

LNG Level Control

This whitepaper highlights the use of the Entech Toolkit by Emerson's Control Performance specialists to improve level control performance



DELTAV

www.EmersonProcess.com/DeltaV



EMERSON[™]
Process Management

Table of Contents

Problem 4

Solutions 5

For Further Information..... 6

Figures

Figure 1 Example of cycling found in the propane ethylene condenser feed chiller of an LNG plant4

Figure 2 Example of process resonance amplified by the controller structure ... Error! Bookmark not defined.

Figure 3 Lambda tuning of the integrating process loop gives a critically damped, non-oscillatory response of the PV and the output.6

Problem

Many units in the process industries have flow through a series of vessels with level controllers on each vessel. Cycling of the level loops should be avoided because it creates variability in the surrounding processes and can greatly reduce the life of the control valves. In general, cycling of a control loop can be caused by

- Oscillatory tuning of the controller
- Interaction between master (outer) and slave (inner) loops due to inappropriate cascade tuning
- Nonlinearity in the inner loop or control valve
- Oscillations passed to the subject loop from surrounding processes
- Process resonance

The example data in Figure 1 is taken from a Liquefied Natural Gas (LNG) plant that uses the Phillips Optimized Cascade Process engineered by Bechtel Corporation. The plant was replacing the level control valves every few months due to severe wear. Upon arriving at the plant, the Emerson consultant found the large slow cycle shown in Figure 1 and a small fast cycle shown in Figure 2. Figure 2 also illustrates that the high proportional gain, typically required in the level controller, amplifies any PV cycling into large output changes to the control valve. In this case, the small PV cycle caused most of the cumulative travel of the control valve.

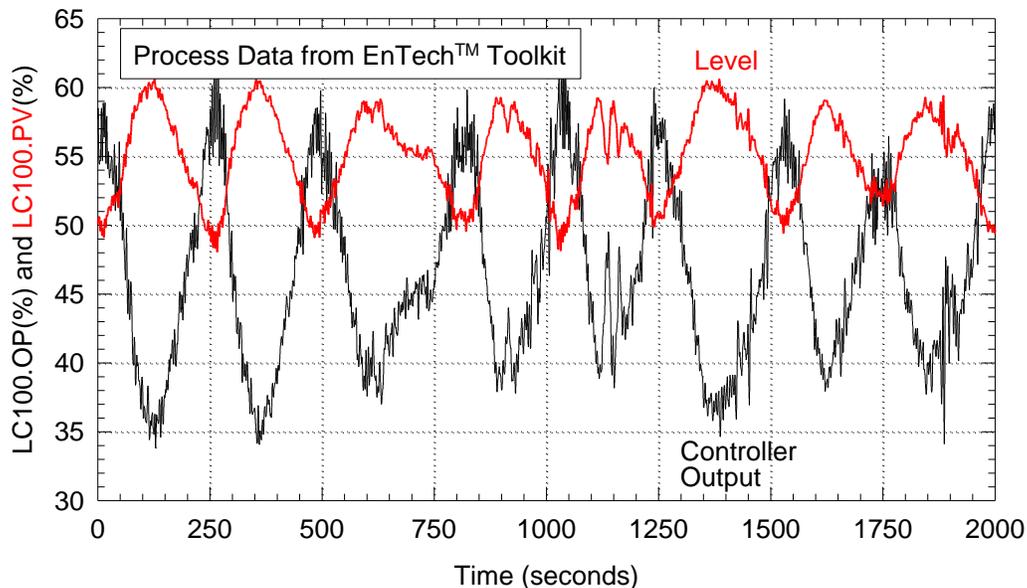
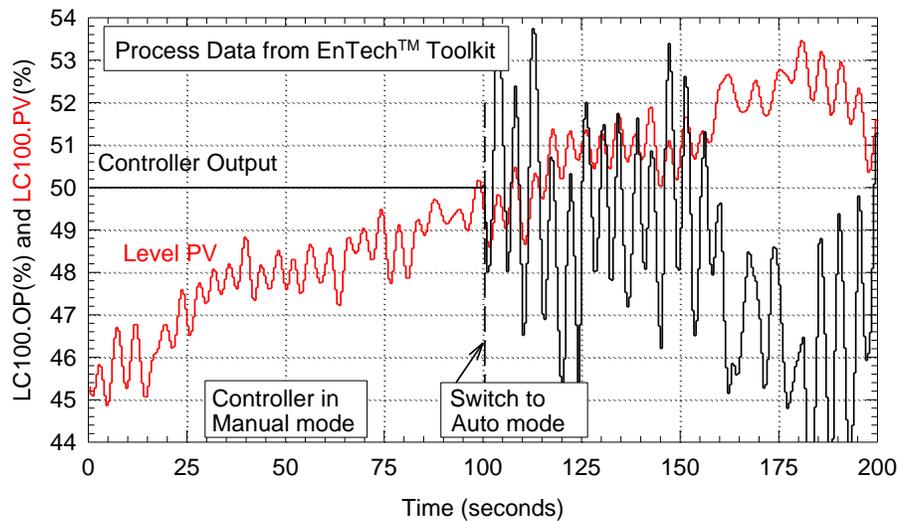


