White Paper

Honeywell

Honeywell Process Solutions

Crude Unit Profit Controller Implementation Using Profit Stepper

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Introduction

Suncor Energy's Commerce City, Colorado, refinery recently commissioned Honeywell's Profit® Controller to stabilize control of the feed coming into the #2 crude unit. Refinery engineers employed Honeywell's online Profit Stepper R320 tool to collect controller data, automate step testing and perform online identification of process models.

The Profit Stepper solution saved time in model identification during the test procedures, while also providing higher quality models than traditional methodologies.

Background

Suncor Energy Inc. pioneered commercial development of Canada's Athabasca oil sands, one of the world's largest petroleum resource basins. Its August 2009 merger with Petro-Canada created Canada's largest integrated oil company and the fifth largest in North America with approximately 12,900 employees.

Suncor extracts bitumen from oil sands near Fort McMurray, Alberta and upgrades the bitumen to high quality synthetic crude oil. Its crude oil production (synthetic and conventional) totals approximately 680,000 BPD. Suncor refineries, located in Edmonton, Alberta; Sarnia, Ontario; Montreal, Quebec; and Commerce City, Colorado, have a total capacity of 433,000 BPD.

Suncor also explores for, develops and produces natural gas primarily in Western Canada. Additionally, the company operates a lubricants facility in Mississauga, Ontario

Suncor purchased the Commerce City, Colorado, refinery in 2003 from ConocoPhillips along with associated storage, pipeline and distribution facilities. Suncor also purchased the adjacent Valero refinery in 2005. The refineries are a major source for Colorado's gasoline and diesel fuel, as well as a supplier of jet fuel to the Denver International Airport. They are also the largest supplier of paving-grade asphalt in Colorado. Refinery products are marketed in the state under the Shell brand name.

Located just outside Denver, with a combined capacity of 90,000 BPD, the Commerce City complex is the largest refining operation in the Rocky Mountain region. In 2006, Suncor completed a $445 million upgrade allowing the refinery to produce refined products that meet newly regulated emission levels for low-sulphur diesel fuel. The modernization also enabled the refinery to integrate a broader slate of crude oil products, including sour crude oil from the company's Canadian oil sands production (See Fig. 1).

Figure 1. Located just outside Denver, Suncor's Commerce City refining complex has a combined capacity of 90,000 BPD.

Operational Challenges

Today's competitive petroleum demands automation solutions that increase production efficiency and profitability. Control system performance can significantly impact a plant's bottom line. Refineries must find ways to optimize large-scale, multivariable applications with various CVs, MVs and DVs.

At the Commerce City refinery, engineers needed an effective solution for stabilizing control of the feed coming into the #2 crude unit. In particular, they required the ability to adjust charge rates with a single handle and lessen the impact of downstream units. The refinery also wanted to minimize operator intervention when adjusting rates and during changing process conditions.

As a first step in optimizing the performance of the #2 crude unit, Honeywell's Profit Loop, a single input, single output model-based controller, was added to control flash tower level and charge rate to the crude heater. Suncor hoped to implement the new controller with a minimum amount of disruption to operations and engineering time.

Prior to the use of Profit Loop technology, flash tower level control was mostly done on a manual basis. Numerous set point (SP) adjustments were required during each operator shift. Operators manually adjusted the SP of the total charge controller, as well as the master feed controller to the crude heater. This approach resulted in poor level control, as well as difficulty maintaining the desired target charge rates.

The Profit Loop application helped to stabilize the level in the flash tower. Based on the success of the level control, additional study of the process and operational experience, it was decided to implement a Profit Controller application to further stabilize the flash tower and crude heater operation.

The new Profit Controller solution had to be built with interface points on the Local Control Network (LCN) to support Native Window graphics. Refinery engineers also sought higher quality models, and wanted to move away from traditional step testing and model identification method.

