Fundamentals of Overhead Transmission Line Design

PTEC 500

At a glance

Whether it is training for power system engineers, commissioning engineers, control room operators, or field maintenance and repair personnel, Siemens Power Academy TD – North America (NA) and the consultants at Siemens Energy Inc., Siemens Power Technologies International (Siemens PTI) want to be your comprehensive partner in T&D training and professional development. We offer:

- Professional certificates
- Training for long-term career progression
- Short courses designed to teach technical skills quickly
- Courses at our regional training centers or custom on-site delivery
- Expert instructors and practical content that counts.

The Siemens Power Academy TD – NA believes that training is a component critical to the success of any organization. With our long history in the fields of power generation, transmission and distribution, instrumentation and controls, and equipment-based training Siemens PTI offers training solutions along the entire power conversion chain

The challenge

Changes in the electric utility industry have thrust a number of engineers without experience in line design into overhead transmission line related positions. These individuals require an understanding of the theory and practice of overhead lines in planning, design, construction, operation, and maintenance. They need to understand how the physical components of transmission lines fit into an integrated design. Engineers need an overview of the important aspects contemporary applications of transmission lines.

Our solution

PTEC 500 – Fundamentals of Overhead Transmission Line Design is part of our Power Transmission Engineering Curriculum (PTEC) and is a required course in our Power Systems Technology Associate Level Certification Program. Developed by the Siemens Power Academy TD – NA, these certification programs address the growing need for meaningful training and development challenges faced at all levels of power transmission and distribution system management.

This course provides participants with a fundamental understanding of the electrical and mechanical design of 69-765 kV transmission lines with special emphasis on the basics. Topics covered in **PTEC 500** include:

- Line design overview, Line components and ROW, Considerations on costs, constraints, safety and environment, Typical tasks related to overhead line analysis, design and construction
- Overhead line route selection and licensing
- NESC overview & Line design criteria
- Conductors and Shield Wires, Types and characteristics, Electrical and mechanical ratings, Line thermal rating, Effects of conductor operation at high temperature, Stress-strain curves, Technical-economical selection, Line parameters and power flow
- Catenaries, catenary equations, Sag-tension calculations, Initial, Final and Creep conditions, Wind and Ice loading, Ruling span, Wind span and Weight span concepts, Tower uplift , Wind-induced conductor motions
- Electric and Magnetic Environmental Effects, Electric field, Magnetic field, Corona, Radio and Television noise, Audible noise, EMF issues, EMF& health Required and Recommended Limits
- EMI/EMC between overhead lines and nearby facilities

- Structure: types and applications, design loads, loading trees, cost factors
- Foundations: types, loading, basic concepts on uplift capability
- Insulator types and characteristics, Electrical and mechanical ratings, Performance under pollution, Insulator string dimensioning, associated hardware
- Voltage Stresses: power frequency stresses, switching surges and lightning impulses.
- Insulation Coordination against the Voltage Stresses, Insulator string length, Tower top clearances, Conductor-to-ground clearance, Conductor blow-out, NESC requirements
- Lightning Performance improvement, Shielding angles, Grounding resistances, Line surge arresters
- Overview on Overhead Line Uprating / Upgrading Feasibility

Course structure

This is a four and one-half (4.5) day course. Material is presented in both morning and afternoon sessions for a total of six (6) hours of daily instruction. Standard course hours are 9:00 am to 4:00 pm each day, except the last day, which concludes at noon.

Documentation

A bound set of course notes, including printed copies of the instructor's presentation and relevant handouts, is provided to each course participant.

Instructors

All courses offered through Siemens Power Academy TD – NA and Siemens PTI are developed and taught by leading industry engineers. In addition to their proven instructional ability, our engineers have advanced degrees complemented by first-hand knowledge and experience solving power system problems throughout the world.

Benefits of certification

Earning Siemens Power Academy TD – NA professional certification enhances your path to productivity, sets you apart from your peers, adds depth to your understanding of the field and ability to meet the demand for skills in the global market place. With fewer available on-the-job resources, engineers who invest in rigorous training and gain certification will be in high demand at the world's leading utilities and system operators.

