Course Title: Subsea Pipeline Free Span

Duration: 3 Days

Course Description:

This comprehensive “Subsea Pipeline Free Span” course comprises of lectures, case studies and workshops providing an overview of free span assessment of rigid subsea pipelines. This course provides an insight to fundamental issues for a robust, safe, and economical design of subsea pipeline against free spans and also evaluation of free spans observed in in-service pipelines post subsea survey. The topics of the course are carefully selected to cover free span engineering aspects from conceptual to detailed design. The principal code followed in this course is DNV-RP-F105 “Free Spanning Pipelines” supplemented with DNV-RP-C203 “Fatigue Design of Offshore Steel Structures”, DNV-RP-C205 “Environmental Conditions and Environmental Loads”, DNV-OS-F101 “Submarine Pipeline Systems” and PD 8010-2 “Code of practice for pipelines”.

The attendees will receive a certificate from Z-Subsea by completion of the training course.

This training course helps to gain understanding on:

- Steps involved in engineering and design of free spanning pipeline systems from for both new and existing pipelines;
- Key topics related to engineering of free spans;
- Physical concept behind free spanning pipelines;
- Criteria for robust and safe design of free spanning pipelines.

Who should attend:

- Pipeline design engineers;
- Pipeline Integrity engineers;
- Marine engineers;
- Naval architects;
- Subsea and offshore engineers;
- Project engineers and managers;
- Engineers from other sectors of the Oil and Gas industry who wish to gain understanding of subsea pipeline engineering.

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Course Contents:

Chapter 1 - Wave and Current Modelling

- Sea-states;
- Representation and characterisation of sea-states;
- Short-term modelling of waves;
- Long-term modelling of waves and currents;
- Wave setter diagrams;
- Wave and current histograms;
- Construction of wave and current histogram from return period values.

Chapter 2 - Wave and Current Loads

- Wave theories;
- Selection of appropriate wave theories;
- Wave kinematics;
- Drag and inertia forces.

Chapter 3 - Introduction to Free Spans

- Where free spans exist?
- Free span characterisation;
- Parameters affecting free span response;
- Interacting spans.

Chapter 4 - Free Span Induced Failure Modes

- Fatigue due to in-line and cross-flow vortex induced vibration (VIV);
- Fatigue due to direct wave and current cyclic loading;
- Strength failure (yield) due to pipe self-weight and maximum environmental loading.

Chapter 5 - Free Span Assessment Approaches

- Screening;
- Detailed fatigue assessment based on simplified structural response model;
- Detailed fatigue assessment incorporating finite element modelling;
- Extent of applicability and limitations of above approaches.

Chapter 6 - Safety Factors

- Pipeline safety class effect on general safety factors;
- Effect of certainty of free span physical parameters on safety factors;
- Safety factors for screening criteria.

Chapter 7 - Structural Response of Free Spanning Pipeline

- Modelling of pipe-soil interaction (stiffness and damping);
- Span effective length;
- Natural frequencies and effect of pressure and temperature;
- Stress amplitudes;
- Static bending and deflection.

Chapter 8 - Screening Level Assessment

- Required wave and current information;
- Reduced velocity;
- Check against in-line vibration;
- Check against cross-flow vibration;
- Check against direct wave and current cyclic loading
- Limitations of screening level assessment.

Chapter 9 - S-N Curves

- What is S-N curve?
- Palmgren-Miner Law;
- Classification of the welds in the pipeline;
- Stress Concentration Factor (SCF);
- Internal and external fatigue;
- S-N curves based on DNV-RP-C201;
- S-N curves based on BS 7910.

Chapter 10 - In-Line VIV

- Important In-Line parameters;
- In-line response model;
- In-line VIV amplitude;
- In-line induced stress range;
- In-line vibration frequency;
- In-line damage.

Chapter 11 - Cross-Flow VIV

- Important Cross-Flow parameters;
- Cross-flow response model;
- Cross-flow VIV amplitude;
- Cross-flow induced stress range;
- Cross-flow vibration frequency;
- Cross-flow damage;
- Cross-flow induced in-line motion.

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Chapter 12 - Direct wave and current cyclic loading

- Vibration frequencies;
- Force model;
- Fatigue damage.

Chapter 13 - Marginal Fatigue Capacity and Total Fatigue life

- Comparison of in-line VIV damage and force model damage;
- Calculation of marginal fatigue capacity in each sea-state due to in-line VIV and cross-flow induced motion and integration over long-term current distribution;
- Calculation of marginal fatigue capacity in each sea-state due to cross-flow VIV and integration over long-term current distribution;
- Calculation of marginal fatigue capacity in each sea-state due to direct wave and current cyclic loading;
- Integration of fatigue damage over all sea states.

Chapter 14 - Ultimate Limit State (ULS) Check

- Calculation of maximum in-line and cross flow loading;
- Local buckling code check against DNV-OS-F101;
- Code check against PD 8010-2.

Chapter 15 - Multi-Mode Response and Finite Element Assessment

- FE Modelling;
- Extraction of mode shapes and natural frequencies;
- Calculate fatigue damage at each point alongside the pipeline;
- Extract maximum damage.

Chapter 16 - Free Span Assessment of In-Service Pipelines

- Survey information;
- Splitting the pipeline in several sections;
- Free span assessment;
- Intervention.