



**Bismarck State College
National Energy Center of Excellence
Electrical Maintenance Technician
Apprenticeship Program**

TPC 111 – How Power Plants Work

Covers the basic steam generation system, how thermal energy is converted into electrical energy, components of the system, and design features for gaining thermal efficiency. Includes handling of water, fuel, and wastes, and the operating features of a power plant.

TPC 112 – Generating Steam in the Power Plant

Covers energy principles and boiler maintenance. Explains coal, oil, and natural gas combustion, and how to conserve energy through improved combustion control.

TPC 113 – Using Steam in the Power Plant

Covers how to conserve energy in turbines, auxiliaries, electric power generation, and air conditioning systems.

TPC 101 - Blue Prints

Covers all types of blueprints used in industrial plants. Discusses machine parts and machine drawings. Features drawings of a compound rest and a clutch-brake control. Examines hydraulic, pneumatic, piping, plumbing, electrical, air-conditioning, and refrigeration drawings. Introduces sketching used in industrial plants.

TPC 102 - Reading Schematics and Symbols

Covers all types of schematics and symbols used in commercial and industrial settings. Examines symbols on schematics, electrical symbols and diagrams, piping symbols and diagrams, hydraulic and pneumatic diagrams and symbols. Discusses air conditioning and refrigeration systems, including explanations of electrical/electronic control schematics. Covers welding and joining symbols.

TPC 202 – Batteries and DC Circuits

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 203 - Transformers and AC Circuits

Covers differences between DC and AC circuits. Explains AC sine wave, using vectors to solve AC problems, calculating impedance in circuits having inductance, capacitance, and resistance, AC power relationships in single-phase and three-phase circuits, and principles of transformer maintenance.

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 205 - Electrical Protective Devices

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 Control

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 207 – Single 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 – Three Phase System

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 – AC Control Equipment

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 210 – 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 280 - Safety, Calibrations and Testing

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 251 – Semiconductors

Covers the theory behind semiconductor operation. Describes the characteristics and operation of various diodes and transistors. Stresses the importance of proper environmental conditions and explains how to minimize electrostatic discharge (ESD) and radio frequency interference (RFI). Discusses printed circuit board (PCB) and integrated circuit (IC) technology, including connection and replacement methods. Identifies kinds of semiconductor packages. Explains how to interpret manufacturers' spec sheets and how to analyze circuit performance by Q points and characteristics.

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 253 – Amplifiers

Covers the effects of gain, bandwidth, and distortion on amplifier performance. Compares linear and nonlinear (switching) amplifiers. Explains how to use transistor curves to analyze amplifier operation in terms of operating regions, load lines, operating (Q) points, and biasing. Discusses impedance matching and compares capacitive, transformer, and direct-coupled amplifiers. Describes many ways op amps are used today, including integrators and comparators. Provides specific methods for troubleshooting common amplifier problems.

TPC 254 – Oscillators and Waveforms

Covers how oscillation is started and maintained. Compares LC (tuned), RC (phase-shift), and crystal oscillators. Compares sine-wave oscillators and square-wave switching circuits. Discusses monostable, astable, and bistable flip-flop operation in detail and shows expected waveforms. Explains how logic clocks are generated and conditioned. Discusses Schmitt trigger circuits, frequency dividers, and ripple counters, as well as propagation delays and glitches. Describes the operation of low-pass, high-pass, band-pass, and band-reject filters, including differentiators and integrators. Describes the equipment and procedures for troubleshooting oscillator components and circuits.

TPC 283 – Data Transmission

Covers mechanical, hydraulic, pneumatic, and telemetric data transmission methods. Discusses indicators, other devices, and methods used for electrical/electronic data transmission in detail. Compares methods and standards for parallel and serial digital data transmission. Describes optical isolation and the operation of optical data transmission systems in detail. Provides specific methods for preventing common kinds of data transmission interference.

TPC 304 – Bearings

Covers principles and applications of various types of bearings, including plain journal, ball, and roller bearings. Explains installation, inspection and repair of bearings. Deals with specialized bearings, including powdered-metal, nonmetallic, and hydrostatic bearings. Covers bearing seals, lubrication, and maintenance practices.

