



Applied Professional Training

www.aptc.edu (800) 431-8488

Electric Power Systems Training

Proficiency Certifications

Specializations

- System Operator** (*Including Reliability, Balance and Transmission*)
- Power Generation**
- Distribution System Operation** (*Including Operators and Dispatchers*)
- Substation Operation and Maintenance**
- Monitor, Control and Communications**
- Design & Management**

Applied Professional Training's (APT's) Proficiency Certification program in Electric Power Systems provide the employer confidence in workforce development through validated levels of proficiency. Students earn valuable industry knowledge that is applicable to the current needs of electric power industry. This proficiency certification program and its strategic specializations were carefully designed by industry experts to produce well trained individuals ready for the challenges and demands of today's electric power industry. Each specialization has two levels; **Level I** achieves "competency" and **Level II** achieves "proficiency". There are approximately 200 contact hours in each specialization. *APT's* goal is to increase our customers' business productivity by helping educate personnel in modern technology through high quality training in various formats including instructor-led, online, and correspondence programs. These programs are continuously updated and taught by highly experienced industry leaders.

Applied Professional Training, Inc. (APT) was founded in 1993 and is accredited for degree and certification programs by the U.S. Department of Education through the Distance Education and Training Council (DETC). *APT* as a premier technical training provider for the electric power, renewable energy and telecommunications industries throughout the United States and internationally. *APT* has been approved by the International Association of Continuing Education Training (IACET) to offer Continuing Education Units (CEUs) and the North American Electric Reliability Corporation (NERC) for Continuing Education Hours. *APT* offer's college degrees, college credits and industry certifications. *Ask for APT's transfer credit matrix that can help you promote for Level I (Competent), to Level II (Proficient and then to an Associate's Degree in Electric Power Systems.* *APT* is a service company, dedicated to long-term relationships with our students, customers, business clients.

If you are interested in learning more about these and other *APT* programs, price, etc. please visit our website or contact our friendly office for assistance. We look forward to serving your electric power training needs. Thank you!

Sincerely,

Steve Blume, MSEE, PE
President & CEO

For SCHEDULE information:

Call: (800) 431-8488

Email: aptc@aptc.edu

Website: www.aptc.edu



Proficiency Certification Program Matrix

Proficiency Certification Courses		Specialization											
Course	Hours	System Operator (with NERC CEFPs)		Power Generation (with NERC CEFPs)		Distribution System Operation		Substation Operations and Maintenance		Monitoring, Control and Communications		Design and Management	
		Level	Level	Level	Level	Level	Level	Level	Level	Level	Level	Level	Level
PC-100: Electric Power System Fundamentals	24	1	1	1	1	1	1	1	1	1	1	1	1
PC-101: Power System Equipment	16	1	1	1	1	1	1	1	1	1	1	1	1
PC-102: Distribution Systems	24	1	1	1	1	1	1	1	1	1	1	1	1
PC-103: Safety Grounding and Switching	16	1	1	1	1	1	1	1	1	1	1	1	1
PC-104: Protection Principles	16	1	1	1	1	2	2	2	2	2	2	2	2
PC-105: Monitoring & Control	16	1	1	1	1	1	1	2	2	1	1	2	2
PC-110: Power Calculations	16							2	2			1	1
PC-115: Electrical Print Reading	16							1	1			2	2
PC-120: Power Plants	16							1	1			1	1
PC-130: Power Quality	16							2	2				2
PC-140: Maintenance Test Instruments & Procedures	16							1	1				1
PC-150: Communications and Telecommunications	8	1	1	2	2	1	1						
PC-200: Principles of Generation Operations	24	2	2	2	2								
PC-205: Monitoring & Control - II	16									2	2		
PC-210: Power System Planning	16												1
PC-215: Interconnected Systems	16	2	2	2	2								
PC-220: Reliability & Security (including Cyber Security)	16	2	2	2	2	2	2	2	2			2	2
PC-230: Voltage Control & Collapse	16	2	2	2	2	2	2	2	2			2	2
PC-240: Emergency Operations (with restoration)	16	2	2	2	2	2	2	2	2				
PC-245: Emergency Operations - II (with restoration)	16	2	2	2	2	2	2	2	2				
PC-250: Situational Awareness	8	2	2	2	2	2	2	2	2				
PC-255: Situational Awareness - II	8	2	2	2	2	2	2	2	2			2	2
PC-260: Utility Telecommunications Systems	16							2	2			2	2
PC-265: High Voltage Protection for Telecommunications	16							2	2			2	2
Total Contact Hours	384	240	240	240	240	208	208	224	224	152	152	224	224
Total Contact Days	48	30	30	26	26	28	28	28	28	24	24	28	28

Required in all specializations



Proficiency Certification

Electric Power – System Operator *(Including Reliability, Balance & Transmission)*

APT's Proficiency Certification Program in Electric Power Systems is based on a set of objectives that are valuable to the industry, the employer and the student. This program incorporates strategically designed curriculum to maximize the knowledge and skills in the electric power industry. This certification program consists of two levels of proficiency. **Level I** provides the important knowledge components needed to confidently work in this specialization. **Level II** builds the student's knowledge and skills to the level to proficient. **This certification credit applies towards APT's Associate Degree in Applied Sciences – Electric Power Systems.** This program is a must for those interested in a lifelong career in electrical power systems and wants to be productive, proficient, and recognized.

***Note:** APT is recognized by the North American Electric Reliability Corporation as a continuing education provider who adheres to NERC Continuing Education Program Criteria. These classes provide NERC CE Hours.*

Program Objectives

- **Provide opportunity** for entry level students to become NERC credentialed electric power system operators
- **Proficient in system reliability, voltage control and load shedding** under normal and emergency conditions
- **Demonstrate proper control and restoration techniques** during normal and emergency system conditions
- **Demonstrate situational awareness for reliable grid operations** in accordance to NERC standards
- **Explain equipment functions and ratings** during normal and emergencies
- **Describe the various system protection components** and their applications for system reliability
- **Apply NERC Standards throughout the courses**
- **Demonstrate skills learned through power simulators**
- **Apply credit towards NERC CEHs and College Credits.**

Features and Benefits

- Course curriculum, objectives and learning outcomes target employment and industry needs
- Interactive instruction from highly qualified and experienced instructors
- No prerequisites!
- State-of-the-art curriculum that is always updated
- Flexibility in scheduling
- **APT** considers prior experience or other accredited courses towards certificate and degree credit.

