

Instrumentation for Centrifugal Pumps

How much is Appropriate

Presented to the

Calgary Pump Symposium

9 November 2007

Outline

- Philosophy
- Types of Instrumentation
- Small Spared Pumps
- Large Spared Pumps
- Large Unspared pumps
- Support Systems
- Vibration and Temperature Monitoring
- Minimum Flow Systems
- Remote Installations

Introduction

- Why do we Instrument Pumps

Safety

Process Protection

Performance Monitoring

Machine Protection

Philosophy

- Keep Instrumentation to a minimum
- Priority is –
 - Safety
 - Environment
 - Process control
 - Condition Monitoring

Philosophy

- Adding of Instrumentation to pumps is expensive, be sure there is value in having it
- Equipment protection instrumentation should be weighed against the cost of a machine failure (Repairs)

Types of Instrumentation

- Process – Pressure, Temperature, Flow
- Power
- Mechanical -Vibration, Bearing Temperature
- Alarm – Any of above
- S/D – Any of Above

Small Spared Pumps



Small Spared Pumps

- Small Pumps are usually spared as they are relatively inexpensive
- Instrumented for Process Control Only
- May be part of a walk around CM Programme

Small Spared Pumps

- Want to be able to conduct performance checks so will need:-
 P_s , P_d , Flow and Motor Power
- Need to Have P_s at the pump suction
- Flow not always available as pump not always on flow control

Large Spared Pumps



Large Spared Pumps



Large Spared Pumps

- Rolling Element Bearings

Treat as a Smaller Pump

Process Instrumentation only

Make this Pump part of a walk around Program

Depending on Repair Cost may want Vibration Transmitter

Hydrodynamic Bearings

- API calls for a switch to Hydrodynamic Bearings when

$$\left(\frac{d + D}{2} \right) n \geq 500,000$$

- d =Inner Diameter mm, D = Outer Diameter mm, n = rotation Speed
- This takes effect about 4" Shaft
(For a Pump Running at 3600 rpm)

Hydrodynamic Bearings

- Some Users opt for Change at a hp level
Say 1000 hp, or at a smaller Shaft Diameter
say 3.5”
- Need to consider Pump Speed in decision
- HD Bearings have potentially an infinite life (depending on Load, Lubrication, cleanliness, etc.)

Large Spared Pumps



Large Spared Pumps

- Would have Process Instrumentation
- Condition monitoring and Machine protection is weighed against repair cost and process loss
- If this machine has HD Radial Bearings reliability is higher. An estimate of failure rate and the associated repair cost vs Cost to install monitoring instrumentation may show Instrumenting does not pay out
- If this machine is spared process loss would be small or zero.

Large Spared Pumps

- When repairs were weighed on this pump and compared with the cost of Instrumenting, it was very close and so protection instruments were installed
(part of a larger plant wide system)
- In addition, Power was > 1500 hp and Instrumenting was installed at that point
(on this particular project)

Large Unspared Pumps



Large Unspared Pumps

- Pump is Unspared, so process loss if pump fails, is high
- Pump is multistage and complex so repair cost if it fails, is high
- Pump running at >5000 rpm
- This pump would be fully instrumented

Support Systems

- Simple Seal Systems such as Plan 11, 13
- More complex Seal Systems such as Plan 5X
- Lube Systems

Simple Seal Systems

- Can Add leak detection
(typically a pot with a level switch)
In a manned Plant usually not required as operator is in the unit frequently
- If added should be alarm only to allow operator to respond

Complex Seal Systems

- Plan 5X Used on hazardous services
Either environmental, health or Fire concern
- Seal failure is alarmed to allow operator to respond.(switch pumps and S/D) or in case of Non spared pump, to have a controlled S/D

Lube Systems

- Pumps with Ring oil
 - Filter ΔP Alarm
 - Low oil Pressure Alarm
- Pumps with Tilt Pad radial or thrust bearings
 - Filter ΔP Alarm
 - Low oil Pressure Alarm and S/D

Vibration Monitoring

- Want to Avoid Nuisance Trips

Set alarm at 50% above normal levels

Set S/D at high levels say Bearing clearance(+)

Bearing temperatures

- Installed on HD bearings
- Alarm at or close to 85C
- If set to trip set high say 110C

Minimum Flow Bypass

- A nice to have
- Expensive to install and inefficient to operate
- Should only be installed where there is a design Operating condition that is below the pump minimum flow

Remote Pumps

- Most Measurement points will be fitted with Transmitters to allow monitoring from remote control centre
- Pump will be fitted with more trips than at a manned facility
Usually agreed by Ops Mtce. and Eng

END