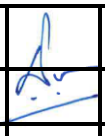
ZEE ENGINEERING

ENGINEERING CAPABILITY STATEMENT FOR OIL/GAS INDUSTRY

PROCESS, PIPELINES, PLATFORMS AND FLOATING SYSTEMS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A	NOVEMBER 2013	Issued For Information	GM	MIZ	HP	
Rev	Date	Description	By	Chk'd	Appv'd	Company

STATUS CODE: A = Issued for information - B = Issued for approval - C = Approved - D = Issued for Class approval

Prepared by:

ZEE ENGINEERING SDN. BHD (MALAYSIA)

Document No.: ZEE – PJM – PCS/PLR/STR/MAR - 002	Revision	Status
	B	A

Contents

1.0 INTRODUCTION

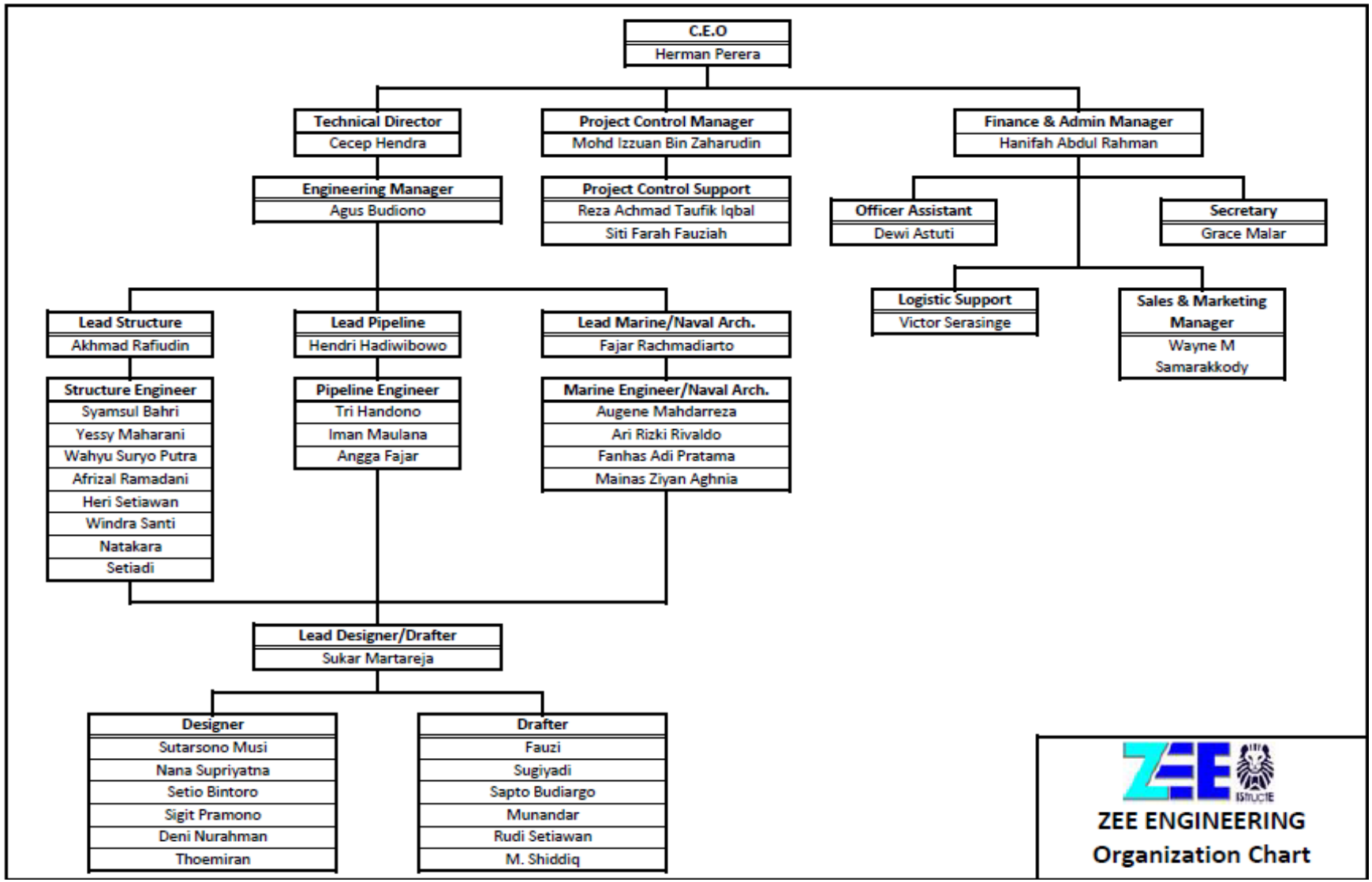
ZEE Engineering Consultants (ZEE) was established in1986 to provide engineering consultancy services to the Oil/Gas industry in the South East Asia region. At the inception ZEE specialized in offshore installation engineering offering services to the Engineering, Procurement, Construction, and Commissioning (EPCC) contractors.

Over the years ZEE has evolved in to a multi disciplinary engineering company engaged in Conceptual, Front End Engineering Design (FEED), Detail Engineering, and contract supervision of complete Oil/Gas related projects. Nevertheless ZEE has continued to enhance Installation Engineering by investing in advanced software and training in-house personnel.

1.1 Objective

The objective of this document is to demonstrate the ZEE Engineering capabilities related to pipeline, fixed and floating systems.

2.0 OVERALL ORGANIZATION



3.0 ZEE PRODUCT PORTFOLIO

- Process and Facilities
- On-shore Pipelines
- Off-shore Rigid Pipelines
- Off-shore Flexible Pipelines
- Mooring Systems
- Flow Analysis (Off-shore / On-shore)
- Corrosion Control
- Transportation and Installation (T & I)
- Pipeline End Manifold (PLEM)
- Cables (Onshore & Offshore),
- Jackets & Topsides (Offshore),
- Floaters (Offshore),
- Installation Aids (Offshore).

