

# Pipeline Process Control Optimization Techniques

## Improving Pipeline Process Control Performance

### COURSE TOPICS:

Pumping System Fundamentals  
Process Control Basics  
Understanding Process Dynamics  
Lambda Tuning Procedures  
Nonlinearity  
Pipeline Control Strategies  
Troubleshooting Pipeline Control Problems

Pipeline system pressure and flow control applications are somewhat unique. The pipeline control valves may spend much of their time wide open to minimize pumping costs but also need to respond quickly and accurately to sudden pressure excursions to prevent unscheduled line shutdowns. One key to 'good' pipeline control is careful selection and sizing of the pressure/flow control valves in order to minimize non-linear dynamics and ensure valve stability. The control valve speed and resolution are also key requirements. A structured, scientific approach to control loop tuning is needed to ensure fast, stable controller response to upsets. Finally the control strategy needs to compensate for the high non-linearity resulting from hydraulic design and the wide range of operating conditions.

### COURSE DESCRIPTION

The course begins with a review of pump and pipeline fluid dynamic fundamentals and the basic functioning of the control loop. Open loop bump testing to measure process dynamics, evaluate control valve performance (resolution, speed of response) and develop Lambda tuning constants are core topics. The key pipeline control strategies (override control, ratio control, coordinated VFD/valve control, output characterization) are explained in detail. Analytical troubleshooting techniques to identify / correct process control problems is the final topic. Approximately 40% of the course is devoted to a computer-based lab, where the student demonstrates that they have understood the main concepts.

### INSTRUCTORS

**George Jablonsky, ASCT** has over 20 years of industry experience in process control, instrumentation and optimization. He is a recognized expert in optimizing pipeline process control performance. extensive experience in troubleshooting .

**Doug Nelson, P.Eng.** has over 25 years of industrial process control experience. He has broad expertise in process control training of operators, instrumentation specialists and process control engineers.

**Roger Shirt, P.Eng, Ph.D** has 15 years of process control and simulation experience in the liquid pipeline and oil sands industries. He is a recognized expert in control valve selection and control strategy optimization.

### WHO SHOULD ATTEND

The three day course is intended to strengthen the student's ability to optimize petroleum pipeline process control performance. The course is primarily intended for process and control engineers, instrument and electrical technicians and operations management personnel who want to improve their ability to optimize/troubleshoot pipeline process controls. The course explores the implications of process equipment design on control performance and would be beneficial for maintenance and design engineers.

### COURSE LOCATION

The course is being held at the conference facility. Attendees are responsible for arranging their own accommodations.

### REGISTRATION

Registration fee is \$2000 US for the 3-day course. . Attendees need to register 3 weeks in advance to ensure space and materials will be available. ProNamics Control reserves the right to cancel the course based on a minimum number of registrants. The course is limited to 15 participants.

## COURSE SCHEDULE

### Day One

- Lecture 1**      **Pipeline Process Control Overview**  
08:00 - 08:30
- Lecture 2**      **Pumping System Fundamentals**  
08:30 - 10:00  
Definitions  
Bernoulli's Law, Energy balance, Friction  
Pump Performance - Fixed and variable speed
- Lecture 3**      **Control Loop Fundamentals**  
10:00 - 11:30  
Block diagram overview  
Loop components—sensors, controllers  
Actuators/valves and performance guidelines
- Lab 0**            **Simulator Introduction**  
11:30 - 12:00
- Lecture 4**      **Process Dynamics**  
1:00 - 2:30  
Open Loop Bump Testing  
First Order process dynamics  
Second Order process dynamics  
Filtering
- Lab 1**            **Measuring 1st, 2nd order dynamics**  
2:30-4:30  
Pump station discharge and suction pressure control  
Holding/Manifold Pressure control

### Day Two

- Lecture 5**      **Lambda Tuning**  
8:00 - 10:00  
PID control algorithms  
Lambda tuning procedures for 1st order loops  
Lambda tuning procedures for 2nd order loops  
Examples
- Lunch Breaks between 12:00 & 1:00 each day

### Day Two (Cont'd)

- Lab 2**            **Lambda Tuning**  
10:00 - 12:00  
Pump station discharge/suction pressure  
Holding /Manifold Pressure
- Lecture 6**      **Process Non-linearities**  
1:00 - 2:30  
Control Valve backlash/stiction/ response time  
Valve Flow Characteristics/ VFD  
Impact of Fluid Characteristics
- Lab 3**            **Non-Linear Lab**  
2:30 - 4:30  
Identifying backlash and stiction  
Valve Flow Characteristic / VFD induced  
process gain nonlinearities
- Day Three**
- Lecture 7**      **Pipeline Control Strategies / Lambda Tuning Application**  
8:00 - 10:00  
Output Characterization, Override Control  
VFD/PCV Coordinated Control  
Ratio Control, Dealing with Loop Interaction
- Lab 4**            **Output Characterization**  
10:00 - 11:00  
Pump station discharge/suction pressure controllers
- Lecture 8**      **Troubleshooting Pipeline Control Problems**  
11:00 - 12:00  
Troubleshooting Tools, Identifying the problem source, Complex strategies
- Lab 5**            **Troubleshooting Lab**  
1:00-4:00  
Identifying / solving control problems
- Wrap-Up**  
4:00-4:30

## ABOUT ProNamics Control

**ProNamics Control** is based in Vancouver, BC. The company conducts process and control optimization surveys, prepares process simulations to establish best practices and provides a range of training courses related to process control optimization. Visit our web sites at [www.pronamicscontrol.com](http://www.pronamicscontrol.com) for more information about our services.

## REGISTRATION FORM / CONTACT US:      Fax to 604-898-1378

Name: \_\_\_\_\_ Position: \_\_\_\_\_  
 Company: \_\_\_\_\_ Email: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Phone: \_\_\_\_\_ Fax: \_\_\_\_\_

Payment:     Full Payment Enclosed     Invoice my company

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

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