Figure 1 Example of cycling found in the propane ethylene condenser feed chiller of an LNG plant



Solutions

- The Lambda tuning method used by Emerson's Control Performance group provides critically damped response that will not create an oscillation on the output or a resulting oscillation in neighboring loops. As shown in Figure 3, Lambda (λ) is a user-selected parameter representing the arrest time for a step load disturbance. Emerson offers training on this method in courses 9030 and 9032.
- Lambda tuning also provides an explicit parameter to separate the dynamics of inner and outer loops. For example, one can readily choose Lambda of the level loop much greater than Lambda of an inner flow loop.
- Selection of control valves to minimize installed dead band and other nonlinearities is very important. The Control Performance group has extensive experience and tools in diagnosing control valve problems and specifying the valve, actuator, and positioner components for best performance. The actuator readback and diagnostic information provided by Fieldbus (e.g., PlantWeb®) installations can be helpful in optimizing the installed performance.
- Lambda tuning of the level loops prevents oscillation. Also, Lambda can be chosen to make each vessel absorb disturbances instead of propagating them.
- In level control, resonance of the free surface is common and must be handled properly in the controller structure.

In this case, the Emerson consultant recommended a change in the controller structure to minimize the impact of resonance, a modification to the control valve components to better resist wear, and application of Lambda tuning.

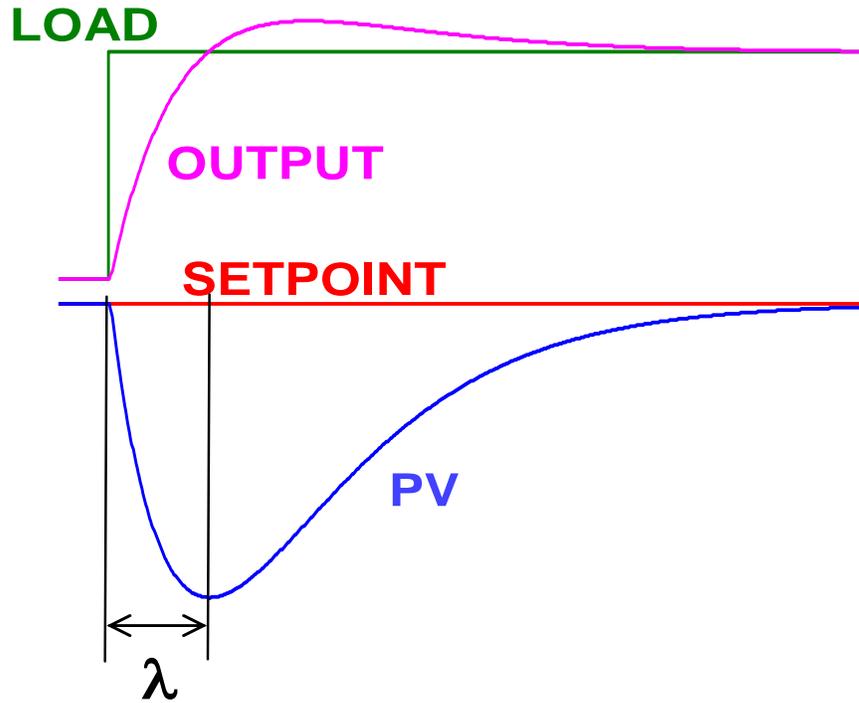


Figure 2 Lambda tuning of the integrating process loop gives a critically damped, non-oscillatory response of the PV and the output.

For Further Information

Mark Coughran

Control Engineering Consultant

EnTech Control Performance division of Emerson Process Management

512-832-3884 (voice)

mark.coughran@emersonprocess.com

To locate a sales office near you, visit our website at:

www.EmersonProcess.com/DeltaV

Or call us at:

Asia Pacific: 65.777.8211

Europe, Middle East: 41.41.768.6111

North America, Latin America: +1 800.833.8314 or

+1 512.832.3774

For large power, water, and wastewater applications

contact Power and Water Solutions at:

www.EmersonProcess-powerwater.com

Or call us at:

Asia Pacific: 65.777.8211

Europe, Middle East, Africa: 48.22.630.2443

North America, Latin America: +1 412.963.4000

© Emerson Process Management 2009. All rights reserved. For Emerson Process Management trademarks and service marks, go to:
<http://www.emersonprocess.com/home/news/resources/marks.pdf>.

The contents of this publication are presented for informational purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the design or specification of such products at any time without notice.



www.EmersonProcess.com/DeltaV

