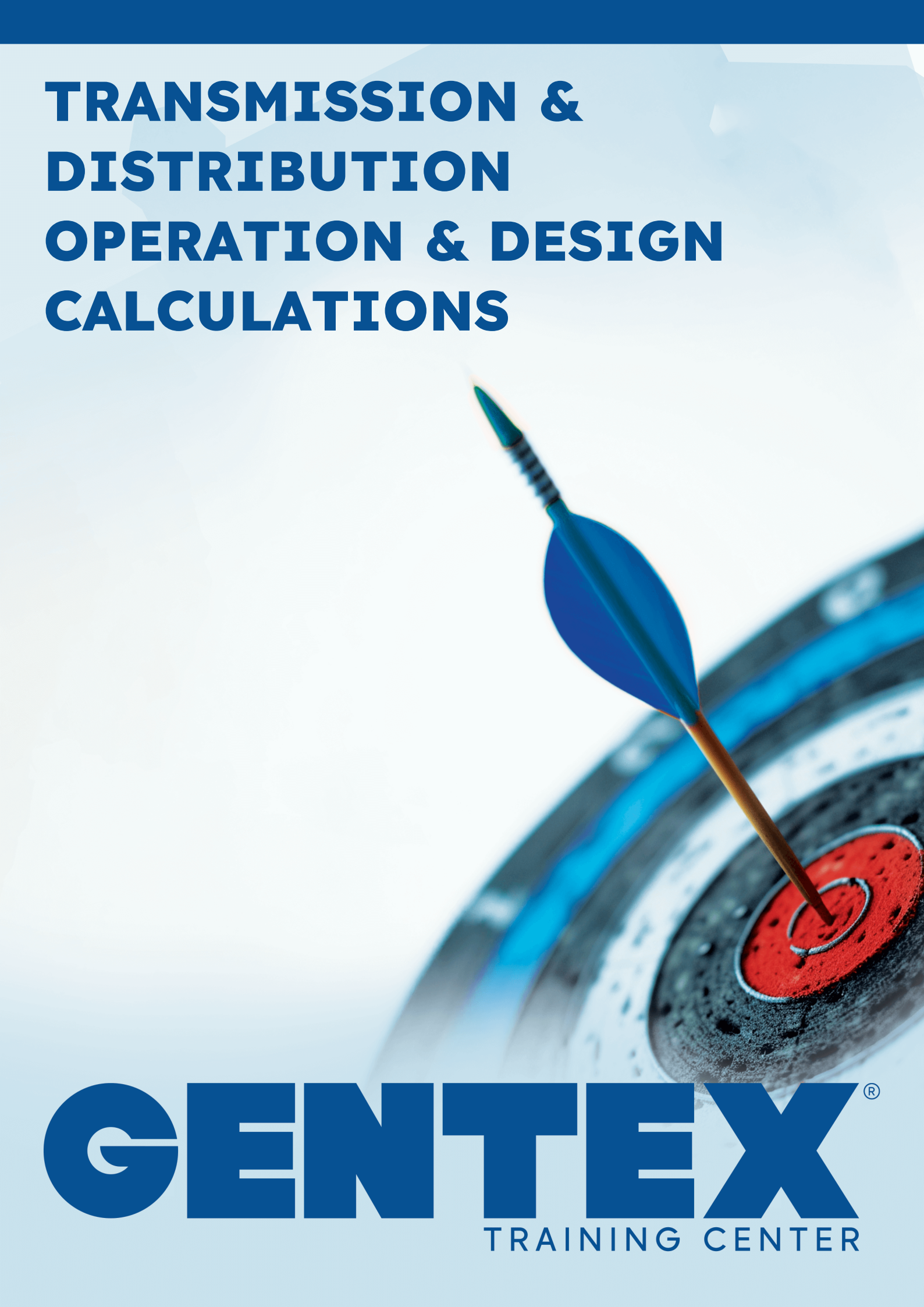
TRANSMISSION & DISTRIBUTION OPERATION & DESIGN CALCULATIONS



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Introduction

Power networks fail for calculable reasons: a conductor sized below its thermal limit, a transformer loaded past its rating, a protection device set outside coordination, or a voltage drop nobody checked. Each of those is a calculation, and getting them right is what separates a reliable network from a fragile one. This Transmission & Distribution Operation & Design Calculations Training Course gives electrical engineers and network planners a complete working method for the numbers behind the design. Participants learn load flow analysis, short circuit calculation, voltage drop and loss analysis, transformer and conductor sizing, protection setting, and earthing calculations.

Transmission & Distribution Operation & Design Calculations Course Objectives

- Perform load flow analysis for transmission and distribution networks.
- Calculate short circuit currents for balanced and unbalanced faults.
- Apply per unit (pu) calculation methods to network studies.
- Calculate voltage drop, regulation, and power loss on feeders.
- Size conductors and transformers against thermal and economic limits.
- Apply symmetrical components to fault analysis and protection.
- Calculate protection settings and verify coordination margins.
- Apply earthing and touch voltage calculation methods per IEEE 80.
- Apply IEC 60909 methods to short circuit current calculation.
- Measure results with loss index, voltage compliance, and protection selectivity.

Course Methodology

- Facilitated sessions built on real network data, single-line diagrams, and study reports.

