

Z-Subsea Subsea Design and Advanced Analysis Profile

Overview of Subsea Design Services (Conceptual, Pre-FEED, FEED and Detail Design)

- ❑ Field Development Options;
- ❑ Field Layout and Route Selection;
- ❑ Subsea Pipelines and Risers;
- ❑ Flexible Risers and Umbilicals;
- ❑ Installation Analysis;
- ❑ Subsea Structures and Pipeworks
- ❑ Materials and Coating Selection;
- ❑ Corrosion Protection Philosophy and CP Design
- ❑ Components Design (Bulkhead, Y-Pieces, Tee, Flange);
- ❑ Subsea Controls;
- ❑ Subsea Process;
- ❑ Flow Assurance
- ❑ Safety Engineering;
- ❑ Cost And Schedule Estimate;

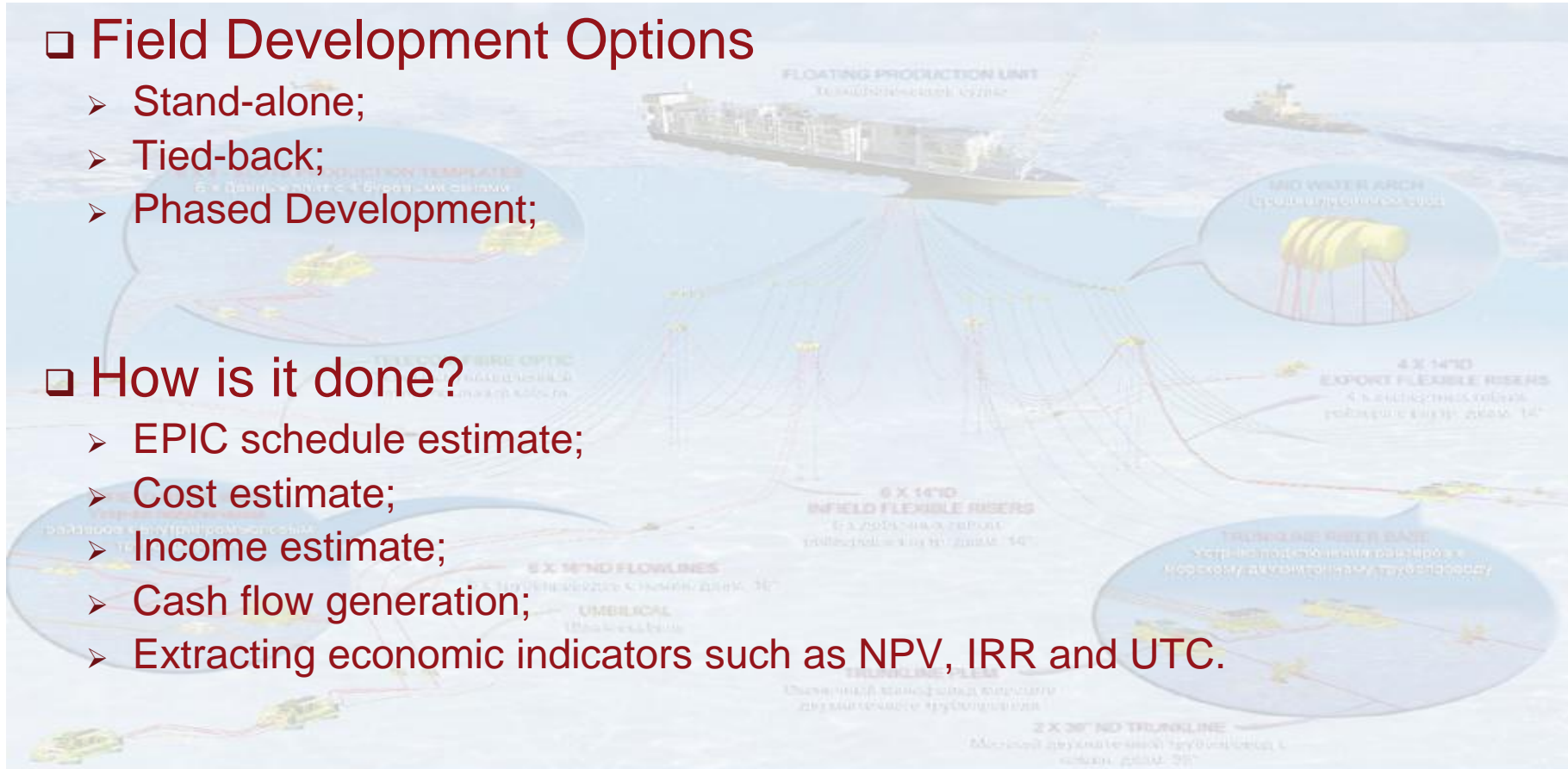
Subsea Design Services – 1

□ Field Development Options

- Stand-alone;
- Tied-back;
- Phased Development;

□ How is it done?

