

# LINE DESIGN & STAKING COURSE – PHASE I

**Date:**

Monday – Thursday,  
January 9 - 12, 2012

**Time:**

10:00 am–4:30 pm - Mon  
8:00 am–4:30 pm - Tue-Thu

**Location:**

Colorado Rural Electric Assn.  
5400 North Washington St.  
Denver, Colorado

**Instructor:**

Hi-Line Engineering

**Fee:**

\$1,200 per student

**To Register:**

Contact Meg Vetting at  
(303) 455-2700 ext. 700 or  
[mvetting@coloradorea.org](mailto:mvetting@coloradorea.org)

**Registration Deadline:**

January 3, 2012

**Confirmation:**

A minimum of eight people must be registered for the course to be held. A letter will be faxed to all participants confirming their registration in the course.

**Cancellation Policy:**

Cancellations received on or before the registration deadline will receive full refunds. Cancellations received after the deadline may be billed the entire registration fee.

## COURSE DESCRIPTION

**BASIC SURVEYING:** This domain will teach the student the basic methods of line route surveying. He or she will learn how to make accurate distance measurements, turn and bisect line angles, and measure changes in elevation using the basic surveying instruments. A basic overview of total station and GPS surveying will be included as a reference and introduction to further study.

1. Fundamental principles
  - a) How to achieve a level of accuracy relative to the job
  - b) Understanding township, range, and section lines
2. Measurements
  - a) Length — pacing, 100-ft tape, Rolatape (wheel)
  - b) Turning and bisecting line angles — 100-ft tape, pull-finder, hand compass, transit
  - c) Structure alignment — range rods, binoculars, transit
3. Elevation profile and object height
  - a) Measuring changes in elevation using a hand level
  - b) Measuring height and elevation using an Abney level or clinometer
  - c) Using a transit and level rod for surveying a complete elevation profile
4. Special techniques
  - a) Running offset lines around obstacles
  - b) Busting-in between two points
  - c) Extra long distance alignment
5. Total station (introduction and overview)
  - a) Description of equipment and accessories
  - b) Programming the job and conducting a survey
  - c) Transfer of field data to AutoCAD
6. Geographical Positioning Systems (introduction and overview)
  - a) Types of GPS systems and basic operation
  - b) Using GPS to inventory existing line routes
  - c) Overlay of GPS data to geo-referenced maps and aerial photographs

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**OVERHEAD STRUCTURE DESIGN:** The student will learn to design overhead electrical distribution structures. Tables and graphs will be provided for the student to lookup design values for immediate application in the field. He or she will also learn to make basic calculations to determine strength and maximum allowable spans for wind and ice loading, plus total guy load due to tension and wind.

1. Conductors

- a) Ruling span theory and calculation
- b) Sag and tension calculations and tables
- c) Galloping and Aeolian vibration
- d) Maximum span based on vertical and horizontal conductor separation
- e) Conductor stringing and sag measurement

2. Poles

- a) Ultimate resisting and bending moments of wood poles
- b) Transverse conductor wind load and calculations
- c) Calculation of maximum wind span for tangent poles
- d) Designing un-guyed small line angle poles and embedment
- e) Selection of pole class based on transformer weight and vertical loading

3. Pole-top assemblies

- a) Types of horizontal and vertical pole-top assemblies
- b) Crossarm loading and maximum weight spans
- c) Characteristics and selection of pin and post type insulator assemblies
- d) Pole-top assembly strength calculations

4. Guys and anchors

- a) Determination of horizontal pull based on transverse and longitudinal loads
- b) Calculation of total guy load as a resultant of guy lead to height ratio
- c) Soil classification and anchor selection
- d) Designing a deadend anchor/guy assembly
- e) Designing a line angle anchor/guy assembly

**JOINT USE STAKING:** This course will teach the student how to handle joint use attachments. He or she will learn how to perform make ready surveys, measure clearances, determine strength requirements, prepare construction estimates, make final inspections, and understand the requirements of joint use contracts.

1. Types of joint use

- a) Communication on distribution
- b) Distribution on transmission
- c) Distribution on distribution

2. Determining strength requirements for joint use aerial attachments

- a) NESC grades of construction
- b) Transverse wind load on tangent structures

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3. NESC joint use requirements for separation of joint use utilities
  - a) Overhead vertical and horizontal clearance at supports and mid-span
  - b) Climbing and working space for operating personnel
  - c) Separate lay and random lay of underground cables in a joint use trench
  - d) Position of power and communication cables in an underground duct system
4. Joint use contracts
  - a) The anatomy of a joint use contract
  - b) Owner and renter responsibilities
  - c) Permitting and application procedure
  - d) Special requirements for joint use attachment
  - e) Determining rental and construction costs
5. Inspection of joint use attachments
  - a) System-wide inspections for NESC violations
  - b) Post make-ready construction and attachment
  - c) Attachment pole count frequency and procedure
6. Performing make-ready surveys
  - a) Establishing attachment positions and measuring clearance
  - b) Preparing construction specifications and cost estimates

**UNIQUE STRUCTURES:** The student will learn to design special structures that require additional strength due to extreme wind load, long spans, and multiple circuits. This section also includes designing steel pole and unguyed wood pole structures.

1. Extreme wind loading
  - a) Evaluating pole strength for extreme wind applications
  - b) Example problems
2. Double circuit
  - a) Configuration options
  - b) Guying techniques
  - c) Vertical spacing between circuits
  - d) Maximum span lengths
3. Steel poles
4. Un-guyed line angle poles

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**SUPPLIES NEEDED:**

Workbooks and manuals will be supplied for the specialized instruction. Each student will be required to supply a personal copy of the *National Electrical Safety Code* and RUS Specifications. Each student should bring a scientific calculator and note taking materials to each seminar. The students will work class problems both in groups and individually. These problems will involve both the lookup tables and calculations based on the material contained in the manuals. The instructors will answer questions and go through the solutions to the problems. The instructors will also be available to discuss ideas and questions to a reasonable extent after normal class hours.

**CERTIFICATION:**

The course of study leads to certification as a qualified staking technician. The certification will be awarded after the student accomplishes well-defined tasks and demonstrates a working knowledge of the subject material through observation and completion of comprehensive written tests. The classroom and field training is divided into three phases of four domains each to be taught in three separate four-day seminars. To achieve certification, the student must attend all three seminars and pass a test for each of the twelve domains. Students may re-take any test if their first try is unsuccessful.