Earn Siemens Power Academy TD – NA Certification in the following programs: Power Systems Technology, Distribution Systems Technology, or PSS® Network Planning and Analysis. Professionals can pursue certification at the Associate, Advanced, or Expert Levels. Contact your Siemens Power Academy Training TD – NA to get started today.

IEEE Members Receive 10% Discount

As an IEEE member, you are eligible to receive a 10% discount off our regular tuition price. Contact us for details.

Continuing Education Units (CEUs), Professional Development Hours (PDHs) and NERC Continuing Education Hours (CEHs):

Licensed engineers, on a voluntary or mandated basis, attend continuing professional education for licensure renewal to ensure competency. All courses offered through Siemens Power Academy TD – NA meet the requirements for (CEUs) and (PDHs).

Continuing Education Units (CEUs) is the nationally recognized unit for recording participation in professional development and noncredit educational programs. Participants completing this course will be awarded CEUs based on the instructional hours of the course: one CEU is awarded for ten classroom hours of instruction.

Professional Development Hours (PDHs) Continuing professional education for Professional Licensed Engineers (PE) need to earn annual Professional Development Hours (PDH's): for all of our instructor-led training participants earn one PDH for each one hour of instruction. The participant is responsible for maintaining records of courses taken in support of licensure.

NERC Continuing Education Hours (CEHs)

Siemens Power Academy TD – NA is recognized by the North American Electric Reliability Corporation as a continuing education provider who adheres to NERC Continuing Education Program Criteria. Many of our courses qualify for NERC CEH and PDHs. Please contact our office if you would like more information on NERC approved courses.

NERC Approved CEH Provider

Convenient training locations

Siemens Power Academy TD – NA provides scheduled training at the following offices:

- Burlington, Ontario, Canada
- Houston, TX USA
- Littleton, CO USA
- Minnetonka, MN USA
- Mountain View, CA USA
- Orlando, FL USA
- Schenectady, NY USA
- Your Company Office

Contact us for details or to request a training quotation.

View the PTEC 500 Course Schedule on the web at:

https://siemens.coursewebs.com/siemens/pageCourseInfo.aspx?Course_ID=ptec500

Contact us

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Career Highlights

With over 30 years of diverse power systems experience and professional training, Mr. Daconti brings a wealth of experience to Siemens PTI. His work over the years has been in the areas of electric power system planning and analysis, overhead transmission lines, electromagnetic compatibility and electric power quality.

He has performed various activities of power system planning, including several analyses of interconnection of independent power producers to utility networks in New York and Colorado. He has been a technical contributor for numerous and diverse electromagnetic transient analyses, such as switching of capacitor banks, transmission line unbalance, and restoration of a power system after a blackout. His work with overhead transmission lines has included all major types of electrical analyses needed for the design of 230 kV and 500 kV lines. With respect to power system electromagnetic compatibility, his major experiences have concerned the influence of high voltage transmission lines on metallic pipelines. His experience in electric power quality has included harmonic penetration studies, calculation of harmonic impedances needed for the design of SVC filters, and recommendations for reduction of voltage sags.

Before joining Siemens PTI he worked for electric utilities and gas, telecommunication, and irrigation companies in Brazil. In 2001 Mr. Daconti joined Siemens PTI where has been a project manager and a technical contributor for a variety of consulting projects in his areas of expertise. Additionally, he teaches several Siemens PTI courses for worldwide clients.

Experience

Mr. Daconti's professional areas of expertise include:

- Power System Planning
- System Reliability Impact Studies (Load Flow, Short-circuit, Stability and Transfer Limit Analyses)
- Electromagnetic Transients in Power Systems
- Electric Systems Power Quality
- Power System Electromagnetic Compatibility
- Expert Testimony Before Public Service Commission
- Overhead Lines Electrical and Mechanical Design
- Environmental Impact of Transmission Lines
- Computer Skills: PSS®E, ASPEN, EMTP, FORTRAN, MATLAB
- Languages: English, Portuguese/Spanish

He has worked on projects in the US and several other countries, including Brazil, Colombia, the Philippines, and Jordan.