4.0 ZEE SCOPE OF SERVICE

4.1 General

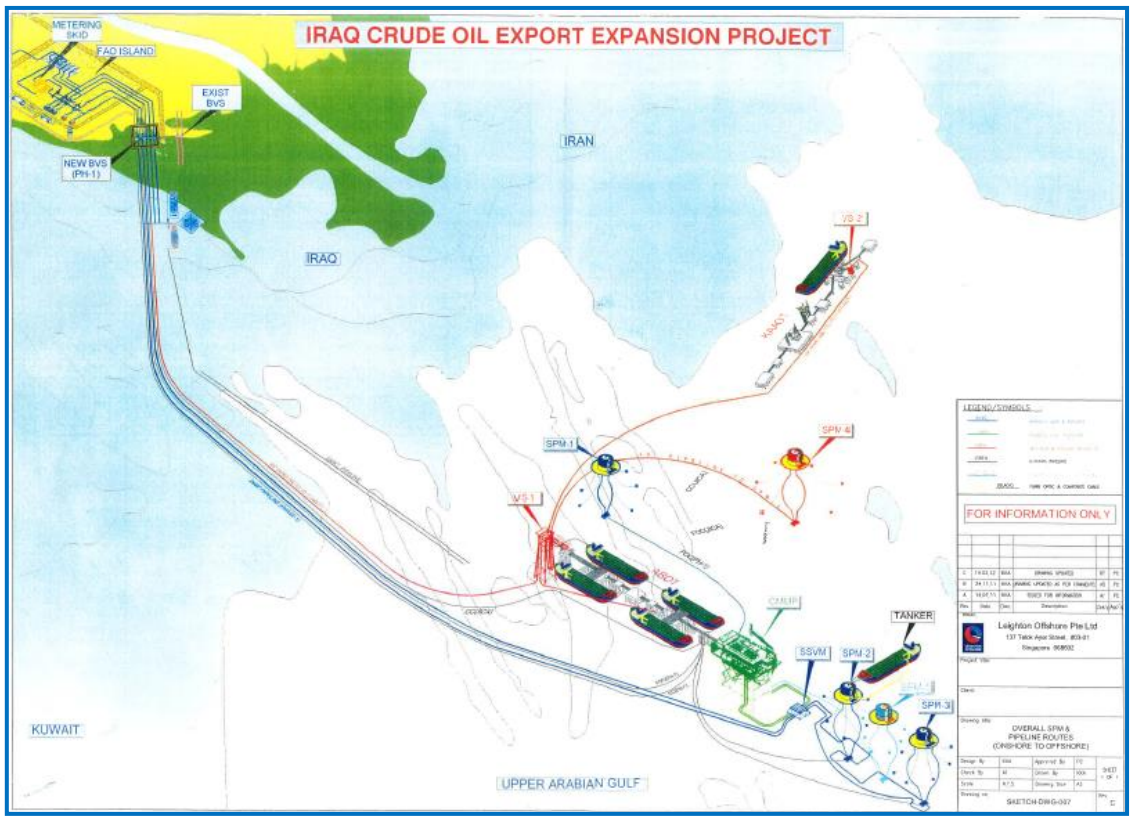
- Conceptual / FEED / Detail Engineering,
- Design Basis Definition,
- Compiling specifications,
- Compiling of Bid documents (RFQ),
- Supervise field survey and data processing,
- Compiling purchase specifications,
- MTO,
- Identification of long lead items,
- Constructability Studies,
- Cost Analysis,
- Vendor selection,
- Leasing with third parties for certification,
- Rehabilitation and Repair,
- Construction Management & Supervision.

4.2 Engineering Capabilities

The scope of projects completed can be summarized as follows;

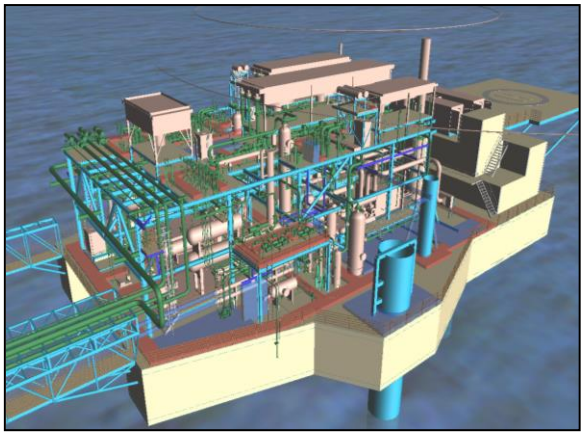
- **General**
  - Compiling Request for quotation (RFQ) documents - technical,
  - Compiling Specifications,
  - Vendor Selection,
  - Design basis definition,
  - Onshore/Offshore Supervision (field engineers),
  - Constructability studies,
  - Offshore Towing, Transportation (intact & damaged stability),
  - Onshore/Onshore Installation Engineering,
  - Assisting in compiling method statements & Procedure,
  - Cost Analysis,
  - MTO and long lead item identification.

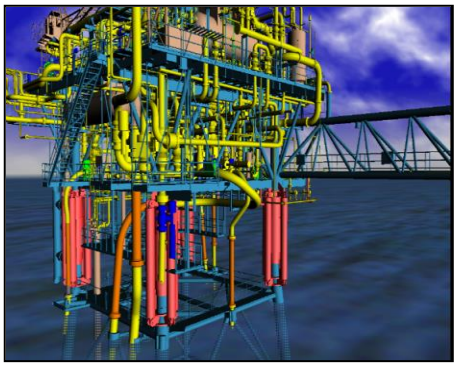
- Certification
  - Lease with third parties for certification
  - Lease with Warranty Surveyors, and other organizations for sail out.