Courses

Level I Certification (Competent; 120 hrs, 15 days)

- PC100 Electric Power System Fundamentals (24 hrs)
- PC101 Power System Equipment (16 hrs)
- PC102 Distribution Systems (24 hrs)
- PC103 Switching, Grounding & Safety (16 hrs)
- PC104 Protection Principles (16 hrs)
- PC105 Monitoring & Control (16 hrs)
- PC150 Communications & Telecommunications (8 hrs)

Level II Certification (Proficient; 120 hrs, 15 days)

- PC200 Generation Principles (24 hrs)
- PC215 Interconnected Systems (16 hrs)
- PC220 Reliability & Security (including Cyber Security) (16 hrs)
- PC230 Voltage Control & Collapse (16 hrs)
- PC240 Emergency Operations (16 hrs)
- PC245 Emergency Operations II (16 hrs)
- PC250 Situational Awareness (8 hrs)
- PC255 Situational Awareness II (8 hrs)

Program Hours: 240 (30 days), up to 240 NERC hrs.

Accreditation



APT is accredited by the U.S. Department of Education's Distance Education and Training Council (DETC).



All courses qualify for CEUs (Continuing Education Units) approved by the International Association of Continuing Education and Training



APT is recognized by the North American Electric Reliability Corporation.



APT courses are approved by Veterans Administration, GI Bill and DANTES!

Contact APT for more information!

www.aptc.edu

(800) 431-8488

LEVEL I (Competent)**PC100 Electric Power System Fundamentals (24 hrs) [NERC: 20-CEH, 20-OT, 0-STD, 0-SIM, 20-EOP, 24-P]**

Agencies ◦ Terminology ◦ Generation ◦ Transmission ◦ Substations ◦ Distribution ◦ Protection ◦ Interconnections ◦ Control Centers ◦ Telecommunications ◦ Basic Concepts (circuit components, Ohm's Law, AC/DC, single-phase, three-phase, delta and wye)

PC101 Power System Equipment (16 hrs) [NERC: 14-CEH, 14-OT, 4-STD, 4-SIM, 14-EOP, 16-P]

Substation Layouts ◦ Transformers ◦ Breakers ◦ Switches ◦ Arresters ◦ Capacitors ◦ Reactors ◦ Control Buildings ◦ Batteries & Chargers ◦ Lines (design, maintenance, vegetation and underground) ◦ Operating Ratings (substation equipment and lines)

PC102 Distribution Systems (24 hrs) [NERC: 16-CEH, 16-OT, 0-STD, 4-SIM, 16-EOP, 24-P]

Radial ◦ Overhead ◦ Underground ◦ Metering ◦ Consumption ◦ Protection Overview ◦ Voltage Control (regulators, line drop compensators, capacitors and reactors) ◦ Load Balance ◦ Power Quality ◦ Service Reliability ◦ Automation

PC103 Switching, Grounding & Safety (16 hrs) [NERC: 16-CEH, 16-OT, 0-STD, 0-SIM, 14-EOP, 16-P]

Switching & Tagging ◦ Grounding Systems ◦ Ground Potential Rise ◦ Safety (touch-step, personal protective equipment) ◦ Equipment Testing ◦ Arc-Flash ◦ NESC Clearances ◦ PCB ◦ MSDS

PC104 Protection (16 hrs) [NERC: 14-CEH, 14-OT, 6-STD, 8-SIM, 14-EOP, 16-P]

Faults ◦ Fuses ◦ Relay Types ◦ Sensing Equipment ◦ Control Circuits ◦ Distribution (under-frequency, undervoltage, overcurrent, series reactors and reclosing) ◦ Transmission (zones, differential, breaker failure, out of step, pilot, phase comparison, transfer trip and single pole tripping) ◦ Interconnection ◦ Special and Intelligent Schemes ◦ Disturbance Monitoring Equipment ◦ Transmission Loadability

PC105 Monitoring and Control (16 hrs) [NERC: 16-CEH, 16-OT, 4-STD, 8-SIM, 16-EOP, 16-P]

Monitoring System Conditions ◦ Equipment Organization ◦ SCADA (master & remotes) ◦ E-Tagging ◦ EMS ◦ Time Error Correction ◦ Automatic Time Error Correction ◦ Satellite Time Calibration ◦ Intelligent Devices ◦ Substation Automation

PC150 Communication and Telecommunications (8 hrs) [NERC: 6-CEH, 6-OT, 2-STD, 0-SIM, 6-EOP, 8-P]

Communications & Coordination ◦ Effective Communications ◦ Departmental and Entities ◦ Best Practice ◦ Telecommunications Systems ◦ Fiber Optics ◦ Microwave ◦ Power Line Carrier ◦ Circuit Types and Classes ◦ Reliability

LEVEL II (Proficient)**PC200 Generation Principles (24 hrs) [NERC: 20-CEH, 20-OT, 6-STD, 16-SIM, 20-EOP, 24-P]**

Power Transfer ◦ Frequency Stability ◦ Automatic Generation Control (AGC) ◦ Generator Excitation ◦ Power System Stabilizers ◦ Generator Speed Droop ◦ Generator Capability Curve ("D") ◦ Operating Reserves

PC215 Interconnected Systems (16 hrs) [NERC: 16-CEH, 16-OT, 12-STD, 12-SIM, 16-EOP, 16-P]

Interconnected Systems ◦ Agreement Types ◦ Responsibilities ◦ Dynamics of Interconnected Systems (islands, motor starting, ACE, Bias) ◦ Protection ◦ Frequency/Voltage Load Shedding ◦ Load Flow ◦ Available Transfer Capability (ATC) ◦ Total Transfer Capability ◦ Capacity Benefit Margin ◦ Transmission Loading Relief ◦ Interconnection Reliability Operating Limits ◦ Disturbance Control Standard ◦ Interchange Schedules ◦ Dynamic Transfers ◦ Source ◦ Sink Balancing Authorities

PC220 Reliability and Security (16 hrs) [NERC: 16-CEH, 16-OT, 4-STD, 12-SIM, 16-EOP, 16-P]

Control Center Operations ◦ System Reliability Concepts ◦ Reliability Awareness ◦ Equipment Reliability ◦ System Reliability ◦ Cyber Security (terminology, application, situational awareness, vulnerability analysis, studies, drills, threats) ◦ Security Improvement

PC230 Voltage Control and Collapse (16 hrs) [NERC: 16-CEH, 16-OT, 4-STD, 12-SIM, 16-EOP, 16-P]

Voltage Control Concepts (excitation, reactive support, regulators, static var compensators, power factor correction and load control) ◦ System Operating Limits (derivation, normal, emergency, flexibility) ◦ Voltage Collapse (types, causes, actions, responsibility)

PC240 Emergency Operations (16 hrs) [NERC: 16-CEH, 16-OT, 12-STD, 12-SIM, 16-EOP, 16-P]

Responsibilities (TO, RC, BA, GO) ◦ System Emergencies ◦ Real Time Contingency Analysis ◦ Load Shedding ◦ System Restoration ◦ Line Loading ◦ Load Restoration ◦ Offline System Analysis Tools ◦ Backup Control Centers ◦ Backup Operating Plans ◦ Sabotage ◦ Responses ◦ Congestion Management.

