Sask Power ER Successes

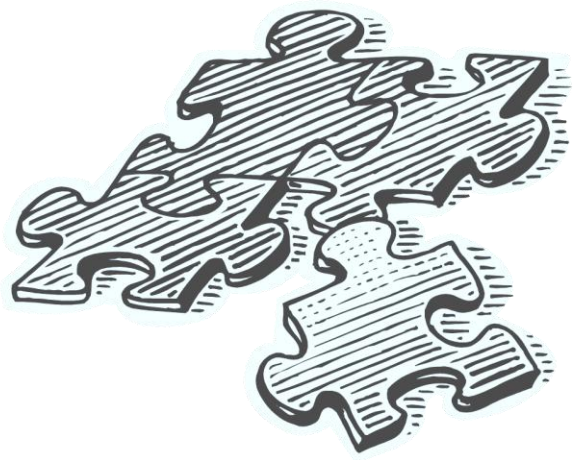
August 2010

CURTISS WRIGHT Flow Control Company

SCIENTECH

Prologue

- The Beginning
- The Deployment
- The Finds
- The Example Catches
- The Q&A



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The Beginning

- God created North America
- Pioneers founded Canada
- Soon after Sask Power became a reality
- Two men with deep fore-thinking abilities emerged
- Began a quest to find a key supplier who could help improve - *unit availability, equipment reliability, cycle efficiency*
- Scientech was discovered and FAMOS was acquired
- Happiness and benefits now reign in the province

The Deployment

- **PMAX, PdP and Rules Engine deployed at:**
  - Popular River 1 - October 2008 (32 models)
  - Popular River 2 - June 2008 (32 models)
  - Shands 1 - August 2009 (49 models)
  - Boundary Dam 3,4,5,6, - December 2009 (126 models)

    Totals: 7 Units, 239 component models

- **Pending deployments:**
  - Boundary Dam 1,2 - ~December 2010 (60 models)
  - Queen Elizabeth 1,2,3,4,5,6,7,8,9, - ~January 2011 (44+ models)
  - Cypress & Centennial Wind Farms - 2011 (99+ models)
  - ?

The Deployment -cont.

- Applications deployed on central corporate servers
- Sask central support engineering personnel primary users
- Site cognizant person being established per site
- Engaging Scientech for remote Monitoring & Diagnostic (M&D) support

The Finds

Over 22 months of involvement, PdP identified:

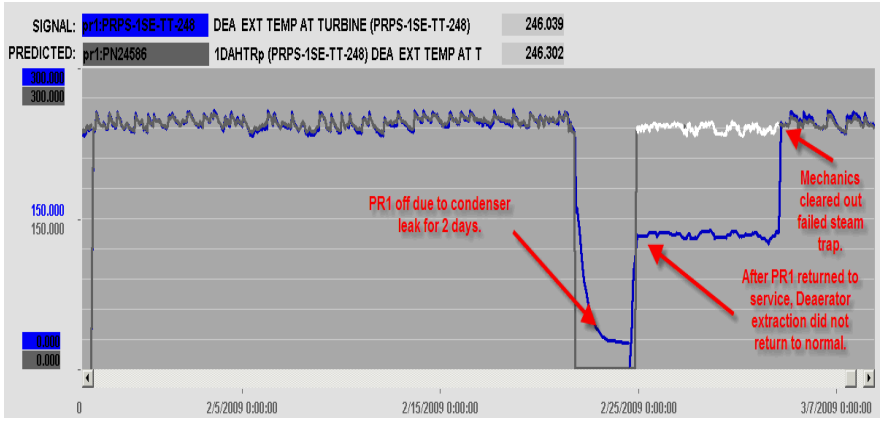
- >120 anomalous equipment situations
- Several equipment condition anomalies
- variety of signal/sensor issues

