Progressing
Cavity Pump Controller

NOV Monoflo's Progressing Cavity Pump (PCP) Controller provides a number of features specifically designed for operation of progressing cavity pumps. The drive combines motor and pump control into a single, compact package that increases production, improves energy efficiency and enhances the reliability of both new and existing pumping systems.

Overview

Multiple Constraint Optimization

At any instant during the life of a well, there is a single constraint that limits production. Production can be maximized without compromising efficiency or reliability by forcing the system to operate at the constraint limiting production at each instant of time. Determining the application limits and moving smoothly between them in real time is a key advantage of the NOV Monoflo system. Models of all the system elements are run in real time at the wellhead to detect appropriate limits and enforce associated control strategies. At different points in time, the system may be limited by motor voltage, motor current, motor speed, motor torque, motor thermal capacity, power demand, rod string torque, flow line pressure, fluid level or well inflow. Multiple constraint optimization is particularly beneficial in applications with variable inflow conditions, such as those found in coal bed methane, high gas /oil ratio, and thermally stimulated wells.

Sensorless Operation

The drive uses a number of unique methods for precisely determining performance parameters from models of the pumping system elements without requiring external surface or downhole sensors. Sensorless system variables including rod speed, rod torque, pump speed, pump torque, fluid flow, fluid level, suction pressure, discharge pressure and differential pressure can be observed through the drive keypad / display or recorded as circle charts and time based plot. Fluid level, pump flow and total production are displayed in selectable engineering units.

Multiple Constraint Optimization

Embedded mathematical models of the drive, motor, drive head, rod string, pump, flow line, tubing, casing, fluid and reservoir use component specifications and well completion information along with field set up parameters to monitor pumping system operation. Identification routines automatically determine installation dependant system parameters including those of the motor, rod string and pump. the models capture the thermal, mechanical, electrical and hydraulic behavior of the system to control the pumping process with greater precision than ever before.

Pump Speed Control

The drive provides a number of options for manual, remote and automatic control of pump speed. Speed commands can be selected from a number of sources including potentiometer adjustments, keypad presets, serial data, communications and internal optimization controllers. The motor can be operated up to twice base speed at constant power. This allows the overall gear ratio to be increased, thereby providing increased low speed torque without loss of maximum pump speed. Dual motors can be controlled from a single drive for operation of large pumps. The system can be configured for optimization of fluid production, gas production, energy efficiency, and/or power flow.

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Features

Production Optimization
Level control maximizes fluid production by regulating the downhole pump inlet pressure. An optional surface flow sensor can be used to automatically locate the point of maximum production while protecting the system from a pump off condition. A search routine uses an optional gas flow sensor input to automatically select the fluid level that maximizes gas production in coalbed methane pumping applications. Current limit control increases production by raising motor speed during periods of reduced pump load. A power flow optimizer maximizes production from gassy wells by allowing the drive and motor to operate at their maximum thermal capacities.

Production Monitors
A pump flow monitor provides a continuous estimate of flow without the need for additional instrumentation. Pumping speed and pump effective volume are used to estimate the actual production rate. Pump flow is totaled in a resetable production accumulator. Estimated well production is displayed for the operator and is available for remote well monitoring through a serial communication port.

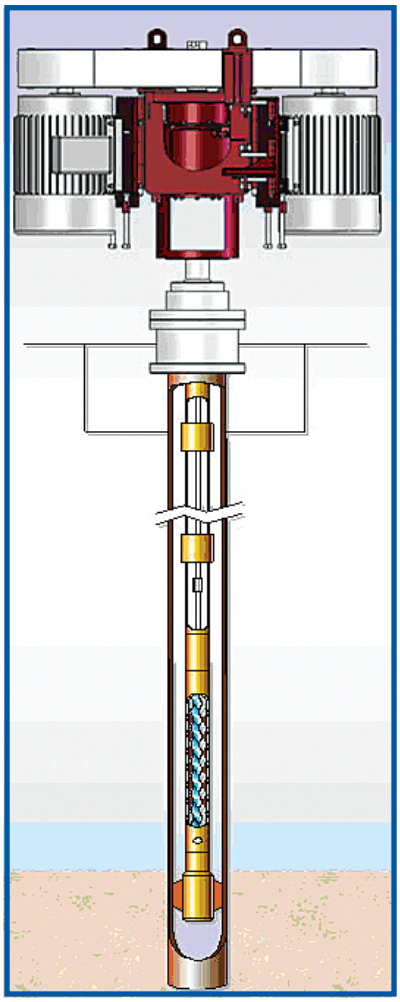
Fluid Level Monitor
A fluid level monitor provides a continuous estimate level from pump head, fluid properties, tubing pressure, and casing pressure. Tubing and casing pressures can be entered as parameters for relatively fixed pressures or input from analogue sensors significantly variable pressures.

System Protection
Torque limiting protects the motor from excessive torque loads and the rod string against breakage. Stick slip oscillation damping reduced rod string fatigue failures. Excess flow line pressure can be used to prevent damaging pump loads. Low speed detection protects the system in case of a stall condition, such as a stuck pump or blocked flow line. Breakaway torque detection identifies pump problems during starting. Low torque detection indicates a rod break, belt failure, or plugged sand screen. Sensing of pump inlet and outlet differential pressure is used to protect the pump from overloading.

Energy Savings
A power flow optimizer reduces the electric utility cost for any inflow rate. A cyclic energy optimizer provides additional utility cost reduction by pumping at the maximum efficiency point necessary to achieve required flow. Time of use control can be used to minimize on peak energy demand charges. The drive incorporates an input power, motor power, rod power, pump power and average efficiently to aid in utility cost control.

Data Capture
A data sampler captures real time information for generation of motor, rod and pump performance charts as well as plots of production information. A data logger collects time stamped fault, warning and event logs that can be viewed through the drive keypad/display, uploaded to a personal computer or retrieved by a network server. Typical events include start, stop, mode change, power up, power loss, over voltage, over current, low torque and low speed. A multichannel analog interface option allows data logging of additional well parameters.

Data Communications
Several industry standard serial protocols are available for communicating with popular programmable controllers as well as personal computers or network servers. Available protocols include ANSI, Modbus, RTU, Modbus Plus, Controlnet, Profibus and Ethernet. Optional software is available for monitoring the pumping system using Palm type handheld devices and Windows based personal computers or network servers. A wireless interface option allows remote monitoring of system performance and control of pump operation. User programmable reports can be generated using software that



Information programmed into the controller protects all the equipment while maximizing production

Automatic Restart
The drive can automatically recover from fault conditions and intermittent power outages to ensure continuous operation of unattended wells. Auto restart control sequences starting of multiple pumps after power outages to eliminate surges in power demand. Start/stop events are automatically logged for subsequent retrieval.

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