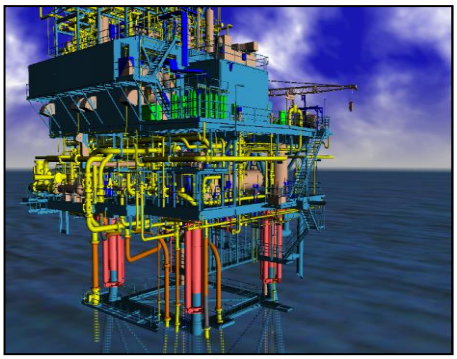


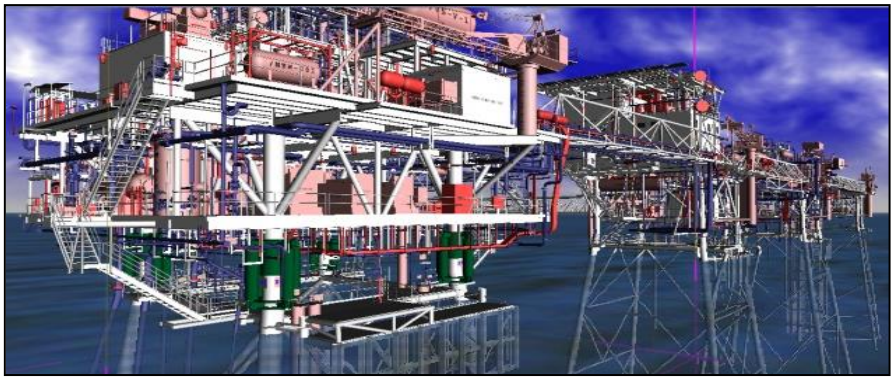
4.3 Process and Facility Engineering

- Front End Engineering Design,
- Detailed Engineering,
- Debottlenecking and Capacity Review,
- Development and Maintenance of Asset Data,
- Management System (Facilities databases, PDMS model),
- Plan of Development Assistance,
- Cost estimation for development/life cycle cost,
- Value Engineering,
- Coordination with sub-surface, drilling and operation teams to ensure consistent development strategy across all disciplines,
- Process Design,
- Electrical,
- Instrumentation,
- 3D Modeling,
- Flow Assurance,
- Mechanical Design,
- Piping,
- Corrosion design.









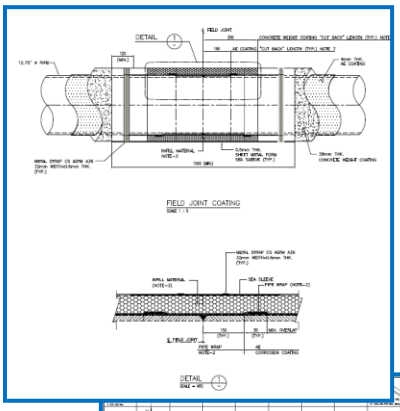
4.4 Pipelines

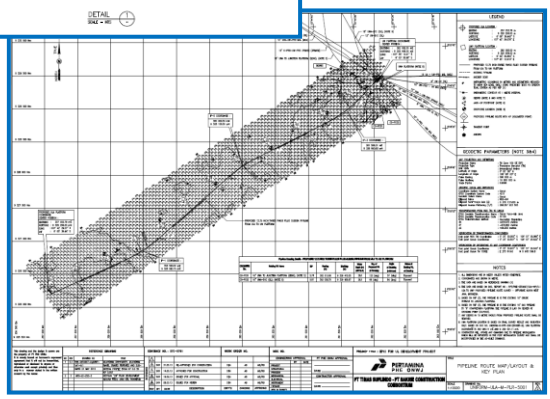
Over the last 20 years ZEE has designed over 250 pipelines. The engineering services offered includes the following;

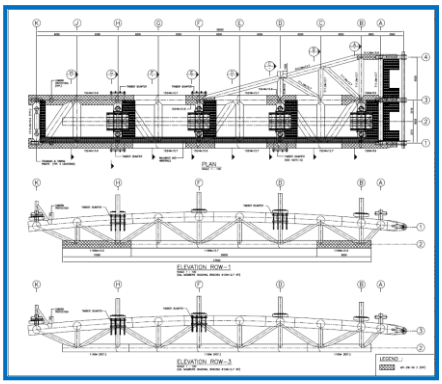
4.4.1 Off-Shore Pipelines

In-Service design

- Develop route selection,
- Perpetration of route drawings,
- Design basis definition,
- Wall thickness and material selection,
- On-bottom stability calculations,
- Upheaval buckling assessment,
- Crossing design,
- Support design,
- Riser design,
- Expansion Calculation,
- Corrosion Protection Design

