

# RESOURCE 7

## Utility Industry Curricula

### Power Plant Engineer/Operator

This Utilities Industry specific skills curriculum provides trainees with the courseware that enables them to perform the tasks associated with a *Power Plant Engineer/Operator*. This print based curriculum has been developed to meet the subject requirements of either an apprenticeship or an organization's skills development program. When combined with on-the-job training, this program will provide trainees with the comprehensive skills and knowledge they will need to perform in this trade area.

The recommended Power Plant Engineer/Operator curriculum covers the primary skill needs for electric (including coal and fossil fuel plants), hydroelectric, steam, and nuclear power plant operations, and substation operations. The curriculum provides the mathematics background needed to understand the principles and operation of the machinery that generates electricity. Scientific, mechanical technologies, and electrical/electronics courses provide a technical foundation for understanding machinery and equipment operation/maintenance used in utilities. The training covers power plant machinery and equipment including generators, motors, switchgear, protective relaying, and electric power generation, transmission, and distribution.

This curriculum, as modified by custom assembling the appropriate courses, applies to utilities positions such as: Dispatcher, Generating Station Operator, Plant Relayman, and Power Plant General Instrument Mechanic. This training is appropriate for both entry level and experienced utilities employees.

Upon completion of this program, students will be able to:

- Perform calculations using algebra, trigonometry, and geometry.
- Understand the meaning of mathematical formulas as applied to mechanics.
- Understand the principles, components and measuring instruments associated with AC and DC electricity.
- Understand the operation and control of the common motors and generators found in utilities.
- Differentiate between distribution and power transformers by construction and application.
- Discuss the application of protective relays to protect motors, generators, buses and transformers.
- Understand the purpose and operation of the various equipment used in electric power generating stations.
- Describe the functions of the equipment used in power distribution stations.
- Explain the principles of operation of the various types of steam generators.
- Describe the methods used to regulate the voltage of distribution systems.

### Base Curriculum

Course Title	Course Number
<b>Pre-Technical Foundation Skills</b>	
Trades Safety: Getting Started .....	186001
Working Safely with Chemicals .....	186002
Fire Safety.....	186003
Material Handling Safety .....	186006
Basic Industrial Math.....	Block X21
Addition and Subtraction .....	186008
Multiplication and Division .....	186009
Fractions, Percents, Proportions, and Angles .....	186010
Metric System .....	186011
Formulas .....	186012
Introduction to Algebra.....	186013
Practical Measurements .....	Block X22
Linear and Distance Measurement .....	186021
Bulk Measurement.....	186022
Temperature Measurement .....	186023
Energy, Force, and Power .....	186024
Fluid Measurement .....	186025
Problem Solving and Troubleshooting .....	186073
Introduction to Algebra, Geometry, and Trigonometry.....	Block X02
Algebra: Monomials and Polynomials.....	X0201
Algebra: Factoring.....	X0202
Algebra: Addition and Subtraction of Fractions .....	X0203
Algebra: Multiplication and Division of Fractions .....	X0204
Algebra: Linear Equations.....	X0205
Algebra: Simultaneous Linear Equations.....	X0206
Algebra: Determinants .....	X0207
Algebra: Quadratic Equations.....	X0208
Algebra: Exponents .....	X0209
Algebra: Radicals and Imaginary Numbers .....	X0210
Applied Geometry .....	186085
Practical Trigonometry.....	186086
Working Safely with Electricity .....	4400
Quality Concepts: Tools and Applications .....	186036
Preventive Maintenance .....	286085
Preventive Maintenance Techniques.....	286086
Predictive Maintenance .....	286087
<b>Scientific Principles</b>	
Heat, Part 1 .....	686001
Heat, Part 2 .....	686002
Steam .....	2620
Elements of Chemistry.....	5011
Engineering Chemistry.....	5012
Heat Transfer .....	2545

**Power Plant Operating Principles**

Fundamentals of Power Plant Operation, Part 1 .....	786005
Fundamentals of Power Plant Operation, Part 2 .....	786006
Fundamentals of Power Plant Operation, Part 3 .....	786007
Power Plant Water Treatment, Part 1 .....	786008
Power Plant Water Treatment, Part 2 .....	786009
Power Plant Water Treatment, Part 3 .....	786010
Power Plant Station Power .....	786011
Power Plant Fuel Flow Paths, Part 1 .....	786018
Power Plant Fuel Flow Paths, Part 2 .....	786019
Power Plant Fuel Flow Paths, Part 3 .....	786020
Power Plant Steam Flow Paths, Part 1 .....	786021
Power Plant Steam Flow Paths, Part 2 .....	786022
Power Plant Steam Flow Paths, Part 3 .....	786023
Power Plant Auxiliary Equipment .....	786024
Power Plant Instrumentation Systems .....	786025
Power Plant Boilers and Related Equipment .....	786026
Conveyor Systems .....	786027
Combustion Turbines, Part 1 .....	786013
Combustion Turbines, Part 2 .....	786014
Combustion Turbines, Part 3 .....	786015

**Mechanical Technologies and Maintenance**

Pumps, Part 1 .....	286001
Pumps, Part 2 .....	286002
Pumps, Part 3 .....	286003
Pneumatics, Part 1 .....	286098
Pneumatics, Part 2 .....	286099
Pneumatics, Part 3 .....	286100
Air Compressors, Part 1 .....	286096
Air Compressors, Part 2 .....	286097
Bearings and Seals, Part 1 .....	286093
Bearings and Seals, Part 2 .....	286094
Lubrication, Part 1 .....	286091
Lubrication, Part 2 .....	286092
Mechanical Power Transmission Part 1 .....	286101
Mechanical Power Transmission Part 2 .....	286102
Mechanical Power Transmission Part 3 .....	286103
Mechanical Testing of Materials .....	2608A-B
Engineering Mechanics, Part 1 .....	286036
Engineering Mechanics, Part 2 .....	286037
Engineering Mechanics, Part 3 .....	286038
Engineering Mechanics, Part 4 .....	286039
Fluid Mechanics, Part 1 .....	286010
Fluid Mechanics, Part 2 .....	286011
Fluid Mechanics, Part 3 .....	286012

