CONCEPT

Overhead Transmission Lines: Design, Sag-Tension, Construction and Maintenance

16 – 27 August 2027
London - Central London four-star



Overhead Transmission Lines: Design, Sag-Tension, Construction and Maintenance

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Introduction:

Overhead transmission and distribution lines fail or lose capacity when conductor choice, sag-tension values, clearances, hardware and earthing are settled separately from how the line will be built and maintained, leaving hot joints, clearance infringements and repeated outages. This Core Concept course trains line engineers to rate conductors, calculate sag and tension with the ruling span, check clearances and insulation, supervise foundations, erection and stringing, and plan inspection, vegetation and refurbishment work. Participants produce an Overhead Line Design Calculation Pack and Maintenance Plan for a case line.

Course Objectives:

- Select conductor type and size for an overhead line from thermal rating, losses and mechanical loading
- Calculate sag and tension for tension sections using the ruling span and change-of-state method and issue stringing charts
- Verify ground, crossing and right-of-way clearances and choose insulators, fittings and structure types for each span
- Specify shield wire and tower footing earthing arrangements that control back-flashover and shielding failure
- Supervise foundation, erection, stringing, jointing and pre-energisation testing against documented acceptance records
- Build a risk-ranked inspection, vegetation and refurbishment plan from patrol, thermography and condition data

Target Audience:

- Line design engineers responsible for routing, conductor selection, sag-tension and structure schedules
- Construction and site engineers responsible for foundations, tower erection and conductor stringing
- Maintenance engineers responsible for patrols, defect repair and line outage work
- Asset engineers responsible for condition assessment, refurbishment and reconductoring decisions
- Technical supervisors responsible for contractor quality checks and line acceptance records

Course Outline:

Day 1: Overhead Line Components, Voltage Classes and Route Selection

- Overhead Line Anatomy: Phase Conductors, Shield Wires, Insulator Strings and Support Structures
- Transmission, Subtransmission and Distribution Voltage Classes with Typical Structure Families
- Route Corridor Selection: Constraint Mapping, Crossings and Access Tracks
- Topographic, LiDAR and Geotechnical Surveys for Plan-and-Profile Drawings
- Tower Spotting on the Profile: Span Lengths, Angle Points and Terminal Positions

Day 2: Conductor Selection, Ampacity and Line Electrical Parameters

- Conductor Types Compared: ACSR, AAAC and High-Temperature Low-Sag Designs
- Steady-State Thermal Rating Heat Balance: Joule, Solar, Convective and Radiative Terms
- Conductor Size Economics: Resistive Losses Versus Capital Cost Trade-Off
- Series Resistance, Inductive Reactance and Shunt Capacitance per Kilometre
- Voltage Regulation, Surge Impedance Loading and Phase Transposition Effects

Day 3: Sag-Tension Calculations and the Ruling Span

- Catenary Equation and Parabolic Approximation for Level and Inclined Spans
- Loading Cases: Everyday Stress, Maximum Wind, Ice and Maximum Operating Temperature
- Change-of-State Equation with Conductor Creep and Thermal Elongation
- Ruling Span Method for Tension Sections with Unequal Spans
- Stringing Charts and Sag Templates for Construction Crews

Day 4: Clearances, Insulators, Hardware and Support Structures

- Ground, Road, Building and Crossing Clearance Checks at Maximum Sag
- Right-of-Way Width from Conductor Blowout and Insulator Swing Angle
- Insulator Selection: Porcelain, Toughened Glass and Polymer with Creepage Distance for Pollution Levels
- Line Hardware: Suspension Clamps, Tension Assemblies, Spacers, Vibration Dampers and Grading Rings
- Lattice Towers, Steel, Concrete and Wood Poles, Guy Wires and Foundation Types Overview

