

## Vermont Law School Summer Session 2021

### Three Essentials of the Electric Grid: Engineering Essentials (ENV 5510)

Tuesday, June 1-4, 1-4 PM Hybrid model

**Instructors:** Christopher Root, ([croot@velco.com](mailto:croot@velco.com)) , COO, VELCO.

**Text:** Electric Power System Basics for the Nonelectrical Professional, by Steven W. Blume. 2<sup>nd</sup> Edition, IEEE Press and Wiley and Sons

**Overview:** This course provides an introduction to the electric grid: its main components, architecture, operation and fundamental limitations. The goal is to introduce students to the key characteristics of this complex technical system and to develop an understanding of how electricity is generated, distributed and consumed. The physics of the electricity will be discussed and how the laws of physics can dictate what the electrical grid can and cannot do. There will be a discussion of the history of the grid and its evolution into what the US has today. The course will also include information on the evolution of the power grid into a “Smart Grid” including technology and design changes taking place in the industry today.

The homework assignments will include reading, qualitative short paragraphs as well as quantitative problem-solving. No advanced math skills are assumed or required. A take home final will be given. The homework will account for 40% of the grade. The final exam will count for 50% with the remaining 10% of the final grade based on class participation.

## **Tentative Schedule:**

### **Tuesday, June 1**

Introduction to electricity

Basic Physics

Volts, Amps and Watts

Power versus Energy

Direct and Alternating Current

Generators and Loads

Energy Storage

### **Wednesday, June 2**

Three phase power

Transmission and Distribution lines

What is reactive power?

Transformers

Substations

Line losses and their importance

Protection Systems

### **Thursday, June 3**

Grid Operation: balancing supply and demand

Monitoring of the Power System

Outage Planning

Computer modelling of power systems

Role of the Independent System Operator (ISO)

Inertia and Power System Stability

The big bad blackout- The Texas story.

### **Friday, June 4**

Security Issues in the Power System

Smart Grid

Microgrids

Interactions of the gas and electric systems

Deregulated generation and the power system

Solar, Wind and storage generation

Integration of the renewables into the power system

**Take Home Final- Due Monday, June 7<sup>th</sup> at 6 PM**