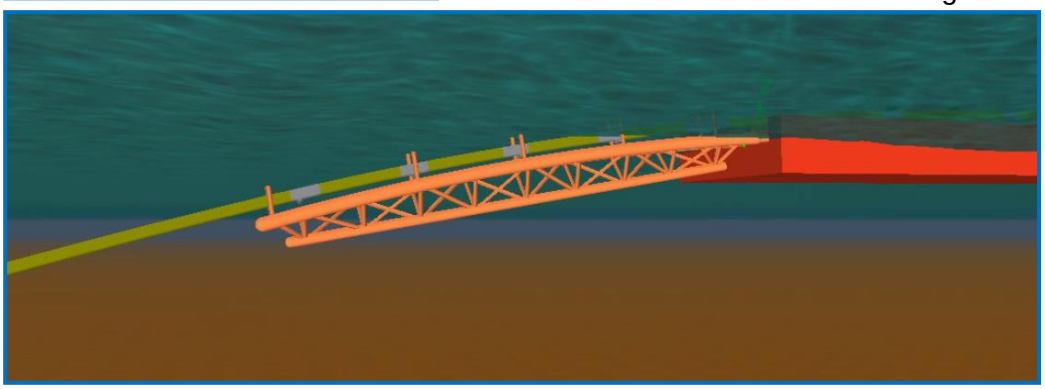




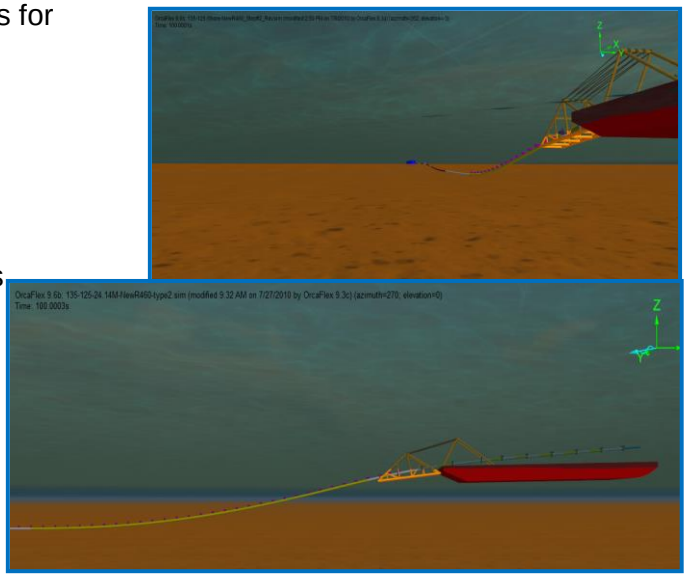


Pre-Service design

- **Traditional DLB**
  - DLB suitability studies,
  - Compiling of Anchor patterns,
  - Mooring studies for DLB stability and pipeline integrity under various sea conditions,
  - Barge modification for pipelay mode,
  - Stinger Design.



- **Pipelay analysis static, dynamic and time domain**
  - Lay Start Up and Lay Down studies for various methods,
  - Pipelay analysis,
  - Termination Analysis,
  - Abandonment and retrieval,
  - Wet and Dry buckle repair analysis
  - Weld repair analysis,
  - Design for Contingency

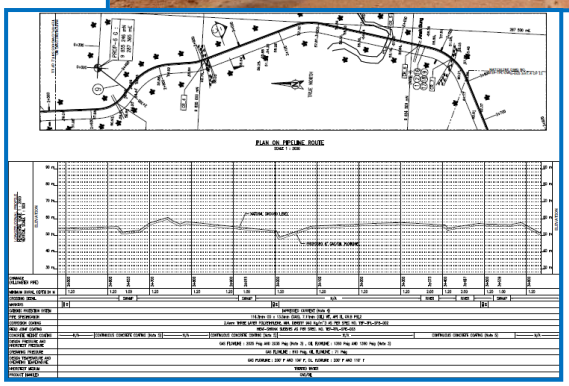


- **Floating pipelines**
  - Surface, on- bottom, off-bottom tow analysis,
  - Various installation techniques,

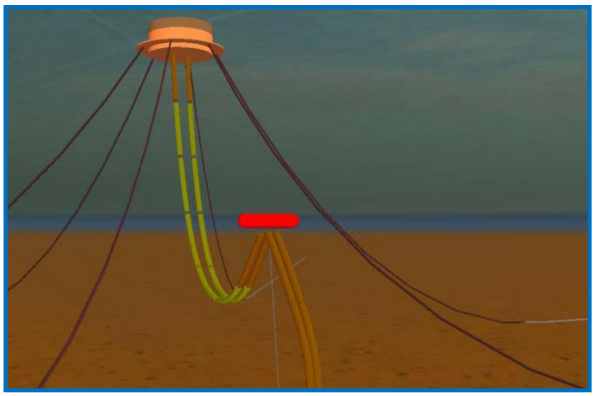
- **Method Statements and Supervision**
  - Compiling method statements for various phases of pipeline installation,
  - Construction supervision.

4.4.2 On-Shore Pipelines

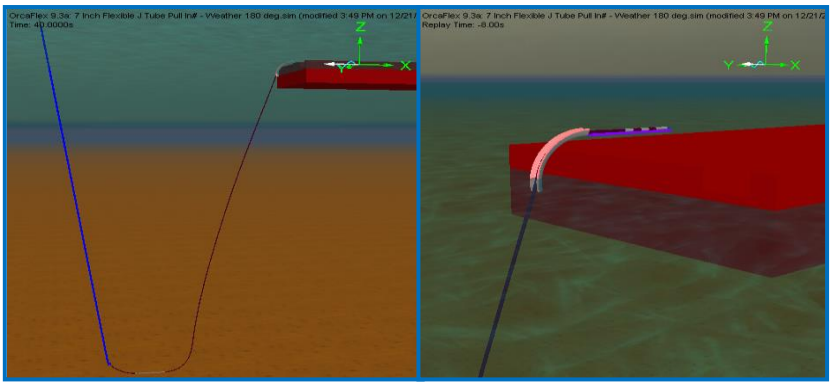
- Develop route selection,
- Perpetration of route drawings.
- Design basis definition,
- Wall thickness and material selection,
- On-bottom stability calculations for swamp crossing,
- Upheaval buckling assessment,
- Crossing design (Road, Stream river),
- Support design,
- Corrosion Protection Design.