The Example Catches

1. **U1 Deaerators**
   - steam extraction valve problem: - $44K avoided costs
   - flow orifice installed improperly: - >$100K avoided costs
2. **#2A & #2B Primary Air Fan** - High winding temps due to motor air filter plugging problems
   – $30K - $600K avoided costs
3. **#2B Boiler Feed Pump** - Aux Lube Oil Pump continuously running
   – $15K - $30K avoided costs
4. **#1B Primary Air Fan** - Bearing vibration problem
   – >$100K possible

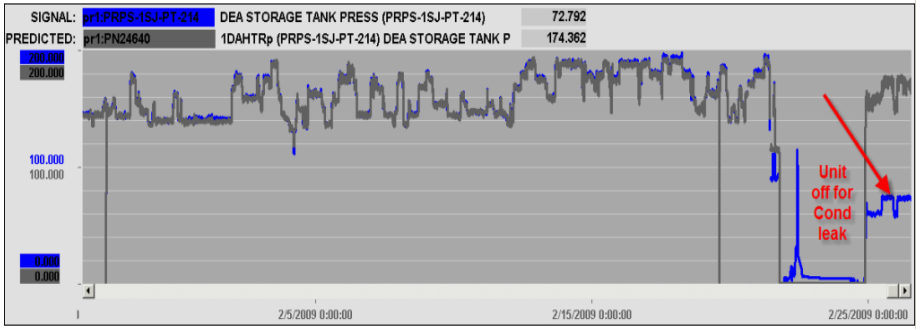
The PR1 Deaerator Story

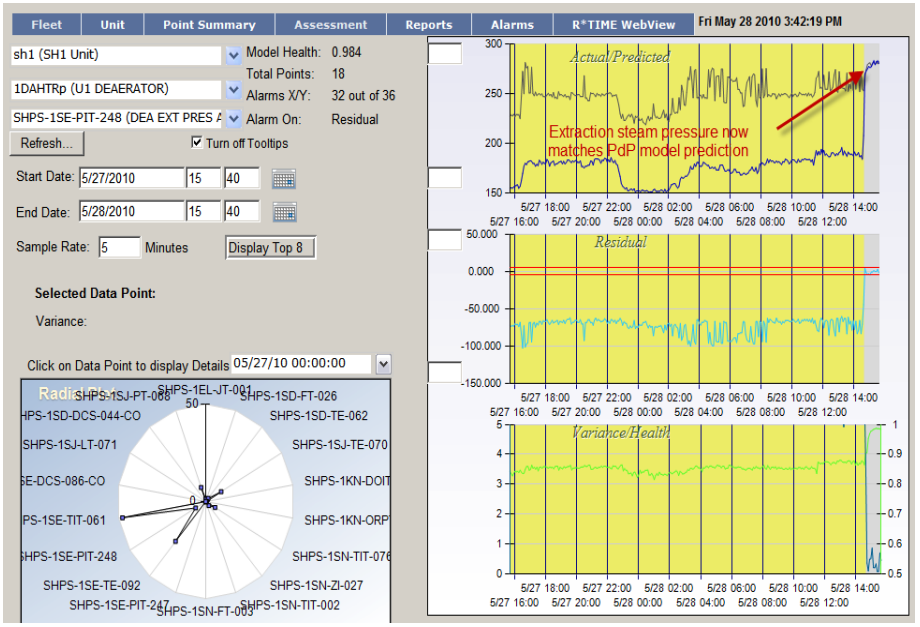
- After unit returned to service, the Deaerator was not performing as before
- Extraction steam temp & pressure dropped considerably
- No Operator concern identified
- Found steam trap on extraction valve not fully opened
- Ultimately found extraction steam trap was plugged