PC245 Emergency Operations – II (16 hrs) [NERC: 16-CEH, 16-OT, 12-STD, 12-SIM, 16-EOP, 16-P]

Area Control Error (ACE), Interconnection Islands, Real Time Contingency Analysis, System Restoration and Black Start.

PC250 Situational Awareness (8 hrs) [NERC: 8-CEH, 8-OT, 4-STD, 6-SIM, 8-EOP, 8-P]

Situational Awareness ◦ Situation Analyses ◦ Manage and Control Operations ◦ Operating Tools ◦ Best Practices ◦ Conditional Awareness

PC255 Situational Awareness – II (8 hrs) [NERC: 8-CEH, 8-OT, 0-STD, 6-SIM, 8-EOP, 8-P]

Voltage and Frequency Limits ◦ MW Reserves ◦ System Operating Limits ◦ Interconnection Reliability Operating Limits ◦ Forecasting ◦ Contingency Analysis ◦ Disturbance Control Standard (CPS1 and CPS2) ◦ Warning Signs



Proficiency Certification

Electric Power – Power Generation

APT's Proficiency Certification Program in Electric Power Systems is based on a set of objectives that are valuable to the industry, the employer and the student. This program incorporates strategically designed curriculum to maximize the knowledge and skills in the electric power industry. This certification program consists of two levels of proficiency. **Level I** provides the important knowledge components needed to confidently work in this specialization. **Level II** builds the student's knowledge and skills to the level to proficient. **This certification credit applies towards APT's Associate Degree in Applied Sciences – Electric Power Systems.** This program is a must for those interested in a lifelong career in electrical power systems and wants to be productive, proficient, and recognized.

APT is recognized by the North American Electric Reliability Corporation as a continuing education provider who adheres to NERC Continuing Education Program Criteria. These classes provide NERC CE Hours.

Program Objectives

- **Discuss how electric power plants** affect interconnected operations during normal and emergency situations
- **Discuss how generation controls** system voltage and frequency of interconnected power systems
- **Describe how generation balance with load** affect reliability, voltage control and load shedding
- **Demonstrate control and restoration techniques** during normal and emergency system conditions
- **Describe the purpose, function and operation** of the various water systems and equipment in power plants
- **Discuss the various generator system protection components** and their applications for system reliability

Features and Benefits

- Course curriculum, objectives and learning outcomes target employment and industry needs
- Interactive instruction from highly qualified and experienced instructors
- No prerequisites!
- State-of-the-art curriculum that is always updated
- Vast course selection provides mobility and specialization
- Flexibility in scheduling
- **APT** considers prior experience or other accredited courses towards certificate and degree credit.

Courses

Level I Certification (Competent, 128 hrs, 16 days)

- PC100 Electric Power System Fundamentals (24 hrs)
- PC101 Power System Equipment (16 hrs)
- PC102 Distribution Systems (24 hrs)
- PC103 Switching, Grounding & Safety (16 hrs)
- PC104 Protection Principles (16 hrs)
- PC105 Monitoring & Control (16 hrs)
- PC120 Power Plants (16 hrs)

Level II Certification (Proficient, 112 hrs, 14 days)

- PC150 Communications and Telecommunications (8 hrs)
- PC200 Generation Principles (24 hrs)
- PC215 Interconnected Systems (16 hrs)
- PC230 Voltage Control & Collapse (16 hrs)
- PC240 Emergency Operations I (16 hrs)
- PC245 Emergency Operations II (16 hrs)
- PC250 Situational Awareness I (8 hrs)
- PC255 Situational Awareness II (8 hrs)

Program Hours: 240 (30 days)

Accreditation



APT is accredited by the U.S. Department of Education's Distance Education and Training Council (DETTC).



All courses qualify for CEUs (Continuing Education Units) approved by the International Association of Continuing Education and Training



APT is recognized by the North American Electric Reliability Corporation.



APT courses are approved by Veterans Administration, GI Bill and DANTES!

Contact APT for more information!

www.aptc.edu

(800) 431-8488

LEVEL I (Competent)

PC100 Electric Power System Fundamentals (24 hrs)

Agencies ◦ Terminology ◦ Generation ◦ Transmission ◦ Substations ◦ Distribution ◦ Protection ◦ Interconnections ◦ Control Centers ◦ Telecommunications ◦ Basic Concepts (circuit components, Ohm’s Law, AC/DC, single-phase, three-phase, delta and wye)

PC101 Power System Equipment (16 hrs)

Substation Layouts ◦ Transformers ◦ Breakers ◦ Switches ◦ Arresters ◦ Capacitors ◦ Reactors ◦ Control Buildings ◦ Batteries & Chargers ◦ Lines (design, maintenance, vegetation and underground) ◦ Operating Ratings (substation equipment and lines)

PC102 Distribution Systems (24 hrs)

Radial ◦ Overhead ◦ Underground ◦ Metering ◦ Consumption ◦ Protection Overview ◦ Voltage Control (regulators, line drop compensators, capacitors and reactors) ◦ Load Balance ◦ Power Quality ◦ Service Reliability ◦ Automation

PC103 Switching, Grounding & Safety (16 hrs)

Switching & Tagging ◦ Grounding Systems ◦ Ground Potential Rise ◦ Safety (touch-step, personal protective equipment) ◦ Equipment Testing ◦ Arc-Flash ◦ NESC Clearances ◦ PCB ◦ MSDS

PC104 Protection Principles (16 hrs)

Faults ◦ Fuses ◦ Relay Types ◦ Sensing Equipment ◦ Control Circuits ◦ Distribution (under-frequency, undervoltage, overcurrent, series reactors and reclosing) ◦ Transmission (zones, differential, breaker failure, out of step, pilot, phase comparison, transfer trip and single pole tripping) ◦ Interconnection ◦ Special and Intelligent Schemes ◦ Disturbance Monitoring Equipment ◦ Transmission Loadability

PC105 Monitoring and Control (16 hrs)

