ABB MEASUREMENT & ANALYTICS | DATA SHEET

Wellhead control application

Flow computers & remote controllers

Overview

Many of ABB Totalflow's wellhead control applications can be used individually or together, to provide many forms of wellhead automation. With these applications, you are able to implement such things as:

- Timer based and process based intermitting
- Production control with overrides
- Adaptive plunger lift control
- Nominations control
- Emergency shutdown control
- Reservoir / well test control
- Injection well control
- Simple math/logic with user operators
- Complex math/logic using IEC61131

Many of ABB Totalflow's wellhead control schemes are implemented in two standard applications:

- Valve control
- Plunger lift

After many years and thousands of wells, these applications have proven to provide a robust and mature base from which solutions can be implemented, often without change.

ABB Totalflow continues to adapt these applications and, if needed, can also adapt them to meet your requirements.

Other types of custom math and control logic can be accommodated using:

- User operators
- IEC61131 control language

Valve control

This application fundamentally provides automatic feedback control of Differential Pressure (DP), Static Pressure (SP), or Flow Rate for the purpose of positioning a control valve to maintain a desired value.

Additionally, other parameters (such as differential pressure and static pressure) can be monitored for override conditions. If override conditions are met the controller will maintain the override value until the override condition clears, after which the controller will revert to the primary control scheme. This feature can be used, for example, to control a well's production rate, as well as to help maintain pressure entering the gathering system. It can also automatically shut-in a well when a compressor goes down and then bring the well back on when the compressor starts back up.

Through configuration options it is also possible to intermit a well based either on simple timers or based on more dynamic measurements of differential and static pressure.

It is also possible to halt the control algorithm and manually step the valve in either direction. The valve can be moved in small increments or can be instructed to ramp the valve to it's full open or full closed position.

Controller algorithm

The control algorithm is best described as a 'Single Speed Floating Algorithm'. This algorithm provides integral action based on:

- The process variable's difference from set point (error).
- The process variable's range of control (span).
- The total possible valve travel time or (gain).
- The controller output is computed and applied anytime the (error) term is outside a user defined dead band.

Controller output

Digital valve actuator

A digital actuator, such as a stepper motor or an E/P actuator is interfaced to the XSeries/*X*CORE Valve Controller using two digital outputs and two digital inputs. The outputs are used to control the polarity and duration of the control signal. The inputs are used to detect valve stops. In this scheme, the computed outputs from the Controller are (1) duration and (2) direction. Voltage is applied to the valve actuator for the computed duration in either the open or close direction. This output results in valve movement. The output voltage duration and direction, and the resulting valve movement are such that the Process Variable is maintained at a pre-determined user defined value (Set point).

Analog valve actuator

An analog actuator, such as an I/P actuator is interfaced to the XSeries/*X*CORE Valve Controller using a 4-20 ma analog output. In this case, the analog output is used to control the percent open or close position of the valve.

Summary of features

The following are features provided with ABB Totalflow's standard Valve Control Application:

- Single Speed Floating Algorithm providing integral action feedback control of flow rate, differential or static pressure.
- Continuous monitoring of override conditions for secondary control needs.
- Manual control of valve.
- Use of either two digital outputs or an analog output to interface to control valve actuator.
- Appropriate valves and communication options can be powered from the same battery packs used for the XSeries/*X*CORE device.
- Control of wellhead pressure using downstream static pressure by estimating pressure drop using Weymouth equation.
- Intermitting logic based on either timers or dynamic inputs, such as differential pressure and static pressure.
- All control features can be accessed either locally with PCCU32 or remotely with WinCCU, ABB's SCADAvantage or TDS32 (non-ABB SCADA systems).
- Valve Control is an option on all XSeries/*X*CORE products by simply adding the appropriate TFIO module or I/O daughter card.

Nomination application

The nomination application is used to deliver a specified amount of volume over a specified period of time. For example, if a delivery point is contracted to deliver an exact volume of gas over a month's period of time, then nominations is used to ensure these targets are met.

The nomination application is implemented in the XSeries/ *X*CORE device. Once properly configured the application operates unattended, making sure your requirements are being met.

The nomination application is implemented as a supervisory application, atop the valve control application. As such, the nomination application continuously feeds new flow rate set points to the valve control application in order to meet the nominated volume over the specified period of time.

All the while, the valve control application is honoring overrides making sure to maintain the process variable at set point. Even if valve control needs to shut in a well, due to a down compressor, the system will attempt to make up the nominated volume automatically, when the compressor comes back on line.

As shown here, there are three standard nomination periods.
- Previous Period: Settings and results of the most recently completed nomination period.
- Current Period: Settings and status of the currently active nomination period.
- Next Period: Settings for the upcoming nomination period.

All control features can be accessed either locally with PCCU32 or remotely with WinCCU, ABB's SCADAvantage or TDS32 (other SCADA systems).

Plunger lift application

Plunger lift is often used on wells exhibiting production drop-off from fluid build-up and has been shown to increase gas production and extend well life. In one sense, plunger lift logic is merely another form of intermittent logic. However, superior plunger logic has several common traits.

- Monitors dynamic parameters (pressures, differential pressures, flow rates and plunger arrival time) in order to predict the optimum conditions for continuing to flow or continuing to shut-in the well.
- Supports adaptive algorithms to dynamically tune the control system to each unique well, with minimal oversight and unattended operation.
- Maintains data logger for engineering and operations analysis.
- Can be configured and tuned either on-site using local user interfaces or off-site, using remote communications.
- Is implemented in a software environment that can be readily adapted to new control algorithms as state-of-the art evolves.

