Course Title: Steam Plant Operation I

Course Prefix & No.: PROT 2320

LEC: 4.5    LAB: 0    Credit Hours: 4.5

COURSE DESCRIPTION:

Students learn the skills generally required for entry-level employment in a steam power plant. Topics include boiler theory, boiler design, boiler components and types, combustion systems, boiler accessories, boiler operation and maintenance, steam turbines, condensers and cooling towers, auxiliary steam plant equipment, and environmental control systems.

COURSE PREREQUISITE(S):

None

RATIONALE:

Industry representatives asked to have course work developed to introduce skills required for entry-level employment in the power industry.

REQUIRED TEXTBOOK(S) and/or MATERIALS:

Title: Steam Plant Operation
Edition: Current
Author: Woodruff and Lammers
Publisher: Mc-Graw-Hill

Title: Power Plant Operation I
Edition: Current (978-1-256-18682-3)
Author: NCCER (custom text)
Publisher: Pearson

Attached course outline written by: Bob Boyer __________________________ Date: June 2011
Reviewed/Revised by: Bob Boyer __________________________ Date: August 2018
Effective quarter of course outline: 18/FA __________________________ Date: ________________
Academic Dean Scott Broady __________________________ Date: December 11, 2018

Course Objectives, Topical Unit Outlines, and Unit Objectives must be attached to this form.
TITLE: Steam Plant Operation II  PREFIX/NO: PROT 2320

COURSE OBJECTIVES:

1. Students will be introduced to and develop an understanding of boiler design, boiler components and boiler fittings used in the power industry.

2. Students will be introduced to, and develop an understanding of the various types of combustion systems, equipment and processes found in a steam power plant.

3. Students will be introduced and develop an understanding of boiler accessories found in a steam power plant.

4. Students will be introduced to and develop an understanding of steam turbines, condensers, heat exchangers and cooling towers found in the power industry.

5. Students will be introduced to and develop an understanding of steam systems and auxiliaries found in the power industry.

6. Students will be introduced to and develop an understanding of environmental control systems found in the power industry.

TOPICAL UNIT OUTLINE/UNIT OBJECTIVES:

**Week One – Objective #1**

Students will be welcomed and introduced to the course syllabus and expected outcomes. Students will be introduced to boilers designed for use in the power industry.

Upon completion of this unit the student will be able to identify and describe various types of boilers used in the power industry including:

- Package Boilers,
- Waste Heat Recovery Boilers,
- Water Tube Boilers,
- Fire Tube Boilers,
- Fluidized Bed Boilers,
- and Supercritical boilers.
Week Two – Objective #1
Discussion will continue on various types of boilers from week one. Students will be introduced to the pressurized and non-pressurized components in the boiler.

Upon completion of this unit the student will be able to identify and describe the function of boiler pressure and non-pressure components, fittings and their location in the boiler including:

- Steam Drum, Mud Drum, Waterwall Tubes, Relief Valves, Economizer, Primary Superheater,
- Secondary Superheater, Windbox, Downcomers and Air Control Dampers

Week Three – Objective #2
Students will be introduced to, and develop an understanding of the various types of combustion systems, equipment and processes found in a steam power plant including the following:


Upon completion of this unit a student will:

- Describe the role air and oxygen play in the combustion process
- Describe the equipment and process required for the combustion of pulverized coal.
- Describe the equipment and process required for the combustion of fuel oil
- Describe the equipment and process required for the combustion of fuel gasses.

Week Four – Objective #3
Students will be introduced to the boiler accessories required to support a steam power plant.

Upon completion of this unit a student will describe and develop an understanding of the accessories required to support the boiler including:

- Auxiliary Boiler, Feedwater, Steam Generator Blowdown (Surface blow down), Boiler Drains, Deaerators, System Chemical Cleaning, External Water Treatment and Boiler Instrumentation
Week Five – Objective #4
Students will be introduced to the theory and operation of various steam turbines and condensers found in a power plant.

Upon completion of this unit students will be able to describe and explain the operation of various steam turbines, condensers, related systems and controls used in the power plant including:


Week Six – Objective #4
Students will be introduced to the cooling towers and heat exchangers found in the power plant.

Upon completion of this unit:

A student will explain the operation of the cooling towers and heat exchangers necessary for a power plant to operate efficiently.

A student will be knowledgeable about problems that can occur with heat exchangers and cooling towers.

Week Seven – Objective #5
Students will be introduced to the auxiliary steam and other systems required in operating a power plant.

Upon completion of this unit a student will understand the function of the auxiliary steam and auxiliary systems and equipment required for the operation of the power plant including:


Week Eight – Objective #1
Students will be introduced to various nuclear steam generators found in power plants

Upon completion of this unit a student will be able to explain the function of the components that make up BWR and PWR steam generators.

Week Nine – Objective #6
Students will be introduced to Environmental Control Systems found in the power industry.

Upon completion of this unit a student will demonstrate knowledge of the environmental concerns and instrumentation used monitoring power plant operations

Week Ten
Students will tour an operating power plant. This may be one tour or two or more tours during the course.

Week Eleven – Objective #6
Students will be introduced to Environmental Control Systems found in the power industry.

