MAINTENANCE WITH BUDGET CUTS

ADVANCE PLANNING AND EMPLOYING INHOUSE LABOR COULD HELP TO CUT COSTS

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POND AND LUCIER

ALL	QT	UN	NAME	DWG	MCPC DWG
HOT GAS	10	EA	600IB TRANS PIECE	DWG: 101E2572G001	MCPC DWG: ML0702
COMBUSTION	10	EA	600IB TRANS PIECE	DWG: 101E2572G001	MCPC DWG: ML 0702
MAJOR	10	EA	600IB TRANS PIECE	DWG: 101E2572G001	MCPC DWG: ML 0702
MAJOR	1	EA	SEAL AIR	DWG: 114A3576G001	MCPC DWG: ML 0801 0007
MAJOR	2	EA	STUD BB	DWG: 114A3644P002	MCPC DWG: ML 0812 0011
Operational	24	EA	FILT CART	DWG: 114A3786P003	MCPC DWG: ML 1053
Operational	2	EA	VLV SOLEN	DWG: 114A8218P034	MCPC DWG:ML 1019
COMBUSTION	10	EA	TPBULLHORN MS6001	DWG: 149D2914G002	MCPC DWG: ML 0717 0003
CAPITAL	64	EA	BLD STA IGV 6001 450	DWG: 151D8781P001	
MAJOR	1	EA	BRG DEFL#1	DWG: 154D7145G001	MCPC DWG: ML 0801 0002
Operational	1	EA	RELAYHYTRP	DWG: 155C1645G003	MCPC DWG ML 0544 0001 0054
MAJOR	2	EA	STUD-BB	DWG: 156A1591P014	MCPC DWG: ML 0805 0014 0010
MAJOR	2	EA	STUD BB	DWG: 156A1591P020	MCPC DWG: ML 0802 0005
HOT GAS	2	EA	SPKPG TERM	DWG: 158A3479P023	MCPC DWG: 1214 0006
COMBUSTION	2	EA	SPKPG TERM	DWG: 158A3479P023	MCPC DWG: ML 1214 0006
MAJOR	2	EA	SPKPG TERM	DWG: 158A3479P023	MCPC DWG: ML 1214 0006
MAJOR	4	EA	STUD	DWG: 158A4647P001	MCPC DWG: ML 0706 0001 0024
MAJOR	1	EA	STUD-BB	DWG: 158A4647P002	MCPC DWG: ML 0705 001 061 008
MAJOR	1	EA	STUD	DWG: 158A4647P008	MCPC DWG: ML 0705 001 061 003
MAJOR	56	EA	GASKET	DWG: 158A7685P004	MCPC DWG: ML 1614 0054
MAJOR	1	EA	GASKET	DWG: 158A7685P038	MCPC DWG: ML 1614 0052
MAJOR	1	EA	GASKET	DWG: 158A7685P039	MCPC DWG: ML 1614 0053
MAJOR	128	EA	BUSHING	DWG: 158A7888P002	MCPC DWG: ML 0811 0011
MAJOR	1	EA	BRG SEAL#1	DWG: 164C2807G003	MCPC DWG: ML 0801 0004
MAJOR	1	EA	BRG THRUST MS6001	DWG: 164C2817G002	MCPC DWG: ML 1507 0003
MAJOR	1	EA	BRG DEFL#2	DWG: 164C2819P001	MCPC DWG: ML 1502 0003
MAJOR	2	EA	BRG SEAL#2	DWG: 164C2822G003	MCPC DWG: ML 1502 0004
HOT GAS	10	EA	NOZZLE TIP	DWG: 169D3414G004	MCPC DWG: ML 0512 0002

Table 1: Above is a spreadsheet for GE turbines. Parts should be grouped according to the type of maintenance, such as major inspection, minor inspection, combustion inspection and so on

