Turbine Generator Outage Cycle Optimization

TG Advisers, Inc.

Outage Cycle Optimization Goals

- Baseline current outage cycle
- Complete a Turbine Generator Health Assessment
- Establish component inspection requirements
- Develop component based outage cycle scenarios
- Optimize cycle on cost, technical, and logistic requirements
- Provide financial return with lowered outage costs while maintaining or improving unit availability

Baseline Current Outage Cycle

- Outage Cycle Baseline Process
  - Establish period of interest (usually 10 - 12 years)
  - Review planned scopes and intervals within the period
  - Collect data to determine outage and replacement power costs and outage durations
  - Perform a cash flow analysis using cost of money and inflation rates

Example Outage Cycle Baseline

- Original outage cycle for a 800 MW coal plant

Baseline Outage Schedule	Outage Year				Total PV
	3	6	9	12	
Outage Scope	Valves	Unit	Valves	Unit	N/A
Incremental Outage Duration (weeks)	-	5.0	-	5.0	10.0
Incremental Power Replacement Costs	$ -	$ 8,606	$ -	$ 10,276	$ 8,132
Maintenance Costs	$ 284	$ 2,159	$ 339	$ 2,578	$ 2,397
Total Outage Related Costs	$ 284	$ 10,765	$ 339	$ 12,853	**$ 10,529**

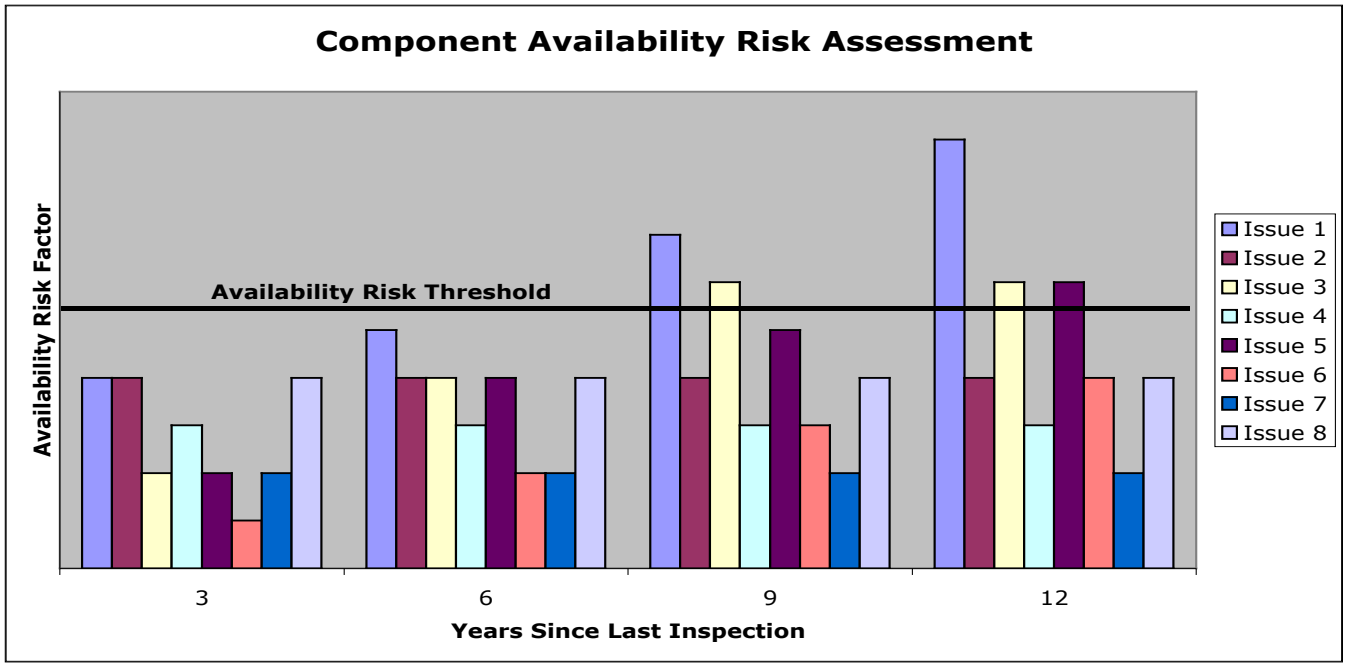
  - Costs in $000s
  - Incremental outage duration above and beyond boiler outage
  - Inflation rate of 3%
  - Discount rate of 10%

T-G Health Assessment

- Necessary step to evaluate equipment condition
- Used to identify problem areas, and associated risks
- Provides input to a time-based risk analysis for each turbine generator component
- Provides benefits on a standalone basis

Component Inspection Requirements

Critical problem area risk for each component is evaluated over the period of interest and…



…a threshold is used to establish an appropriate inspection interval

Component Based Outage Scenarios

- Individual component inspection requirements are grouped into candidate scenarios
  - From a risk standpoint, some components require less frequent inspection than the baseline.
  - Other components require more frequent inspection
  - Components are grouped around common inspection frequencies and logistic advantages

Year	Base Scenario	Scenario 1	Scenario 2	Scenario 3
3	Valve Outage	Valve Outage	Valve Outage	Valve Outage
6	Full T-G Train	Partial T-G A	Partial T-G D	Partial T-G G
9	Valve Outage	Partial T-G B	Partial T-G E	Partial T-G H
12	Full T-G Train	Partial T-G C	Partial T-G F	Partial T-G I

Financial Benefit

The optimum maintains or improves availability at lowest cost

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	3	6	9	12	
Outage Scope	Valves	Unit	Valves	Unit	N/A
Incremental Outage Duration (weeks)	-	5.0	-	5.0	10.0
Incremental Power Replacement Costs	$ -	$ 8,606	$ -	$ 10,276	$ 8,132
Maintenance Costs	$ 284	$ 2,159	$ 339	$ 2,578	$ 2,397
Total Outage Related Costs	$ 284	$ 10,765	$ 339	$ 12,853	**$ 10,529**

Revised Outage Schedule	Outage Year				Total PV
	3	6	9	12	
Outage Scope	Valves	Partial A	Partial B	Partial C	N/A
Incremental Outage Duration (weeks)	-	1.0	1.0	1.0	3.0
Incremental Power Replacement Costs	$ -	$ 1,721	$ 1,881	$ 2,055	$ 2,424
Maintenance Costs	$ 284	$ 1,447	$ 1,397	$ 1,899	$ 2,228
Total Outage Related Costs	$ 284	$ 3,168	$ 3,278	$ 3,954	**$ 4,652**

Savings for this 800MW unit amount to $6,000,000 in current $

Financial Benefit (continued)

- Savings
  - Reduction in power replacement costs
  - Reduction in maintenance costs
  - Sensitive to internal costs and power agreements
- Smaller units also benefit
  - Savings estimate for 150MW unit is $1,200,000

Conclusions

- Outage optimization offers substantial savings
- Successful implementation requires:
  - Risk management
  - Thorough understanding of unit condition
  - In depth Turbine and Generator expertise
- TG Advisers stands ready to provide the expert knowledge to help you meet your operational and financial goals