



45<sup>TH</sup> TURBOMACHINERY & 32<sup>ND</sup> PUMP SYMPOSIA  
HOUSTON, TEXAS | SEPTEMBER 12 – 15, 2016  
GEORGE R. BROWN CONVENTION CENTER

# MPP SHORT COURSE *Key Features* *of Topside and Subsea MultiPhase* *Pumps*

Authors/Presenters : Dr. Paul COOPER (Flowserve) | Pierre-Jean BIBET (Total E&P)

Guest Speakers : Mike MOORE (ITT ) | Bob HEYL (Consultant)  
Ravi Balasubramanian (GE Oil & Gas)



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**Pierre-Jean BIBET**  
**TOTAL E&P**

Pierre-Jean is a senior rotating equipment Engineer at Total E&P in Paris, France, who has been working in the Rotating Machinery Department of the Technology Division since 2003. His work concentrates on subsea boosting projects, following 20 years of professional experience with pumps, and he has specific expertise in Multiphase Pumps (MPP).



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**Paul Cooper –  
Independent Consultant**

Paul Cooper is an independent consultant, based in Titusville, New Jersey, and has spent 55 years in the pump industry. He retired in 1999 from 22 years of pump research and development at IDP, now part of the Flowserve Corporation. Prior to this, at TRW Inc., he performed the hydraulic design of aircraft fuel pumps and inducers as well as submersible centrifugal pumps for the oil field. More recently, he has included multiphase pumping as one of his areas of concentration, with emphasis on the design and performance prediction of twin-screw pumps.

Dr. Cooper is a Life Fellow of the ASME and is the recipient of ASME's Fluid Machinery Design Award and their Henry R. Worthington Medal for achievement in the field of pumping machinery. He has written many papers in this field and is a co-editor of the Fourth Edition of McGraw-Hill's Pump Handbook.



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**Mike Moore –  
ITT Bornemann**

**Michael (Mike) Moore** is the Global Product Director, Twin-Screw for ITT Bornemann. Over the course of his nearly 26 years in the pump industry Mr. Moore has worked for the Flowserve Pump Division and the Colfax Fluid Handling Division prior to joining ITT Bornemann in 2013. His rotating equipment work experience has been derived and applied to a wide variety of centrifugal and positive displacement pump types, both API and non-API. Over the last 16 years he has focused on the development and application of twin screw multiphase boosting technologies applied to upstream surface (onshore and offshore,) sub-sea, and down hole oilfield production environments. Mr. Moore has served as the task force secretary for API 676 – positive displacement pumps, rotary. Mr. Moore received his education in Mechanical Engineering at McMaster University and the Mohawk Technical Institute, both located in Hamilton, Ontario, Canada.



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**Bob Heyl –  
Independent Consultant**

**Robert F. (Bob) Heyl** is now an Independent Consultant after working for Texaco and Chevron for 43 years in research, downstream operations, and company-wide corporate engineering and project development. He has been a team leader of the Chevron Machinery and Mechanical Systems Technology Network, coordinator of the Rotating Equipment Facilities Engineering Organizational Community, and leader of the Mechanical Equipment. His responsibilities included equipment application, specification, selection, installation, troubleshooting, and working with and promoting the use of multiphase pumps. Mr. Heyl has a B.S. degree (Engineering Science) from Hofstra University and attended Columbia University. Mr. Heyl is now an emeritus member of the Texas A&M Turbo and Pump Advisory Committees and has also been an Advisory Board member of the Multiphase Pump User Roundtable (MPUR) recently receiving the Distinguished Member of the Year Award. For the last 4 years, Bob has been serving on The Methodist Hospital Patient Safety Committee as a Community Representative.



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**Ravi Balasubramanian**  
GE Oil & Gas

**Ravi Balasubramanian** is a Senior Staff Engineer in the Advanced Technology Organization of GE Oil & Gas. He leads and supports activities on subsea boosting pump design and development. His responsibilities also include development of system-level design tools and multi-phase computational models for performance prediction and optimization. Prior to joining GE Oil & Gas, he worked as a Subsea Pump Design Engineer at FMC Technologies responsible for multiphase pump hydraulics and multiphase analysis software development for flow assurance, and rotating equipment analysis/design. Dr. Balasubramanian received his M.S. and Ph.D. degrees from Mississippi State University with focus on Fluid and Thermal Sciences. He joined the PAC in November, 2013



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## Course Overview:

This short course targets Rotating Equipment engineers, Process engineers, and Project engineers interested in gaining a better understanding of the unique characteristics of Multiphase Pumps.

The agenda is built to go through the key features of Topside and Subsea Multiphase Pumps (MPP), for both Twin-screw and Helicoaxial technologies.

The program will start with the definition of the main parameters describing a multiphase flowing process. Then for each MPP technology, the presenters will go through the working principles, the design/construction features, operational behavior, operational methodology, and typical control and protection strategies. At the end of this session, the attendees will have gained a working knowledge of both volumetric and a rotodynamic MPP's, realistic benefits of their application on a producing field, and what is the state-of-the-art of these technologies, for both Topside and Subsea.



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## Course Description:

08h30 - 08h45

**Introduction**  
(PJ BIBET)

- Welcome address
- Speakers presentation
- Multiphase Pumping : why multiphase...
- Some Definitions.
- Various Flow conditions.
- Two Multiphase Pumping Process:
  - Positive Displacement MPP:
  - Rotodynamic MPP (helicoaxial).





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## Course Description:

08h45 - 10h00

**Twin-Screw MPP**  
(Dr Paul COOPER)

10h00 - 10h30

**COFFEE BREAK**

### **PART I**

#### **1. Positive Displacement MPP**

1. Piston (simple or double-acting).
2. Double-screws.

#### **2. Twin-Screw MPP**

- a) Working principle – Pump Operation, Performance and Size.
- b) Pump Performance envelopes and limitations.

### **PART II**

#### **3. TOPSIDE MPP Design/Construction Features**

#### **4. Pump Protection**

#### **5. Control Mode.**

#### **6. Behavior in Operation**



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## Course Description:

10h30 - 11h00

**Twin-Screw MPP**  
(Mike MOORE)

### **PART III**

**7. Topside Installations Worldwide**

11h00 - 12h00

**Twin-Screw MPP**  
(Dr Paul COOPER)

### **PART IV**

**8. TSMPP for the Sea Floor**

12h00 - 13h30

**LUNCH**



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## Course Description:

13h30 - 15h00

**Helicoaxial MPP**  
(PJ BIBET)

10h00 - 10h30

**COFFEE BREAK**

### **PART I**

1. Working principle:
2. Key Parameters.
3. Pump Performance Curve, and limitations.

### **PART II**

4. Topside MPP Design Features.
5. Pump Protection.
6. Control Mode.
7. Behavior in Operation
8. Some Topside Installations.



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## Course Description:

15h30 - 16h30

**Helicoaxial MPP**  
(PJ BIBET)

**PART III - Helicoaxial MPP on the Sea Floor**

- 9. Subsea approach.
- 10. Key Features of a subsea HAMPP.

16h30 - 17h00

**Keynote**  
(Bob HEYL)

**Multiphase Pumping !**

**How do we get to such a decision.**

17h00 - 17h10

**CONCLUSIONS**