The SH1 Deaerator Story -2

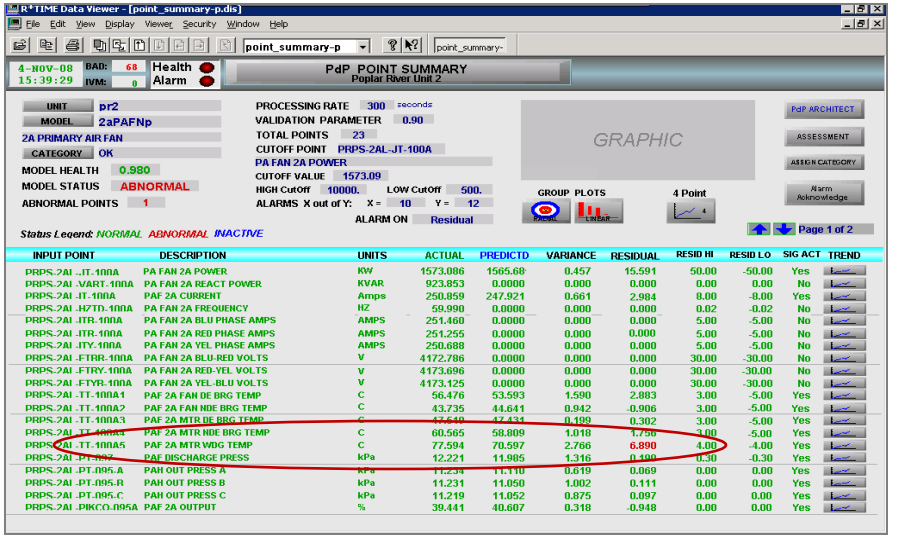
- After start-up, problems with condenser backpressure
- Performed testing, closed extraction steam valve
- Never re-energized control drive for valve
- No indication of problem on Operator DCS screens
- No serious problem, but could have affected heat rate