Suncor began the controller implementation on the #2 crude unit by reviewing several months of process data collected from PI in an effort to develop seed models for closed-loop stepping. Unfortunately, there was not enough perturbation in the data to obtain seed models, thus requiring open-loop step testing.

Testing Solution

In preparation for the Profit Controller implementation, Suncor's project team spent time with Honeywell reviewing the features and functionality of Profit Stepper R320. This powerful tool, which is designed for automated data collection and step testing, can be used to perform initial controller development, update models as controller performance degrades, and change controller matrix.

Profit Stepper technology dramatically reduces the time and effort required for multivariable controller step testing. It has a unique ability to allow testing of the plant as both a mixed closed-loop and open-loop structure while the existing Profit Controller application continues to execute. Traditional testing technologies normally require a temporary decommissioning of the advanced process control application and affect process performance (See Fig. 2).

Figure 2. Profit Stepper R320 is a powerful tool designed for automated data collection and step testing.

During open-loop testing, Profit Stepper collects data from the control system via an OPC interface leveraging base-level control templates common to all Profit Suite applications. Variables move individually or in a concerted fashion according to a generalized binary noise (GBN) signal design. Users choose which independent variables to manipulate, the acceptable step magnitude for each variable and dependent variable response time. The stepper frequency algorithm modifies independent variable signal design to focus on deficient areas of the developing models' power spectrums. This minimizes the required plant test duration. Automated model identification occurs based on content and/or user-designated intervals.

During closed-loop testing, Profit Stepper collects data from the Profit Controller engine via direct Unified Real Time connectivity for all existing application variables. All connections are automatically discovered and configured for Profit Controller applications without additional adaptations. The Profit Controller engine injects a GBN signal for each selected independent variable. Individual signal magnitudes and intervariable switching times adapt throughout the test to reflect model identification results. This minimizes plant test duration by addressing deficient areas of the developing model's power spectrums. Model identification occurs based on information content and/or user-designated intervals.

Profit Stepper provides a highly automated, yet interactive user interface to track the status of a plant test. Engineers can view at-a-glance visualizations for test progress and feedback for key test and modeling parameters from Profit Suite Runtime Studio and PDS. Detailed information is provided on past, current and future MV movement, as well as summary and variable-by-variable modeling results as the test progresses. MV windup stepping is held until the windup condition is cleared. The base value of step and duration can even be changed on the fly.

Project Results

At the Commerce City refinery, open-loop step testing was performed to obtain the necessary controller models for crude unit feed control. This project involved sequential testing of one MV at a time. Suncor rolled the Profit Stepper solution out to refinery personnel with only four weeks of training; the tool proved easy to install, learn and use.

Configuring Profit Stepper for step testing was a very straightforward process. When an MV constraint was projected, Profit Stepper moved the MV away from the constraint. Few problems were experienced during the test procedures, although testing had to be suspended due to level issues with the flash tower as a result of crude composition changes.

The advanced functionality of Honeywell's solution helped convince refinery operators of the advantages offered by the new controller. There was a high level of operator cooperation during step testing, and confidence in the technology has only increased since the controller was commissioned.

Thanks to Profit Suite, Suncor expects to benefit from improved unit stability, increased plant efficiency, greater throughput and reduced operator intervention in the process.

Close cooperation with Honeywell also shortened the design and commissioning time for the Profit Controller implementation, and helped ensure project success. Step testing was performed in February 2010 over a five-day period with models in the controller based on step test data. Engineers stepped two of the four heater passes, but in retrospect, should have stepped all four heater passes. Future plans call for re-stepping in closed-loop model to obtain optimal results.

Commissioning of the new crude unit controller was completed in May 2010 in approximately four weeks.

Conclusion

Use of Profit Stepper provided Suncor's Commerce City refinery with higher quality models than standard plant test procedures, thus resulting in better performing control applications. Going forward, Profit Stepper will enable targeted and efficient application maintenance.

More Information
For more information on Profit Controller, visit www.honeywell.com/ps or contact your Honeywell account manager.

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