Monitoring System Conditions ◦ Equipment Organization ◦ SCADA (master & remotes) ◦ E-Tagging ◦ EMS ◦ Time Error Correction ◦ Automatic Time Error Correction ◦ Satellite Time Calibration ◦ Intelligent Devices ◦ Substation Automation

PC120 Power Plants (16 hrs)

Introduction power plants and power plant equipment ◦ Discusses steam turbines, hydro turbines, combustion turbines and common renewable energy plants ◦ Explains distributed generation ◦ Describes electric generator components and characteristic curves

LEVEL II (Proficient)

PC150 Communication and Telecommunications

Communications & Coordination ◦ Effective Communications ◦ Departmental and Entities ◦ Best Practice ◦ Telecommunications Systems ◦ Fiber Optics ◦ Microwave ◦ Power Line ◦ Carrier Circuit Types and Classes ◦ Reliability

PC200 Generation Principles (24 hrs)

Power Transfer ◦ Frequency Stability ◦ Automatic Generation Control (AGC) ◦ Generator Excitation ◦ Power System Stabilizers ◦ Generator Speed Droop ◦ Generator Capability Curve (“D”) ◦ Operating Reserves

PC215 Interconnected Systems (16 hrs)

Interconnected Systems ◦ Agreement Types ◦ Responsibilities ◦ Dynamics of Interconnected Systems (islands, motor starting, ACE, Bias) ◦ Protection ◦ Frequency/Voltage Load Shedding ◦ Load Flow ◦ Available Transfer Capability (ATC) ◦ Total Transfer Capability ◦ Capacity Benefit Margin ◦ Transmission Loading Relief ◦ Interconnection Reliability Operating Limits ◦ Disturbance Control Standard ◦ Interchange Schedules ◦ Dynamic Transfers ◦ Source ◦ Sink Balancing Authorities

PC230 Voltage Control and Collapse (16 hrs)

Voltage Control Concepts (excitation, reactive support, regulators, static var compensators, power factor correction and load control) ◦ System Operating Limits (derivation, normal, emergency, flexibility) ◦ Voltage Collapse (types, causes, actions, responsibility)

PC240 Emergency Operations (16 hrs)

Responsibilities (TO, RC, BA, GO) ◦ System Emergencies ◦ Real Time Contingency Analysis ◦ Load Shedding ◦ System Restoration ◦ Line Loading ◦ Load Restoration ◦ Offline System Analysis Tools ◦ Backup Control Centers ◦ Backup Operating Plans ◦ Sabotage ◦ Responses ◦ Congestion Management.

PC245 Emergency Operations – II (16 hrs)

Area Control Error (ACE) ◦ Interconnection Islands ◦ Real Time Contingency Analysis ◦ System Restoration ◦ Black Start

PC250 Situational Awareness (8 hrs)

Situational Awareness ◦ Situation Analyses ◦ Manage and Control Operations ◦ Operating Tools ◦ Best Practices ◦ Conditional Awareness

PC255 Situational Awareness – II (8 hrs)

Voltage and Frequency Limits ◦ MW Reserves ◦ System Operating Limits ◦ Interconnection Reliability Operating Limits ◦ Forecasting ◦ Contingency Analysis ◦ Disturbance Control Standard (CPS1 and CPS2) ◦ Warning Signs



Proficiency Certification

Electric Power – Distribution System Operation *(Including Operators & Dispatchers)*

APT's Proficiency Certification Program in Electric Power Systems is based on a set of objectives that are valuable to the industry, the employer and the student. This program incorporates strategically designed curriculum to maximize the knowledge and skills in the electric power industry. This certification program consists of two levels of proficiency. **Level I** provides the important knowledge components needed to confidently work in this specialization. **Level II** builds the student's knowledge and skills to the level to proficient. **This certification credit applies towards APT's Associate Degree in Applied Sciences – Electric Power Systems.** This program is a must for those interested in a lifelong career in electrical power systems and wants to be productive, proficient, and recognized.

***Note:** APT is recognized by the North American Electric Reliability Corporation as a continuing education provider who adheres to NERC Continuing Education Program Criteria. These classes provide NERC CE Hours.*

Program Objectives

- **Contribute and interact** with technical professionals in all aspects of distribution system operations
- **Discuss generation** and its fundamental operations
- **Describe the various system protection equipment** and applications for system reliability
- **Discuss energy management programs** and operation during normal and emergency conditions
- **Describe system reliability, security, voltage control and load shedding parameters under normal and emergency operation conditions.**
- **Discuss field activities of the operations department**
- **Promote** your future with courses that earn recognition through certification and college credits

Features and Benefits

- Course curriculum, objectives and learning outcomes target employment and industry needs
- Interactive, leader-led classroom instruction from highly qualified and experienced instructors
- No prerequisite entrance exams!
- State-of-the-art curriculum that is always updated
- Vast course selection provides mobility and specialization
- Flexibility in course scheduling
- **APT** will consider prior experience or other accredited courses towards certificate credit.

Courses

Level I Certification (Competent; 120 hrs, 15 Days)

- PC100 Electric Power System Fundamentals (24 hrs)
- PC101 Power System Equipment (16 hrs)
- PC102 Distribution Systems (24 hrs)
- PC103 Switching, Grounding & Safety (16 hrs)
- PC105 Monitoring & Control (16 hrs)
- PC120 Power Plants (16 hrs)
- PC150 Communications & Telecommunications (8 hrs)

Level II Certification (Proficient; 88 hrs, 11 Days)

- PC104 Protection Principles (16 hrs)
- PC130 Power Quality (16 hrs)
- PC220 Reliability & Security (including Cyber Security) (16 hrs)
- PC230 Voltage Control & Collapse (16 hrs)
- PC240 Emergency Operations (16 hrs)
- PC250 Situational Awareness (8 hrs)

Program Hours: 208 hours (26 days)

Accreditation



APT is accredited by the U.S. Department of Education's Distance Education and Training Council (DETC).



All courses qualify for CEUs (Continuing Education Units) approved by the International Association of Continuing Education and Training



APT is recognized by the North American Electric Reliability Corporation.



APT courses are approved by Veterans Administration, GI Bill and DANTES!

