Best Practices in Operations and Maintenance

Monitoring, Reporting, and Forecasting Fuel Supply and Plant Performance
Why Monitor Performance

• To answer the age old question:
  • Is the Resource or the Power Plant Responsible for the Generation Curtailment?

• But a better way to look at this is:
  • By monitoring trends in performance of plant equipment and possible changes in the resource, problems can be identified and address before generation curtailment occurs
Monitor Performance

- Power plant performance tracking
  - Turbo-Generator performance
    - Turbine isentropic efficiency*
    - Condenser performance tracking *
    - Cooling tower performance tracking
- Resource performance
- Well performance tracking
- Forecasting of well workovers/cleanouts

* Examples
Monitor Turbine Performance

Overall Turbine/Generator Efficiency (design) = 81.3%
Monitor Condenser Model
Monitor Condenser Performance
(based on vendor’s performance plot)

Condenser Pressure (observed, in Hg)

Condenser Pressure (Design, in Hg)

Date prior to turnaround (July 2014-March 2015)

y = 1.0886x

y = x
Monitor Condenser Performance
(based on vendor’s performance plot)

Condenser Pressure (observed, in Hg)

Condenser Pressure (Design, in Hg)

\[ y = 1.0118x \]

\[ y = x \]

Data since turnaround (April-Dec 2015)
Monitor Performance

- Resource Performance – Supplement to periodical well tests
  - Tracking plant inlet enthalpy*
  - Tracking brine chemistry– NCG*

* Examples
Monitor Resource Performance
(inlet enthalpy calculated from Heat & Mass Balance)

- Calculated from plant data
- Model based on daily production rates
- Upper Control Limit (2 sigma)
- Plant Heat & Mass Balance (ave=404.8 BTU/lb)
- Lower Control Limit (2 sigma)
Monitor Resource Performance
(inlet brine chemistry – NCG example)
Monitor Performance

• Well performance tracking
  • Extrapolate production data to minimal WHP*
    • Minimal plant inlet pressure
    • Pressure drop in wellhead valves and production pipeline
  • Extrapolate injection data to maximum WHP*
    • Maximum WHP based on frac gradient
    • Maximum injection pump pressure
    • Pressure drop in injection pipeline
  • Decline Curve Analysis of normalized well performance data*

* Examples
Monitor Well Performance
(Extrapolate production data to minimal WHP)
Monitor Well Performance
(Extrapolate injection data to maximum WHP)

Extrapolated data points:
- May 13-14, 2012 data
- August 2013 data
- Feb 9-11, 2015 data
- May 5-12 2015 data
- July 21-13, 2015 data
- August 22-25, 2015 data
- August 28, 2015 data

Equations:
y = 0.3103x - 434.59
y = 0.5144x - 434.59
y = 0.7944x - 434.59

Legend:
- ▲ May 13-14, 2012 data
- ○ August 2013 data
- △ Feb 9-11, 2015 data
- × May 5-12 2015 data
- ❌ July 21-13, 2015 data
- ■ August 22-25, 2015 data
- + August 28, 2015 data

Injection Rate (KPH)
Wellhead Pressure (psig)
Monitor Well Performance
(Decline Curve Analysis of normalized well performance data)
Monitor Performance

• Forecasting of well workovers/cleanouts*

* Examples
Forecasting of well workovers/cleanouts

Production Capacity (KPH)

- Summer Plant Demand
- Winter Plant Demand