7FA Gas Turbine Routine Maintenance Fundamentals Course

Learning Objectives:

Ch1 - Turbine Maintenance Overview
This chapter provides an overview of gas turbine maintenance performed at routine intervals. At the completion of this topic the trainee will be able to identify the different types of maintenance performed on the gas turbine.

Ch2 - Preventive Maintenance
At the completion of this topic the trainee will be able to: provide a description of gas turbine preventive maintenance. Read and understand a typical preventive maintenance schedule.

Ch3 - Combustion Inspection Overview
This chapter provides an overview of a gas turbine combustion system inspection.

Ch4 - Combustion Inspection Pre-Maintenance Procedures
This chapter provides a description of the work required to prepare for a gas turbine combustion inspection.

Ch5 - Combustion Inspection
This chapter provides a step for step description of the disassembly of the gas turbine combustion system for inspection.

Ch6 - Reassembly
This chapter provides a step by step description of the reassembly of the gas turbine combustion system following the combustion inspection, including machine retest.
213_B5_Ch1 Routine Maintenance Overview

1. Maintenance Types

   a. Maintenance comes in many different types:
      - Running maintenance that can be conducted while the machine is in operation.
      - Predictive maintenance which utilize comparison charts to trend the machine’s operating condition over time.
      - Preventive maintenance that is performed based on a periodic schedule or hours of operation.
      - Planned maintenance that typically requires a period of non-operating time or a planned outage. Both preventive and corrective maintenance should be included in the planning.
      - Unplanned outage maintenance is corrective maintenance that must be performed to restore the unit or plant to operation. Obviously the most undesirable maintenance type.
      - During this lesson we will explore these types of maintenance in more detail.
2. Running Maintenance

a. Running maintenance is maintenance performed by operations and maintenance personnel on a daily basis on the running machine. This maintenance includes:

b. Monitoring of gas turbine and support system operating parameters. This operating data should be recorded to permit an evaluation of the equipment’s performance and maintenance requirements.

c. These parameters will include:
   - Pressure readings
   - Temperature readings
   - Flow readings
   - Tank levels
   - Filter differential pressures
   - Voltages and currents

d. A complete list of recommended operating data is provided by the manufacturer.
3. Operator Responsibilities

a. While the operators make their rounds, they should note the condition of instruments and their displays; clean if necessary. Check instrument calibration if the readout is suspect. Schedule repair or replacement of damaged instruments.
b. They should also be diligently looking for equipment leaks, loose or vibrating piping, conduit, or fittings and schedule maintenance actions for them.
c. Keep the floors clean of dirt, water, oil, rags and other debris. Locate sources of standing water or oil.
d. Check compartment door seals for deterioration. Schedule replacement as required.
4. Repairs

a. The repair of small items, which does not require access to hazardous areas is encouraged. Some examples of these are:
   - Valve stem packing adjustments
   - Small leak repair
   - Filter switching and replacement

b. Items identified by operations personal that cannot be repaired immediately are reported to maintenance personal and recorded for planning purposes.

5. Routine Maintenance
a. Running maintenance will also include scheduled preventive maintenance items such as:

- Gas turbine on-line water wash
- Gas turbine generator brush inspections
- Overspeed tests, etc.

6. Predictive Maintenance

a. Predictive maintenance is maintenance that is performed to aid in determining the machines current operating condition to that of when the machine was new or newly overhauled.

b. Types of predictive maintenance include:

- Operating log review and trending
- Performance testing
- Vibration testing and analyzes
- Lube oil sampling and analyzes
- Borescope inspections
7. Predictive Results

a. The results of predictive maintenance and these tests, plotted over time, can provide a prediction of when the unit will require planned maintenance to restore it to its original performance.

b. Being able to plan the maintenance will allow the parts and contracts, if needed, to be prepared well ahead of the actual maintenance period.
8. Preventive Maintenance

a. Preventive maintenance is maintenance that is performed that will extend the life of the equipment being serviced. A significant amount of work is required to set up an efficient preventive maintenance program.

b. A good preventive maintenance program will include a library of:
   - Equipment owner’s manuals and technical documentation provided by the equipment manufacturer. These manuals provide recommended preventive maintenance schedules for the specific equipment and the procedures for the maintenance. Manuals will also provide the component’s part lists and a recommended spare parts inventory to maintain.
   - System and component schematics. These provide a visual aid to the person performing the maintenance.
   - System Piping and instrument drawings or P. and I. D.s. P. and I. D.s are valuable for determining where to isolate, lock and tag, and drain the components prior to starting work.

c. A schedule is provided that informs the operation and maintenance personnel when the maintenance is to be done and what operating condition the turbine should be in.

d. More on Gas Turbine Preventive maintenance is covered in a separate lesson.

