

TEEBA Engineering Inc.



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Electrical / Civil / Construction / Mechanical / Project Management





Civil and Electrical Substation Design, Construction and Commissioning

March 14-18, 2016. Hampton Inn, Mississauga West, Ontario
May 9-13, 2016. Hampton Inn, Calgary Airport, Alberta

Description

This course in substation design fundamentals will guide you through a step-by-step study of the civil and electrical substation design and construction process. You will consider all phases, from initial site review and selection, structures and loading, soil foundations, power system studies, grounding and power quality, protection and control, all the way to substation start-up and commissioning.

After participating in this course you will be able to do the following:

- **Choose** the right location of substation with appropriate drainage system
- **Develop** reliable electrical and civil substation designs
- **describe** structure and loading characteristics and effects on cost of power
- **Understand** the soil and the substation foundations
- **Demonstrate** the fundamentals of system protection, grounding, and power quality problems, along with the commissioning plan
- **Keep** your project on schedule

Objective

To teach participants the construction and operations of civil and electrical power substation systems.

Who Should Attend

- Electrical and civil engineers
- Industrial, utility, or plant engineers
- Engineering technicians
- Substation operations specialists
- Consulting engineers
- Transmission and distribution line design engineers and technicians
- Project managers
- Construction supervisors
- Managers of design engineering departments
- Electric utility engineers involved in transmission and distribution engineering, operations, or planning

Program Outline

DAY 1 | MAY 14, 2016

Substation Introduction

Choosing The Right Location

1. Types of Yards and Site Preparation
2. Drainage consideration
3. Drainage planning and Design
4. Roadways and Erosion requirements
5. Security Fence Specification and Design

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Structures

1. Factors influencing materials selection
2. Design Loads as per Ontario Building Code
 - a. Wind load
 - b. Vertical load
 - c. Wire pull
 - d. Ice
3. Deflection Consideration
4. Support Structure
5. Seismic Load
6. Load combination
7. Equilibrium and free body diagrams
8. Determinate structure
9. Shear and bending moment diagrams
10. Structure behavior: beams columns, and trusses

6. Design for overturning
7. Slabs on grade
8. Distribution line design
 - a. Mechanical loading
 - i. Wind and ice loads
 - ii. Longitudinal loading
 - iii. Construction and maintenance loading
 - b. Wood pole design
 - c. Basic structure calculations; tension and compression, bending and shear
 - d. Conductor basic span and sags terminology, arc length and tension limits, tension sag calculations methods
 - e. Practical example of actual sag tension calculations

Substation Civil Design Case Study

DAY 2 | MAY 15, 2016

Design Approach

1. Structure steel design
 - a. Product properties and failure modes
 - b. Design of beams, columns, tension and compression members
 - c. Member design examples
2. Factored load and factored strength
3. Hands on structure design example
4. Foundations and soil investigation
 - a. Soil bearing capacity
 - b. Ground water level consideration
 - c. Foundation types
5. Foundation design example

DAY 3 | MAY 16, 2016

General Planning and Design Considerations

- Electric power system, transmission and distribution
- Nominal voltage levels
- Applicable codes, policies, and standards (IEEE, NEC, CEC, OESC)
- Main stages of the design process
- Reliability of electric power supply
- Economic considerations
- Power loading (normal and contingency)
- Operations and maintenance considerations
- Aesthetics
- Route selection and rights-of-way
- Joint use

Substation Components

- Substation Types



Civil and Electrical Substation Design, Construction and Commissioning

- Design and Construction
- Substation Diagrams
- Bus Arrangement
- Transformers
- Protective System Elements
- Circuit Breakers and Switchgears
- Fuses
- Instrument Transformers
- Control House
- Grounding System

Conductors

- Classification
- Conductor sizes
- Mechanical and electrical characteristics
- Secondary (low voltage) cables
- Primary cables
 - stranding
- Manholes
- Canadian Electrical Code Requirements

DAY 4 | MAY 17, 2016

Cable Construction, Standards and Specifications

- Introduction
- Cable construction (conductors, insulation, shielding, sheaths, jacket)
- Conductor and cable: types and applications
- Insulating Materials
- Cable sizing considerations
- Cable standards (CEC calculations and sizing)

Power Systems Studies

- Load Flow
- Short Circuit
- Protective device coordination
- Harmonics Analysis
- Voltage Stability

Protection and Control

- Feeder Protection
- Bus Protection
- Transformer Protection
- Generator Protection
- Transmission Line Protection

DAY 5 | MAY 18, 2016

Arc Flash

- CSA Z462 definitions
- Shock hazards and boundary applications
- Bolted and Arcing Faults
- Arc Flash hazards and analysis using IEEE 1584
- Arc Flash Mitigations

Grounding and Lightning

- Purposes of grounding and lightning
- CEC/IEEE requirements
- Grounding and Lightning standards
- HV Substation Grounding and Lightning Design

Power Quality

- Power Quality Definitions and Indices
- Voltage Disturbances
 - a. Lightning (transients)
 - b. System Switching
 - c. System Faults
 - d. Sags
 - e. Swells
 - f. Unbalance

Substation Automation

- Communication need in power system
- Power Line Carrier Communication
- SCADA, IEDs and RTUs
- Automatic meter reading (AMR)



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Commissioning Substations

- Review Work Plan
- Power Transformers
- Instrument Transformers
- Circuit Breakers

- Relays
- Capacitors
- Grounding System

Substation Electrical Design Case Study

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Program Schedule

(Day 1 - Day 5)

08:30	Registration
09:00	Morning Session Begins
10:30-10:45	Refreshments & Networking Break
12:00	Lunch break
13:00	Afternoon Session begins
14:30-14:45	Refreshments & Networking Break
16:30	Day Ends

Fees*

Registration Types	Single	Group(3+)**
Register for the first 2 days (Civil Substation Design)	\$999	\$899
Register for the second 3 days (Electrical Substation Design)	\$1,499	\$1,349
Register for the full 5 days (Civil and Electrical Substation Design)	\$2,199***	\$1,999

- * Early birds (registration before March 21, 2016) will get \$100 off per registration
Fees include hot breakfast, lunch, hard copy course material and certificate
- ** Group means three (3) or more registrants from the same company
- *** Save \$300 per registrant by registering to the full 5 days course!