TPC 343 – Installation and Replacing Bearings

Covers plain bearings, their parts, dimensions, functions, and relining techniques. Continues with installation and replacement of antifriction bearings. Also covers linear motion bearings and shaft seals.

TPC 318 - Industrial Rigging

Covers techniques and safeguards in the use of rope, chain, hoists, and scaffolding when moving heavy plant equipment and maintaining plant utilities.

TPC 431 - Refrigeration Cycle

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 432 - Refrigeration Oils

Covers the physical properties of refrigerants, including pressure-temperature relationships. Discusses various kinds of refrigerant and their safe handling. Examines the effects of refrigerants on the atmosphere and related EPA requirements. Discusses filters, driers, leak detection equipment, gauge manifold set. Explains system charging, evacuation and dehydration, refrigerant recovery/recycling, and oil maintenance and servicing.

TPC 433 – Compressors

Explains the function of the compressor in a refrigeration system. Introduces information on the construction and use of reciprocating, rotary, helical, scroll, and centrifugal compressors. Covers compressor motors, control, and protection. Concludes with a lesson on preventive maintenance for compressors as well as troubleshooting and repair.

TPC 434 – Air Conditioning and Refrigeration Evaporators

Explains the function and construction of evaporators. Covers direct-expansion, dry-expansion, and flooded evaporators, as well as systems using multiple evaporators. Discusses ways to boost evaporator performance. Explains evaporator defrosting, maintenance, and troubleshooting. Describes the function, operation, and maintenance of various metering devices, including hand-operated, automatic, thermostatic, thermal-electric devices.

TPC 435 – Condensers and Cooling Towers

Covers the function, construction, and operation of both air- and water-cooled condensers and related devices. Discusses cooling towers and spray ponds, including maintenance and troubleshooting. Includes a lesson on evaporative condensers. Concludes with a discussion of water-related problems and how to solve them.

TPC 436 – Air Conditioning and Piping Systems

Examines piping system materials and sizing. Includes coverage of codes, valves and fittings, and the cutting and joining of piping and tubing. Explains the function and unique requirements of the discharge line, liquid line, and suction line. Concludes with a lesson on piping system maintenance, including handling dirt and scale, expansion, vibration, corrosion, and leaks.

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 438 – Air Handling Systems for AC

Begins with coverage of airflow basics, including how air moves, types of airflow, and pressure relationships. Compares and contrasts various types of fans and fan motors. Examines types of ducts, fittings, connections, insulation, and terminal devices. Covers various methods of cleaning and filtering air, as well as balancing and troubleshooting the air-handling system. Concludes with a lesson on indoor air quality and sick building syndrome.

TPC 439 – System Troubleshooting

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.

TPC 261 – Intro to Computers

Covers a brief history of the computer and defines fundamental computer terms. Introduces the binary and hexadecimal number systems. Explains the different levels of programming languages. Describes microprocessor characteristics and architecture in general terms. Concludes with examples of practical applications.

TPC 262 – Input/Output 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 266 – How Computers Function

Covers the function and basic operation of each major element of a microprocessor. Explains the structure and purpose of various computer buses. Examines characteristics of different types of main memory in detail. Includes in-depth discussion of both low- and high-level computer languages.

TPC 267 – Input/Output Devices II

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 291 – Digital Logics Systems

Covers the comparison of analog and digital switching circuits. Explains Boolean logic functions. Describes TTL and CMOS logic, as well as IC logic devices. Explains how flip-flops, clock circuits, counters, multiplexers, and memory circuits work. Describes the sections and interfaces in functional logic systems, including microprocessors. Describes proper methods for detection and correction of common fault potentials.

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 268 – Servicing Computer Systems

Covers the maintenance of microprocessor-based equipment, including preventive maintenance. Describes diagnostic procedures and takes a "hands-on" look at many types of test equipment, including oscilloscopes, logic analyzers, and in-circuit emulators. Emphasizes the importance of thorough documentation in all areas. Discusses general troubleshooting guidelines and covers troubleshooting aids and accessories.