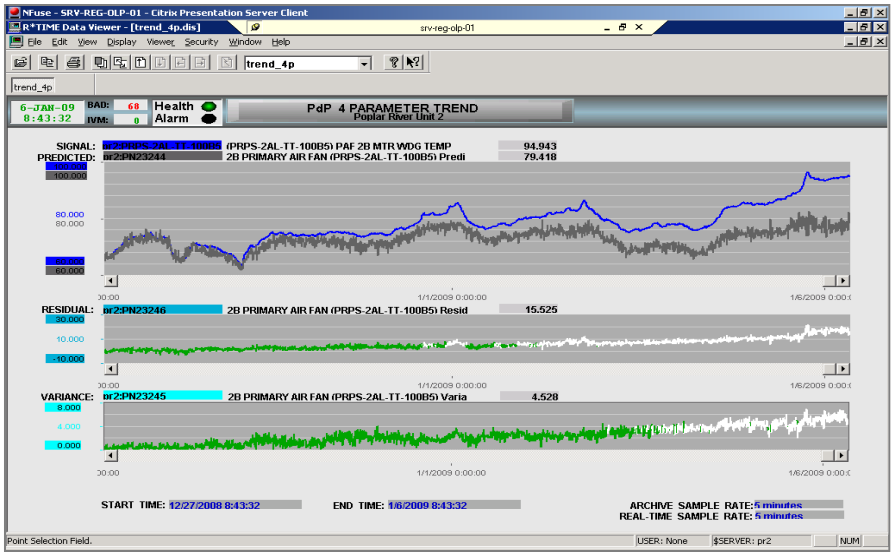




The #2A & #2B Primary Air Fan Motor Story

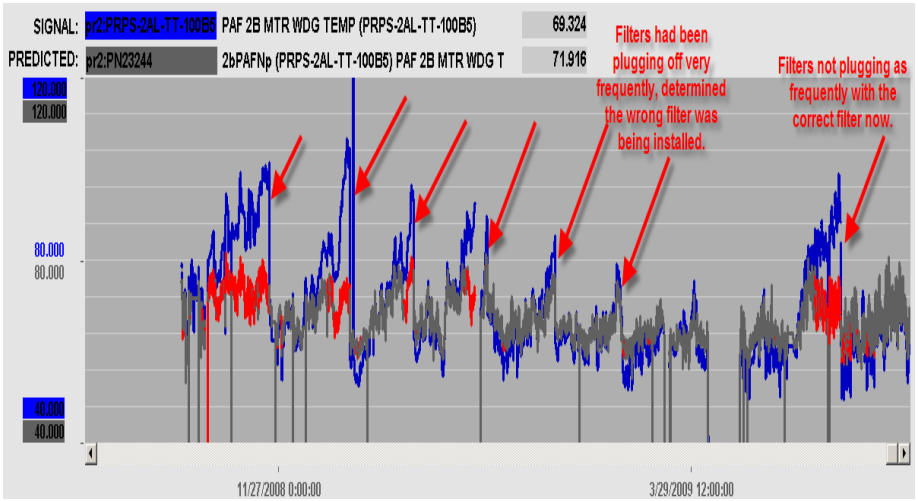
- After model retraining, identified increasing winding temps
- Indications were of a motor cooling problem
- Found plugged filters
- No indication of problem on Operator DCS screens
- Could have led to cycle inefficiencies, higher load draw, or motor failure

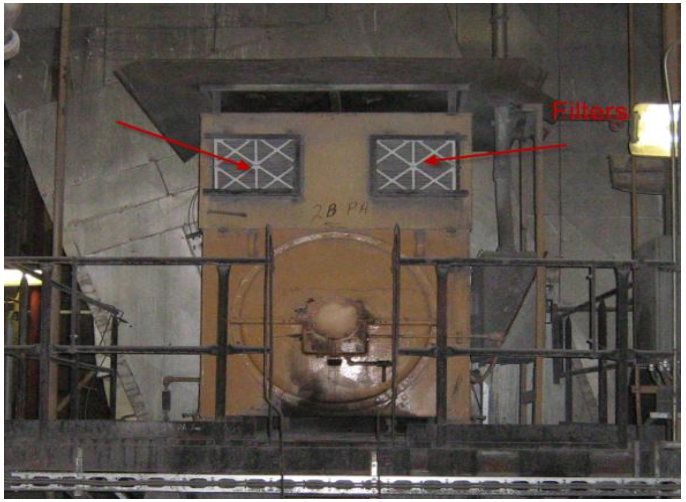




The #2B Primary Air Fan Motor Story

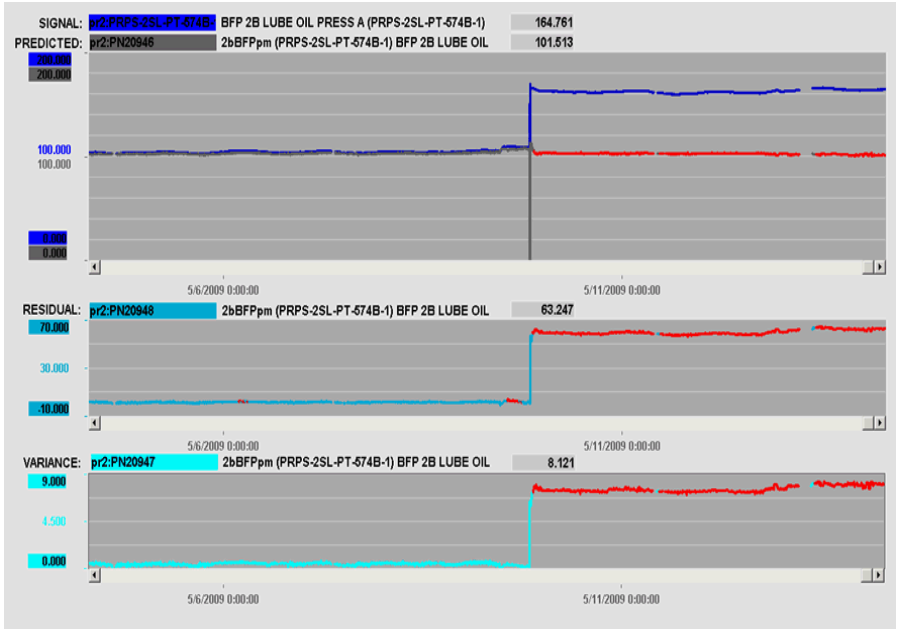
- **PdP identified cyclic winding temp conditions** (correlated with plugged air filters)
- **2A was responding different**
- **Inspection of 2B found wrong size (finer) filter**
- **Could have led to cycle inefficiencies, higher load draw, or motor failure**

