



Course Information Letter ---- OP406

PREDICTIVE MAINTENANCE OP406

A predictive maintenance program is essentially an extension of the preventive maintenance program commonly found at most industrial sites, is based on the actual condition of the component and employs monitoring and includes trending of component operating conditions. In this fashion a failure of the component can be predicted and averted by performance of minor maintenance at a convenient time, such as during a scheduled outage.

Predictive maintenance programs require a significant amount of analytical ability. Since this is the case, it is not suitable for all types of plant equipment. The equipment failure modes for those components in the program must be evaluated and the failure indicators periodically trended. To perform these parts of the program requires considerable skill and knowledge, along with specialized equipment. With this in mind we need to analyze the elements of a predictive maintenance program.

- Keep Operating Equipment Running
- Reduce Forced Outage Occurrences

Predictive Maintenance Programs go a long way to reducing forced outages and in this course you will learn:

- Predictive Maintenance Techniques
- Plant Equipment Selection
- Selection of Monitoring Techniques and Monitoring Equipment
- Frequency of Monitoring
- Trend Analysis of Monitoring Data

As Management, you are not only required to manage the day-to-day maintenance activities, but also maintain records, trend problem areas and find the causes of recurring problems in your plant. In this course we will deal with the reduction of “unplanned” or “in-service-failure” of key equipment through the use of Predictive Maintenance Programs and Condition Monitoring. We will also look at the trending of certain monitoring areas on equipment that cannot be spared (Critical Equipment).

OBJECTIVES: At the completion of this course the participant will be able to:

1. State the elements which make up a Predictive Maintenance program
2. Discuss the factors which go into selection of equipment to be covered in a Predictive Maintenance Program
3. Describe the function of a Predictive Maintenance program
4. Describe the philosophy used to develop a predictive maintenance program
5. Discuss how goals for the predictive maintenance program are developed
6. State the different types of Predictive Maintenance Program organizations
7. Discuss each type of program organization
8. Describe the advantages and disadvantages of the different types of organizations
9. List the requirements for organizing each different type of program
10. Discuss the requirements for the various personnel positions within the predictive maintenance program
11. Discuss the criteria for selection of the program personnel
12. Describe the training requirements for a typical Predictive Maintenance program

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13. List the steps involved in performing a detailed personnel needs analysis
14. State the theory of an oil analysis-monitoring program
15. Discuss the requirements for an oil analysis
16. Explain the terminology used in vibration analysis
17. Describe the common causes of vibration
18. State the theories and applications for acoustic leak monitoring
19. State the theories and applications for an ultrasonic transducer system
20. State the theories and applications for thermography.

COURSE OUTLINE

- I. **Introduction**
- II. **Elements of A Predictive Maintenance Program** Selection Process, Preparation Process, Performance, Review
- III. **Establishing the Predictive Maintenance Program** Program Justification, Financial, Benefits
- IV. **Program Types** Centralized Program, Independent Program
- V. **Personnel Requirements** Selection Criteria, Attitude, Leadership, Compatibility, Technical Requirements, Program Manager, Support Engineer, Support Technician, Maintenance Engineer, Maintenance Supervisor, I&C Technician, Instructor, Needs Analysis, Training
- VI. **Budgets Estimates** Budget Plan, Equipment Costs, Personnel Costs, Training Costs, Transportation, Instrumentation Costs, Miscellaneous Costs
- VII. **Mechanical Analysis Techniques** Vibration Monitoring, Oil Analysis, Infrared Thermography, Ultra Sound
- VIII. **Course Conclusion and Round Table Discussions**

WHAT YOU WILL RECEIVE:

1. 1 copy of HPC Technical Services' textbook, OP416, [Principles of Power Plant Performance](#).
2. A "Certificate of Completion" with 2.6 CEUs, authorized for issue by the International Associate of Continuing Education/Training.

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COURSE DATES/LOCATION/FEE

For current dates / locations / prices, please see HPC's website, www.hpcnet.com.

COURSE OUTLINE

- I. **ASME Performance Test Codes:** Philosophy, History, Test Code Structure, and Application of Codes
- II. **Thermodynamics:** Laws of Thermodynamics, Power Plant Cycles, Heat Balance, Heat Rate, Incremental Heat Rate
- III. **Steam Generators:** Theory, Heat Transfer, Pressure Boundary Points, Fuel Considerations, Furnaces/Waterwall, Steam Drum Internals, Superheaters, Reheaters, Desuperheaters, Economizers, Auxiliary Equipment
- IV. **Steam Generator Combustion Theory & Equipment:** Theory and Equations, Fuel Analysis, Combustion Products, Calculations, Combustion Equipment, Efficiency Testing {Heat Loss Method, Efficiency Calculation, I/O Method}, and Monitoring
- V. **Steam Turbine:** Turbine Theory; Turbine Types; Construction Details; Valves; Turbine Efficiency; Cycle Efficiency; Enthalpy Drop Test
- VI. **Factors Influencing Turbine Efficiency:** Steam Condition, Exhaust Loss, Size, Configuration, Use of Reheat, Feedwater Heater Operation, Mode of Operation, and Mechanical Condition
- VII. **ASME Performance Test Codes for Turbines:** Practical Aspects for Turbine Testing, Thermal Kits, Generator Corrections, Example of Simplified Test Calculations, Calculation of Change in Heat Rate from Change in Enthalpy Drop Efficiency, Determination of N₂ Leakage, Calculation of Primary Flow, Diagnosis of Turbine Problems, Examples of Testing Programs
- VIII. **Power Plant Heat Exchanger:** Heat Transfer Theory, Condenser Testing (Considerations and Calculations of Test Results)
- IX. **Factors Affecting Heat Exchanger Performance:** Low Circulating Water Flow Rate, High Air Leakage, Fouled Tubes, High Inlet Water Temperature, Reduction in Load, Deaerator Theory and Construction
- X. **Centrifugal Pumps:** Pump Theory, Design & Construction, Testing Considerations and Monitoring Operation
- XI. **Measuring Instruments:** Temperature, Pressure, Flow, Electrical, Flue Gas, Data Logging Systems and Computers
- XII. **Evaluation:** Statistics, Test Design, Data Reduction and Trending