- EPIC schedule estimate;
- Cost estimate;
- Income estimate;
- Cash flow generation;
- Extracting economic indicators such as NPV, IRR and UTC.



Subsea Design Services – 2

□ Field Layout and Route Selection

- Geotechnical and geophysical surveys;
- Manifolds and structures locations;
- Pipeline routes;
- Pipeline system (single, piggybacked, PIP or bundle);
- Controls (EHC, distribution centres);

Subsea Design Services – 3

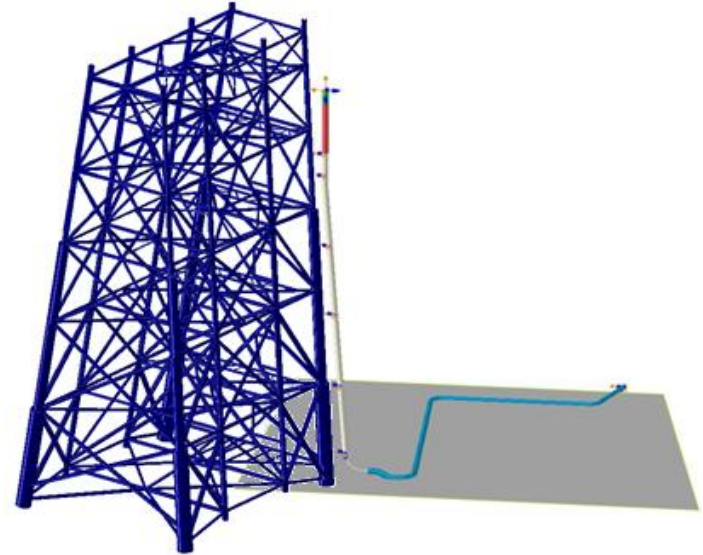
□ Subsea Pipelines

- Material Selection
- Wall Thicknesses
- On-bottom stability
- On-bottom roughness and Free span
- Pipeline protection
- Fatigue
- Lateral and upheaval buckling
- Expansion and Walking
- Crossing design
- Pipe-in-pipe
- Tie-in spools (conventional, vertical)
- Pipe-soil interaction models
- Alignment sheets
- High Pressure/High Temperature (HPHT)

Subsea Design Services – 4

□ Risers and Umbilicals

- Single rigid risers
- Pipe-in-Pipe Risers
- Caisson risers
- Retrofit risers
- J-tubes
- Flexible risers
- Umbilicals
- SCRs



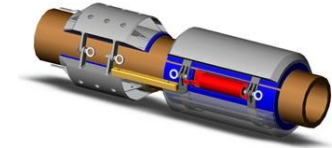
▶ Subsea Structures and Pipework

- SSIV
- Manifold
- PLEM, PLET, UTA
- Foundation (Mud mat, Suction pile)

Subsea Design Services – 5

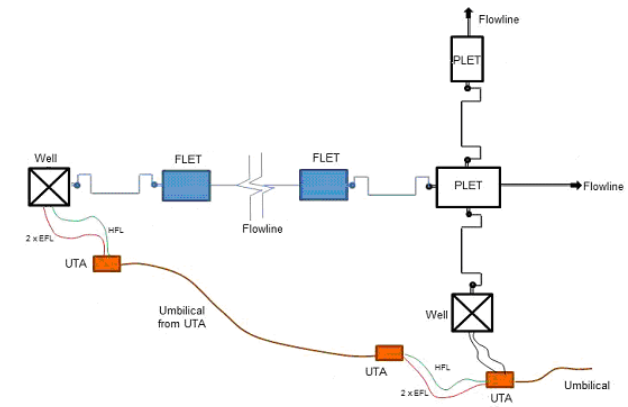
❑ Corrosion protection philosophy and CP design