Upon completion of this unit a student will demonstrate knowledge of the systems equipment and procedures used in the power plant to address environmental concerns including:

- Identify and explain the operating principals of Ammonia Storage & Injection, Flue Gas Desulfurization (SDA), Reagent Receiving & Storage (Lime for SDA), Carbon Injection (Mercury Removal-Powder Activated Carbon which is injected into the flue gas right before the SDA), Continuous Emissions Monitoring System(CEMS), Baghouse, Precipitators, Fly Ash, Bottom Ash and slagging.

**COURSE REQUIREMENTS/EVALUATION:**

AAO Revised 3-13-01
### COURSE OBJECTIVES

**Students will be introduced to and develop an understanding of boiler design, boiler components and boiler fittings used in the power industry.**

Students will be able to identify and describe various types of boilers including:


Students will be able to identify and describe the following boiler pressure components and their location in the boiler:

- Steam Drum, Mud Drum, Waterwall Tubes, Economizers, Primary Super Heater, Secondary Super Heater, Windbox, Downcomers, etc.

Students will be able to identify and describe the following non-pressurized boiler components and their location in the boiler:

- Convection air heaters, regenerative air heaters and air control dampers

Students will understand the principals of forced and natural circulation in a boiler

**Students will be introduced to, and develop an understanding of the various types of combustion systems, equipment and processes found in a steam power plant.**

Students will be able to describe the function and operation of the following equipment:


Students will be able to describe the equipment and process required for the combustion of various fuels used in power plant boilers.

### ASSESSMENT MEASURES

Lecture and class presentations will be used to introduce material in this section.

Reading assignments and on-line research assignments will aid students in understanding the boilers, components and fittings used in power plants.

Working in small groups students will be given drawings and questions to use in identifying boilers, components and fittings.

As a group students will present material to the class.

The student is given an essay test over the drawings, group presentations and questions.
| Students will be introduced to and develop an understanding of boiler accessories found in a steam power plant. | Students will develop an understanding of boiler accessories required for safe boiler operation including:  
Auxiliary Boiler, Feedwater, Steam Generator Blowdown (Surface blow down), Boiler Drains, Deaerators, System Chemical Cleaning, External Water Treatment and Boiler Instrumentation | Lecture and class presentations will be used to introduce boiler accessories necessary for safe boiler operation  
Reading assignments and on-line research will aid students in understanding the material  
Working in small groups students will be given drawings and questions to use in identifying and understanding boiler accessories.  
Each group will present the results of the group project to the class.  
The student is given an essay test over the questions drawings and group projects. |
|---|---|---|
| Students will be introduced to and develop an understanding of steam turbines, condensers, heat exchangers and cooling towers found in the power industry. | Students will be able to describe the design and operation of various turbines, condensers, heat exchangers and cooling towers found in power plants  
Students will understand the various systems and equipment required for operating turbines, condensers, heat exchangers and cooling towers including:  
Circ. Water Makeup Treatment, Turbine Generator, Circ. Water, Turbine Drains, Turbine Control, Turbine Supervisory, Condensate Polishing, Condensate, Heater Vents and Drains, Condenser Evacuation, Lube Oil, Turbine Gland Seals and Drains, Low Pressure Heaters, High Pressure Heaters and Turbine Instrumentation. | Lecture and class presentations will be used to introduce steam turbines, condensers, heat exchangers and cooling towers  
Reading assignments and on-line research will aid students in understanding the material  
Working in small groups students will be given drawings and questions to use to develop a presentation on what they understand about steam turbines, condensers, heat exchangers and cooling towers.  
Each group will present the results of the group project to the class.  
The student is given an essay test over the questions drawings, and group projects. |
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<thead>
<tr>
<th>Students will be introduced to and develop an understanding of steam systems and auxiliaries found in the power industry.</th>
<th>Students will be introduced to and develop an understanding of environmental control systems found in the power industry.</th>
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<tr>
<td>Students will be able to describe the operation of the various steam systems and auxiliary systems required in operating a steam power plant. Including: Service Water, Raw Water, Potable Water, Demineralizers, Plant Heating, Plant Ventilation and other Auxiliary Steam Systems</td>
<td>Students will develop an understanding of environmental concerns in the operation of a steam power plant. Students will be able to describe the function and operation of various environmental control systems and procedures including: Ammonia Storage &amp; Injection, Flue Gas Desulfurization (SDA), Reagent Receiving &amp; Storage (Lime for SDA), Carbon Injection (Mercury Removal-Powder Activated Carbon which is injected into the flue gas right before the SDA) Combustion Gases Emissions (CEMS), Baghouse, Precipitators, Fly Ash, Bottom Ash and Slagging.</td>
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<td>Lecture and class presentations will be used to introduce auxiliary systems required for operating a power plant. Reading assignments and on-line research will aid students in understanding the material. Working in small groups students will be given drawings and questions to use in identifying and understanding auxiliary systems. Each group will present the results of the group project to the class. The student is given an essay test over the questions drawings and group projects.</td>
<td>Lecture and class presentations will be used to introduce environmental control systems found in power plants. Reading assignments and on-line research will aid students in understanding the material. Working in small groups students will be given drawings and questions to use in identifying and understanding environmental control systems and procedures. Each group will present the results of the group project to the class. The student is given an essay test over the questions drawings and group projects.</td>
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