Classroom Discussion Point:

1. Plant owners and operators must ensure that after construction, “as-built” P&IDs and drawings are issued.
2. Operators must also ensure that any red lined P&IDs and drawings are forwarded to the proper departments for correct updates.
9. Period Inspection Schedule

a. Periodic Inspection Schedule layout. The “Inspection” column lists all the systems, components and devices on the gas turbine and generator that require inspection.
b. The “What to Inspect For” column provide items to look for that may require correction.
c. The “Inspection Frequency and Turbine Status” column provides a code for the frequency that the maintenance is to be performed. The codes are:
   - D for Daily Inspection
   - W for Weekly Inspection
   - M for Monthly Inspection
   - Q for Quarterly Inspection
   - SA for Semiannual Inspection
   - CI for Combustion Inspection
   - A for Annual inspection
   - HGP for Hot Gas Path Inspection
   - Yrs for Years
   - Maj for Major Overhaul Inspection
d. Turbine status codes are:
   - O for Turbine Operating
   - S for Turbine Shutdown
e. Finally, the last column lists the applicable “Document or Page Reference” to the applicable inspection and maintenance page or IMP.
10. Planned Maintenance

a. Planned maintenance is maintenance that will require an outage to perform.
b. Typically, an outage is planned around scheduled major equipment inspections that require disassembly of the equipment. Then all other preventive and corrective maintenance is planned around that inspection.
c. The specific inspection items for the 7FA gas turbine are the Combustor Inspection or CI, the Hot Gas Path Inspection or HGP, and the Major inspection. The specifics of these inspections will be covered in another lesson.
d. Most power plants schedule a planned outage at various frequencies, typically once a year. The length of the outage time depends mainly on the amount of work to be performed and the plant’s availability schedule.
11. Planned Maintenance

a. Even after all of the routine and scheduled maintenance that has been performed, a failure can still occur which can put you into an unplanned outage.
b. Corrective maintenance will be needed to restore the plant to full service.
c. This too, will require thoughtful planning to correct. The largest concern will be spare part availability.
Test

1) Maintenance Types

Of the following maintenance types, which one is the least desirable?

A. Predictive maintenance
B. Running maintenance
C. Unplanned outage maintenance
D. Planned maintenance

2) Running Maintenance

Running maintenance is generally performed by contractors on a monthly basis.

A. True
B. False
3) Operator Responsibilities

Which of the following is not generally the responsibility of the plant operators?

A. Correct safety hazards
B. Plant dispatch
C. Observe system operating conditions
D. Perform running maintenance

4) Repairs

Items that cannot be repaired by the operator immediately should be reported and recorded for planning purposes.

A. True
B. False
5) Routine Maintenance

Which of these items would not be considered routine operator performed preventive maintenance?

A. CTG overspeed tests  
B. CTG brush inspection  
C. On-line water wash  
D. CTG spark plug replacement

6) Predictive Maintenance

Predictive maintenance records operating data, which is compared to the initial data recorded during the machine’s commissioning.

A. True  
B. False
7) Predictive Results

What is the advantage of performing predictive maintenance?

A. Provides an early detection of component failure
B. Allows for part procurement prior to failure
C. Allows planning for outage to repair before failure
D. All of the above

8) Preventive Maintenance

Preventive maintenance is performed after a failure has occurred.

A. True
B. False
9) Periodic Inspection Schedule

The “O” on the Periodic Inspection Schedule states for what?
A. O-rings
B. Order parts
C. Operating
D. Operator performed

10) Planned Maintenance

Planned maintenance is conducted every year during the summer months.
A. True
B. False
11) Planned Maintenance

The biggest concern for conducting corrective maintenance is what?

A. Man power required
B. Parts availability
C. Plant conditions
D. Management authorization
Test Answers

1) C
2) False
3) B
4) True
5) D
6) True
7) D
8) False
9) C
10) False
11) B