Day 5: Earthing, Lightning Performance and Guided Line Design Case

- Shield Wire Shielding Angle and Tower Footing Resistance Targets
- Back-Flashover and Shielding Failure Mechanisms on Line Structures
- Guided Case: Conductor Choice and Thermal Rating for a Case Line
- Guided Case: Sag-Tension Table and Clearance Check Across One Tension Section
- Guided Case: Structure and Insulator Schedule with Design Assumptions Log

Day 6: Foundation Works, Tower Erection and Pole Setting

- Foundation Construction: Pad-and-Chimney, Piled, Rock Anchor and Direct-Embedded Poles
- Stub Setting, Concrete Curing and Foundation Acceptance Records
- Tower Erection Methods: Piecemeal Build, Section Lift, Gin Pole and Crane Assembly
- Bolt Torque, Member Verification and Structure Plumb Checks
- Distribution Pole Setting, Crossarm Framing and Stay Installation

Day 7: Stringing, Jointing, Testing and Energisation Quality

- Tension Stringing Set-Up: Puller, Tensioner, Pilot Rope and Running Blocks
- Sagging-In by Sight, Transit and Dynamometer Methods with Temperature Correction
- Compression Joints, Dead-End Clamps and Jumpers: Die Selection and Joint Resistance Checks
- Pre-Energisation Tests: Insulation Resistance, Continuity, Phasing and Footing Resistance Measurement
- Energisation Checklist, Construction Punch List and As-Built Line Records

Day 8: Line Inspection, Live-Line Working Principles and Landowner Liaison

- Ground and Climbing Patrols: Defect Categories and Inspection Forms
- Infrared Thermography of Joints and Clamps with Temperature Rise Grading
- Drone Visual Surveys and Ultraviolet Corona Camera Inspection
- Live-Line Working Principles: Hot Stick, Insulated Glove and Bare-Hand Methods Within Isolation Rules
- Wayleave Holder, Landowner and Community Liaison for Line Access

Day 9: Vegetation, Outage Planning, Line Failures and Condition Indicators

- Vegetation Management: Clearance Zones, Cutting Cycles and Regrowth Monitoring
- Line Outage Planning: Work Bundling, Switching Requests and Return-to-Service Timelines
- Common Failure Modes: Conductor Fatigue at Clamps, Insulator Flashover, Corrosion and Foundation Settlement
- Refurbishment Options: Reconductoring, Insulator Replacement and Structure Strengthening
- Asset Condition Scoring, Line Fault Rate and Availability Indicators

Day 10: Capstone: Line Design Calculation Pack and Maintenance Plan

- Case Line Brief: Route Profile, Load Growth and Condition Survey Data
- Calculation Pack Build: Conductor Rating, Sag-Tension Tables and Clearance Verification
- Structure, Insulator and Earthing Schedule for the Case Line
- Risk-Ranked Inspection and Maintenance Programme with Outage Windows
- Calculation Pack and Maintenance Plan Review with Instructor Feedback

Skills You Will Gain:

- Conductor Thermal Rating
- Sag-Tension Calculation
- Clearance and Right-of-Way Verification
- Insulator and Hardware Specification
- Lightning Performance Assessment
- Stringing and Jointing Supervision
- Thermographic Defect Grading
- Line Refurbishment Prioritisation

Why Attend This Course:

- Return with an Overhead Line Design Calculation Pack and Maintenance Plan built on a case line
- Catch clearance infringements, undersized conductors and weak earthing at the profile stage instead of after energisation
- Move in week two from design calculations to construction quality, inspection technology and refurbishment decisions
- Compare line practice with engineers from transmission utilities, distribution networks, industrial plants and construction contractors

Conclusion:

An overhead line carries its rated load safely for decades when the conductor, sag-tension values, clearances, insulation and earthing are designed with construction and maintenance in mind. Week one builds design capability from route surveys and conductor rating to sag-tension, clearances, hardware and lightning performance, closing with a guided design case. Week two adds foundations, erection, stringing, jointing, testing, inspection methods, live-line principles, vegetation, outage planning and refurbishment. The capstone produces an Overhead Line Design Calculation Pack and Maintenance Plan.