

Vermont Law School Course
Three Essentials of the Electric Grid: Engineering Essentials
Instructor: Chris Root (croot@Vermontlaw.edu and croot@velco.com)

Course Text: Electric Power Systems: A Conceptual Introduction by Alexandra von Meier. John Wiley and Sons, Inc. 2006

May 28 – May 31 1-4PM

Grading: 30% Homework, 10% Classroom Participation, 60% Final Exam

Final Exam: Take home due Monday June 3 at 8 AM.

HOMEWORK

#1 Before First Class - Read Chapter 1 & 2 in Text. Questions 1 - 7 (except #2) on Homework Problems after first class.

#2 Before Second Class - Read Chapters 3, 5 and 6 in Text. Homework problems # 2, 8-13 after second class.

#3 Before Third Class- Read Chapter 8. Homework problems 14-16 after third class.

4 Before Fourth Class- Read Chapter 9, Take home final

FINAL is due Monday, June 3 at 8AM. Email it to Chris Root at croot@Vermontlaw.edu

Topics Covered by Class

1. Tuesday, May 28

- a. Forms of energy and basic concepts
- b. Laws of Physics
- c. Electric Power and Circuits
- d. Generators
- e. Loads
- f. Introduction to AC Power

2. Wednesday, May 29

- a. Power System Overview
- b. Major Power System Elements
- c. Power, Energy, Losses
- d. Power system protection basics
- e. Transmission and Distribution
- f. Overhead vs Underground lines
- g. Three phase power fundamentals
- h. HVDC Basics
- i. Reactive Power

3. Thursday, May 30

- a. Operations
 - i. Purpose of the Control Room
 - ii. VELCO as part of ISO-NE Operations
 - iii. What is an EMS and a SCADA system?
 - iv. What are the responsibilities of the control room operator?
 - v. What is a contingency analysis?
 - vi. How does the monitored information get back to Rutland?
 - vii. What role does the FERC/NERC/NPCC play in Operations?
- b. ISO Relations
 - i. What is an energy market?
 - ii. What are the major parts of the NE energy market and how does it work?
 - iii. What is a Regional Transmission Rate as compared to Local Transmission Rates?
- c. Transmission Planning
 - i. Basics of Planning Criteria
 - ii. Voltage and Thermal criteria
 - iii. What is a load flow and what does it do?
 - iv. What is a bus, load forecast, generation plan?
 - v. N-1 and N-1-1 Criteria in planning
 - vi. Non-transmission alternatives

4. Friday, May 31

- a. Introductions & the Changing Utility Landscape
 - b. Issues/Challenges/Opportunities with Distributed Energy Resources
 - i. Increasing complexity and situational awareness
 - ii. Integrating Intermittent Resources: time and location matters
 - iii. Distribution System challenges
 - c. Constrained areas?
 - d. Blackouts?
 - e. What is a Smart Grid?
 - f. What is a MicroGrid?
 - g. Energy Storage?
 - i. Why is it important?
 - ii. How is it used?
 - iii. What is its future?
 - h. Vermont Weather Analytics Center (VWAC)
 - i. What is it?
5. Instructor Evaluation