Contact APT for more information!

www.aptc.edu

(800) 431-8488

LEVEL I (Competent)

PC100 Electric Power System Fundamentals (24 hrs)

Agencies ◦ Terminology ◦ Generation ◦ Transmission ◦ Substations ◦ Distribution ◦ Protection ◦ Interconnections ◦ Control Centers ◦ Telecommunications ◦ Basic Concepts (circuit components, Ohm's Law, AC/DC, single-phase, three-phase, delta and wye)

PC101 Power System Equipment (16 hrs)

Substation Layouts ◦ Transformers ◦ Breakers ◦ Switches ◦ Arresters ◦ Capacitors ◦ Reactors ◦ Control Buildings ◦ Batteries & Chargers ◦ Lines (design, maintenance, vegetation and underground) ◦ Operating Ratings (substation equipment and lines)

PC102 Distribution Systems (24 hrs)

Radial ◦ Overhead ◦ Underground ◦ Metering ◦ Consumption ◦ Protection Overview ◦ Voltage Control (regulators, line drop compensators, capacitors and reactors) ◦ Load Balance ◦ Power Quality ◦ Service Reliability ◦ Automation

PC103 Switching, Grounding & Safety (16 hrs)

Switching & Tagging ◦ Grounding Systems ◦ Ground Potential Rise ◦ Safety (touch-step, personal protective equipment) ◦ Equipment Testing ◦ Arc-Flash ◦ NESC Clearances ◦ PCB ◦ MSDS

PC105 Monitoring and Control (16 hrs)

Monitoring System Conditions ◦ Equipment Organization ◦ SCADA (master & remotes) ◦ E-Tagging ◦ EMS ◦ Time Error Correction ◦ Automatic Time Error Correction ◦ Satellite Time Calibration ◦ Intelligent Devices ◦ Substation Automation

PC120 Power Plants (16 hrs)

Introduction power plants and power plant equipment ◦ Discusses steam turbines, hydro turbines, combustion turbines and common renewable energy plants ◦ Explains distributed generation ◦ Describes electric generator components and characteristic curves

PC150 Communication and Telecommunications (8 hrs)

Communications & Coordination ◦ Effective Communications ◦ Departmental and Entities ◦ Best Practice ◦ Telecommunications Systems ◦ Fiber Optics ◦ Microwave ◦ Power Line Carrier ◦ Circuit Types and Classes ◦ Reliability

LEVEL II (Proficient)

PC104 Protection Principles (16 hrs)

Faults ◦ Fuses ◦ Relay Types ◦ Sensing Equipment ◦ Control Circuits ◦ Distribution (under-frequency, undervoltage, overcurrent, series reactors and reclosing) ◦ Transmission (zones, differential, breaker failure, out of step, pilot, phase comparison, transfer trip and single pole tripping) ◦ Interconnection ◦ Special and Intelligent Schemes ◦ Disturbance Monitoring Equipment ◦ Transmission Loadability

PC130 Power Quality (16 hrs)

Working knowledge of power quality issues ◦ concerns ◦ performance standards ◦ problem types ◦ vulnerable configurations ◦ stray voltages and currents ◦ radio/television interference ◦ ferroresonance ◦ cause analysis ◦ resolution ◦ test, monitor and troubleshoot ◦ case studies

PC220 Reliability and Security (16 hrs)

Control Center Operations ◦ System Reliability Concepts ◦ Reliability Awareness ◦ Equipment Reliability ◦ System Reliability ◦ Cyber Security (terminology, application, situational awareness, vulnerability analysis, studies, drills, threats) ◦ Security Improvement

PC230 Voltage Control and Collapse (16 hrs)

Voltage Control Concepts (excitation, reactive support, regulators, static var compensators, power factor correction and load control) ◦ System Operating Limits (derivation, normal, emergency, flexibility) ◦ Voltage Collapse (types, causes, actions, responsibility)

PC240 Emergency Operations – I (16 hrs)

Responsibilities (TO, RC, BA, GO) ◦ System Emergencies ◦ Real Time Contingency Analysis ◦ Load Shedding ◦ System Restoration ◦ Line Loading ◦ Load Restoration ◦ Offline System Analysis Tools ◦ Backup Control Centers ◦ Backup Operating Plans ◦ Sabotage ◦ Responses ◦ Congestion Management.

PC250 Situational Awareness – I (8 hrs)

Situational Awareness ◦ Situation Analyses ◦ Manage and Control Operations ◦ Operating Tools ◦ Best Practices ◦ Conditional



Proficiency Certification

Electric Power – Substation Operations and Maintenance

APT's Proficiency Certification Program in Electric Power Systems is based on a set of objectives that are valuable to the industry, the employer and the student. This program incorporates strategically designed curriculum to maximize the knowledge and skills in the electric power industry. This certification program consists of two levels of proficiency. **Level I** provides the important knowledge components needed to confidently work in this specialization. **Level II** builds the student's knowledge and skills to the level to proficient. **This certification credit applies towards APT's Associate Degree in Applied Sciences – Electric Power Systems.** This program is a must for those interested in a lifelong career in electrical power systems and wants to be productive, proficient, and recognized.

Note: APT is recognized by the North American Electric Reliability Corporation as a continuing education provider who adheres to NERC Continuing Education Program Criteria. These classes provide NERC CE Hours.

Program Objectives

- **Productively contribute and interact** with technical professionals in all aspects of substation maintenance
- **Discuss industry practices** on proper installation, maintenance and troubleshooting
- **Describe the safety aspects** of electric power substations
- **Gain valuable knowledge** to actively participate in electric power system maintenance activities.
- **Learn installation and repair** techniques to become productive and valuable.
- **Promote learning** and earn recognition demonstrated by proficiency certification and college credit

Features and Benefits

- Course curriculum, objectives and learning outcomes target employment and industry needs
- Interactive instruction from highly qualified and experienced instructors
- No prerequisites!
- State-of-the-art curriculum that is always updated
- Vast course selection provides mobility and specialization
- Flexibility in scheduling
- **APT** considers prior experience or other accredited courses towards certificate and degree credit.

Courses

Level I Certification (Competent; 112 hrs, 14 Days)

- PC100 Electric Power System Fundamentals (24 hrs)
- PC101 Power System Equipment (16 hrs)
- PC102 Distribution Systems (24 hrs)
- PC103 Switching, Grounding & Safety (16 hrs)
- PC115 Electrical Print Reading (16 hrs)
- PC140 Maintenance Test Instruments & Procedures (16 hrs)

Level II Certification (Proficient; 112hrs, 14 Days)

- PC104 Protection Principles (16 hrs)
- PC105 Monitoring & Control (16 hrs)
- PC110 Power Calculations (16 hrs)
- PC130 Power Quality (16 hrs)
- PC205 Monitoring & Control – II (16 hrs)
- PC260 Utility Telecommunications Systems (16 hrs)
- PC265 High Voltage Protection for Telecommunications (16 hrs)

Program Hours: 224 hours (28 days)

Accreditation



APT is accredited by the U.S. Department of Education's Distance Education and Training Council (DETC).



