

**Course Description****ETP1220 | Power Plant Fundamentals | 2.00 credits**

This course is designed to familiarize students preparing for careers in electrical power technology with the fundamental knowledge of power plants and their operations. Students will learn how power plants operate, as well as general administrative procedures for completing routine tasks.

**Course Competencies**

**Competency 1:** The student will demonstrate an understanding of electrical power production and distribution by:

1. Describing the basic process of how a nuclear reactor produces electricity
2. Identifying the major systems of the nuclear reactor used to produce electricity
3. Explaining how electricity is distributed
4. Explaining the general organization of a nuclear power plant facility
5. Describing how electricity is distributed into the power grid

**Competency 2:** The student will demonstrate a basic understanding of the role and responsibilities of the maintenance technician in the nuclear power plant by:

1. Discussing the duties of a maintenance technician
2. Distinguishing between the electrical, mechanical, and instrumentation and control maintenance functions
3. Explaining the general maintenance process, including identifying, diagnosing, and repairing system and component problems; general administrative procedures and policies; safe handling of materials, parts, components, and systems
4. Describing the administrative controls for performing local and manual operation of components during maintenance activities
5. Explaining the limitations of and requirements for maintenance activities associated with environmentally qualified and safety-related components and equipment

**Competency 3:** The student will demonstrate an understanding of basic mechanical components by:

1. Identifying types of valves and dampers
2. Discussing the limitations of different valve types
3. Explaining the lubrication principles associated with components, including the problems associated with improper lubrication
4. Explaining the construction, function, and operation of strainers, filters, and traps, including demineralizers, screens, and centrifuges
5. Describing the types of steam traps (such as lever-operated, piston-operated, and float-operated) and their applications

**Competency 4:** The student will demonstrate a basic knowledge of mechanical equipment used in the power plant by:

1. Describing the theory, construction, and application of diesel engines including: accessories/support systems, failure mechanisms and systems, main structural components, main moving components, principles of operations
2. Explaining the theory, construction, and application of rotating equipment including motors, generators, and motor-generators
3. Discussing the theory, construction, and application of structural and auxiliary equipment
4. Discussing the basic operation and rescue methodology of elevators
5. Describing the type and operations of hangers and snubbers for support and restraint and the different types of water hammer (including water slug, valve slam, column rejoining, and condensate induced)
6. Explaining the operations and applications of manual and electric hoists and cranes
7. Distinguishing between electric, gas-fired, and fuel-oil-fired boilers and explaining their basic construction function, and how they operate
8. Describing the construction and application of fire barriers including how to identify barrier degradation

9. Explaining the principles, types, and uses of pumps, ejectors, and educators, to include: the requirements of minimum flow and effects of dead-heading pump; the causes and indications of cavitation and how to prevent it

**Competency 5:** The student will demonstrate a basic understanding of electrical control components by:

1. Describing the theory, construction, and application of resistive electrical equipment (including heaters and the reasons for using heat tracing)
2. Describing the theory, construction, and application of electrical supply components, including: switchgear, load centers, and motor control centers (such as protective relaying and schematics of a basic system from high voltage to lower voltage); transformers (such as step-up transformers and step-down transformers, winding configurations); inverters and uninterruptible power supplies; circuit breakers (such as protection); batteries and chargers
3. Describing the theory, construction, and application of electrical control components, including: relays (such as schematics to show operation of relays that energize to actuate, time delay energize, and time delay de-energize); meters (such as voltage and current and how a change in meter indication could indicate circuit degradation of a change in process (pump discharge valve opened for increased flow)); control circuits (such as proportional, integral, and derivative or a combination thereof); cables (such as routing for train separation and methods of fire detection/protection for cables/cable trays)
4. Differentiating between various valve actuator types e.g., motors, pneumatic, hydraulic and describing their uses and operation, including the impact of environmental conditions
5. Describing the theory and application of electronic equipment such as analyzers and signal converters

**Competency 6:** The student will demonstrate a basic understanding of the function and operation of heating, air conditioning, and ventilation systems in the power plant environment by:

1. Describing the theory, construction, and application of heat exchangers (such as cross-flow, counter-flow, and parallel flow)
2. Explaining the purpose, construction, and operation of steam condensers and steam generators (U-tube and once-through)
3. Explaining the process of heat transfer across the heat exchanger
4. Identifying indications of heat exchanger fouling
5. Discussing the function, construction, and operation of air compressors, including rotary, reciprocating, and centrifugal
6. Explaining the basic components, functions, and operations of air conditioning and refrigeration systems in the power plant

**Competency 7:** The student will demonstrate knowledge of the role and history of nuclear energy production by:

1. Researching and reporting on major milestones and developments in nuclear power energy production.
2. Identifying and discussing key issues concerning nuclear power, including social, economic, environmental, and political
3. Summarizing basic information about major industry operating experience, including the events and lessons learned from: Three Mile Island Nuclear Station accident, Chernobyl Nuclear Power Plant accident, Salem Generating Station turbine blade throw, Browns Ferry Nuclear Plant fire, Idaho Falls stuck rod accident, Davis-Besse Nuclear Power Station event

