

Wisconsin Technical College System Curriculum Standards & Program Design Summary

50-468-1 SUBSTATION ELECTRICAL APPRENTICE (Related Instruction)

Program Information

Program Description

Substation electricians inspect, test, repair and maintain both high and medium voltage electrical equipment related to power transmission and distribution, with a specialization on substations. Tasks involve oversight of construction and commissioning of new equipment, routine maintenance and testing, analyzing test results, troubleshooting faulty equipment and monitoring the operation of substations. Typical work involves repairing or replacing substation equipment and components. Equipment involved in this trade includes motors, controls, circuit breakers, switches, relays, transformers, wiring raceways, timers, lighting systems, emergency generator systems, battery back-up systems, and security (both physical and electronic). Workers frequently interpret electrical schematics, wiring diagrams, and technical engineering related information. Worker should be proficient in both below-ground and above-ground designs and work in a wide range of medium to low voltages. Safety training and hazard awareness is critical including safety related to electricity, construction, confined spaces, moving vehicles, aerial and overhead work, and more. Some substation electricians provide an interface between substation owners, outside contractors, civil engineering personnel, and utility operations.

Substation Electricians enjoy a broad range of job duties which include assisting with site surveys; inspecting concrete foundations and construction work; installing substation grounding systems; installing subgrade and above ground raceways; erecting and modifying steel structures; installing bus and conductor systems; assembling and installing substation equipment; installing and terminating cable, installing components of relay and control facility buildings; operating substation equipment; repairing substation equipment; performing routine maintenance and testing; working safely around high and medium voltage, construction operations and equipment, and electrical hazards; using data and information systems, including SCADA interfaces, and relay event information effectively.

The work of substation electricians has become more complex and sophisticated due to trends and technologies associated with green energy, smart grids, alternative & renewable energy sources, and distributed power generation systems.

External Requirements

- 8,000 hour Apprenticeship
- 648 hours of Related Instruction
- 7,352 hours of On-The-Job Learning
- Undetermined hours of Unpaid Related Instruction
- Physical Abilities - lifting, climbing, outdoor work in all types of weather, use of manual and power tools
- Mechanical ability and aptitude
- CDL or heavy equipment operator certifications as required by the employer
- OSHA 10 or OSHA 30, and other safety training as required by the employer
- First Aid and CPR as required by the employer
- Wisconsin Registered Apprentice

Program Outcomes

- 1 Protect self, other workers, equipment, facilities, and the environment from injury and damage
- 2 Handle oil properly and protect the environment
- 3 Apply basic electrical theory to substation systems
- 4 Be aware of site surveying
- 5 Inspect substation construction sites
- 6 Assemble substation grounding systems
- 7 Assemble subgrade and above ground raceways
- 8 Erect and modify steel structures
- 9 Install non-insulated bus systems
- 10 Assemble substation equipment
- 11 Install and terminate cables and insulated conductors
- 12 Install components of relay and control facility buildings
- 13 Operate substation equipment
- 14 Perform routine inspection, maintenance, and testing
- 15 Repair substation equipment
- 16 Work with Supervisory Control and Data Acquisition (SCADA) interfaces and protective devices

Program Configuration for Related Instruction

The apprenticeship program standards specify 648 hours of related instruction. The following program configuration is designed for 8 semesters of 80 hours per semester, plus the 8-hour transition to trainer requirement. The program configuration calls for two 1-credit, 40-hour block schedules per term and selected courses are broken down into 1-credit modules. The Transition to Trainer course should be taken in the last year and may be scheduled according to employer and employee needs.

Total Credits = 16.0

Total Hours = 648 @ 80 hours per term times 8 terms, includes Transition to Trainer @ 8 hours

Term 1

Course #	Course Title	Credits & Hours	Course Description
50-468-501	Substation Trade Math, Safety, Environmental Protection & Orientation to the Trade	2.00 80 hours	Course reviews trade related math, including arithmetic, geometry, simple trigonometry, US and metric units, algebra, and math commonly experienced by electricians. Course introduces safety related to the trade and school. Apprentices will learn about tools, equipment, and protecting the environment. An orientation to the occupation will further introduce apprentices to job duties, tasks and work processes.