- CP selection
- CP interference
- CP and anode weight calculation



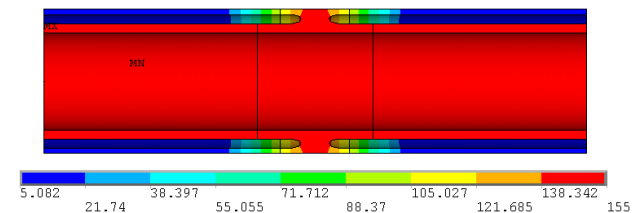
▶ Subsea Controls

- EPU: Electrical Power Unit
- HPU: Hydraulic Power Unit
- TUTU: Topside Umbilical Termination Unit
- SDU: Subsea Distribution Unit
- UTA: Umbilical Termination Assembly
- SCM: Subsea Control Module
- MCM: Manifold Control Module



▶ Material and Coating Selection

- Sour service (CRA, inhibitor, chemical injection)
- External corrosion
- U value



▶ Cost and schedule estimate

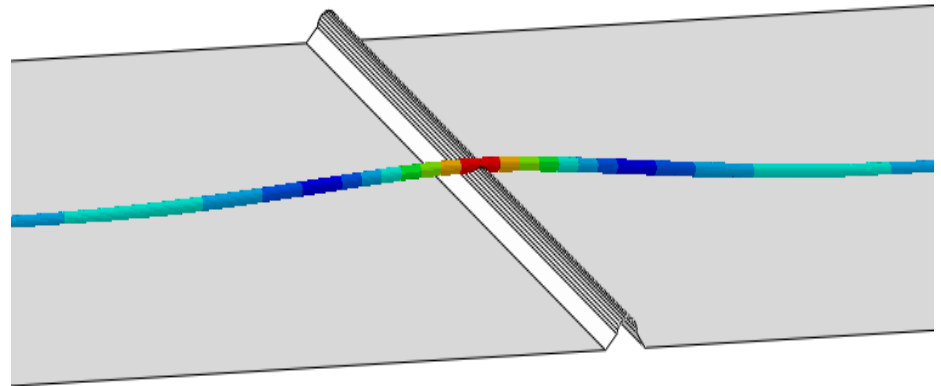
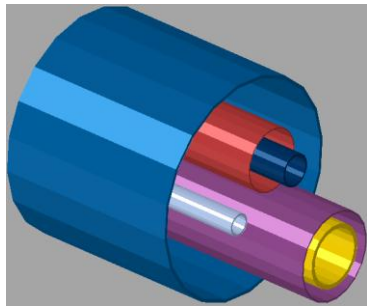
Contract Management Services

- Engineering management
 - Conceptual
 - Pre-FEED
 - FEED
 - Detailed Design

- Procurement Management
 - Market study and assessment of suppliers
 - Procurement management

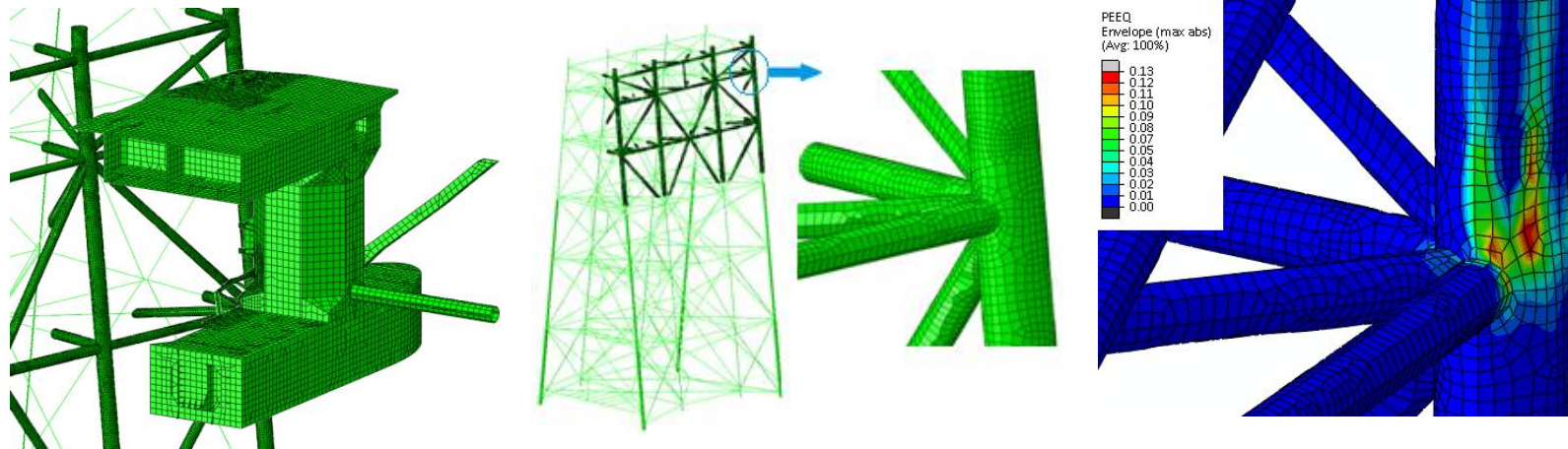
Z-Subsea Specialised Areas – Advanced Analysis

