

4 DAY SEMINAR

PRESENTED BY:

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STEAM SURFACE CONDENSER AND CLOSED FEEDWATER HEATER OPERATION, MAINTENANCE AND PERFORMANCE

Presentation Time: 13 sessions totaling 4 days

Reference Material: Each participant's text material will serve as a guide and will minimize the need for note taking. Background information, copies of diagrams, and relevant papers will be included in the text.

Lecture Abstract: The Steam Surface Condenser and Closed Feedwater Heater Seminar is conducted in a slide assisted lecture/ discussion format. The seminar instructors are highly experienced power plant heat exchanger engineers. The seminar content is directed towards plant engineers, results/performance engineers and plant operations/ maintenance supervisors. The intent of the seminar is to provide the participants with the necessary background information that is required to identify, evaluate, and correct condenser and feedwater heater performance, operation and maintenance problems. This information includes a review of the related heat transfer principles, and techniques for identifying mechanical failures and heat transfer deficiencies. The multiple choices of possible corrective actions that can be taken in each given are presented. Each seminar session is followed by discussions of the methods that are employed to select the optimum technical-economic corrective action, amongst all of the choices that were previously described.

This course also includes a session regarding the design of steam surface and fabrication of steam surface condensers, feedwater heaters and tubes. Since this topic is extensive two session time slots are devoted for session 4.

SEMINAR OUTLINE – 4 DAYS

STEAM SURFACE CONDENSER AND CLOSED FEEDWATER HEATER OPERATION, MAINTENANCE AND PERFORMANCE

SESSION 1 - Heat Transfer Principles For Steam Surface Condensers

This session material builds upon simple conduction through a solid plate of a homogeneous material and adds the complexity of evaluating heat transfer through a series of plates of different materials to demonstrate the analysis of multiple heat transfer resistances. In addition, circular geometry is discussed. This leads to the analysis of heat transfer in a heat exchanger tube. Temperature duty diagrams for the condensing phase are reviewed. The five resistances to heat transfer are identified and related to steam surface condenser rating methods.

SESSION 2 - Steam Surface Condenser Functions and Theory of Operation

The heat transfer principles of single tube condensing are applied to large tube bundles. Bundle design principles such as radial flow are discussed. The theory of tube bundle operation is reviewed. In addition, the functions of a steam surface condenser in today's power plants are identified.

SESSION 3 - Feedwater Heater Functions and Theory of Operation/Application

The functions of a feedwater heater are discussed. The types of feedwater heaters and the types of feedwater heaters zones are identified and advantages and disadvantages of each are discussed. The vent and drain system design practices are reviewed. Design practices for preventing turbine water induction are also identified.

SESSION 4 – Selected Heat Exchanger Design and Construction

Topics Include:

- Drawn Tube Fabrication
- Seam Welded Tube Fabrication
- Condenser Tubesheet Design
- Tube-to-Tubesheet Connections
- Impingement Baffles
- Zone Baffles
- Support Plates
- Bundle Arrangement

SESSION 5 - Fouling in a Steam Surface Condensers

Forms of macrofouling and microfouling in various environments are discussed. Control methods and condenser cleaning technologies are identified.

SESSION 6 - Feedwater Heater Failure Causes

An overview of the most frequent failure causes such as impingement erosion is presented. The relationship between feedwater design, feedwater heater normal and abnormal modes of operation, alternate tube materials and other component failures such as impingement plates are discussed.

SESSION 7 - Feedwater Heater Operation and Maintenance

The functions of a feedwater heater are discussed. The types of feedwater heaters and the types of feedwater heaters zones are identified and advantages and disadvantages of each are discussed. The vent and drain system design practices are reviewed. Design practices for preventing turbine water induction are also identified.

SESSION 8 - Condenser Failure Causes

An overview of the most frequent tube problems both on the steamside (impingement attack, flow induced vibration, condensate corrosion and stress corrosion cracking) and on the waterside (such as galvanic corrosion, dealloying, pitting, and sulfide attack) is presented. Proper design, operation and maintenance methods are also identified.

SESSION 9 - Condenser Instrumentation and Performance Testing

Circulating waterside and steamside monitoring parameters and the instrumentation for determining these parameters on-line and in testing are identified. Performance testing is discussed including the need for testing, available codes, and alternate techniques.

SESSION 10 - Condenser Operation and Maintenance

Operation and maintenance practices for the steam surface condensers are identified. These include performance monitoring and economic cleaning schedules. The methods of equipment condition monitoring and assessment are also discussed. These include recordkeeping, visual examination techniques, non-destructive examination techniques, and destructive examination. Tube plugging and life extension technologies are also identified.

SESSION 11 – Nondestructive and Destructive Examination Techniques

Principles of various techniques, including eddy current testing and ultrasonic testing will be discussed and their application to condensers and feedwater heaters will be identified.

SESSION 12 – Condition Assessment

Condition assessment methods are discussed. Examples of condenser and feedwater heater assessments are used.

SESSION 13 - Condenser Retubing and Rebundling

The available methods and tooling will be identified and the advantages and limitations of each will be discussed.