Education

Hubert Humphrey Fellowship Program (Electric Power Systems & Electric Power Quality), Cornell University, 1997
MSEE, Electric Power Systems, with honors, Federal School of Engineering, Itajuba, Brazil, 1986
Course of Specialists in Electric Power Systems, Federal School of Engineering, Itajuba, Brazil, 1981
BSc, Electrical Engineering, Polytechnic School of Engineering, Recife, Brazil, 1977

Professional Memberships and Activities

Mr. Daconti is a Senior Member of the IEEE. He is a member of the Technical Board of Reviewers of *IEEE Transactions on Power Delivery*. He has chaired technical sessions at the IEEE T&D Conference and Exposition, and the International Conference on Harmonics and Quality of Power (ICHQP). He has contributed to technical standards, such as IEEE Standard 738 on Thermal Limits of Overhead Line Conductors. Since 2006, he has been the Schenectady Chapter Chairman of the IEEE PES.

Mr. Daconti is a CIGRE Distinguished Member. He was the Brazilian Chairman and Representative at CIGRE Study Committee 36 on Power System Electromagnetic Compatibility from 1992 to 2000. He was the General Chairman and a Technical Reporter at the 1995 CIGRE SC 36 International Colloquium.

He is a Full Member of Sigma Xi (The Scientific Research Society).

Publications and Technical Papers

Technical Book and Brochure

1. "Transmission Systems," in *Standard Handbook for Electrical Engineers,* 15th ed., New York: McGraw-Hill, 2006, sec. 14, pp. 14-1–14-111.
2. "Guide on EMC in Power Plants and Substations," CIGRE SC 36 Technical Brochure, Paris, France, 1997 (co-authors: members of WG 36.04).

Transactions and Conference Papers

1. "Experience Of CHESF Concerning Interference Between EHV Transmission Lines And Pipelines," CIGRE Session, Paris, France, 1986 (co-author: D.O.C. Brasil).
2. "Disturbances On the Environment Due to High Voltage Electrical Installations," IX SNPTEE, Belo Horizonte, Brazil, 1987 (co-authors: C.P.R. Gabaglia, C. Fernandes, D.O.C. Brasil). Paper in Portuguese.
3. "Calculation of Metallic Pipeline Electrical Parameters," 2nd Latin American Regional Meeting of CIGRE, Puerto Iguazu, Argentina, 1987.
4. "Special Grounding Mats for 69 Kv Urban Distribution Network in Salvador City," *APEE*, September 1988, Recife, Brazil. Paper in Portuguese.
5. "Effects of High Voltage Transmission Lines on the Environment," *Eletricidade Moderna*, August 1989, Sao Paulo, Brazil (co-authors: C.P.R. Gabaglia, C. Fernandes, D.O.C. Brasil). Paper in Portuguese.

6. "Interference from 230 and 500 kV Transmission Lines on Metallic Pipelines – Experience of CHESF," X SNPTEE, Curitiba, Brazil, 1989 (co-authors: F.D. Ferro, J. Varela, M.O.B.C. Melo, O. Regis). Paper in Portuguese.

7. "Induced Effects on Metallic Installations Close to AC High Voltage Transmission Lines," 3rd Latin American Regional Meeting of CIGRE, Foz do Iguacu, Brazil, 1989 (co-authors: R. Sanz, O.G. Vera, J.L. Pineiro, D.O.C. Brasil, A.M. Franca, S.T. Sobral, J.R. Medeiros). Paper in Portuguese.

8. "Electromagnetic Interference on the Gas Pipeline Entering the 230 kV Camacari Substation," CIER Conference, Caracas, Venezuela, 1989 (co-authors: F.D. Ferro, M.O.B.C. Melo). Paper in Portuguese.

9. "Induced Effects Caused by Overhead Transmission Lines on Metallic Structures," CIGRE Session, Paris, France, 1990 (co-authors: R. Sanz, O.G. Vera, J.L. Pineiro, D.O.C. Brasil, A.M. Franca, J.R. Medeiros, S.T. Sobral).

10. "Effects on Other Installations of the Injection of Short-Circuit Currents into the Ground," 4th International Symposium on Short-Circuit Currents in Power Systems, Liege, Belgium, 1990 (co-authors: D.O.C. Brasil, D.M. Correia).

11. "Disturbances Caused by the Proximity between the 230 Kv Teresina-Piripiri Transmission Line and a Railroad Near Teresina City," XI SNPTEE, Rio de Janeiro, Brazil, 1991 (co-authors: M.O.B.C. Melo, O.L.S. Paiva, M.A.A.C. Lima, D.M. Correia). Paper in Portuguese.