Term 2

Course #	Course Title	Credits & Hours	Course Description
50-468-502	Substation DC Theory, Print Reading, Safety & Circuit Analysis	1.00 40 hours	Apprentices will compare sources of electricity, apply math skills to DC circuits, compute units of measure, and calculate voltage, current, resistance, power and conductance. In addition, they will analyze DC circuits, compare conductors and insulators, and examine electromagnetism. Apprentices will examine motor actions related to electrical devices as they prepare for future coursework in related instruction. Learning Plans will discuss safety issues surrounding DC electricity, build skills in reading electrical schematics and symbols, solve DC circuit problems, and work with hands-on equipment and activities to apply DC theory to practice.
50-468-503	Substation AC Theory, Safety, Print Reading, & Circuit Analysis	1.00 40 hours	AC Theory, Safety, Print Reading and Circuits examines the characteristics of alternating current. Explore safety concepts surrounding AC electricity and get introduced to reading electrical prints and symbols related to AC circuits. Apprentices will also learn to use AC measuring instruments and examine capacitors, analyze different AC circuits, and receive an introduction to 3-phase power.

Term 3

Course #	Course Title	Credits & Hours	Course Description
50-468-504	NEC & NESC Codes & Electrical Safety for Substation Electricians	1.00 40 hours	Investigate the NESC and other electrical codes that pertain to substations. Apprentices will learn to determine proper conductors and raceways for substation applications. Other competencies include sizing cords and cables according to electrical codes; comparing proper boxes, cabinets, gutters, and conduits; and comparing substation grounding devices and systems. NEC, NESC, PSC, NFPA, and related rules and regulations will be covered. Apprentices will be challenged to identify field installations which meet, and do not comply with, NESC and other electrical utility codes, rules, and regulations.
50-468-505	Substation Motor Controls, Fluid Power & Mechanical Systems	1.00 40 hours	<p>This course will lead apprentices through (1) motor controls; (2) variable speed drives; (3) fluid power systems; and (4) mechanical principles during the second half of the third semester of related instruction.</p> <p>First, apprentices will learn the fundamentals of electric motors and motor controls, and how to apply these concepts to substation equipment. Apprentices will also learn to draw and read simple ladder and wiring diagrams and apply the logic used in motor controls to interpret control circuit schematics. AC and DC electrical theory will be applied.</p>

			<p>Second, variable speed drives will be explored, with competencies included for how they need to be installed, inspected, maintained and repaired. Third, a basic review of mechanical principles commonly used by utilities will support apprentices with installing, operating, and maintaining substations. Power transmission systems will be compared and applications to substations will be emphasized.</p> <p>Finally, fluid power systems will be introduced including both pneumatic and hydraulic applications. Substation equipment applications commonly found in the field will be discussed. Competencies related to installing, maintaining, inspecting, testing, and repairing fluid power systems will be emphasized.</p>
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Term 4

Course #	Course Title	Credits & Hours	Course Description
50-468-506	Substation Power System Basics	2.00 80 hours	Apprentices will explore electrical power systems with a focus on competencies which support installing, operating, maintaining, and repairing substation equipment and components. Course will apply electrical theories learned in previous coursework to electrical power systems. Substation equipment and components will be introduced. Coordination of different power systems and contingency planning is addressed. Course reinforces electrical safety, print reading, and 3-phase electricity.

Term 5

Course #	Course Title	Credits & Hours	Course Description
50-468-507	Substation Equipment Maintenance & Testing	2.00 80 hours	Apprentices will explore critical substation equipment from an assembly, installation, inspection, maintenance, testing, repair and service viewpoint. Topics covered will include circuit breakers, transformers, voltage regulators, capacitors, protective relays, and cable systems. In addition, oil pumps, rotating machinery, inverters, battery systems, and other equipment will be discussed. Learning activities will include classroom activities, shop skills development, hands-on training on a substation training center, and videos with workbooks.