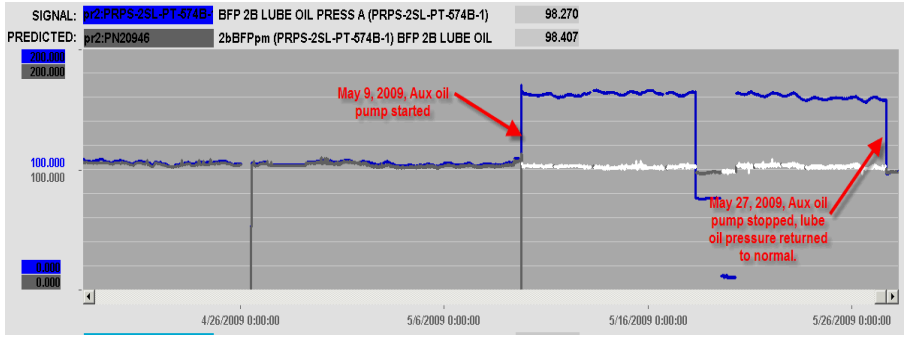




The #2B BFP Oil Pump Story

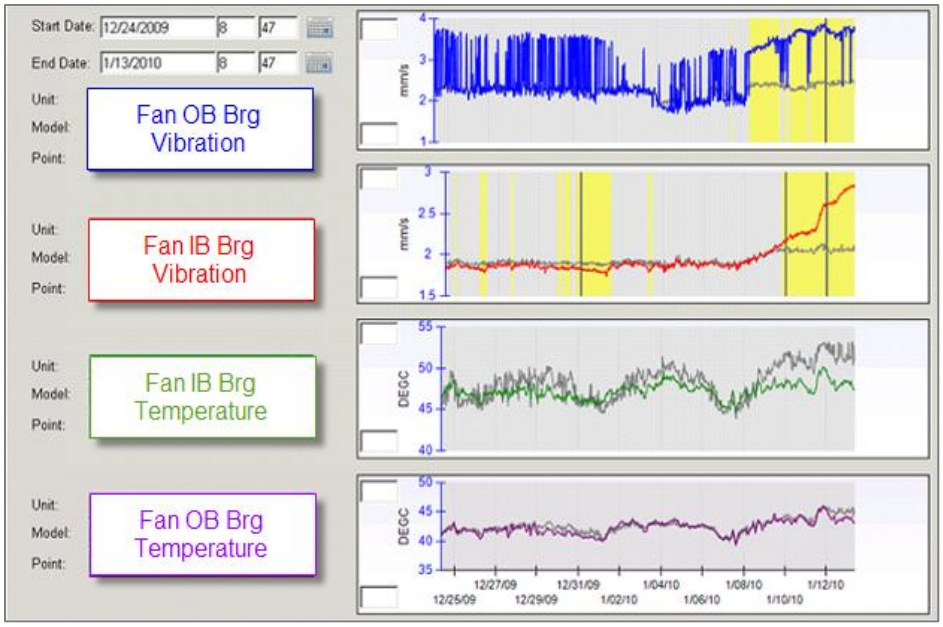
- **PdP identified lube oil pressure change, much higher than should be**
- **Found Aux Oil Pump was continually running in "Auto"** (normally "off")
- **No DCS alert to Operators**
- **If left on continuously, could have led to Aux Oil Pump failure, or BFP bearing problems**