All courses qualify for CEUs (Continuing Education Units) approved by the International Association of Continuing Education and Training



APT is recognized by the North American Electric Reliability Corporation.



APT courses are approved by Veterans Administration, GI Bill and DANTES!

Contact APT for more information!

www.aptc.edu

(800) 431-8488

LEVEL I (Competent)

PC100 Electric Power System Fundamentals (24 hrs)

Agencies ◦ Terminology ◦ Generation ◦ Transmission ◦ Substations ◦ Distribution ◦ Protection ◦ Interconnections ◦ Control Centers ◦ Telecommunications ◦ Basic Concepts (circuit components, Ohm's Law, AC/DC, single-phase, three-phase, delta and wye)

PC101 Power System Equipment (16 hrs)

Substation Layouts ◦ Transformers ◦ Breakers ◦ Switches ◦ Arresters ◦ Capacitors ◦ Reactors ◦ Control Buildings ◦ Batteries & Chargers ◦ Lines (design, maintenance, vegetation and underground) ◦ Operating Ratings (substation equipment and lines)

PC102 Distribution Systems (24 hrs)

Radial ◦ Overhead ◦ Underground ◦ Metering ◦ Consumption ◦ Protection Overview ◦ Voltage Control (regulators, line drop compensators, capacitors and reactors) ◦ Load Balance ◦ Power Quality ◦ Service Reliability ◦ Automation

PC103 Switching, Grounding & Safety (16 hrs)

Switching & Tagging ◦ Grounding Systems ◦ Ground Potential Rise ◦ Safety (touch-step, personal protective equipment) ◦ Equipment Testing ◦ Arc-Flash ◦ NESC Clearances ◦ PCB ◦ MSDS

PC115 Electrical Print Reading (16 hrs)

Identify, illustrate and diagram drawings associated with electric power systems ◦ standard symbols ◦ one-line diagrams ◦ 3-line drawings ◦ wiring diagrams ◦ as-built drawings ◦ DC control circuits ◦ equipment connections ◦ verification ◦ industry standards ◦ construction ◦ maintenance

PC140 Maintenance, Test Instruments & Procedures (16 hrs)

Working knowledge of common test instruments used in power system maintenance ◦ Megger ◦ Hi-Pot ◦ Dissolved Gas Analysis ◦ dielectric strength ◦ transformer turns ratio ◦ micro-Ohm ◦ test procedures (i.e., batteries, earth resistivity, etc.) ◦ cable fault location ◦ capacitor testing ◦ maintenance ◦ safety precautions ◦ PCB handling ◦ lead awareness

LEVEL II (Proficient)

PC104 Protection (16 hrs)

Faults ◦ Fuses ◦ Relay Types ◦ Sensing Equipment ◦ Control Circuits ◦ Distribution (under-frequency, undervoltage, overcurrent, series reactors and reclosing) ◦ Transmission (zones, differential, breaker failure, out of step, pilot, phase comparison, transfer trip and single pole tripping) ◦ Interconnection ◦ Special and Intelligent Schemes ◦ Disturbance Monitoring Equipment ◦ Transmission Loadability

PC105 Monitoring and Control (16 hrs)

Monitoring System Conditions ◦ Equipment Organization ◦ SCADA (master & remotes) ◦ E-Tagging ◦ EMS ◦ Time Error Correction ◦ Automatic Time Error Correction ◦ Satellite Time Calibration ◦ Intelligent Devices ◦ Substation Automation

PC110 Power Calculations (16 hrs)

Apply basic power system calculations ◦ circuit analysis 3-phase power systems ◦ High-Voltage ◦ High Current ◦ insulation ◦ conductors ◦ clearances ◦ designs ◦ special issues ◦ voltage drop ◦ fault calculations ◦ introduction to symmetrical components ◦ applications ◦ engineering and operations fundamentals

PC130 Power Quality (16 hrs)

Power quality issues ◦ concerns ◦ performance standards ◦ problem types ◦ vulnerable configurations ◦ stray voltages and currents ◦ radio/television interference ◦ ferroresonance ◦ cause analysis ◦ resolution ◦ test, monitor and troubleshoot ◦ case studies

PC205 Monitoring and Control – II (16 hrs)

Gain working knowledge of control center real time data gathering equipment ◦ communications links ◦ control centers and remote terminal equipment connections ◦ transducers ◦ scale factors ◦ interface relays ◦ calibration procedures ◦ monitoring devices ◦ testing and troubleshooting ◦ cyber security in telecommunications

PC260 Utility Telecommunications Systems (16 hrs)

Telecommunications applications for electric operations ◦ transport fundamentals (fiber optics, microwave, power line carrier, wireless, satellite and wireline communication systems) ◦ substation and distribution automation ◦ auto-transfer switches ◦ Programmable Logic Controllers (PLC) ◦ Intelligent Electronic Devices (IED) ◦ communications protocols (Ethernet, ATM, SONET, IP and Utility Communications Architecture)

PC265 High Voltage Protection for Telecommunications (16 hrs)

High voltage isolation equipment ◦ reliable telecommunications circuits ◦ industry standards and practices ◦ proper installation ◦ Ground Potential Rise concerns ◦ wireline and fiber interfaces ◦ proper maintenance ◦ avoiding interruption of critical communications circuits ◦ optical ground wires ◦ safety for telecom personnel



Proficiency Certification

Electric Power – Monitor Control and Communications

APT's Proficiency Certification Program in Electric Power Systems is based on a set of objectives that are valuable to the industry, the employer and the student. This program incorporates strategically designed curriculum to maximize the knowledge and skills in the electric power industry. This certification program consists of two levels of proficiency. **Level I** provides the important knowledge components needed to confidently work in this specialization. **Level II** builds the student's knowledge and skills to the level to proficient. **This certification credit applies towards APT's Associate Degree in Applied Sciences – Electric Power Systems.** This program is a must for those interested in a lifelong career in electrical power systems and wants to be productive, proficient, and recognized.

Note: APT is recognized by the North American Electric Reliability Corporation as a continuing education provider who adheres to NERC Continuing Education Program Criteria. These classes provide NERC CE Hours.

Program Objectives

- **Productively contribute and interact** with technical professionals in all aspects of monitoring, control and communications relating to electric system operation
- **Properly install, maintain and troubleshoot** telecommunications equipment for remote control of power system equipment according to industry practices
- **Describe the safety procedures** working around telecommunications equipment in high voltage environments
- **Discuss signal fundamentals** including physical transport, multiplexing, protocols and equipment compatibility
- **Describe the operation** of fiber optics, microwave, powerline carrier and wireline communication systems
- **Promote** your future by completing valuable courses and earn recognition through proficiency certification
- **Learn installation and repair** techniques to become productive and valuable.