Registration:

- ✓ Register by email to: Khaled.akida@teebaengineering.com
- ✓ Registration fee of \$150 (part of the course fee but not refundable) will guarantee your spot, and is part of the course fee by Credit Card or by bank transfer
- ✓ The balance can be paid by at the door by a bank certified check to TEEBA Engineering Inc.
- ✓ TEEBA Engineering reserves the right to cancel the course maximum 7 days before it starts

In-House Training

In-House Training Cost effective In-house courses, tailored specifically to your organization's needs, can be arranged at your preferred location and time. If you would like to discuss further, please contact our inhouse division at Khaled.akida@teebaengineering.com

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About your Course Facilitators



Mohamed Khalil, Ph.D., MBA, P.Eng.

Dr. Mohamed Khalil is the Founder & Managing Director of Stenvro Engineering Inc. (www.stenvro.ca) and has over 24 years of experience in concrete, steel and wood design. He previously worked as Marketing Manager for aircraft and aircraft components at both Pratt and Whitney Canada, and Bombardier Aerospace. At Pratt and Whitney Canada, Dr. Khalil was a specialist in designing critical rotating structures under high and low cycle fatigue loading.

He has also been involved in designing, strengthening and rehabilitation of many projects for the Government of Canada, Rogers Wireless, Wind Mobile, Ford Motor Company, MascoTech Inc., Kobelco Metal Powder of America Inc., and the American Iron and Steel Institute.

His projects have included high-rise buildings, underground metro stations, education centers, education residences, and steel factories. Dr. Khalil has instructed many courses in the area of engineering, engineering economics and engineering management, at educational institute and universities.

A co-author for many technical journal papers, he has delivered scientific and marketing presentations in technical symposiums around the world. He is also a technical reviewer for international scientific journals.

Dr. Khalil obtained his M.A.Sc. and PhD from the University of Waterloo, Canada and he also completed his Master of Business Administration at Rotman school of Management at the University of Toronto.



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About your Course Facilitators



Khaled Akida, MBA, P.Eng., M.Sc.

Khaled is a registered professional engineer in Canada (provinces of Ontario and Alberta) with 15+ years of experience in power system studies, substation design, field-testing and commissioning, protection and control, grounding and power quality audits, electromagnetic field and interference (EMF/EMI) audits, and Environmental Health and Safety (EHS).

He is the General Manager of TEEBA Engineering Inc. (www.teebaengineering.com), an engineering consulting firm based in Mississauga, ON, Canada.

Formerly, he was Engineering Manager at GE Canada and Schneider Electric Canada in Ontario, where he managed medium to large engineering projects across North America.

He received his M.Sc. in electrical engineering from the University of New Brunswick (UNB), Canada, and his MBA from Laurier School of Business (WLU) in Waterloo, Canada.

Khaled has managed and executed many engineering projects on substation design, field testing, power quality audits and power system studies (short circuit, coordination study, arc flash, load flow, power factor correction, harmonics, dynamic stability, transient motor starting, ground grid testing and design, etc.), EMF/EMI audits and grounding audits, for major electrical utilities, mines, oil and gas, data centers, industrial and commercial facilities in Canada and the USA.

Mr. Akida has various IEEE publications, has served as a technical reviewer in many IEEE journals in power systems and control systems, and was the ex-chair of the Industry Application Chapter (IAS) for IEEE Toronto Section. He remains an active member for the IEEE substation committee of IEEE Std. 81 ground testing (WGE6) and IEEE Std. 80 ground design (WGD7). A certified electrical safety trainer by GE Corporate, Khaled also taught many technical courses across Canada, USA, Asia and the Middle East.



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Partial List of Customers Includes:

- ✓ Hydro One
- ✓ Hydro Ottawa
- ✓ Toronto Hydro
- ✓ Oakville Hydro
- ✓ North Bay Hydro
- ✓ GreatLakes Power Transmission
- ✓ Canadian Nuclear Laboratories
- ✓ ATCO Electric
- ✓ EPCOR
- ✓ Vale
- ✓ BC Hydro
- ✓ Dofasco
- ✓ Millar Western
- ✓ Puerto Rico Electrical Power
Utilities
- ✓ Telus
- ✓ Rogers Communications
- ✓ Lafarge
- ✓ Meralco Power Generation
(Philippines)
- ✓ SNC Lavalin
- ✓ ABB Canada
- ✓ GE Energy (USA, Canada)
- ✓ GE Power & Water
- ✓ GE Hitachi Canada
- ✓ Schneider Electric Canada
- ✓ Siemens Canada
- ✓ Nova Chemicals
- ✓ Plan Group
- ✓ Weston Consulting
- ✓ Wind Mobile
- ✓ Pratt & Whitney
- ✓ Bombardier
- ✓ Ford Motor Company,
- ✓ MascoTech Inc.
- ✓ Kobelco Metal Powder of
America Inc.
- ✓ American Iron and Steel
Institute.