



**Bismarck State College**  
**National Energy Center of Excellence**  
**Substation Electrician Apprenticeship Program**

**APP 109 – Safety I**

This course covers the general safety practices and information employees need while working in any segment of the electrical industry, and the Federal Agencies responsible for insuring a safe working environment. Students will also gain an understanding of the Workers Right to Know regulations and awareness of Public Safety issues.

**TPC 204 – Electrical Measuring Instruments**

Covers the principles on which electrical test instruments operate. Basic instruments covered include voltmeter, ammeter, wattmeter, ohmmeter, and megohmmeter. Covers AC metering, split-core ammeter, use of current and potential transformers. Includes detailed coverage of modern multimeters. Explains functions and uses of oscilloscopes.

**TPC 280 – Safety Calibrations and Testing Procedures**

Covers the responsibilities of employer, employee, and regulatory agencies in maintaining safety. Discusses ways of identifying and handling chemical, electrical, biological, radiation, and mechanical hazards. Discusses importance of maintenance (including calibration) and proper record keeping. Describes use of common electrical and electronic test instruments. Offers guidelines for handling heavy equipment, decontaminating and servicing pneumatic and hydraulic equipment, and troubleshooting.

**TPC 307 – Basic Hydraulics**

Covers hydraulic principles, types of hydraulic fluids and their characteristics. Describes components of the hydraulic system and their functions, including filters and strainers, reservoirs and accumulators, pumps, piping, tubing and hoses, control valves, relief valves, and actuating devices. Covers a variety of cylinders and hydraulic motors.

**TPC 309 – Basic Pneumatics**

Covers how work, force, and energy are applied to principles of pneumatics. Shows operating principles of reciprocating, positive displacement, rotary, and dynamic air compressors. Covers primary and secondary air treatment. Includes valves, logic devices, cylinders, and air motors.

**APP 150 – Reading Electrical Diagrams I**

This course gives students an introduction to the different schematics used in power plant operations and electrical transmission and distribution systems. Students will gain an understanding of the standard symbols used in the various systems schematics and how to read them. Students learn how to read basic piping and instrumentation diagrams, and how to interpret single line electrical diagrams. Students finish the course by studying electrical system diagrams beginning at the generator and following through to the distribution system.

**APP 151 – Reading Electrical Diagrams II**

This course covers advanced electrical prints used to navigate complex electrical systems and feeder maps. Students also study schematics that are used when working with electronic systems and system instrumentation that is used to control and monitor the flow of electricity through the electrical system. Students also learn to use the diagrams to troubleshoot system problems and to safely isolate sections of the electrical system.

**APP 120 - Troubleshooting and Emergency Repair of DC Systems and Equipment**

The course provides a basic understanding of how to locate problems in DC systems and equipment and make temporary repairs. Particular emphasis is placed on industrial DC systems, subsystems, units, and components commonly in use.

**APP 119 - Troubleshooting and Emergency Repair of AC Systems and Equipment**

This course provides a basic understanding of how to locate problems in AC systems and equipment and make temporary repairs.

**TPC 210 - Developing Electrical Troubleshooting Skills**

Covers use of schematic diagrams, determining sequence of operation, and use of building diagrams and single-line diagrams. Includes troubleshooting procedures for control circuits and combination starters. Explains troubleshooting practices on DC and AC motors, identifying unmarked leads on three-phase delta and Y-connected motors, and troubleshooting lighting systems.

**TPC 202 – Storage Batteries and Chargers**

Covers how electrochemical action is used. Covers batteries, electrolytic action, electroplating, Characteristics of storage batteries, application and maintenance of lead-acid, nickel-alkaline, and nickel-cadmium batteries, putting batteries into service, charging batteries, maintaining records, fundamentals of DC circuits, and using Ohm's Law to solve problems in DC series, parallel, and series-parallel circuits.

**TPC 308 – Hydraulic Troubleshooting**

Covers understanding the systems, using schematic diagrams, installation procedures, cleanliness and safety. Includes tubing cutting, bending, and flaring, identification and selection of proper fluid, and charging the system. Discusses planned maintenance, specific repair/replacement recommendations, system diagnosis, and troubleshooting.

**TPC 310 – Developing Pneumatic Troubleshooting Skills**

Covers pneumatic systems, schematic symbols and diagrams, installing system components, planned maintenance, system diagnosis, and troubleshooting. Includes maintenance of air compressors, control valves, air motors, electrical components, and hybrid systems.