Features and Benefits

- Course curriculum, objectives and learning outcomes target employment and industry needs
- Interactive instruction from highly qualified and experienced instructors
- No prerequisites!
- State-of-the-art curriculum that is always updated
- Vast course selection provides mobility and specialization
- Flexibility in scheduling
- **APT** considers prior experience or other accredited courses towards certificate and degree credit.

Courses

Level I Certification (Competent; 112 hrs, 14 Days)

- PC100 Electric Power System Fundamentals (24 hrs)
- PC101 Power System Equipment (16 hrs)
- PC102 Distribution Systems (24 hrs)
- PC103 Switching, Grounding & Safety (16 hrs)
- PC105 Monitoring & Control (16 hrs)
- PC120 Power Plants (16 hrs)

Level II Certification (Proficient; 80 hrs, 10 Days)

- PC104 Protection Principles (16 hrs)
- PC115 Electrical Print Reading (16 hrs)
- PC205 Monitoring and Control – II (16 hrs)
- PC260 Utility Telecommunications Systems (16 hrs)
- PC265 High Voltage Protection for Telecommunications (16 hrs)

Program Hours: 192 (24 days)

Accreditation



APT is accredited by the U.S. Department of Education's Distance Education and Training Council (DETC).



All courses qualify for CEUs (Continuing Education Units) approved by the International Association of Continuing Education and Training



APT is recognized by the North American Electric Reliability Corporation.



APT courses are approved by Veterans Administration, GI Bill and DANTES!

Contact APT for more information!

www.aptc.edu

(800) 431-8488

LEVEL I (Competent)

PC100 Electric Power System Fundamentals (24 hrs)

Agencies ◦ Terminology ◦ Generation ◦ Transmission ◦ Substations ◦ Distribution ◦ Protection ◦ Interconnections ◦ Control Centers ◦ Telecommunications ◦ Basic Concepts (circuit components, Ohm's Law, AC/DC, single-phase, three-phase, delta and wye)

PC101 Power System Equipment (16 hrs)

Substation Layouts ◦ Transformers ◦ Breakers ◦ Switches ◦ Arresters ◦ Capacitors ◦ Reactors ◦ Control Buildings ◦ Batteries & Chargers ◦ Lines (design, maintenance, vegetation and underground) ◦ Operating Ratings (substation equipment and lines)

PC102 Distribution Systems (24 hrs)

Radial ◦ Overhead ◦ Underground ◦ Metering ◦ Consumption ◦ Protection Overview ◦ Voltage Control (regulators, line drop compensators, capacitors and reactors) ◦ Load Balance ◦ Power Quality ◦ Service Reliability ◦ Automation

PC103 Switching, Grounding & Safety (16 hrs)

Switching & Tagging ◦ Grounding Systems ◦ Ground Potential Rise ◦ Safety (touch-step, personal protective equipment) ◦ Equipment Testing ◦ Arc-Flash ◦ NESC Clearances ◦ PCB ◦ MSDS

PC105 Monitoring and Control (16 hrs)

Monitoring System Conditions ◦ Equipment Organization ◦ SCADA (master & remotes) ◦ E-Tagging ◦ EMS ◦ Time Error Correction ◦ Automatic Time Error Correction ◦ Satellite Time Calibration ◦ Intelligent Devices ◦ Substation Automation

PC120 Power Plants (16 hrs)

Introduction power plants and power plant equipment ◦ Discusses steam turbines, hydro turbines, combustion turbines and common renewable energy plants ◦ Explains distributed generation ◦ Describes electric generator components and characteristic curves

LEVEL II (Proficient)

PC104 Protection (16 hrs)

Faults ◦ Fuses ◦ Relay Types ◦ Sensing Equipment ◦ Control Circuits ◦ Distribution (under-frequency, undervoltage, overcurrent, series reactors and reclosing) ◦ Transmission (zones, differential, breaker failure, out of step, pilot, phase comparison, transfer trip and single pole tripping) ◦ Interconnection ◦ Special and Intelligent Schemes ◦ Disturbance Monitoring Equipment ◦ Transmission Loadability

PC115 Electrical Print Reading (16 hrs)

Identify, illustrate and diagram drawings associated with electric power systems ◦ standard symbols ◦ one-line diagrams ◦ 3-line drawings ◦ wiring diagrams ◦ as-built drawings ◦ DC control circuits ◦ equipment connections ◦ verification ◦ industry standards ◦ construction ◦ maintenance

PC205 Monitoring and Control – II (16 hrs)

Gain working knowledge of control center real time data gathering equipment ◦ communications links ◦ control centers and remote terminal equipment connections ◦ transducers ◦ scale factors ◦ interface relays ◦ calibration procedures ◦ monitoring devices ◦ testing and troubleshooting ◦ cyber security in telecommunications

PC260 Utility Telecommunications Systems (16 hrs)

Telecommunications applications for electric operations ◦ transport fundamentals (fiber optics, microwave, power line carrier, wireless, satellite and wireline communication systems) ◦ substation and distribution automation ◦ auto-transfer switches ◦ Programmable Logic Controllers (PLC) ◦ Intelligent Electronic Devices (IED) ◦ communications protocols (Ethernet, ATM, SONET, IP and Utility Communications Architecture)

PC265 High Voltage Protection for Telecommunications (16 hrs)

High voltage isolation equipment ◦ reliable telecommunications circuits ◦ industry standards and practices ◦ proper installation ◦ Ground Potential Rise concerns ◦ wireline and fiber interfaces ◦ proper maintenance ◦ avoiding interruption of critical communications circuits ◦ optical ground wires ◦ safety for telecom personnel



Proficiency Certification

Electric Power – Design and Management

APT's Proficiency Certification Program in Electric Power Systems is based on a set of objectives that are valuable to the industry, the employer and the student. This program incorporates strategically designed curriculum to maximize the knowledge and skills in the electric power industry. This certification program consists of two levels of proficiency. **Level I** provides the important knowledge components needed to confidently work in this specialization. **Level II** builds the student's knowledge and skills to the level to proficient. **This certification credit applies towards APT's Associate Degree in Applied Sciences – Electric Power Systems.** This program is a must for those interested in a lifelong career in electrical power systems and wants to be productive, proficient, and recognized.

