OIL & GAS

DNV GL’s 16th Technology Week
Advanced Simulation for Offshore Application

31 October 2016
## AGENDA

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Ungraded
Technology Seminar Spotlight: Advanced Simulation for Offshore Application

About Technology Seminar

DNV GL invites you to attend the 16th annual Technology Seminar hosted in Houston, Texas. Specialist will host workshops and discuss the most recent developments. This information delivers cost savings for clients as well as best practices for improving sustainability.
Agenda

- Welcome-Introductions
- Overview of Advanced Simulations in Oil and Gas
- Today’s Program
Global Reach – Local Competence

150 years
400 offices
100 countries
16,000 employees

Ungraded
OIL & GAS

Addressing challenges in the oil and gas industry

Safety and environmental issues
Deepwater and harsh environment
Ageing assets and performance issues
Technology development
Cost pressure and standardization
Risers and Flowlines - Our People, services and tools

- **Core competencies**
  - Risers, Umbilical, Pipelines and Moorings
  - Finite element analysis
  - Fatigue and fracture
  - Engineering Critical Analysis
  - Hydrodynamics
  - CFD

- **Service areas**
  - CVA and IVA
  - Advisory services
Houston Approval Center – Class Approval

- **World Wide Product Responsible**: SPARs, TLPs
- **All Asset Types**: FPSOs, Drill Ships, Semis, TLP’s, Spars, JackUps, OSV, etc.
  - Moho Nord (TLP)
  - Delta House (Semi)
  - Chevron Rosebank (FPSO)
  - Hebron and Husky (GBS)
  - Otto Candies (OSV)
  - Cascade Chinook CVA(FPSO)
  - Kikeh (Spar)
  - Frontier Bully 1&2 (Drillships)
Regulatory Compliance for GOM

- Document review as per NTL No. 2007-G14
- Independent analysis
  - **Strength**
  - **Wave Fatigue (Full scatter diagram)**
  - **VIV Fatigue**
  - **VIM Fatigue**
  - **Interference analysis**
- Vendor component design review
  - **Stress joints**
  - **Flex joints**
  - **Strakes**
  - **Materials**
**Strength and Fatigue of Umbilical**

**Compliant configuration**
- Floater motions absorbed by change in geometry
- Large deformations in 3D space
- Pronounced non-linear response characteristics

**Cross-sectional design**
- Layered structure where each component has a dedicated function
- Plastic sheaths as internal pressure barriers
- Strength/functional elements arranged in helix geometry
Offshore Pipelines Technical Advisory

- Technical Advisory
- Structural Design
  - Pipe reeling & snaking
  - Pipeline installation
  - Global and local buckling
  - Fatigue analyses for free spans and VIV
  - On-bottom stability
  - Structural design
- Flow Assurance
- Erosion assessment
- Materials
Focus Area 1: Pipelines and Risers

- Modelling and Simulation of Pipelines and Risers
  - Coupling between CFD and FEA
  - Fluid-Structure interaction
  - Vortex-Induced Vibration (VIV)
  - Flow-Induced Vibration (FIV)

**Flow-induced Vibration Simulation includes coupling of CFD and FEA.**

**Vortex Induced Vibration of a Complex Subsea Jumper**

**Riser VIV**

**Rigidly Coupled cylinders in tandem arrangement at 2.5D and 6.0D spacing, respectively**
Focus Area 2: Multiphase Flows

- Multicomponent flows:
  - gas-liquid
  - gas dispersion
  - Immiscible flows (free surface)
  - phase transitions, cavitation

Gas Plume destabilisation of semisubmersible rig

Gas leakage with supersonic jet expansion; Mach number (left) and temperature (right)

System Flow Assurance

North Sea Flow Induced Failure
Focus Area 3: Vortex Shedding

- Viscous Wake
  - Vortex shedding
  - High flow field visualization
  - Simulation of complex structures
  - CFD for design evaluations

Hydrodynamic Force Assessment on a BOP/LMRP Structure

Vortex Shedding behind a smooth cylinder

Iso-surfaces in the wake of a circular cylinder (Q-criterion)

Improvement of ruder design
Focus Area 4: Marine Structures

- Environmental Loads on Marine Structures
  - Highly Non-linear wave diffraction loads
  - Extreme response on ships
  - Shallow water
  - Floating Structures
  - Vortex-Induced Motion (VIM)
  - Wind Load around a platform

Visualization of viscous roll motion of a container ship

CFD Study to assess the wind velocity streamline deformation around the Chesapeake Light Tower (CLT) off the US East Coast

CFD Simulation s of Spar VIM – Vorticity Contours
DNV GL HPC Centers

- Global DNV GL centers dedicated to CFD
  - Houston, USA (1250 cores)
  - Hamburg, GERMANY (7000 cores)
  - Oslo, NORWAY (2000 cores)
  - Vast number of dedicated CFD solvers
- Fluid-structure coupling
- Hydrodynamic load analysis
- Simulation of complex flows

Ballast Water Treatment

Zublin Semi-Sub Wind Mill Lifter

Slamming on Free Fall Lifeboat
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Instructor Bios

Mustafa Kara (Mustafa.Kara@dnvgl.com)
Engineer

Mustafa Kara is an Engineer in DNV GL USA’s Deepwater Technology Department where he works on riser analysis and CFD of Fluid Structure Interaction (FSI) problems. While a Ph.D. student at Georgia Tech, Mustafa developed a novel CFD code for modeling FSI using the Immersed Boundary Method. He has a strong background in structural engineering and fluid mechanics, experienced in inter-disciplinary projects involving multi-scale structural problems and multi-physics modeling with a focus on FSI by developing strategies using robust models, numerical methods and innovative tools.

Mustafa holds a Ph.D. in Structural Engineering from the Georgia Institute of Technology.
Jianfeng Xu is a Senior Engineer within the department of Deepwater Technology, DNV GL North America. He has 10 years of experience in the oil and gas industry for subsea pipeline design and advanced analyses. His experience covers wall thickness design, route selection, on-bottom stability, bottom roughness, span VIV, thermal expansion, lateral buckling, upheaval buckling, walking, and installation, etc. His expertise also covers heat and mass transfer, computational fluid dynamics, and pipeline interaction with Arctic environments.

Jianfeng Xu carries a Ph.D. degree in Mechanical Engineering, a M.Sc. degree in Thermal Engineering, and a B.Sc. degree in Nuclear Engineering. He is Registered Professional Engineer in State of Texas, and a Charted Engineer with IMarEST.
Mazdak Parsi (Mazdak.Parsi@dnvgl.com)
Engineer

Mazdak Parsi is an Engineer in DNV GL USA’s Deepwater Technology Department where he specializes at CFD, multiphase flow, and particulate flow with the specialty in sand particle erosion. While a Ph.D. student at University of Tulsa, Mazdak conducted experimental studies of sand particle erosion in multiphase churn\ annular flow and employed CFD validations. He is DNV GL’s expert on solid particle erosion modeling for oil and gas wells and pipelines applications.

Mazdak holds a Ph.D. in Mechanical Engineering from University of Tulsa.
How can DNV GL help you?

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