**Blueprint Reading**

Reading Prints and Schematics .....	Block X25
Introduction to Print Reading .....	186080
Print Reading Symbols and Abbreviations .....	186081
Dimensioning and Tolerancing .....	186082
Print Reading Applications .....	186083
Building Drawings .....	186043
Electrical Drawings and Circuits .....	186044
Electronic Drawings .....	186045
Hydraulic and Pneumatic Drawings .....	186046
Piping: Drawings, Materials, and Parts .....	186047
Welding Symbols .....	186048
Sheet Metal Basics .....	186049
Sketching .....	186050
Reading Shop Prints, Part 1 .....	386043
Reading Shop Prints, Part 2 .....	386044

**Electrical/Electronics Principles and Equipment**

DC Principles .....	Block A21
Nature of Electricity .....	086096

Circuit Analysis and Ohm's Law .....	086002
Capacitors and Inductors .....	086003
Magnetism and Electromagnetism .....	086004
Conductors, Insulators, and Batteries .....	086005
DC Motors and Generator Theory .....	086006
AC Principles .....	Block A22
Alternating Current .....	086007
Alternating Current Circuits .....	086008
Inductors in AC Circuits .....	086009
Capacitors in AC Circuits .....	086010
Transformers .....	086011
Alternators .....	086012
Electrical Energy Distribution .....	086013
Rectification and Basic Electronic Devices .....	086014
Analog Circuit Measurement .....	Block A23
Basic Test Equipment .....	086025
Troubleshooting with Volt-Ohm-Milliamp Meters (VOMs) .....	086026
Using Basic Oscilloscopes .....	086027
Electrical Safety for the Trades .....	186005
Electrical Equipment .....	Block A24
Conductors and Insulators in Industry .....	086070
Working with Conduit .....	086071
Electrical Boxes .....	086072
Industrial Enclosures and Raceways .....	086073
Connecting Electrical Equipment, Part 1 .....	086074
Connecting Electrical Equipment, Part 2 .....	086075
Industrial Fuses .....	086076
Industrial Circuit Breakers .....	086077
Plugs, Receptacles, and Lampholders .....	086078
Industrial Switches .....	086079
Industrial Relay Ladder Logic .....	086080
Industrial Relays, Contractors, and Solenoids .....	086081
Industrial DC Motors .....	086051
Industrial AC Motors .....	086052
Controlling Industrial Motors .....	086053
Electrical Grounding .....	086E01
Electrical Wiring Practices .....	086E02
Data, Voice, and Video Cabling .....	086E16
Component Testers .....	086062
Digital Test Equipment .....	086063
Electric Lamps, Part 1 .....	006031
Electric Lamps, Part 2 .....	006032
Electric Heating .....	006034

**Electric and Steam Power Generation Plants – Equipment Operation and Maintenance**

Types of Steam Turbines .....	2505
Steam Turbine Management and Governing .....	2506
Steam Turbine Calculations .....	2507
Pressure Vessel and Tank Print Reading .....	6691
Types of Steam Generators .....	6632
Steam Generator Design .....	2598A-B
Pressure Parts for Steam Generators .....	2588
Steam Generator Settings, Ducts, and Stacks .....	2587
Condensers .....	6553
Feedwater Treatment and Equipment .....	6727
Fuels .....	5340
Solid and Pulverized Fuel Burning .....	6473
Testing Solid and Liquid Boiler Fuels .....	6472
Oil and Gas Firing for Steam Generation .....	2592
Automatic Combustion Control .....	2596A-C
Flue Gas Analysis .....	6810
Steam Boiler Operation and Maintenance .....	6734
Steam Generator Testing .....	6802
Principles of the I-C Engine .....	2525

**Electrical Equipment Applications Used in the Utilities Industry – Operations and Maintenance**

Transformers.....4040  
 DC Machines.....4030A-B  
 Transformer Operation.....4041  
 Distribution and Power Transformers.....4042  
 Instrument Transformers .....6793  
 Storage Batteries .....4343  
 Electric Power Measurements.....4019A-B

**Transmission and Distribution of Electric Power**

Local Distribution of Electrical Power .....006038  
 Switchgear .....086092  
 Protective Relaying.....6538A-B  
 Telemetry.....4048  
 Voltage Regulators for Generators .....4368  
 Voltage Regulation of Distribution Systems.....4370  
 Electric Power Generating Stations .....6589A-B  
 Electric Power Substations .....6590A-B  
 Transmission Lines .....4358  
 Power Line Calculations .....6256  
 Underground Power Systems .....006039  
 Transformation for Lineworkers.....786E05  
 Underground Distribution for Lineworkers.....786E06  
 Electrical Power Distribution and Transmission for the  
 Technician .....786E01

Estimated Curriculum Duration: 1,655 hours.  
 Number of Exams: 202.

**Optional: Hydro-Electric, Nuclear Power Plant Operations**

Hydraulic Turbines .....6718A-C  
 Principles and Uses of Nuclear Energy.....6683

Estimated Duration: 40 hours.  
 Number of Exams: 4.