4.4.3 Flexible Pipelines

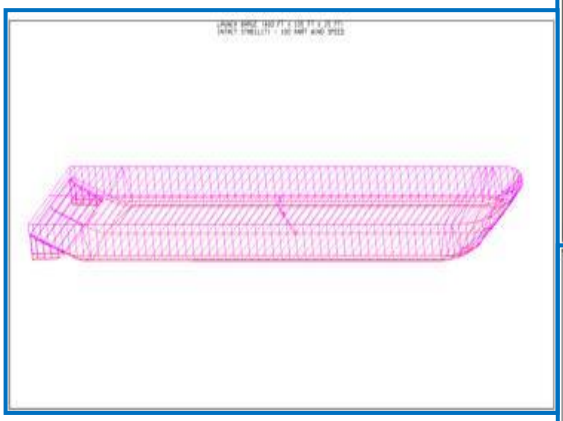


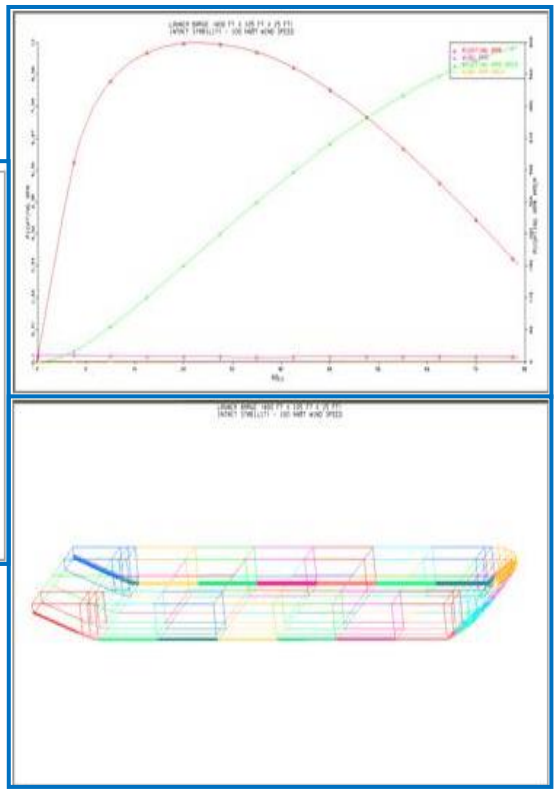
- Under Buoy Hose (SPM),
- Floating Hose,
- Risers,
- Dynamic time domain analysis,
- Simulation & complete hose systems,
- Fatigue assessment,
- Installation Engineering,
- “J” Tube Pull Analysis.

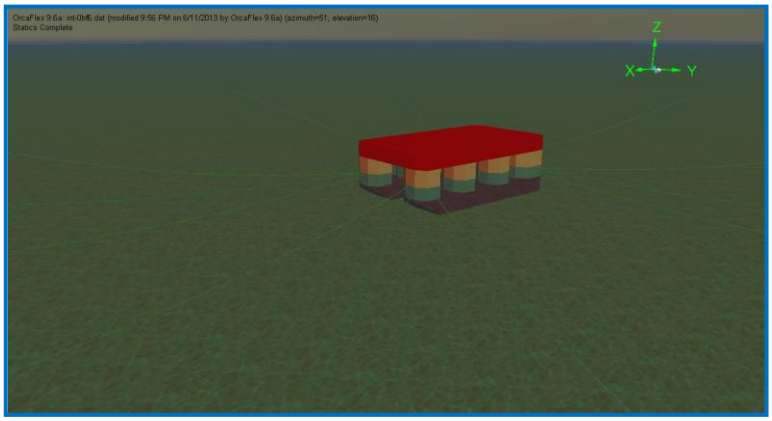


4.4.4 Transportation Studies

- Sea fastening design,
- Stability (Intact / Damaged),







4.4.5 Mooring Design

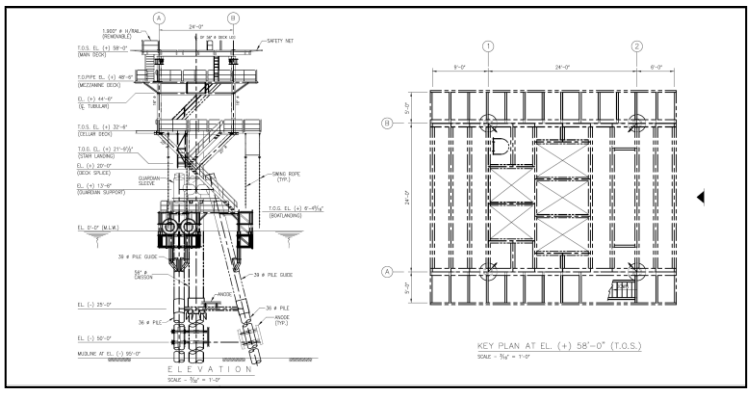
- Anchor pattern development,
- Mooring design,
- Anchor Assessment.

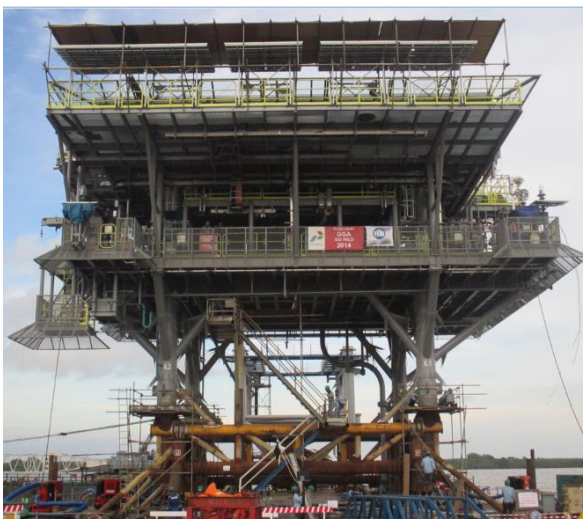
4.5 Fixed Structures

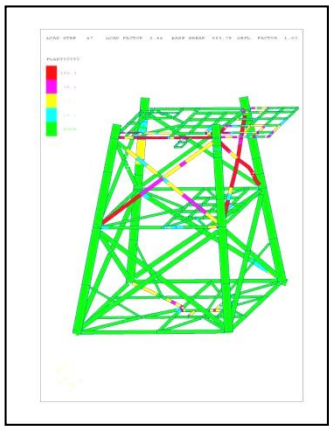
Over the last 20 years ZEE has designed over 50 fixed structures. This includes Jackets, Topsides and Jetty.