Term 6

Course #	Course Title	Credits & Hours	Course Description
50-468-508	Substation Relays & Protective		In term 6 of related instruction, substation apprentices will examine substation protection and

	Relaying	2.00 80 hours	protective devices. Competencies will include examining protective relays, bus protection schemes, various power system protective devices, and planning overcurrent protection. A review of substation equipment protection will be explored. This course is designed for two 40-hour block schedules during the semester.
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Term 7

Course #	Course Title	Credits & Hours	Course Description
50-468-509	Substation Instrumentation & Controls	2.00 80 hours	Apprentices in the seventh term of related instruction will examine substation automation, instrumentation, and controls. This course covers typical functions provided in electric utility substation automation systems, equipment and component interfaces, substation communication protocols, SCADA systems and PLC. Competencies are designed around the roles and responsibilities commonly expected by journey level work and substation communication, control and automation. This course is formatted for two 1-week block schedules of 40 hours per block. Week 1 focuses on theory, concepts, and terminology. Week 2 emphasizes job duties and tasks substation electricians will face in the field.

Term 8

Course #	Course Title	Credits & Hours	Course Description
50-468-510	Substation Capstone Project: Construction, Installation, Testing, & Maintenance	2.00 80 hours	<p>This CAPSTONE course (and project) involves hands-on skill demonstrations with the college's substation. Knowledge, skills, and abilities important to the trade and role of substation electricians will be demonstrated in a semester long project that ties together concepts taught throughout the apprenticeship. Apprentices will review the four phases of a substation: construction, commissioning, testing, and maintenance as they work on a substation training center. Daily team meetings will organize work priorities, communicate project developments and resolve challenges as a group.</p> <p>A project scope scenario will be developed by the instructor(s) for apprentices to respond to during the course. The scenario may involve an engineering design change, new equipment installation, station upgrade, or other project suggested by utilities. The competencies listed in this course outcome summary outlines the general process apprentices MAY use to respond to the scenario and these can vary from group to group based on the scenario selected. Learning objectives listed here have been taught in previous coursework and/or during on-the-job learning, and will be applied to the capstone project. Detailed</p>

			project documentation will be developed by the apprentices and submitted to the instructor for review and feedback. Apprentices will be expected to work together, organize duties, delegate responsibilities, manage their time, and follow through.
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Term 9

Course #	Course Title	Credits & Hours	Course Description
47-455-455	Transition to Trainer: Your Role as a Journey Worker	0.00 8 hours	<p>Apprenticeship training is a collaborative partnership: employer and employee associations, government, and educational institutions each play a part. In reality, most learning takes place through the daily interaction between an apprentice and his/her co-workers. Surveys have shown that the apprentices are least satisfied with the on-the-job portion of their training--particularly the ability of journey level workers and supervisors to pass on their knowledge of the trade.</p> <p>You have already learned to use the tools of your chosen trade. In this workshop you will be introduced to a new set of basic tools--the tools of a jobsite trainer. You will explore the skills that are necessary to be an effective trainer, discover how to deliver hands-on training, and examine the process for giving useful feedback. During the workshop you will build a Training Toolkit to take back to your work on the job.</p>

Wisconsin Technical College System

47-455-455 Transition to Trainer: Your Role as a Journey Worker

Course Outcome Summary

Course Information

Description Apprenticeship training is a collaborative partnership: employer and employee associations, government, and educational institutions each play a part. In reality, most learning takes place through the daily interaction between an apprentice and his/her co-workers. Surveys have shown that the apprentices are least satisfied with the on-the-job portion of their training--particularly the ability of journey level workers and supervisors to pass on their knowledge of the trade.

You have already learned to use the tools of your chosen trade. In this workshop you will be introduced to a new set of basic tools--the tools of a jobsite trainer. You will explore the skills that are necessary to be an effective trainer, discover how to deliver hands-on training, and examine the process for giving useful feedback. During the workshop you will build a Training Toolkit to take back to your work on the job.

