

SURVEY & ESTIMATION OF TRANSMISSION LINES & SUBSTATION

Duration: 32 Hours | 4 Days

TARGET AUDIENCE

This programme is designed for engineers and technical professionals engaged in the planning, survey, design, estimation, tendering and execution of transmission lines and substations. It is suited to civil, electrical and transmission engineers working with power utilities, transmission corporations, EPC contractors, consultancy organisations and project management teams, as well as survey personnel, quantity and cost estimation engineers, contract and procurement professionals, and project supervisors who prepare or review route surveys, tower schedules, substation layouts, bills of quantities and project cost estimates. Participants are expected to have a basic understanding of power transmission systems and construction practices. The course is intended for those who need to convert field survey data into accurate, auditable quantities and cost estimates, and who are responsible for the technical and commercial reliability of transmission line and substation project estimates.

COURSE OUTCOMES

On completion of this course, participants will be able to:

- Understand the survey objectives, project inputs and approval requirements for new transmission lines, line diversions, substations and bay extensions.
- Apply reconnaissance and route/site selection principles to identify technically feasible, constructible, maintainable and economical alternatives.
- Operate and interpret data from total station, GNSS/DGPS, auto level, handheld GPS, drone-derived data and GIS platforms within a disciplined field-to-office workflow.
- Prepare detailed route and profile surveys, route maps, profile sheets, crossing schedules and survey control records.
- Perform tower spotting and span optimisation using profile data and sag templates/software with verified ground clearances.
- Assess crossings, clearances, special locations, soil conditions and access constraints and link them to foundation, tower and logistics requirements.
- Create transmission line bills of quantities covering towers, foundations, conductors, earthwire/OPGW, insulators, hardware, erection, stringing and restoration items.
- Calculate route length, tower schedules, conductor and earthwire lengths, and foundation-wise excavation, concrete, reinforcement and formwork quantities.
- Apply rate analysis and cost build-up methods using approved schedules of rates, contracts, market quotations and utility norms.
- Troubleshoot estimates by identifying omissions, duplication, unrealistic allowances, unit errors and drawing-to-BOQ mismatches.
- Conduct substation site surveys and translate topographic, soil and utility data into layout, grading, drainage and foundation inputs.
- Estimate substation civil quantities, electrical equipment, secondary systems, earthing, illumination, protection, control and auxiliary requirements.

- Structure substation BOQs and verify completeness across civil, electrical, protection, communication, safety and operational interfaces.
- Prepare audit-ready estimate documentation, technical specifications, assumptions, rate references and revision controls.
- Optimize estimate reliability through validation, sensitivity assessment, contingency control and benchmarking against similar projects.

COURSE OBJECTIVES

- To provide a structured understanding of survey planning, data requirements and field methods applicable to transmission line and substation projects.
- To develop proficiency in the use of modern survey instruments, coordinate systems, control points, accuracy checks and digital data workflows.
- To build competence in route profiling, tower spotting, span optimisation and the treatment of crossings, clearances and special locations.
- To establish a clear methodology for deriving quantities from approved survey outputs and converting them into complete bills of quantities.
- To strengthen rate analysis, cost build-up and estimate documentation skills in line with utility norms and approval requirements.
- To create workflow readiness for substation survey, layout coordination, civil and electrical quantity assessment and interface checking.
- To instil disciplined estimate validation, risk allowance, benchmarking and error-control practices.
- To reinforce learning through practical exercises, sample estimate reviews, an integrated line and substation estimation exercise, and group presentation with technical review.

COURSE OUTLINE

The course comprises **32-hours** of theory and labs and is divided into 20 different chapters. Each chapter will be followed by hands-on lab exercises to reinforce learning and gauge understanding of the topics covered.

TABLE OF CONTENTS

Day 1: Survey Planning, Data Requirements, Field Methods and Route Profiling

Module 1: Survey Scope and Project Inputs

- Survey objectives for new transmission lines, line diversions, substations, bay extensions and associated infrastructure.
- Collection and review of maps, system requirements, terminal points, preliminary route corridors, land data and existing utility information.
- Survey planning, team responsibilities, instruments, field records, safety controls and approval requirements.

Module 2: Reconnaissance and Route / Site Selection Principles

- Desktop study and field reconnaissance for technically feasible, constructible, maintainable and economical alternatives.
- Assessment of terrain, habitation, forests, rivers, highways, railways, utilities, airports, defence areas and other constraints.
- Comparison of alternative routes/sites using length, crossings, access, foundation conditions, approvals, risk and lifecycle considerations.

Module 3: Survey Instruments and Digital Tools

- Use and limitations of total station, GNSS/DGPS, auto level, handheld GPS, drone-derived data and GIS platforms.
- Coordinate systems, benchmarks, control points, calibration checks, accuracy, data capture and backup discipline.
- Field-to-office workflow for downloading, validating, plotting and preserving survey data.

Module 4: Field Safety, Documentation and Quality Checks

- Risk assessment for work near roads, railways, water bodies, slopes, vegetation, habitations and existing electrical installations.
- Daily field notes, chainage, coordinates, photographs, sketches, benchmark records and crossing details.
- Independent checks, closure error, repeat observation, data reconciliation and approval of survey outputs.

Module 5: Detailed Route and Profile Survey

- Centre-line alignment, angle points, chainage, longitudinal profile, cross-sections and ground levels.
- Identification of route deviations, access tracks, tower locations, special spans and construction constraints.
- Preparation of route maps, profile sheets, crossing schedules and survey control records.