***Note:** APT is recognized by the North American Electric Reliability Corporation as a continuing education provider who adheres to NERC Continuing Education Program Criteria. These classes provide NERC CE Hours.*

Program Objectives

- **Productively contribute and interact** with technical and engineering professionals in electric power systems
- **Discuss proper installation, maintenance and operation** of power equipment in accordance to industry practices.
- **Describe system protection, monitoring, control and planning** principles and methodologies
- **Confidently discuss distribution systems** with field operations personnel
- **Discuss the safety aspects** of power system operations
- **Continually promote** your future through valuable courses while earning recognition by certification.
- **Learn installation and repair** techniques to become productive and valuable.

Features and Benefits

- Course curriculum, objectives and learning outcomes target employment and industry needs
- Interactive instruction from highly qualified and experienced instructors
- No prerequisites!
- State-of-the-art curriculum that is always updated
- Vast course selection provides mobility and specialization
- Flexibility in scheduling
- **APT** considers prior experience or other accredited courses towards certificate and degree credit.

Courses

Level I Certification (Competent; 112 hrs, 14 Days)

- PC100 Electric Power System Fundamentals (24 hrs)
- PC101 Power System Equipment (16 hrs)
- PC102 Distribution Systems (24 hrs)
- PC103 Switching, Grounding & Safety (16 hrs)
- PC110 Power Calculations (16 hrs)
- PC120 Power Plants (16 hrs)

Level II Certification (Proficient; 112 hrs, 14 Days)

- PC104 Protection Principles (16 hrs)
- PC105 Monitoring & Control (16 hrs)
- PC130 Power Quality (16 hrs)
- PC205 Monitoring & Control – II (16 hrs)
- PC220 Reliability and Security (16 hrs)
- PC230 Voltage Control & Collapse (16 hrs)
- PC260 Utility Telecommunications Systems (16 hrs)

Program Hours: 224 (28 days)

Accreditation



APT is accredited by the U.S. Department of Education's Distance Education and Training Council (DETC).



All courses qualify for CEUs (Continuing Education Units) approved by the International Association of Continuing Education and Training



APT is recognized by the North American Electric Reliability Corporation.



APT courses are approved by Veterans Administration, GI Bill and DANTES!

Contact APT for more information!

www.aptc.edu

(800) 431-8488

LEVEL I (Competent)

PC100 Electric Power System Fundamentals (24 hrs)

Agencies ◦ Terminology ◦ Generation ◦ Transmission ◦ Substations ◦ Distribution ◦ Protection ◦ Interconnections ◦ Control Centers ◦ Telecommunications ◦ Basic Concepts (circuit components, Ohm's Law, AC/DC, single-phase, three-phase, delta and wye)

PC101 Power System Equipment (16 hrs)

Substation Layouts ◦ Transformers ◦ Breakers ◦ Switches ◦ Arresters ◦ Capacitors ◦ Reactors ◦ Control Buildings ◦ Batteries & Chargers ◦ Lines (design, maintenance, vegetation and underground) ◦ Operating Ratings (substation equipment and lines)

PC102 Distribution Systems (24 hrs)

Radial ◦ Overhead ◦ Underground ◦ Metering ◦ Consumption ◦ Protection Overview ◦ Voltage Control (regulators, line drop compensators, capacitors and reactors) ◦ Load Balance ◦ Power Quality ◦ Service Reliability ◦ Automation

PC103 Switching, Grounding & Safety (16 hrs)

Switching & Tagging ◦ Grounding Systems ◦ Ground Potential Rise ◦ Safety (touch-step, personal protective equipment) ◦ Equipment Testing ◦ Arc-Flash ◦ NESC Clearances ◦ PCB ◦ MSDS

PC110 Power Calculations (16 hrs)

Apply basic power system calculations ◦ circuit analysis 3-phase power systems ◦ High-Voltage ◦ High Current ◦ insulation ◦ conductors ◦ clearances ◦ designs ◦ special issues ◦ voltage drop ◦ fault calculations ◦ introduction to symmetrical components ◦ applications ◦ engineering and operations fundamentals

PC120 Power Plants (16 hrs)

Introduction power plants and power plant equipment ◦ Discusses steam turbines, hydro turbines, combustion turbines and common renewable energy plants ◦ Explains distributed generation ◦ Describes electric generator components and characteristic curves

LEVEL II (Proficient)

PC104 Protection (16 hrs)

Faults ◦ Fuses ◦ Relay Types ◦ Sensing Equipment ◦ Control Circuits ◦ Distribution (under-frequency, undervoltage, overcurrent, series reactors and reclosing) ◦ Transmission (zones, differential, breaker failure, out of step, pilot, phase comparison, transfer trip and single pole tripping) ◦ Interconnection ◦ Special and Intelligent Schemes ◦ Disturbance Monitoring Equipment ◦ Transmission Loadability

PC105 Monitoring and Control (16 hrs)

Monitoring System Conditions ◦ Equipment Organization ◦ SCADA (master & remotes) ◦ E-Tagging ◦ EMS ◦ Time Error Correction ◦ Automatic Time Error Correction ◦ Satellite Time Calibration ◦ Intelligent Devices ◦ Substation Automation

PC130 Power Quality (16 hrs)

Power quality issues ◦ concerns ◦ performance standards ◦ problem types ◦ vulnerable configurations ◦ stray voltages and currents ◦ radio/television interference ◦ ferroresonance ◦ cause analysis ◦ resolution ◦ test, monitor and troubleshoot ◦ case studies

PC205 Monitoring and Control – II (16 hrs)

Gain working knowledge of control center real time data gathering equipment ◦ communications links ◦ control centers and remote terminal equipment connections ◦ transducers ◦ scale factors ◦ interface relays ◦ calibration procedures ◦ monitoring devices ◦ testing and troubleshooting ◦ cyber security in telecommunications

PC220 Reliability and Security (16 hrs)

Control Center Operations ◦ System Reliability Concepts ◦ Reliability Awareness ◦ Equipment Reliability ◦ System Reliability ◦ Cyber Security (terminology, application, situational awareness, vulnerability analysis, studies, drills, threats) ◦ Security Improvement

PC230 Voltage Control and Collapse (16 hrs)

Voltage Control Concepts (excitation, reactive support, regulators, static var compensators, power factor correction and load control) ◦ System Operating Limits (derivation, normal, emergency, flexibility) ◦ Voltage Collapse (types, causes, actions, responsibility)

PC260 Utility Telecommunications Systems (16 hrs)

Telecommunications applications for electric operations ◦ transport fundamentals (fiber optics, microwave, power line carrier, wireless, satellite and wireline communication systems) ◦ substation and distribution automation ◦ auto-transfer switches ◦ Programmable Logic Controllers (PLC) ◦ Intelligent Electronic Devices (IED) ◦ communications protocols (Ethernet, ATM, SONET, IP and Utility Communications Architecture)