CLIENT LIST INCLUDES:

Alliance Forest Products, American Municipalities of Ohio, Associate Electric Cooperative, CMS Generation, Denton (TX) City of, Duke Power, Garland (TX) Municipal Utilities, Houston Light & Power, Kansas City Power & Light, Lansing (MI) Board of Water & Light, LGE Power Systems, Long Island Lighting, Louisville Gas & Electric, Lower Colorado River Authority, Ocean State Power, PacifiCorp, Potomac Electric Power, SaskPower, Sierra Pacific Power, Texas Utilities, TransAlta Utilities, UC Operating Services, University of North Carolina, US Department of Energy, Vero Beach Municipalities

FREQUENTLY ASKED QUESTIONS

- Will HPC Technical Services bring this course to our location for our personnel only? YES, call or email Stephen Parker, stparker@hpcnet.com for a price quotation.
- Will HPC Technical Services customize the presentation at our site to suit our particular needs? Yes.
- Is HPC Technical Services' textbook available for purchase as a reference document? Yes. \$129 + S&H.
- What is the cost for HPC Technical Service to deliver this course at our location? Well, of course that can vary, but generally speaking, if you're planning on having 6+ attend, when considering your T&L, it is to your advantage to perform the course at your plant (office). You gain from the customization and price.
- Can HPC Technical Services provide "Technical Assistance" in conducting functional checkouts or troubleshooting problems, or performance audits? Yes we can. Call or contact Harold Parker, hparker@hpcnet.com for our rate sheets and any further information required.

POWER PLANT OPERATOR CERTIFICATION:

This is one of the courses required for Power Plant Operator Certification.

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Those who attend this course are automatically qualified to take HPC Technical Services' Certification Examination. This examination is offered at no additional expense to the participant. An 80% passing grade is required. The examination length will not exceed 2-hours. Those who complete this examination will receive a revised "certificate of completion" that recognizes this accomplishment along with two-copies of a "To Whom It May Concern" letter that states their accomplishment. (Two copies are provided, one for the participants' employer and one for the participants' personal file.)

Consult HPC's website, www.hpcnet.com, for detail on this certification program.

INSTRUCTOR (S):

Dana Elrod

Mr. Elrod has near 30-years experience in operating large electrical power plant facilities. From 1979 thru 2000, MidAmerican Energy Company in Council Bluffs IA employed Dana. Positions held include that of Operations Superintendent, Shift Supervisor, Training & Safety Supervisor and Environmental Specialist. From 1974 thru 1979 Mr. Elrod was employed as an Environmental Specialist for the State of Iowa Department of Environmental Quality. Mr. Elrod holds a BS in Management from Drake University, 1985

Hayes, Robert

Mr. Hayes instructs HPC's Balance-of-Plant O&M courses as well as our popular "Power Plant Blackout Preparedness" course. Mr. Hayes, prior to early retirement, held several positions during his long tenure at Illinois Power: (1) Results Engineer, Results Supervisor. Mr. Hayes had responsibilities, which included equipment performance testing, and rotating machinery vibration analysis and correction. (2) Supervisor Plant Operations. Mr. Hayes had responsibilities which included startup and checkout of new equipment, supervision of four operating shifts, and coal receiving and handling group. (3) Power Plant Operations Specialist. Mr. Hayes had responsibilities, which included frequent visits to all five fossil power stations, participation in control replacement projects, participation in development and implementation of clean air compliance plans, and served as an internal consultant for fossil power generation operations. He led several technical teams that identified and recommended protective system improvements to the large generating units. He conducted root cause analysis of several major equipment failures.

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REGISTRATION FORM

Company: _____

Plant: _____

Address: _____

City/State/Zip: _____

Telephone: _____ FAX: _____

Course Number/Title: _____

Course Dates: ____/____/____ Thru ____/____/____

Course Location: _____ Course Fee: _____

Please enroll the following individual(s) listed below:

Student #1: _____

Student #2: _____

Taking advantage of HPC's 3-4-2 Policy: Send 3, Pay for 2 when paying in advance.

Student #3: _____

Enrolled by: _____ **Date:** _____

METHOD OF PAYMENT

- Check to Follow
- Check Enclosed #: _____
- MC/Visa/AMEX #: _____
Expiration Date: _____ CV Code: _____
- Purchase Order #: _____

HOW DID YOU LEARN OF THIS COURSE?

- Attended HPC courses before
- Magazine advertisement
- Received a fax
- Received an email
- Other: _____