TASK	TIME	HOW CAN WE MAKE IT SHORTER?
JOB START	1 min	
Mobilize	4 days	Mobilize as much as possible before JOB START
Install winch and 220 a/c	10 hrs	Install before JOB START
Take shutdown data	4 hrs	Take data before JOB START
Shutdown	4 hrs	Plan the routine in advance. Try NOT to run this just prior to outage.
Tag out unit	2 hrs	Have tags prepared in advance. Get photos of Robin & Skip for tags
Label all tubing,piping,nozzles, cans	4 hrs	Label before JOB START tags must be heat resistant in case you run
Disable Co2	1 hr	Study how you will do this before JOB START to avoid wasting time
Blank off fuel	1 hr	Study how you will do this before JOB START to avoid wasting time
Cool down	6 hrs	Crank unit for force cool.
Safety meeting	1 hr	Hold meeting in advance so that this can be a review and not a full meeting
Rem nozzle piping & tube	20 hrs	Have everything labeled in advance, have multiple air tools and wrenches, have gofer to lay down piping
Remove Spark Plugs	1 hr	Label bolt size in advance and mark
Remove Flame Detectors	1 hr	Label bolt size in advance and mark
Rem fuel nozzles & fwd can	30 hrs	Label bolt size in advance and mark
Separate nozzles from fwd can	10 hrs	Label bolt size in advance and mark. Make jacking bolts in advance.
Rem liners & x-fire tubes	10 hrs	Make the special liner pulling tool or purchase or borrow.
Rem flow sleeves	5 hrs	Have multiple sets of wrenches and do 2 or more at once
Rem Outer x-fire tubes	20 hrs	Have multiple sets of wrenches and do 2 or more at once
Rem aft cans	20 hrs	Label bolt size in advance and mark
Rem access covers	4 hrs	Have multiple sets of wrenches and do 2 or more at once
Rem Transition pieces	30 hrs	Have multiple sets of wrenches and do 2 or more at once
Pack & Ship Nozzles	10 hrs	Have boxes made in advance
Ship Liners & x-fire tubes	5 hrs	Have boxes made in advance
Pack & Ship Transition Pieces	10 hrs	Have boxes made in advance
Service spark plugs	10 hrs	Have a spare set ready to go
Service flame detectors	10 hrs	Have a spare set ready to go
Inspect first stage nozzle	1 hr	
Drill out broken bolts	20 hrs	Have multiple drills and taps, try to avoid breaking by using torch
Clean bolts	20 hrs	Have new bolts ready & have multiple wire wheels & apply anti-seize in advance. Use spray nickel-eze
Clean flanges	10 hrs	Have multiple sets of wire wheels and do 2 or more at once
WAIT FOR PARTS TO BE REPAIRED	5 wks	Plan in advance. Get a reservation at service shop. Pick vendor on delivery date NOT price.
Receive Transition pieces	1 hr	Use cordless drill to unscrew boxes, do 2 or more boxes at once.
Receive Liners & x-fire tubes	1 hr	Use cordless drill to unscrew boxes, do 2 or more boxes at once.
Receive Fuel nozzles	1 hr	Use cordless drill to unscrew boxes, do 2 or more boxes at once.
Install Transition pieces	30 hrs	Make sure service shop uses a fixture to avoid fit up problems, have guide pin ready, do 2 at once
Install access covers	4 hrs	Label bolt size in advance and mark, bolts pre-prepped, multiple impact wrenches & sockets
Install aft comb can	20 hrs	Label bolt size in advance and mark, bolts pre-preped, multiple impact wrenches & sockets
Install flow sleeves	10 hrs	Install 2 or more at once

Table 2: The Critical Path should be analyzed for possible ways of shortening job length

In recent times, maintenance budgets of power plants, including gas turbines, have been slashed. Here is how operators can perform effective maintenance under these constraints. Advance planning would be the key, as this can cut costs significantly.

Shopping around

Deciding on job scope and the date of execution of each job is the first step in planning for maintenance. This gives sufficient time to shop around for parts.

Sometimes the time available for the maintenance of gas turbine components can be used to perform maintenance on generator parts. This would save time and hence money that would otherwise be spent exclusively on generator outages.

Typically, OEMs charge a premium for quick delivery of parts. Shopping around in advance gives a chance for third parties, who may not have the parts on their shelves but can supply them at a lower price on a later date.

Deciding the date is important because it allows flexibility in scheduling. For instance, labor costs are high during the outage season. Also, service shops are busy at that time and charge more.

The next step would be to make a spare parts list (Table 1). This typically includes fuel nozzles, cross-fire tubes and retaining rings, combustion liners, gaskets and so on. The spare parts should be grouped according to the type of maintenace job. The spreadsheet should include drawing numbers and OEM classifications.

A list of expendables required should also be made in advance and shopped around. This list typically includes rags, duct tape, plywood, tarps and so on.

Then the question comes: How much should be spent on the spares? Where do we draw the line?

Answers to these questions depend on the situation. Some parts have life limits and force the outage, and therefore need to be procured. A refinery operating 24X7 needs all spares. A peaking plant operating 100 hours/year should probably minimize the spares, while a peaking plant operating 1,000 hours/year should strike a balance between spares and profits.

Monthly testing of "Black Start" capability is more valuable than a spare parts stockpile. Also, if the turbine is especially lucrative, such as when it operates under a spinning reserve contract, it makes more sense to have more spares.

Operators should be aware that owning spares could invite taxes. This should be factored into inventory costs.

Plant owners have four ways of performing outage. A Long Term Service Agreement provides several advantages, such as tying the OEM to machine performance. But LTSAs are often the most expensive option.

A turnkey project could have hidden costs such as "extra work" that crops up during the outage. A third option would be power plant owners hiring a Technical Assistant to be the project manager and seperately hire a labor crew. This may be less expensive. But in today's scenario, a fourth option should be seriously considered.

Plant owners could employ inhouse labor. They could hire a Technical Assistant to train the inhouse staff and be the project manager, while a Mechanical Assistant will oversee the project from the "catwalk" as the work is being carried out.

A In House Overhaul Project has the following benefits:

- Savings of $250,000 - $500,000 can be realized, as labor is always a big ticket item
- Workers take pride in their turbine
- Owners are assured that the unit is fully functional at the end of the project
- Crew takes ownership of their unit

Managing the project

The Critical Path Method is often used to optimize the project schedule. But it would serve operators to go back and analyze the CPM. A brainstorming session on ways to shorten each step in the path would save time and money (Table 2).

For instance, the beginning and end of the project have several parallel paths. Putting more manpower in the two stages could help reduce time taken for the project.

Discussing each item in the critical path could turn up surprising ways to reduce the time required, and hence the cost. For instance, identifying bolts and wrench types or building shipping crates in advance could be of significant benefit. If there are any key drawings or inspection forms that would be required, they should be studied in advance.

Then operators should analyze which of the OEM-recommended jobs need to be performed and which can be postponed. Following this, the operators can decide the value of any upgrades they can implement. In some cases, such as dispatching units, efficiency is more important. Refineries that have "free fuel" do not have much need for efficiency, but value output increase.

Some upgrades reduce exhaust heat while others increase exhaust mass flow. A Heat Recovery Steam Generator could skew heat rate improvements by affecting overall cycle efficiency. TI

Authors

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