**TPC 252 – Power Supplies**

Covers the four basic kinds of power supply conversions. Explains how to work with nonchemical cells as well as primary and secondary cells of various materials. Describes in detail the functions and operation of several kinds of rectifiers, filters, and voltage regulators and explains how they work together as power conditioners. Discusses basic tools, test devices, and procedures for troubleshooting to solve the greatest number of problems in the least amount of time.

**TPC 207 – Operating and Maintaining One Phase Motors**

Covers the types and operating principles of common single-phase motors. Explains NEMA motor standards. Explains how to identify motor leads on split-phase, capacitor-start, capacitor-run, permanent split capacitor, and repulsion motors. Also covers universal motors, shaded-pole motors, and other special types, including synchro and servo systems. Gives general maintenance procedures on all single-phase motors.

**TPC 208 – Operating and Maintaining Three Phase Systems**

Covers three-phase motor principles for induction, synchronous, and multi-speed dual-voltage motors. Gives recommended maintenance practices for large AC motors. Covers principles of three-phase motor starters, part winding, reversing, jogging, alternator principles and operation. Describes three-phase power distribution.

**TPC 209 – Understanding Basic AC Control Equipment, Synchronous Motor and Controller Maintenance**

Covers the broad range of industrial motor starting and control equipment, including NEMA sizes and ratings. Includes pushbutton control stations, limit switches, mercury switches, mechanical and magnetic plugging, foot switches, and pressure, temperature, and float switches. Covers control panel wiring and special applications.

**TPC 205 – Electrical Safety and Protection**

Examines electrical hazards and stresses the importance of electrical safety. Covers the equipment and procedures necessary to work safely with electricity, including PPE, lockout/tagout, and first aid. Explains the importance of grounding. Describes many kinds of fuses, circuit breakers, and motor protection devices and their uses.

**TPC 206 – DC Equipment and Controls**

Covers DC power applications in industry, types of DC generators, operating characteristics of DC motors, DC armature principles, and armature maintenance and repair. Includes types of DC relays, DC controllers, overspeed and overload protection, drum and reversing controllers, dynamic braking, DC power supplies, diodes, semiconductors, SCR principles, and DC maintenance practices.

**TPC 262 – Examining Application I/O Devices**

Covers many of the input/output devices that make up a typical computer system. Explores communication-the successful transmission of information between computers-at length. Discusses both the user/machine interface and the machine/machine interface, as well as the various network configurations. Concludes with two "real-world" examples of how microprocessors are connected to I/O devices.

**TPC 267 - Examining System I/O Devices**

Covers more fully many of the input/output devices introduced in Course 262. Describes various magnetic and optical memory devices, including tapes, disks (hard and floppy), and CD-ROMs. Explains how signals are converted from analog form to digital form, and vice versa. Covers data acquisition systems and common digital transmission standards. Defines the error detection techniques used to ensure the accurate transmission of digital data. Describes various types of digital transmission equipment, such as modems and fiber optics. Concludes with a practical application that combines all of the principles presented in previous lessons.

**TPC 298 – Programmable Logic Controllers**

Prepares technicians to take full advantage of vendor training on specific equipment. Covers the basic operating principles of all PLCs, their inputs and outputs, programming, maintenance, and networking.

**TPC 431 – Introduction to Air Conditioning and Refrigeration**

Introduces the basic concepts needed for an understanding of refrigeration. Traces the basic refrigeration cycle. Explains the concepts of heat, temperature, humidity, dewpoint, enthalpy, and simple psychrometrics. Concludes with a lesson on the tools and instruments needed for refrigeration servicing and safe work practices.

**TPC 437 – Control Systems for AC and Refrigeration**

Introduces the need for control, control methods, and system basics. Includes information on self-powered, pneumatic, hydraulic, electric, and electronic systems. Covers various sensors and controlled devices. Covers the basics of two-position, floating, and proportional control systems and their maintenance and troubleshooting. Discusses the various processes requiring control in a refrigeration or air-conditioning system.

**TPC 439 – Troubleshooting Air Conditioning Systems**

Discusses the keys to effective troubleshooting and emphasizes the importance of safety. Details a step-by-step procedure to use when troubleshooting. Covers the use of a troubleshooting flowchart. Examines three sample problems, leading the trainee through the steps necessary to locate the problem in each example.

**APP 153 – Transformer Maintenance**

This course begins with a review of basic transformer design and operation. Students will study 3-phase transformers, single phase loads for 3-phase transformers, and the different connections used in such transformers. The course introduces students to installation procedures and maintenance procedures.