keep it moving

# BEST PRACTICES FOR MONITORING PCP SYSTEMS

11/23/2021

# WHAT IS MONITORING?

- **In general, it is anything we do to observe the condition of our system**
- **We are going to look only at things which can be quantitatively measured**

  Other things would include “Is the drivehead making abnormal noises?”, or “Is the stuffing box leaking?”
- **We can measure things at surface or downhole**

  Examples:  pressure, temperature, flow rate, vibration, fluid level
- **Measurements can be automated or manual**
- **Measurements can be real-time or recorded for later analysis**

11/23/2021

# WHY MONITOR A WELL?

- Optimize production
- Avoid running the pump dry
- Protect the drive equipment (rods, drivehead)
- Troubleshoot operations and analyze failures
- Learn about the reservoir
- Correct (or modify) any design assumptions to improve the next installation

11/23/2021

# SURFACE MONITORING

- **Speed**

  From VFD or tachometer

- **Torque**

  From VFD

- **CHP/THP, temperature**

  Manual gauges and/or transducers connected to SCADA or datalogger

- **Fluid level**

  Acoustic measurement (“fluid shot”), usually manual but automated systems exist

- **Flow rate**

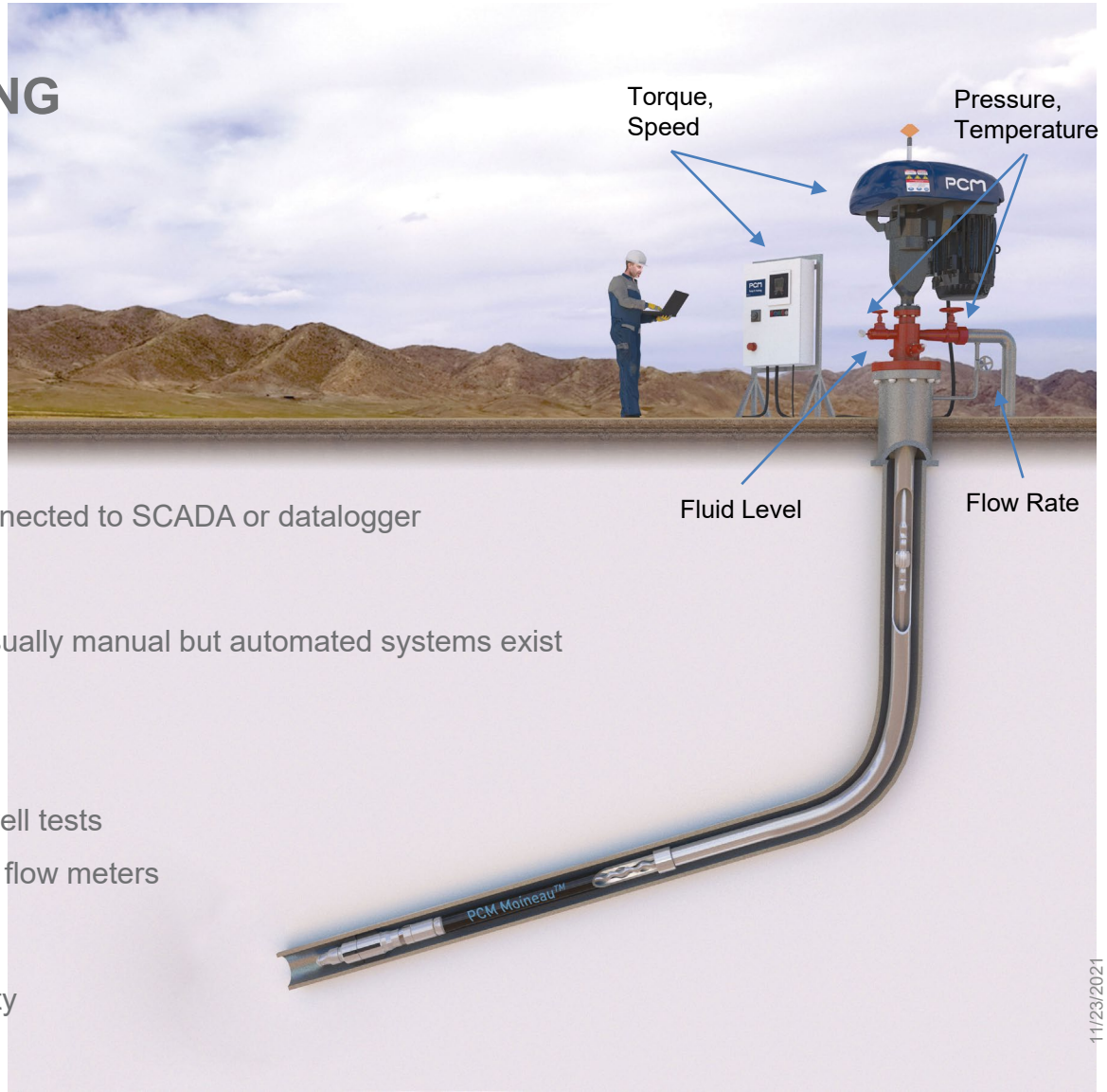
  Gas and liquid rates

  Typically recorded periodically during well tests

  Some automated systems have built-in flow meters

- **Fluid Sampling**

  Water and solids fractions, fluid viscosity




11/23/2021

# DOWNHOLE MONITORING

- **Intake pressure and temperature**
- **Discharge pressure and temperature**
- **Vibration**

- **Fibre optics**

  Distributed temperature, pressure, acoustic measurement

- **Communication types**

  Wired – cable connection from downhole gauge to surface

  Wireless – acoustic or other wireless communication to surface

  Memory – data is only retrieved at the next workover


11/23/2021

# DATA COLLECTION

- **Manual**

  Operator records current information during visit to well by reading gauges and/or data on the VFD panel

  May record it in writing (for later entry into database), or directly into a computer

- **Automated / stored**

  Datalogger at the well (or in the VFD) records data which is occasionally downloaded by an operator

  Limited storage

  Cannot be used for analysis until downloaded, but a controller at the well can use the data

- **Automated / transmitted**