- Subsea Pipelines and Risers advanced analysis
 - Free-span analysis
 - Upheaval and Lateral Buckling
 - Advanced Pipeline/Riser Design (HPHT, Strain Based Design, Low Cycle Fatigue, Pipe-in-Pipe)
 - Single pipe, pipe-in-pipe, bundles
 - Trawling Interference
 - Riser Analysis

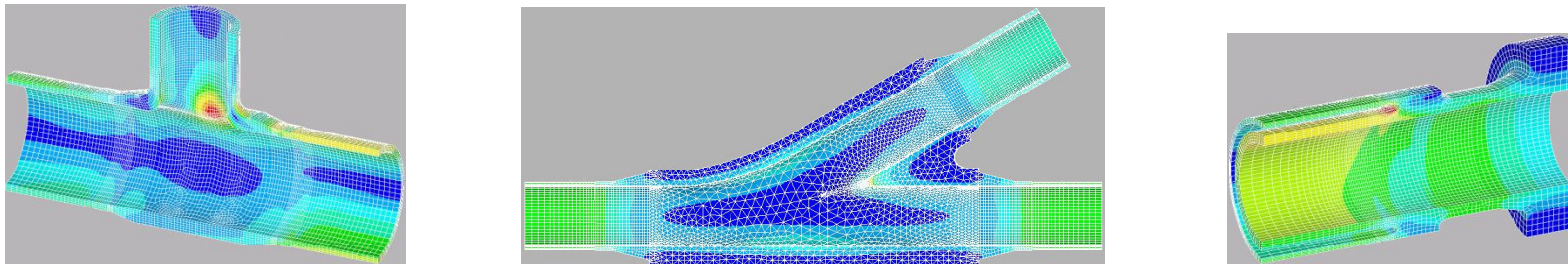


Z-Subsea Specialised Areas – Advanced Analysis

➤ Ship-Jacket Impact Advanced FE Analysis



➤ Component Design (Bulkheads, Flanges, Y-Piece and Tees)



Materials Selection services – 1

□ Welding

- ▶ Screening appropriate welding procedures at the conceptual phase (high level screening)
- ▶ Qualifying nominated procedures at the Design stage for application in Fabrication, Construction, Installation and operation (Repair) phases.
- ▶ Independent/impartial review, audit, and upgrade of existing welding procedure specifications.

□ Non-Destructive Testing (NDT)

- ▶ on-site and/or laboratory based NDT inspections during the procurement, Fabrication, Construction, Installation and operational phases employing qualified NDT personnel.
- ▶ Developing defect acceptance criteria (Tolerable flaw size) for pipeline girth welds for EPC contractors and operators.

Materials Selection services – 2

□ Materials Selection/Corrosion

- ▶ Selection, procurement, managing the fabrication and manufacturing of appropriate material specific to every project.
- ▶ Fit for purpose of the selected materials in terms of the operational condition, resistivity against wear, fatigue, corrosion and protecting requirements (coating and CP systems, etc.).
- ▶ Provision of Materials Engineering expertise via high level materials screening/selection (conceptual phase), provision of procurement specifications especially for the long lead components (Corrosion Resistance Alloys, Clad/lined materials, etc.), support (operation until the end of the design life and beyond (asset life extension) with aiming at reducing the total life cycle cost.
- ▶ Provision of support on procurement specifications, Component fabrication, Vendor assessment and qualification, etc.

CP Design Services

- ❑ Designing of CP systems for CRA materials
- ❑ Design and operation of Deepwater CP systems
- ❑ Performing CP current interaction modelling
- ❑ Performing remedial activities on CP systems (onshore and offshore)
- ❑ Reviewing of annual CP survey reports

