



## **Surge/Waterhammer and other transient fluid flow problems – with practical examples (2 days)**

**Course Topics** Waterhammer/Surge fundamentals, Pump Trip, Two-Phase Flow, Relief Valves, Column Separation, unbalanced loads and Mechanical Analysis. Practical examples and case studies are illustrated using the software CAESAR II and BOSfluids.

**Course Objectives** After the course, the attendee is able to assess dynamic loads that act on a piping system due flow upset conditions such as waterhammer/surge, relief valve opening, pump trips, or valve closure. Attendees will be familiar with typical solutions to waterhammer/surge phenomenon and typical piping designs to avoid air pockets and cavitation. A multitude of real life case studies will be addressed and typical examples will be worked through in detail.

**Course Content**

- Waterhammer/surge fundamentals and theoretical backgrounds.
- Software methods for solving piping surge problems.
- Modeling and analysis of various upset conditions – valve closure, pump trip, pump startup, filling of empty lines, blow down scenarios, etc.
- Determination of unbalanced loads on piping.
- Quasi-static assessment of fluid loading on piping systems (using Caesar II).
- Dynamic assessment of fluid loading on piping systems (using Caesar II).
- The use of surge tanks, air valves and vacuum breakers for safe system design.
- Load development and support design.
- Two phase flow approximations.
- Avoidance of air pockets, cavitation and column separation.
- A large multitude of practical examples and real life case studies.
- Tube rupture in exchangers and loads on the attached pipe.
- Blow down scenarios – making sure the pipe is stable.
- Particular Problems in LNG Service – vapor formation and thrust anchor design.

**Note:** Items may change, be moved to different days, or skipped based on course progress.

**Course outline and structure co-developed by Dynaflow Research Group & Tony Paulin, Jr. P.E.**

Course content developed by Dynaflow Research Group

Course instruction will be carried out by an experienced Dynaflow Research Group trainer who has extensive knowledge of the subject matter and regularly gives training seminars.

## REGISTRATION FORM

**Surge/Water hammer and  
other transient fluid flow problems**  
**2-day Training Seminar**  
April 18-19, 2016  
Cost: \$1,500.00 USD

**Seminar Location:** **PRG Training Room**  
11221 Richmond Ave.  
Suite C-103  
Houston, TX 77082  
281-920-9775

**Recommended Hotel:** Holiday Inn Westchase  
10609 Westpark Dr.  
Houston, TX 77042  
713-532-5400

A rental car is recommended, however the hotel will provide van service to our offices if pre-arranged with the hotel manager upon check-in.

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City, State, Postal Code \_\_\_\_\_

Phone Number \_\_\_\_\_

Email Address: \_\_\_\_\_

**PAYMENT OPTIONS:**

Check Enclosed

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Mastercard / VISA / American Express (Circle One)

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**Cancellation policy:** Paulin Research Group ("PRG") will provide a full refund for cancellations made at least two weeks prior to the seminar. A 50% refund will be given for any cancellations made after that date. PRG reserves the right to cancel this seminar up to two weeks prior to the starting date, based on requirements for minimum registrations at that time. PRG will not be held responsible for any losses you may incur related to travel arrangements due to such cancellation. Your submission of this registration form will serve as acceptance of this cancellation policy in whole, and also serve as your agreement that no other terms, conditions, or contract shall apply to this transaction in any manner.