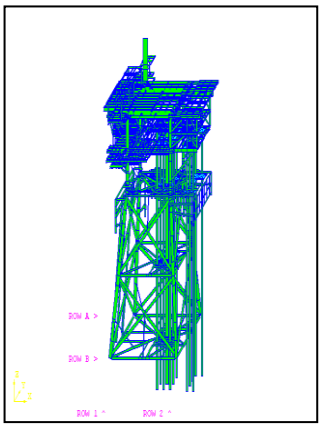
4.5.1 In-Service design

- Develop Design Basis,
- ZEEPod Offshore Substructure Design (patented design for marginal fields),
- Conventional Substructure Design,
- Topside Structure Design,
- Existing Offshore Structure modification design (Substructure and Topside),
- Existing Structure Integrity Study (Push Over) risk assessment, remedial engineering and re-certification.





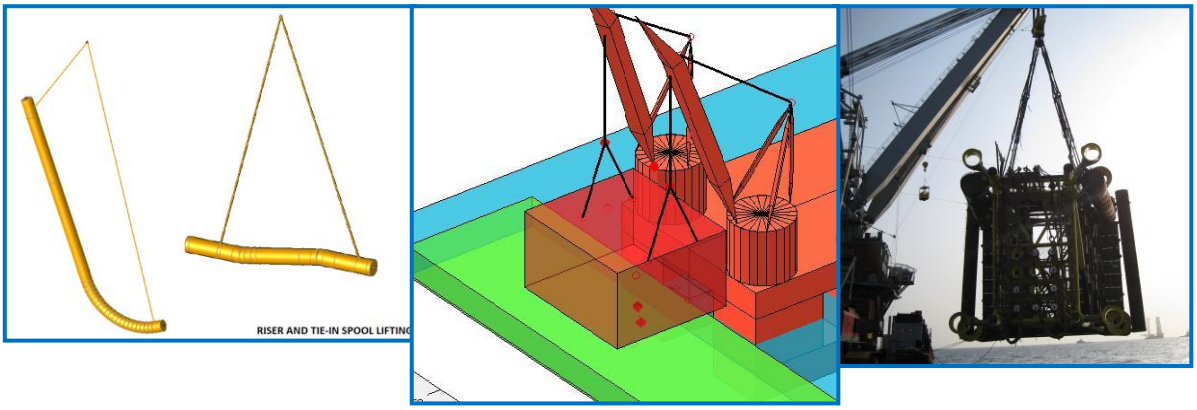




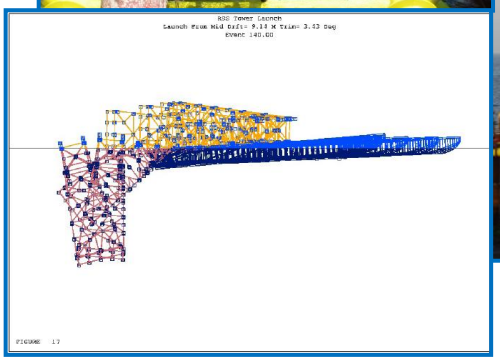
4.5.2 Pre-Service Design

- **Cranes, Crane Barge, Transportation Requirements**

  - Crainage requirements and Barge suitability studies,
  - Generation of barge characteristics such as RAO's, QTF, Damping Matrix,
  - Mooring studies for Barge at Load Out and Installation



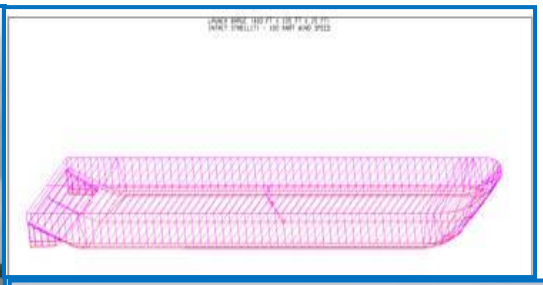
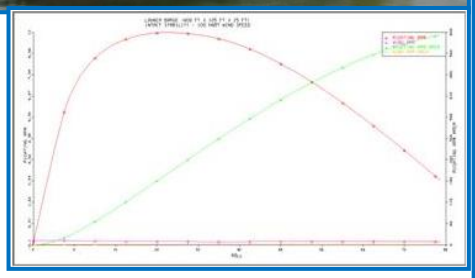
- **Installation Engineering**



  - Establishing COG and Rigging arrangements,
  - Lifting analysis and Rigging sizing (Static & Dynamic).
  - Check appurtenance such as pad eyes
  - Load Out Analysis and sequence.
  - On-bottom Stability Analysis, and check mud-mat sizing and supports
  - Pile Stick up and Drivability Analysis,
  - Jacket flotation and lifting analysis,
  - Jacket Launch Analysis

- **Transportation Analysis**

  - Transportation Layout development,
  - Check barge strength, and deck strengthening studies,
  - Barge grillage and Sea fastening Analysis,
  - Barge Stability (Intact & Damaged) and longitudinal Strength / Motion studies,
  - Barge intact and damage stability studies,
  - Towing Analysis