  Data is transmitted directly to company network where it can be reviewed at any time

  Can be used by control systems (either at the well or at a central location)

11/23/2021

# HOW DO YOU GET VALUE FROM MEASUREMENT?

- Speed + flow rate → pump volumetric efficiency
- Intake pressure + CHP → pump submergence → optimization & pump protection
- Fluid level shots → pump submergence →optimization & pump protection
- Vibration → space-out problems, detection of pump damage, selection of operating speed
- Intake pressure → pressure build up tests (reservoir engineering)
- Intake pressure + flow rate → drawdown tests (reservoir engineering), understand IPR
- Discharge pressure + THP + flow rate → confirm pressure loss calculations, estimate gas in tubing
- Torque → protect rod string (high torque shut down), predict solids plugging, detect problems with swelling and/or pump fit
- Intake pressure + discharge pressure + flow rate + speed → confirm pump performance
- All available data → failure analysis → improve reliability for future installations
- All available data → improve understanding of well and operating conditions → improve (or confirm) system design for future installations

11/23/2021

# OPTIMIZING PERFORMANCE

- **Goal:  maximize production without causing premature failure**
- **Adjust pump speed to maintain a small fluid level above the pump**

  The more we can draw down the fluid level, the greater the production

  If fluid level drops to pump intake, a failure is very likely

  Enough fluid level is required so that if the reservoir becomes less productive, the pump speed can be reduced before the pump runs dry

- **Can be done in different ways:**

  Fluid level shots (manual or automated)

  Downhole intake pressure gauge (should also consider CHP)

  Some systems use flow rate measurement (using change in flow rate with a change in speed)

Need:

Fluid shot
or
Bottomhole pressure
or
Flow rate / speed

11/23/2021

# RESERVOIR DATA

- **Pressure build-up test**

  Every time a well is shut down, the BHP data showing how the pressure builds up over time gives good information that the reservoir engineering team can use to optimize production in the field and/or plan stimulation

  Can help understanding of permeability, skin effects, reservoir pressure, reservoir size, interference of other wells, etc.