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- Case workshops on overloaded feeders, miscoordinated protection, and voltage complaints.
- Load flow, short circuit, and voltage drop calculation exercises with live network data.
- Protection setting and earthing calculation practice labs.
- Group exercise on a network study with recommendations and calculations shown.

Who Should Take This Course

- Transmission and distribution planning engineers.
- Protection and control engineers.
- Substation and network operations engineers.
- Electrical design engineers in utilities and industry.
- Asset and network performance analysts.
- Commissioning and testing engineers.

Transmission & Distribution Operation & Design Calculations Course Outlines

Day 1: Network Modelling and Per Unit Calculations

- Network representation: single-line diagrams and impedance models.
- Per unit system: base values and conversion practice.
- Per unit impedance of transformers, lines, and generators.
- Symmetrical component fundamentals and sequence networks.
- Network reduction techniques for studies.
- Modelling loads, shunt elements, and tap changers.
- Data requirements and assumptions in network studies.

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Day 2: Load Flow Analysis

- Power flow equations and their solution approach.
- Newton-Raphson and Gauss-Seidel methods overview.
- Bus classification: slack, PV, and PQ buses.
- Voltage, angle, and reactive power results interpretation.
- Voltage limits and reactive compensation placement.
- Branch loading and thermal limit assessment.
- Loss analysis: technical loss calculation and reduction options.

Day 3: Short Circuit Calculations

- Fault types and their practical consequences.
- IEC 60909 method for short circuit current calculation.
- Contribution from generators, motors, and grid infeed.
- Peak current, breaking current, and thermal equivalent.
- Fault current decay and DC component basics.
- Equipment rating verification against fault duty.
- Reporting fault study results and protection implications.

Day 4: Voltage Drop, Sizing, and Design Calculations

- Voltage drop calculation for feeders and distributors.
- Permissible voltage variation limits and standards.
- Conductor sizing: thermal, voltage drop, and economic criteria.
- Transformer sizing, loading, and impedance selection.
- Power factor correction and capacitor sizing calculation.

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- Cable derating factors: temperature, grouping, and burial.
- Motor starting voltage dip calculation.

Day 5: Protection, Earthing, and Verification

- Protection setting calculation: overcurrent and earth fault.
- Coordination margins and time-current curve grading.
- Fuse and recloser coordination calculation.
- Earthing system design per IEEE 80 principles.
- Step and touch voltage calculation and mitigation.
- Verification of calculations against measured field data.
- Building a calculation and study documentation standard.

Conclusion

By successfully completing the Transmission & Distribution Operation & Design Calculations Training Course, participants will have acquired a thorough working knowledge of per unit modelling, load flow analysis, short circuit calculation, voltage drop and loss analysis, conductor and transformer sizing, protection setting, and earthing calculation. They will leave able to produce network studies with defendable numbers, verify equipment ratings against fault duty, and justify design decisions with calculations rather than estimates. Gentex Training Center delivers this programme with network planning and protection practitioners working on live systems.

FAQs for the Transmission & Distribution Operation & Design Calculations course

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Q1 What is the "Transmission & Distribution Operation & Design Calculations" course about?

It is a five-day programme on the calculations behind power network design and operation. It covers per unit modelling, load flow analysis, short circuit calculation, voltage drop and loss analysis, conductor and transformer sizing, protection setting, and earthing calculation.

Q2 What are the key benefits of the "Transmission & Distribution Operation & Design Calculations" course?

Participants verify equipment ratings against calculated fault duty instead of manufacturer assumption, size conductors and transformers on thermal, voltage, and economic criteria, and set protection with coordination margins that hold. They also produce study documentation that stands up to independent review.

Q3 What skills will I gain from the "Transmission & Distribution Operation & Design Calculations" course?

You will gain network modelling and per unit calculation, load flow and loss analysis, short circuit and fault level calculation, and equipment sizing, protection setting, and earthing calculation.

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Q4 What tools, methods, or standards are covered in the "Transmission & Distribution Operation & Design Calculations" course?

The course works with network representation through single-line diagrams and impedance models, the per unit system with base value conversion, per unit impedance of transformers, lines and generators, symmetrical components and sequence networks, network reduction techniques, load, shunt element and tap changer modelling, power flow equations and solution methods including Newton-Raphson and Gauss-Seidel, slack, PV and PQ bus classification, voltage, angle and reactive power interpretation, reactive compensation placement, branch loading and thermal assessment, technical loss calculation, fault type analysis, the IEC 60909 short circuit calculation method, generator, motor and grid infeed contribution, peak, breaking and thermal equivalent current, equipment rating verification against fault duty, feeder and distributor voltage drop calculation, permissible voltage variation standards, conductor sizing on thermal, voltage drop and economic criteria, transformer sizing, loading and impedance selection, power factor correction and capacitor sizing, cable derating factors for temperature, grouping and burial, motor starting voltage dip calculation, overcurrent and earth fault protection setting, coordination margin and time-current curve grading, fuse and recloser coordination, earthing system design per IEEE 80, step and touch voltage calculation, and verification against measured field data.

Q5 How is the "Transmission & Distribution Operation & Design Calculations" course applied in real-world practice?

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Teams apply it when sizing a transformer for a new substation, calculating fault level for switchgear rating, checking voltage drop on a long feeder before energisation, setting overcurrent relays with coordination margins, designing an earthing system for a new installation, and reviewing technical losses across a distribution network.