Honeywell

Oil & Gas Application Note
Offshore Oil Production Advanced Control

Introduction

Major operating units on an offshore oil production project typically include process separation, gas scrubbing, and compression. Gas is typically used for fuel, re-injection, and in some cases, gas lift. Production by offshore platforms becomes more challenging as wells become increasingly depleted.

In the case where wells are producing at lower oil to produced water ratios, choke valves on the wells may operate at 100 percent. In order to improve production, it then becomes necessary to investigate other means of improvement.

Overview of Oil Production Operations

A typical process consists of two-stage separation of oil from water. The first stage separation occurs in the HP Separator, where the majority of the water is separated from the oil. Gas is also evolved, which passes on to the HP Scrubber (and then onto the HP Compressor.).

Oil from the HP Separator then passes onto the MP Separator where water is again separated and more gas is evolved. This gas is passed on to the MP Scrubber (and on to the MP Compressor.).

Produced water passes to hydrocyclonic separation, where entrained or emulsified oil is removed, and then passes on to the de-gassing drum. From there it is re-injected back into the wells. Oil recovered from the hydrocyclones is fed back into the process at an appropriate point.

The process usually runs floating on two key pressure controls:

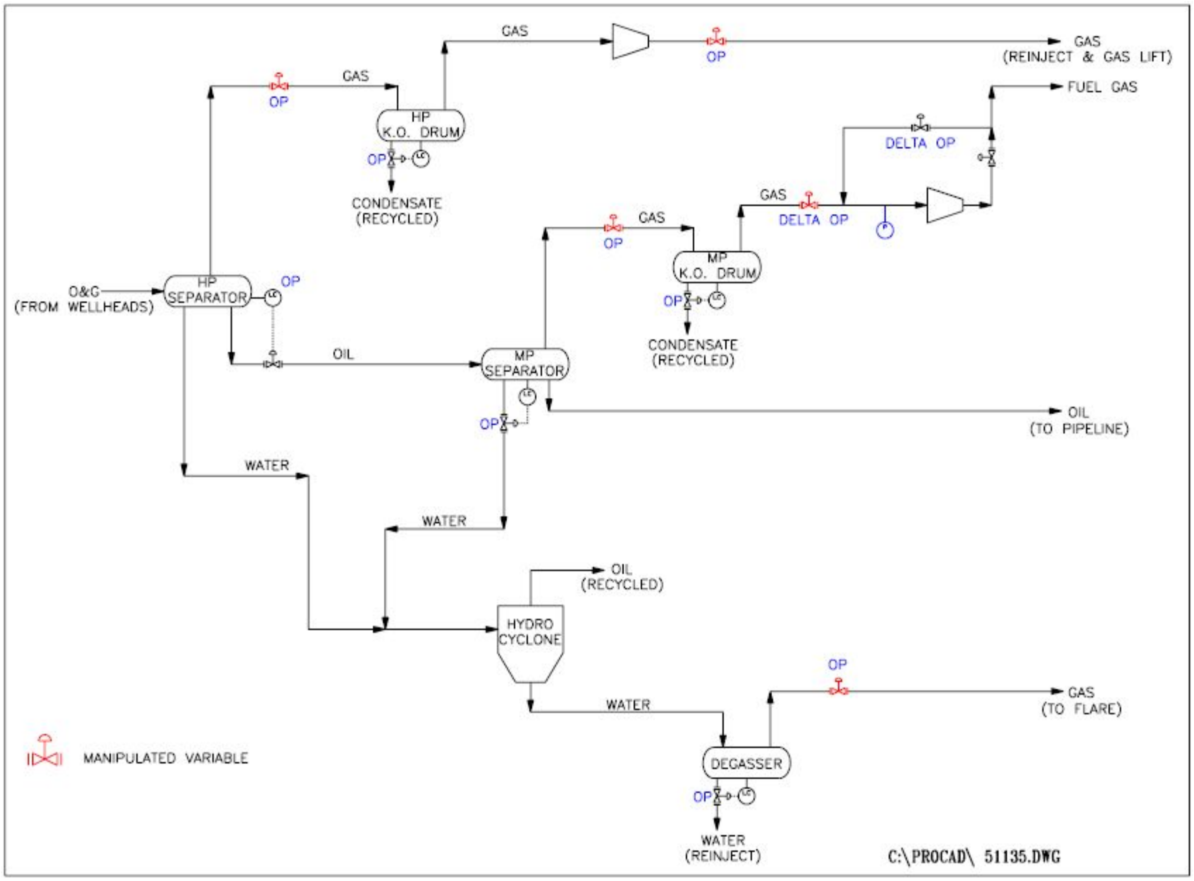
- MP Scrubber pressure control (MP Compressor suction)
- HP Compressor discharge pressure

