

Real-time Heat Rate Monitoring & Optimization

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Agenda

- Performance Management in Power Plants
- Real-time Heat Rate Monitoring
 - Online Heat Balance
 - Performance Calculations
 - Optimisation & Predictive Analytics
- Integrated DX for Power Plants
- **Q&A**



Realtime Performance Management in Power Plants





Realtime Heat Rate Monitoring & Optimisation



Online Heat Balance Calculations



- Implement Data Historian & Analytics
- Use the real-time data to for online heat balance
- Heat Balances gives a more consistent and complete set of data
- Inputs to Performance Calculations
- $\circ~$ Includes data that is not measured
 - Firing temperature
 - $\circ~$ Gas flow and composition
 - Steam turbine exit enthalpies
 - Condenser duty

Typical Gas Turbine Heat Balance



 \sum Mass Into Boundary = \sum Mass Out of Boundary

 \sum Energy Input = \sum Energy Output

INPUTS

- Power
- Inlet Air Temp
- Inlet Air Press
- Compr Disch Temp
- Compr Disch Press
- Exhaust Temp

OUTPUTS

- Fuel Flow
- Air Flow
- Turbine Inlet Temp
- Firing Temp
- Heat Rate
- Compressor Efficiency
- Turbine Efficiency

Thermal Performance Calculations



Typical Power/Heat-rate Change Factors

- Ambient temperature, pressure, RH
- Inlet Cooling or Heating
- \circ Air filter pressure loss
- \circ Guide vanes
- Firing temperature
- Steam/water injection
- Fuel quality
- Exhaust (HRSG) pressure loss
- Performance degradation



Rated Vs Actual & RCA



Predictive Analytics & Optimisation

Predict future operation,

- Anomaly Detection
- Nominate fuel consumption
- Evaluate operational options
- Prepare operational budgets
- Estimate cost of outages

Shows how to maximize profit as conditions change,

- Electric & fuel prices
- Plant load
- Process steam requirements
- Degradation

Thermodynamic Calcs : Comp inlet press - P2 (psia) GasT(F): 90.91 Gas Flow : 4290.70 85.33 : Comp inlet temp - T2 (F) T8A (F): 895.05 893.90 0.139 T8B (F): 893.72 893.93 -0.02% T8C (F): 905.23 T8D (F): 898.90 899.54 -0.07% T8E (F): 908.66 908.13 0.06% T8F (F): 901.45 900.91 0.06% T48A (F) 1085.25 1085.93 0.069 Comp disch press - PS3 (psia) :133.38 Comp disch temp - T3 (F) :659.27 T48B (F) 1084.13 1085.70 -0.14% NGG speed (rpm) :8878.81 T48C (E) 1058 48 1051 22 0.15% PT Speed (rpm) : 3966.73 T48D (F) 1110.26 1110.78 -0.05% T48E (F) 1046.09 1045.55 0.05% Measured Values T48F (F) 1126.58 1127.21 -0.06% T48G (F) 1152.37 1152.74 -0.03% Predicted Values T48H (F) 1084.22 1080.67 0.33% Deviation in % Data Historian Measured ~ typically 500 to 1000 sensors per plant (vibrations, flows, data temperatures, pressures, currents, voltages etc.) Model Predicted data 6 amer Deviation Predictive models

Integrated Analytics & Optimisation

Integrated Digital Transformation Increases Overall Performance



Q & A

Thank you