Course Competencies

- 1 Value your role as a journey worker trainer
- 2 Serve as a mentor and job coach
- 3 Foster a positive work environment by acting as an ally/advocate
- 4 Provide hands-on skills training
- 5 Provide feedback on apprentice performance

Wisconsin Technical College System

50-468-501 Substation Trade Math, Safety, Environmental Protection & Orientation to the Trade

Course Outcome Summary

Course Information

Description Course reviews trade related math, including arithmetic, geometry, simple trigonometry, US and metric units, algebra, and math commonly experienced by electricians. Course introduces safety related to the trade and school. Apprentices will learn about tools, equipment, and protecting the environment. An orientation to the occupation will further introduce apprentices to job duties, tasks and work processes. The WTCS apprenticeship core abilities will be reviewed and practiced, and an orientation to the college and key student success skills is planned.

Total Credits 2.00

Course Competencies

- 1 Apply math skills needed to perform the work required by substation electricians
- 2 Protect self and others from potential safety hazards and possible injury
- 3 Examine the trade and occupation
- 4 Protect the environment
- 5 Provide recommendations for substation security and protection
- 6 Be aware of substation site preparation and construction
- 7 Handle oils, fluids and chemicals properly
- 8 Discover terms, tools, and technical concepts used by the industry
- 9 Demonstrate the effective use of student success skills such as study skills, note taking, time management, conflict resolution and use of support services

Wisconsin Technical College System

50-468-502 Substation DC Theory, Print Reading, Safety & Circuit Analysis

Course Outcome Summary

Course Information

Description Apprentices will compare sources of electricity, apply math skills to DC circuits, compute units of measure, and calculate voltage, current, resistance, power and conductance. In addition, they will analyze DC circuits, compare conductors and insulators, and examine electromagnetism. Apprentices will examine motor actions related to electrical devices as they prepare for future coursework in related instruction. Learning Plans will discuss safety issues surrounding DC electricity, build skills in reading electrical schematics and symbols, solve DC circuit problems, and work with hands-on equipment and activities to apply DC theory to practice.

Total Credits 1.00

Course Competencies

- 1 Apply DC electrical theory to electricity and electrical devices
- 2 Apply electrical safety to DC circuits
- 3 Interpret electrical schematics and symbols related to DC circuits
- 4 Apply math functions (from first semester) to DC circuits
- 5 Apply units of measure for electrical quantities
- 6 Calculate values of voltage, current, resistance, power, and conductance using Ohm's law
- 7 Analyze the voltage, current, resistance, and power dissipation for the series D.C. circuit
- 8 Determine how resistance affects an electrical circuit and substation
- 9 Analyze a resistive series circuit
- 10 Analyze a parallel circuit
- 11 Analyze combination circuits
- 12 Compare conductors and insulators
- 13 Analyze principles of magnetism
- 14 Examine how electromagnetic devices operate
- 15 Examine how motor action relates to the operation of electrical devices
- 16 Produce written documents required for the trade (technical writing, documentation, field notes, as-built drawing notations, and other various written documents)

Wisconsin Technical College System

50-468-503 Substation AC Theory, Safety, Print Reading, & Circuit Analysis

Course Outcome Summary

Course Information

Description AC Theory, Safety, Print Reading and Circuits examines the characteristics of alternating current. Explore safety concepts surrounding AC electricity and get introduced to reading electrical prints and symbols related to AC circuits. Apprentices will also learn to use AC measuring instruments and examine capacitors, analyze different AC circuits, and receive an introduction to 3-phase power.