12. "Experience of CHESF about Mitigation of Electromagnetic Interference – Aspects Concerned with Grounding Mats and Short-Circuit Currents," CIER Conference, Santiago, Chile, 1991. Paper in Portuguese.

13. "Disturbances Caused by Inductive and Resistive Couplings with Low Voltage Networks," XI SENDI, Blumenau, Brazil, 1992 (co-authors: D.M. Correia, D.O.C. Brasil). Paper in Portuguese.

14. "Electromagnetic Compatibility between Electric Power Systems and Other Installations," International Symposium on Electromagnetic Compatibility, Sao Paulo, Brazil, 1994 (co-authors: D.O.C. Brasil, D.M. Correia).

15. "Induction from Transmission Lines and Substations on Other Installations – Practical Cases," 6th Latin American Regional Meeting of CIGRE, Foz do iguacu, Brazil, 1995 (co-authors: D.O.C. Brasil, D.M. Correia). Paper in Portuguese.
16. "Overview on Modern Custom Power Equipment," II SBQEE, Sao Lourenco, Brazil, 1997 (co-authors: A.J.P. Ramos, H.S. Bronzeado). Paper in Portuguese.
17. "Voltage Sag Mitigation by Means of Thyristor Controlled Series Capacitors," ICHQP, Athens, Greece, 1998 (co-author: A.R.M. Tenorio).
18. "Environmental Costs of Transmission Lines," 8th Latin American Regional Meeting of

CIGRE, Ciudad del Este, Paraguai, 1999 (co-authors: R.C. Furtado, F.G. Soares, E. Almeida, J.M.B. Bezerra). Paper in Portuguese.

19. "Electromagnetic Compatibility in Power Plants and Substations," 8th Latin American Regional Meeting of CIGRE, Ciudad del Este, Paraguai, 1999 (co-author: J. Saad). Paper in Portuguese.
20. "The Incorporation of Environmental Costs into the Planning of a Power System Interconnection in Brazil," CIGRE Session 2000, Paris, France (co-authors: R.C. Furtado, F.G. Soares, J.M.B. Bezerra).
21. "Analysis of EMC Problems Related to Capacitive Transformers Inside the 500 kV Xingo Substation," XVI SNPTEE, Foz do Iguacu, Brazil, 2001 (co-authors: F.R. Alves, H.M. Moraes). Paper in Portuguese.
22. "Environmental Management Focused on Risk management of High Voltage Substations," XVI SNPTEE, Foz do Iguacu, Brazil, 2001 (co-authors: R.C. Furtado, J.D. Braga, F.E.C. Farias, R.R. Almeida, P.T. Silva). Paper in Portuguese.
23. "Increasing Power Transfer Capability of existing Transmission Lines," IEEE T&D Conference, Dallas, TX, 2003 (co-author: Daniel C. Lawry).
24. "Overhead Line Thermal Rating Calculation Based on Conductor Replica Method," IEEE T&D Conference, Dallas, TX, 2003 (co-author: Daniel C. Lawry).
25. "Uprating and Upgrading of Overhead Lines," presented at T&D World Expo, Indianapolis, IN, 2004.
26. "Dynamic Thermal Rate Monitoring: An Effective Means for Increasing Power Transfer Capability of Existing Transmission Systems," IX SEPOPE, Rio de Janeiro, Brazil, 2004 (co-author: Daniel C. Lawry).
27. "An Effective Technology for Increasing the Thermal Rating of Transmission Lines," 15th Conference on Electric Power Supply Industry, Shanghai, China, 2004 (co-author: Daniel C. Lawry).
28. "Management of Electrical Risks in Transmission Line – Pipeline Shared Rights-of-Way," 8th International Symposium on Environmental Concerns in Rights-of-Way Management, Saratoga, NY, 2004.
29. "Application of Surge Arresters to Protect Overhead Lines Against Lightning," presented at Power Quality & Reliability Conference, Long Beach, CA, 2006.

Upcoming trainings in 2011

PTEC 500 - Fundamentals of Overhead Transmission Line Design in Schenectady, NY

- May 23 – May 27, 2011
- September 26 – September 30, 2011