project Title	<i>Comparative Evaluation of Two Digital Secondary Systems for a Transmission Substation at Dominion Energy (SEL DOMINION)</i>	Planned Starting Semester	<i>Fall 2021</i>

Senior Design Project Description

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	2
Computer	2	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. Some product examples are shown below:



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 a conventional transmission substation at Dominion Energy. 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 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 transmission substation at Dominion Energy. 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 transmission 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 transmission substation with Sampled Values based digital secondary system. Tabulate the number of devices used 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:

Hardware developed is the property of the Industry Supporter. Typically, 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. Please confirm your expectation in this section.

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

- Interest in Electromagnetic Devices
- Interest in Energy transmission
- Travel may be required to SEL's Charlotte facility