Total Credits 1.00

Course Competencies

- 1 Apply right angle trigonometry to alternating current (AC)
- 2 Summarize the characteristics of alternating current
- 3 Determine electrical values on AC circuits
- 4 Examine nature of inductance
- 5 Analyze capacitor functions in AC circuits
- 6 Analyze resistive-inductive series circuits
- 7 Analyze resistance-capacitive series circuits
- 8 Analyze parallel reactive circuits
- 9 Analyze complex circuits
- 10 Compare three-phase applications for various power systems and substations
- 11 Apply electrical safety to AC circuits
- 12 Interpret electrical schematics and symbols related to AC circuits
- 13 Draw an AC circuit commonly found on substations
- 14 Produce written documents required for the trade (technical writing, documentation, field notes, as-built drawing notations, and other various written documents)

Wisconsin Technical College System

50-468-504 NEC & NESC Codes & Electrical Safety for Substation Electricians

Course Outcome Summary

Course Information

Description Investigate the NESC and other electrical codes that pertain to substations. Apprentices will learn to determine proper conductors and raceways for substation applications. Other competencies include sizing cords and cables according to electrical codes; comparing proper boxes, cabinets, gutters, and conduits; and comparing substation grounding devices and systems. NEC, NESC, PSC, NFPA, and related rules and regulations will be covered. Apprentices will be challenged to identify field installations which meet, and do not comply with, NESC and other electrical utility codes, rules, and regulations.

Total Credits 1.00

Course Competencies

- 1 Apply work rules from the National Electrical Safety Code (NESC) to substations and work performed by the trade
- 2 Classify OSHA standards related to the NESC work rules and substations
- 3 Compare NEC codes and standards to the NESC work rules which pertain to substations
- 4 Interpret PSC rules and regulations related to the NESC work rules and substations
- 5 Summarize other electrical utility regulations which pertain to substation equipment, maintenance, testing, operations or repair
- 6 Recommend proper conductor and raceways for substation applications based on codebook
- 7 Size cords and cables according to electrical codes and industry standards
- 8 Compare proper boxes, cabinets, gutters, and conduits based on conditions
- 9 Apply grounding standards to various substation installations
- 10 Identify correct and incorrect equipment installations in the field
- 11 Produce written documents required for the trade (technical writing, documentation, field notes, as-built drawing notations, and other employer requirements)

Wisconsin Technical College System

50-468-505 Substation Motor Controls, Fluid Power & Mechanical Systems Course Outcome Summary

Course Information

Description This course will lead apprentices through (1) motor controls; (2) variable speed drives; (3) fluid power systems; and (4) mechanical principles during the second half of the third semester of related instruction. First, apprentices will learn the fundamentals of electric motors and motor controls, and how to apply these concepts to substation equipment. Apprentices will also learn to draw and read simple ladder and wiring diagrams and apply the logic used in motor controls to interpret control circuit schematics. AC and DC electrical theory will be applied. Second, variable speed drives will be explored, with competencies included for how they need to be installed, inspected, maintained and repaired. Third, a basic review of mechanical principles commonly used by utilities will support apprentices with installing, operating, and maintaining substations. Power transmission systems will be compared and applications to substations will be emphasized. Finally, fluid power systems will be introduced including both pneumatic and hydraulic applications. Substation equipment applications commonly found in the field will be discussed. Competencies related to installing, maintaining, inspecting, testing, and repairing fluid power systems will be emphasized.

Total Credits 1.00

Course Competencies

- 1 Illustrate the roles of DC generators on substations
- 2 Illustrate the roles for DC motors on substations
- 3 Compare the roles for alternators on substations
- 4 Compare the applications of three-phase motors on substations
- 5 Compare the applications of single-phase motor use on substations
- 6 Explain motor control principles as applied on substations
- 7 Explain the applications for variable speed drives on substations
- 8 Identify mechanical systems found on substations
- 9 Apply power transmission systems to the job duties of substation electricians
- 10 Apply the principles of pneumatic systems
- 11 Analyze pneumatic circuits using a diagnostic and troubleshooting approach
- 12 Apply the principles of hydraulic systems
- 13 Analyze hydraulic circuits using a diagnostic and troubleshooting approach
- 14 Identify substation fluid power system equipment and components
- 15 Develop procedures for inspecting, testing, maintaining, and repairing substation fluid power systems

and components



Wisconsin Technical College System

50-468-506 Substation Power System Basics

Course Outcome Summary

Course Information

Description Apprentices will explore electrical power systems with a focus on competencies which support installing, operating, maintaining, and repairing substation equipment and components. Course will apply electrical theories learned in previous coursework to electrical power systems. Substation equipment and components will be introduced. Coordination of different power systems and contingency planning is addressed. Course reinforces electrical safety, print reading, and 3-phase electricity.