Plunger applications, as implemented in ABB Totalflow's XSeries/ *X*CORE products, have proven to exemplify all of these features. When integrated into ABB's various host and SCADA systems, the user is provided a complete, turnkey solution empowering the user to monitor, control and optimize the whole reservoir.

The plunger application software is implemented in the IEC61131 control language. This software environment allows for rapid and accurate modification of the control algorithm, if the need should arise.

Plunger logic is an option on all XSeries/ *X*CORE products by simply adding the appropriate TFIO module or I/O daughter card and downloading the appropriate plunger application.

Plunger options

The fundamental goal of plunger lift logic is to determine the optimum conditions for continuing to flow the well or continuing to shut-in the well by deciding when to transition from flowing to shut-in and vice versa.

As depicted here, several options are available for deciding when to make these state transitions. Some of these options, and their associated step change criteria, can be automatically adapted by the plunger application in order to achieve the theoretical optimum arrival time of the plunger.

Open Conditions (with optional tuning)
- Timer expires[1]
- (Tubing-Line) > Limit
- (Tubing-Casing) > Limit

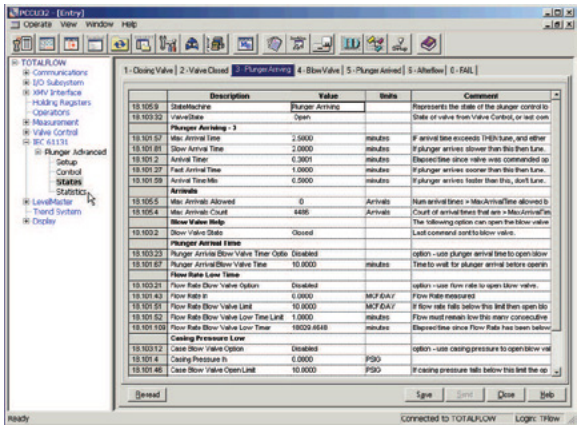
Close Conditions (with optional tuning)
- Timer expires[1]
- Low DP timer expires
- Low flow rate timer expires
- (Tubing-Line) < Limit
- (Tubing-Casing) < Limit
- (Casing < Limit)

The plunger application also supports many details beyond the scope of this overview; among which is the support for a blow valve feature that also has selectable options. Please contact Totalflow for a more detailed description of the plunger applications.

[1]Timers are implemented as fixed duration switches between open and close conditions, acting as override operations, and are not included in any tuning logic.

Plunger and valve control

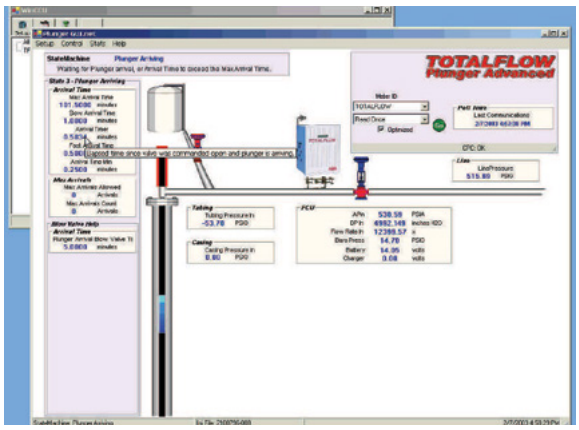
The flow line control valve can be a simple open/close valve or it can be a modulating control valve. When using a simple open/close valve a standard TFIO DI/DO module is used for interfacing to the valve.



PCCU32 Tabular User Interface Screen

When using a modulating control valve a standard TFIO VCIO module is used for interfacing to the control valve. In this case, both the Plunger Application and the Valve Control application are integrated so that the Valve Control application provides automatic control of flow rate, differential pressure or static pressure when the well is flowing.

When used in this way, the standard Valve Control and Nominations features are also made available. Taken together with the Plunger Application this can provide a rich set of wellhead control schemes; all with simple, straightforward options to any XSeries/*X*CORE device.



GUI from Plunger Application Plug-In

Sales **Service** **Software**

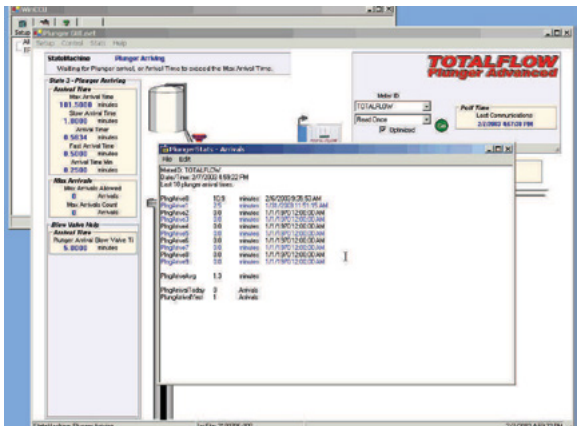
Plunger user interface options

Properly configured, ABB Totalflow's standard PCCU32 and WinCCU products support tabular user interfaces to the plunger application, as depicted here.

An optional WinCCU plug-in is available that provides a more graphical user interface, as depicted here. This application can be used remotely via communications or locally at the site.

In addition to these options, ABB's SCADAvantage, a state-of-the-art, multi-protocol SCADA system can also be interfaced to these and other XSeries/*X*CORE applications. Plunger Lift Plug-In also supports reporting as depicted here.

Additionally, using Totalflow's DDE/OPC driver (TDS32) or Totalflow's Communications Library, other SCADA systems can be interfaced to these and other XSeries/*X*CORE applications.



Report from Plunger Application Plug-In

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DS/2101129-EN Rev. AG 09.2018