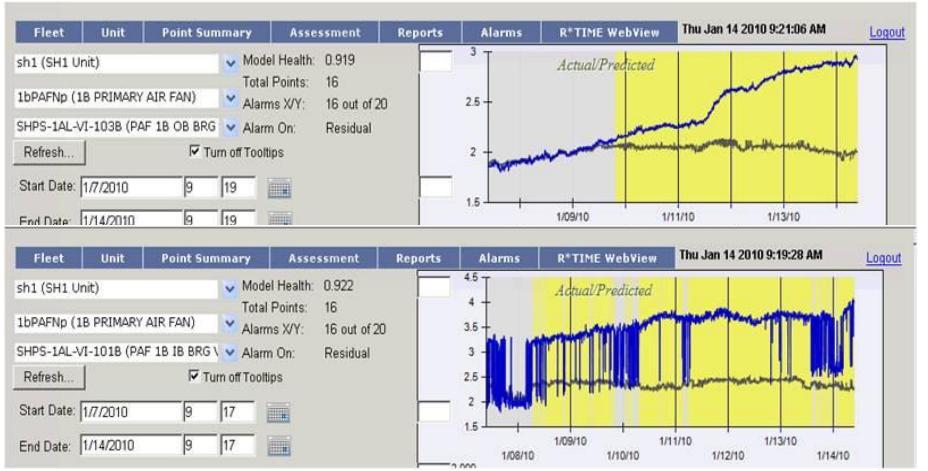




The #1B Primary Air Fan Story

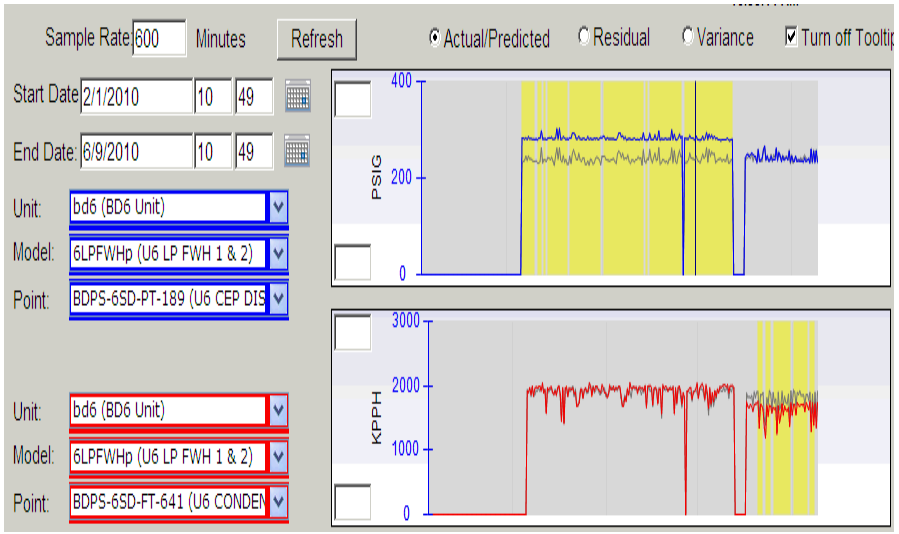
- PdP identified very early indication of a InBd Bearing vibration concern
- The PdP identified step change of OtBd Bearing vibration
- Then PdP re-alerted on the InBd Bearing
- Vibration study did not identify anything significant
- 4 days later, fan bearing failed
- Potential avoided costs >$100K





Also, #6 Condensate Extraction Pump Story

- PdP identified decreasing Feedwater Htr low control valve position at full load
- Reviewed drain line configurations
- Determined probable problem with alternate drain line
- Drain inspected and adjustments made to the heater drain valve configuration, no further control valve problem



The Q & A

FAMOS

Continued success is the result of continued improvement.