**Competency 8:** The student will demonstrate an understanding of general radiological controls and policies affecting nuclear plant operations by:

1. Describing the sources of radiation, the basic types of radiation found in a nuclear plant and their characteristics, and explaining the risks associated with radiation
2. Stating the federal and plant administrative limits on radiation dose
3. Explaining the basic methods to minimize radiation exposure
4. Describing how to use dosimeter devices to monitor dose and to respond to dosimetry problems
5. Describing the methods to minimize the probability of becoming contaminated, spreading contamination to clean areas, or contaminating other workers while working in a contaminated area or with contaminated equipment
6. Describing how contamination can enter the body, how to detect internal contamination, how to eliminate internal contamination from the body, and what measures can reduce internal dose

7. Explaining how to interpret and apply information found in a radiation work permit (RWP) to a task in a radiological area
8. Describing the proper methods for breaching systems, including applicable radiological exposure and contamination controls
9. Recognizing and interpreting the plant radiological postings.
10. Recognizing and responding to radiological alarms
10. Explaining the importance of and the methods used for minimizing the generation of radioactive waste
11. Explaining individual rights and responsibilities regarding working within radiological areas
12. Showing how to wear protective clothing, enter a radiologically contaminated area, remove tools, and exit the radiological area in accordance with plant procedures

**Competency 9:** The student will demonstrate understanding and use of schematics, blueprints, and other plant drawings in a maintenance setting by:

1. Identifying the various types of plant drawings and demonstrating their use, such as electrical schematics and piping/instrument drawings
2. Identifying and explaining the various symbols used on drawings
3. Interpreting schematic drawings
4. Explaining and interpreting the coding system for drawing numbers
5. Explaining and interpreting the coding system for plant equipment
6. Discussing the importance of the station configuration control program and the purpose of using controlled drawings

**Competency 10:** The student will demonstrate an understanding of communication practices in power plants by:

1. Describing the types of communication systems and equipment used by maintenance personnel in a power plant environment
2. Demonstrating the method for conducting clear and concise communication when using plant communication equipment and when conducting face-to-face communication in accordance with plant standards
3. Describing the use and restrictions of communication systems and equipment to accomplish the following: directing work activities, performing test procedures, accomplishing emergency communications, explaining how to contact key personnel, including the following: shift supervisor and control room operators, work supervisor, quality control personnel, fire response and first-aid personnel, radiological protection personnel, security personnel, emergency personnel (e.g., technical support center personnel)
4. Discussing lessons learned from actual plant and industry experience where improper communications adversely impacted the performance of maintenance jobs

**Competency 11:** The student will demonstrate an understanding of general plant knowledge and station policies by:

1. Identifying the function of station departments
2. Stating company policies when working in the station
3. Describing the layout of the major plant buildings and how the plant basically operates
4. Describing basic station industrial safety policies, including identifying and reporting workplace hazards
5. Describing how to minimize the potential for causing a fire and how to properly respond to a fire should one occur
6. Explaining the purpose of the quality program, how the program is accomplished, and how to report quality-related problems
7. Stating how to enter and exit the plant and comply with plant security requirements
8. Describing how to respond to emergency plan activation
9. Describing the radiological restrictions placed on non-radiation workers and some of the basic risks associated with radiation
10. Describing the trustworthiness and reliability requirements for unescorted access to the protected area, discussing the importance of being fit for duty, discussing the potential consequences of substance abuse, and working in compliance with the station access authorization and fitness-for-duty policies
11. Explaining a supervisor's responsibility and recognizing individual behavioral changes which, if left unattended, could lead to acts detrimental to public health and safety

**Competency 12:** The student will demonstrate an understanding of maintenance work control by:

1. Discussing the purpose of instructions and how they are to be followed
2. Explaining the key elements of effective work instructions
3. Describing the conditions and situations that would require a revision to work instructions
4. Explaining how work instruction revisions are processed
5. Discussing the methods and importance of controlling system/equipment status during maintenance.
6. Discussing the consequences of improper work control and giving examples
7. Describing environmental equipment qualification control information and explaining the reasons for such controls
8. Describing the administrative controls and limitations associated with temporary modifications and providing examples.

**Competency 13:** The student will demonstrate an understanding of station procedures by:

1. Describing plant procedure use and adherence requirements (e.g., differences, if any, with words "shall," "should," and "may"; when verbatim compliance applies)
2. Explaining the purpose of and maintenance actions associated with the following types of procedures: administrative, operating (including abnormal and emergency), maintenance repair and replacement (including troubleshooting), surveillance and/or test, emergency plan
3. Describing the administrative control of procedures and the importance and purpose of using controlled procedures
4. Describing maintenance department personnel responsibilities for obtaining procedures to support maintenance activities

**Learning Outcomes**

- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information