Total Credits 2.00

Course Competencies

- 1 Apply motor and generator concepts to power systems
- 2 Maintain motors or generators used in substations
- 3 Troubleshoot motors, motor controls and variable speed drives
- 4 Explore electrical utility generation, transmission, and distribution systems
- 5 Identify equipment and circuit protection devices found in substations and switchyards
- 6 Compare high voltage switching equipment and procedures
- 7 Analyze high voltage controls, grounding and surge arrestors
- 8 Interpret power grids, one-line diagrams, and per unit systems
- 9 Maintain power transformers and related equipment
- 10 Describe power system protection techniques to control outages and minimize interruptions in service
- 11 Classify electrical power system faults
- 12 Compare power system relays and protective devices
- 13 Examine power system instrument transformers
- 14 Compare high voltage terminations used for various power systems
- 15 Summarize work processes for electrical power systems and substations

Wisconsin Technical College System

50-468-507 Substation Equipment Maintenance & Testing

Course Outcome Summary

Course Information

Description Apprentices will explore critical substation equipment from an assembly, installation, inspection, maintenance, testing, repair and service viewpoint. Topics covered will include circuit breakers, transformers, voltage regulators, capacitors, protective relays, and cable systems. In addition, oil pumps, rotating machinery, inverters, battery systems, and other equipment will be discussed. Learning activities will include classroom activities, shop skills development, hands-on training on a substation training center, and videos with workbooks.

Total Credits 2.00

Course Competencies

- 1 Compare station types, functions, and engineering design elements
- 2 Monitor substation construction and the assembly of components and structures according to prints, plans, and standards
- 3 Evaluate maintenance strategies for substation equipment, controls and components
- 4 Monitor substation operations
- 5 Test substation equipment devices
- 6 Inspect substation installations and equipment and manage physical security
- 7 Repair and replace substation equipment
- 8 Compare substation facility and control building service requirements
- 9 Support commissioning of new installations and equipment
- 10 Examine preventative and predictive maintenance
- 11 Follow best work practices for arc hazard safety and fire protection
- 12 Follow best work practices involving insulating oils, fluids, and gases
- 13 Maintain oil systems
- 14 Monitor battery systems
- 15 Maintain high voltage switching equipment
- 16 Maintain ground grids and grounding systems
- 17 Maintain transformers
- 18 Maintain capacitor banks and shunt reactors
- 19 Maintain cable systems, terminations, and accessory equipment
- 20 Respond to system faults and maintain quality power systems

Wisconsin Technical College System

50-468-508 Substation Relays & Protective Relaying

Course Outcome Summary

Course Information

Description In term 6 of related instruction, substation apprentices will examine substation protection and protective devices. Competencies will include examining protective relays, bus protection schemes, various power system protective devices, and planning overcurrent protection. A review of substation equipment protection will be explored. This course is designed for two 40-hour block schedules during the semester.