Day 2: Tower Spotting, Crossings and Transmission Line Quantities

Module 6: Tower Spotting and Span Optimisation

- Principles of normal, angle, tension, terminal and special tower selection based on route geometry and loading conditions.
- Use of profile data and sag templates/software for tower spotting, span distribution and ground-clearance verification.
- Optimisation considering tower quantity, extensions, foundations, access, safety clearances and constructability.

Module 7: Crossings, Clearances and Special Locations

- Survey requirements for roads, railways, rivers, canals, existing lines, pipelines, communication routes and buildings.
- Recording crossing angle, levels, span, obstruction dimensions, approach conditions and authority-specific information.
- Preliminary planning for special towers, protection arrangements, approvals and construction methodology.

Module 8: Soil, Foundation and Access Inputs for Line Estimation

- Collection of soil classification, groundwater, rock, marshy, black-cotton and other foundation-related information.
- Assessment of tower access, temporary roads, material movement, working space and seasonal constraints.
- Linkage of survey observations with foundation type, tower extension, excavation, concreting and logistics quantities.

Module 9: Transmission Line Bill of Quantities

- Quantity assessment for towers, extensions, foundations, stubs, reinforcement, concrete, earthing and anti-climbing devices.

- Conductor, earthwire/OPGW, insulator strings, hardware, accessories, jointing materials and protection requirements.
- Erection, stringing, testing, access works, crossings, temporary arrangements and restoration items.

Module 10: Quantity Calculation from Route and Profile Data

- Deriving route length, tower schedule, tower-wise type/extension and special location quantities from approved survey outputs.
- Conductor and earthwire length estimation with allowances for sag, jumpering, wastage and drum planning.
- Foundation-wise excavation, concrete, reinforcement and formwork quantities based on soil and design categories.

Day 3: Line Cost Estimation, Substation Survey and Layout Inputs

Module 11: Rate Analysis and Cost Build-up

- Use of approved schedules of rates, recent contracts, market quotations and utility norms for estimation.
- Separation of material, labour, transport, loading/unloading, testing, supervision and incidental cost components.
- Treatment of taxes, duties, insurance, contingencies, escalation assumptions and other applicable provisions.

Module 12: Estimate Review and Error-Control Exercise

- Cross-checking route length, tower count, material quantities, foundation classification, crossings and logistics assumptions.
- Identification of omissions, duplication, unrealistic allowances, unit errors and mismatch between drawings and BOQ.
- Practical exercise to review and correct a sample transmission-line estimate.

Module 13: Substation Site Survey and Development Inputs

- Topographic survey, boundary verification, levels, contours, approach road, drainage outfall, water table and existing utilities.
- Soil investigation, filling/cutting, flood level, access, construction space and future expansion requirements.
- Preparation of survey drawings and development inputs for layout, grading, drainage and foundations.

Module 14: Substation Layout and Civil Quantity Assessment

- Understanding equipment layout, bus arrangement, bays, control building, cable trenches, roads, drains and security boundary.
- Quantity assessment for earthwork, foundations, structures, buildings, trenches, roads, drainage, water supply and compound walls.
- Coordination of civil quantities with electrical clearances, earthing, cable routes and future bays.

Module 15: Electrical Equipment and System Estimation

- Preparation of equipment schedule for transformers/reactors, switchgear, instrument transformers, surge arresters and support structures.
- Estimation of bus conductors, insulators, clamps/connectors, control and power cables, earthing, illumination and auxiliary systems.
- Coverage of protection, control, metering, communication, SCADA interfaces, batteries/chargers and fire-protection requirements at estimation level.

Day 4: Substation BOQ, Tender Documentation, Validation and Integrated Application

Module 16: Substation BOQ, Cost Build-up and Interface Checks

- Structuring BOQ by primary equipment, secondary systems, civil works, erection, testing, commissioning and services.
- Use of approved specifications, equipment ratings, drawings, rate sources and supply/works split.
- Checking completeness across civil, electrical, protection, communication, safety and operational interfaces.

Module 17: Technical Specifications and Estimate Documentation

- Linkage of survey report, drawings, design basis, equipment schedule, BOQ and technical specifications.
- Clear description of scope, inclusions, exclusions, measurement basis, testing, documentation and completion requirements.
- Control of revisions, assumptions, rate references and approvals for an audit-ready estimate.

Module 18: Estimate Validation and Risk Allowances

- Sensitivity to route changes, soil variation, special crossings, access constraints, quantity growth and price changes.
- Use of contingency and provisional items only with documented basis and approval.
- Benchmarking against similar projects and investigation of significant cost deviations.

Module 19: Integrated Line and Substation Estimation Exercise

- Group preparation of survey outputs, tower/equipment schedules, principal quantities, BOQ structure and cost summary for a sample project.
- Identification of missing inputs, technical risks, approval dependencies and field-verification requirements.
- Review of quantity logic, rate basis, interface completeness and documentation quality.

Module 20: Group Presentation, Review and Action Plan

- Presentation and technical review of the integrated survey and estimation exercise.
- Consolidated recap of route/site survey, tower spotting, crossings, line quantities, substation quantities, BOQ and cost controls.
- Post-assessment and preparation of action points for improving survey accuracy and estimate reliability.