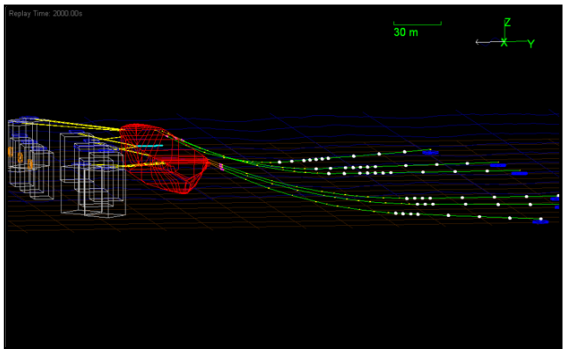




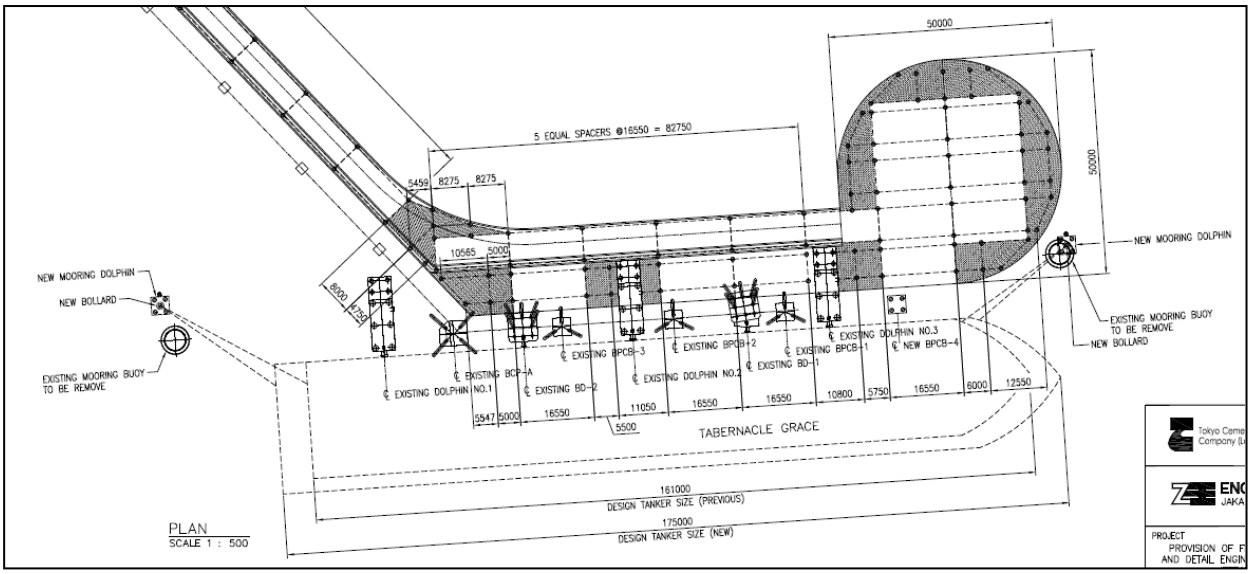

- **Method Statements and Supervision**

  - Compiling method statements for various phases of Jacket and Top side installation,
  - Installation supervision

4.5.3 Jetty Design

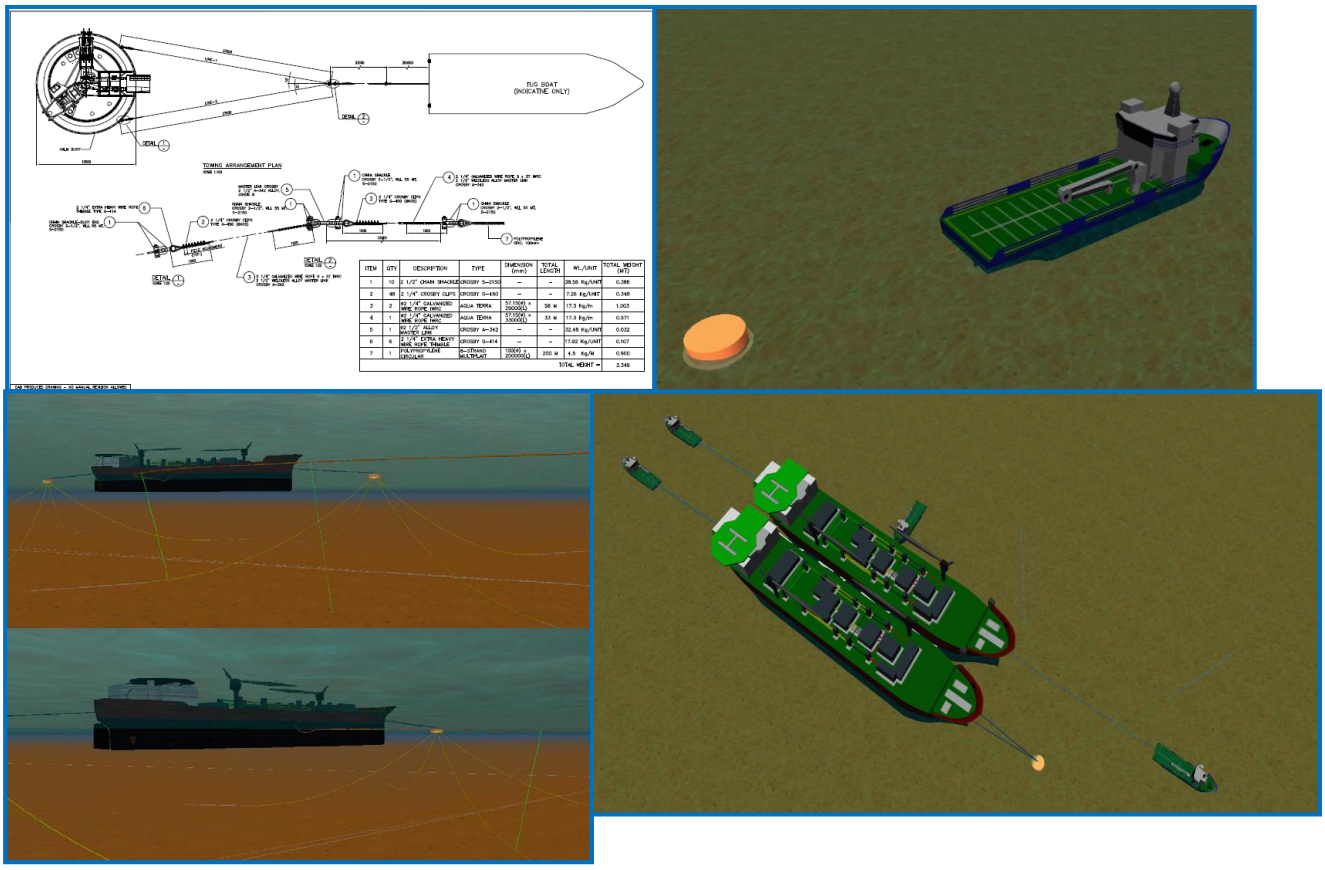
- Develop Design Basis,
- Complete Jetty Civil & Structural Design,
- Dynamic Mooring Analysis (including for Fender Load Design),
- Jetty Head / Loading Platform,
- Mooring Dolphins,
- Breasting Dolphins,
- Trestle and Causeway,
- Catwalk,
- Bollards,
- Fenders,
- Model Testing.