Total Credits 2.00

Course Competencies

- 1 Apply basics of electrical theory and basic power systems to relays
- 2 Examine fundamentals of protective relays and common relay protection systems
- 3 Identify protective relays, devices and equipment commonly found in a substation
- 4 Summarize technology shifts from electro-mechanical systems to digital communications and logic systems
- 5 Compare electric utility practices related to relay testing
- 6 Record relay testing results according to employer accepted work practices and industry standards
- 7 Apply digital logic principles to protective relays
- 8 Develop test plans for protective relays
- 9 Test relays, document results, and prepare final reports
- 10 Interpret maintenance testing programs for protective relays and protection equipment
- 11 Develop plans for overcurrent protection using devices and installations which comply with electric utility codes and regulations
- 12 Summarize protection of substation equipment (including generators, capacitor banks, shunt reactors, bus, motors, lines, and circuits)

Wisconsin Technical College System

50-468-509 Substation Instrumentation & Controls

Course Outcome Summary

Course Information

Description Apprentices in the seventh term of related instruction will examine substation automation, instrumentation, and controls. This course covers typical functions provided in electric utility substation automation systems, equipment and component interfaces, substation communication protocols, SCADA systems and PLC. Competencies are designed around the roles and responsibilities commonly expected by journey level work and substation communication, control and automation. This course is formatted for two 1-week block schedules of 40 hours per block. Week 1 focuses on theory, concepts, and terminology. Week 2 emphasizes job duties and tasks substation electricians will face in the field.

Total Credits 2.00

Course Competencies

- 1 Summarize power system automation terminology and communication requirements
- 2 Examine engineering design principles related to substation integration, automation and communication
- 3 Compare SCADA systems and components
- 4 Identify control system elements associated with SCADA
- 5 Analyze how remote terminal units (RTUs) function
- 6 Summarize RTU and MTU communication strategies
- 7 Summarize SCADA server and MTU operational principles
- 8 Examine operator interfaces
- 9 Explore the limitations and security implications for remote control
- 10 Evaluate the application of different SCADA systems to substations and electrical power systems
- 11 Apply microprocessor engineering design principles to substation automation
- 12 Observe substation monitoring and control from the control and communications center
- 13 Identify automation safety and PPE requirements when working on or near equipment and controls
- 14 Identify SCADA interfaces, reclosers, bus and transformer differentials and related relays on substations
- 15 Summarize SCADA work processes related to installing, operating, and collecting and analyzing data
- 16 Summarize SCADA work processes related to inspecting, maintaining, troubleshooting, and service/repair

Wisconsin Technical College System

50-468-510 Substation Capstone Project: Construction, Installation, Testing, & Maintenance

Course Outcome Summary

Course Information

Description This CAPSTONE course (and project) involves hands-on skill demonstrations with the college's substation. Knowledge, skills, and abilities important to the trade and role of substation electricians will be demonstrated in a semester long project that ties together concepts taught throughout the apprenticeship. Apprentices will review the four phases of a substation: construction, commissioning, testing, and maintenance as they work on a substation training center. Daily team meetings will organize work priorities, communicate project developments and resolve challenges as a group. A project scope scenario will be developed by the instructor(s) for apprentices to respond to during the course. The scenario may involve an engineering design change, new equipment installation, station upgrade, or other project suggested by utilities. The competencies listed in this course outcome summary outlines the general process apprentices MAY use to respond to the scenario and these can vary from group to group based on the scenario selected. Learning objectives listed here have been taught in previous coursework and/or during on-the-job learning, and will be applied to the capstone project. Detailed project documentation will be developed by the apprentices and submitted to the instructor for review and feedback. Apprentices will be expected to work together, organize duties, delegate responsibilities, manage their time, and follow through.

Total Credits 2.00

Course Competencies

- 1 Respond to a scenario simulation involving substation engineering design changes, station upgrades, commissioning new equipment, or other capstone project recommended by employers
- 2 Interpret project documents
- 3 Analyze drawings, schematics, and technical information
- 4 Apply electrical theory and technical concepts to the project
- 5 Recommend a plan of work
- 6 Organize work teams and work processes
- 7 Install new devices according to specifications
- 8 Wire equipment per industry standards
- 9 Verify your work with qualified individuals
- 10 Test substations, equipment, and devices properly
- 11 Commission equipment following standard practices
- 12 Follow safety rules and regulations
- 13 Adhere to industry standards and generally accepted work practices
- 14 Produce written documents required for the trade
- 15 Use computers and software effectively