A typical separation process flow sheet is shown on the next page.

Opportunities for Operations Improvement

The goal in production from depleted wells is to minimize operating pressures across the process. This can be accomplished via reducing MP compressor suction and reducing HP compressor discharge pressure.

Operators usually control short of these optimums, since there is coupling in this process. A problem operators face is that compressor operation can affect MP Separator water level, HP Separator and Scrubber levels, as well as MOL Booster Pump operation.



Solutions – RMPCT Applied to Oil Production

Honeywell's Profit® Suite provides powerful, yet easy-to-use advanced process control technology featuring Robust Multivariable Controller Technology (RMPCT). Profit® Controller with RMPCT is the next-generation multivariable controller employing the latest in robust design technology. The objective of Profit Controller is to control a process closer to its limits and maximize production by manipulating multiple process variables continuously and automatically. Profit Controller predicts future production state, including the effects of disturbances. The process and control objectives and application solution can be broken down as follows:

Production process objectives:

- Maximize oil production.
- Minimize flaring.
- Operate within current equipment constraints.

The RMPCT controller is configured such that the discharge pressure of the HP Compressor will be decreased whenever possible, as will the MP Scrubber pressure (and hence the MP Compressor suction pressure). Decreasing the discharge pressure of the HP Compressor causes the compressor to draw material from the process at a lower pressure, thus ensuring that the HP Separator will run at a lower pressure.

Decreasing the pressures on the process is possible only to a certain physical extent. The lowest possible suction pressure defines the limit of the low-pressure operation for the MP Compressor.

From the above process objectives, the Profit Controller has the following control objectives:

- Minimize operating pressures on the process.
- Operate within current equipment constraint limits such as HP and MP compressor suction pressure, HP scrubber level control valve output, separator water level control valve output, and MP compressor surge controller surge limit.

These operating objectives are reached by a supervisory control strategy, which incorporates all of the relevant variables that effect the process performance: inputs (CV's – controlled variables and DVs – disturbance variables), as well as outputs to

PID controller setpoints (MVs – manipulated variables). The model also takes into consideration process and equipment constraints.

For oil production, the controlled variable (CV) inputs to the model include:

- MP Separator Water Level
- HP Separator Oil Level
- MOL Booster Pump Suction Pressure
- Maximum HP Scrubber Level

The disturbance variable (DV) inputs to the model include:

- None in this example

The manipulated variable (MV) outputs from the model include:

