**Inlet Bay Flow Turbulence**

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Vertical Circulating Water Pump

Pressure Sensors 27.7’ from Suction

Water Level 17.7’ from Suction
Background / Problem

A 58,000gpm single-stage vertically suspended cooling water pump experienced power and discharge pressure oscillations. Vibration and performance testing indicated power and pressure oscillations were caused by turbulence and vortex formation in the inlet bay. Physical hydraulic model testing confirmed that the flow entering the pump suction bell was indeed turbulent and unsteady. A vortex suppressor was used to straighten the flow from the inlet bay structure. The power and TDH variations with time were essentially eliminated.
Observations

• The system resistance is constant; however, significant power, vibration, and discharge pressure variations were observed.
• There was a strong correlation between power, vibration, and discharge pressure changes with time.
• The most likely explanation for these oscillations was variable hydraulic load due to inlet flow pre-rotation/turbulence.
• The motor was used as a sensor in this test; current is proportional to power consumed by the pump.
CWP 6 Motor Current V.S. Vibration 5-12-16
Data Acquisition Time = 0.8 seconds

Amperes RMS
113 115 117 119 121 123 125
17:39 17:42 17:45 17:48 17:51 17:54 17:57 18:00 18:02 18:05

PSI
16 16.1 16.2 16.3 16.4 16.5 16.6 16.7 16.8 16.9 17 17.1 17.2 17.3 17.4 17.5 17.6 17.7 17.8 17.9 18 18.1 18.2 18.3 18.4 18.5

- Current RMS
- Discharge Pressure
CWP 6 Motor Current V.S. Vibration 5-12-16
Data Acquisition Time = 0.8 seconds
CWP 6 Motor Current V.S. Pressure Pulsation 5-12-16

Data Acquisition Time = 0.8 seconds
Pump Top Axial Waterfall

5X or vane-pass
Physical Hydraulic Model Study
Modification

Vortex Suppressor
Compare Performance Data

Original Condition

With Suppressor
VIDEO

Surface Vortex Before

After Suppressor Installation
Lessons Learned

• The vortex suppressor did not eliminate all inlet bay flow issues; however, flow into the pump inlet was more uniform.
• Power and vibration oscillations were essentially eliminated.
• Reduced fluid pre-rotation caused a larger increase in TDH at low flow rates.
• Pump efficiency was improved.
• The suppressor resolved the flow issues without extensive inlet bay modifications.