- **Drawdown tests**

  Operate the well at different speeds, and compare flow rates to pressures; also observe how the pressure reacts to changes in speed

  Can help understanding of permeability, reservoir pressure, reservoir size, etc.

  Helps to understand the IPR performance of a well

Need:

Bottomhole pressure
Flow rate

11/23/2021

# CURRENT PUMP PERFORMANCE

- **Flow rate and pump speed give pump efficiency**
- **With pump differential pressure added, we can evaluate performance relative to expected pump curve**
- **Torque from VFD can be used to protect rod string and drive system from overloading, or to detect solids problems**
- **Vibration measurement can detect abnormal conditions (poor space-out, bent rods, impending pump failure, etc.) and can also be used to select an appropriate operating speed**
- **If you can improve the design model for your pump with better accuracy of the inputs into your design software, you will be able to improve the design of the next installation in the well**

  Correct pump sizing to improve run-life

  Selection of optimum rod and tubing sizes

  Configure system for good gas separation

From SPE 135994

Need:

Speed
Flow Rate
Torque
Vibration
Intake & Discharge Pressure

11/23/2021

# FAILURE PREVENTION AND ANALYSIS

- **Some types of failures can be prevented through monitoring**

- **When a failure happens, the more data available, the more likely it is that the failure cause can be correctly identified**
- **Identifying the failure cause makes it easier to avoid the same failure on a subsequent installation**

Need:

As much data as possible

11/23/2021

# WHAT IS THE BEST PRACTICE FOR MONITORING?

- **There is not one single "Best Practice for Monitoring PCP Systems"**
- **Each operation needs to find its own *balance* between costs (opex and capex), value obtained, and reliability**
- **Capex**

  Cost of the transducers, cables, dataloggers, SCADA, etc., including installation costs

- **Opex**

  Labour for taking fluid shots, manually recording data, or downloading from remote dataloggers, maintenance of systems, analysis of data

- **Value obtained**

  Optimized production (higher rates), greater overall recovery, fewer failures

  Value should be considered not just for *right now*, but for future installations in the well—also consider value of reservoir information

- **Reliability**

  Greater PCP system reliability, but also an additional point of failure:  what happens when the monitoring fails but the pump is still okay?

11/23/2021

# SUMMARY

- **Optimize production**

  Monitor flow rate, fluid level

- **Protect equipment**

  Monitor torque, fluid level

- **Analyze performance (system and reservoir)**

  Monitor speed, flow rates, intake and discharge pressure

- **Analyze failures**

  You can’t know in advance which data will help in analyzing future failures – so monitor as much as you can

- **Don’t forget the things that can’t be measured!**

11/23/2021

# CONCLUSION

- **There are lots of things you *can* monitor and record**
- **Most of these can add value to your operations – some more than others**
- **The question for you is to determine what level of monitoring gives the best value for your operation**

- **It is important to consider the accuracy of your measurement systems—especially when the run life of your pump depends on it**

- **Best practices:**

  If you measure it, record it.  Flow rate, speed, torque, and fluid level are the most important

  Keep enough fluid level over your pump to ensure that it never runs dry, regardless of measurement frequency, measurement accuracy, and variations in reservoir productivity

  Have a back-up plan in case instrumentation fails before the pumping system

  Record enough data to help with failure analysis when needed

  Check your assumptions about fluid properties and reservoir conditions

11/23/2021

# › THANK YOU!

- **Q&A – please enter your questions in the Q&A panel in Teams**

11/23/2021