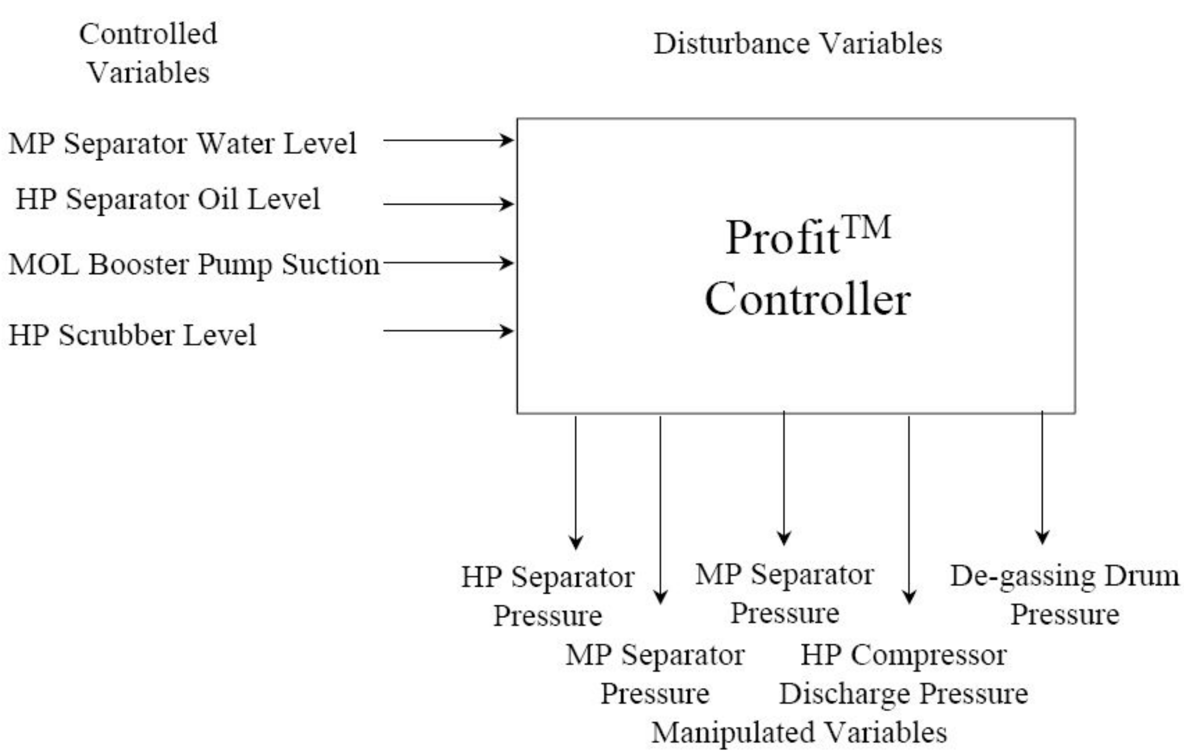
- HP Separator Pressure
- MP Separator Pressure
- MP Scrubber Pressure
- HP Compressor Discharge Pressure
- De-gassing Drum Pressure

Using these variables, a dynamic model is created that defines the relationships between the controlled and disturbance variables with the manipulated variables. The models are built from process data utilizing model identification technology. The Profit Controller then runs the model each minute.

By selecting the best values for the manipulated variables, the model determines how to maintain the controlled variables at their desired values while maintaining the process within its operating constraints. These manipulated variables (set points) are sent to the regulatory control system for deployment.

In the next control cycle (or about one minute later), the Profit Controller runs the model again and deploys another set of manipulated variable set points to stabilize the process and maintain the controlled variables at their desired targets. This constant vigilance results in a very stable operation and better production.

A graphic representation of the model is shown below:



Conclusion

For oil production in a depleted field, there are two key subsystems which contribute to improved throughput: the HP Compressor discharge pressure,and the MP Scrubber pressure (MP Compressor suction). In both cases, the goal is to minimize pressure subject to equipment constraints. In this manner, pressures may be reduced at the upstream separators and de-gassing drum, allowing for greater throughput. Increases in production can range anywhere form 1-6 percent.

Honeywell's TotalPlant® Solution and related methodologies optimize profitability through increased throughput and reduced energy, subject to production economics. This improved profitability is achieved while reducing emissions and maintaining safety and reliability.

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More Information

For more information on Oil and Gas, Visit www.honeywell.com/ps or contact your Honeywell account manager.

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