4.6 Marine And Floating Systems

- Towing Analysis,
- Flexible pipeline installation Analysis,
- Umbilical Installation analysis,
- FSO / FPSO Refurbishing Facility Design,
- FSO / FPSO Mooring Design including Fatigue Analysis,
- SPM Mooring Dynamic Time Domain Analysis,
- SPM, PLEM Installation Engineering,
- Anchor Design,
- Chains and Appurtenance Sizing / Design.



5.0 CODES AND STANDARDS

Familiar with international codes such as;

DnV-OS-F101	:	Submarine Pipeline System
DnV 1981	:	Rules for Submarine Pipeline Systems,
DnV RP B401 (1993)	:	Cathodic Protection Design,
DnV RP F103 (Oct 2003)	:	Cathodic Protection of Submarine pipelines by Galvanic Anodes,
API 5L 2004	:	Specification for line pipe,
API Std 1104	:	Standard for welding Pipelines and related facilities,
API RP 5LW	:	Recommended Practice for Transportation of Line Pipe on barges and Marine vessels,
ASME B31.4	:	Pipeline transportation systems for liquid hydrocarbons and other liquids,
ASME B31.8	:	Gas transmission and distribution piping systems,
API Spec 5L	:	Specification for Line pipe.
APZ Spec 6D	:	Pipeline Valves (gate, Plugs, Ball, Check Valves),
APZ RP 2P	:	Recommended Practice for the Analysis of spread Mooring Systems for floating Drilling units,
APZ RP110	:	Recommended Practice for Pressure Testing of Liquid Petroleum Pipelines.
ISO 9001-2000	:	Quality Management Systems- requirements.
API RP 2SK	:	Recommended Practice for Design and Analysis of station keeping system for Floating Structures, March 1997.
DNV-OS-E301	:	Position Mooring, June 2001.
ABS	:	Guide for Building and Classing Floating Production Installation, June 2000.
BV	:	Guidance Note for the Quasi-Dynamic Analysis of Mooring System using ARIANE Software.
OCIMF	:	Prediction of Wind and Current Loads on VLCC's, 2nd Edition 1994.

And other international codes such as BOSS, BS etc

6.0 SOFTWARE

Zee has in-house, a wide range of software required for the design of submarine pipelines, which includes the following;

SIMSCI : Process Simulation for which predicts steady – state pressure, temperature and liquid holdup profiles in wells, flowlines, and gathering system,

SIMFLEX : Performs static/dynamic flexibility analysis of power, petrochemical, chemical and other industrial plant piping systems subject to pressure, temperature, weight, wind, earthquake and other loading. Stress compliance reports are generated for ANSI B31.1, B31.3, B31.4 and B31.8. Pipe/Soil frictional effects are also included.

HYSYS : Process design (flow design),

ORCAFLEX : Dynamic coupled time domain analysis of floating and moored systems including detail pipelay analysis,

OFFPIPE : Static and Dynamic analysis of Pipelay,

AutoPIPE : Piping analysis software in small to high-end piping projects.

PIPE : ZEE In-house suite of programs for the in-service design of pipeline for DnV 1981 and DnV-OS-F101,

MOSES : Naval Architect Software for Vessel/Barge Motion, RAO Generation, Hydrostatic, Stability Analysis, etc.

SACS	:	Structural Analysis static and dynamic,
GRLWEEP	:	Dynamic Pile Drivability Analysis

7.0 SIGNIFICANT RECENTLY COMPLETED PROJECTS

- Heera Redevelopment Project (India)
  Operator ONGC, EPCC Contractor Punj Lloyd

  Design of 4 new Well Head Platforms and modifications to 8 existing platforms. The project included infield 8 no rigid pipelines and 3 no flexible lines. The scope included the detail and installation engineering. Also included the stinger modification to DLB Ganesh.

- Betara Complex Development (Indonesia)
  Operator PetroChina International, EPCC contractor SembCorp (Singapore)

  Design of 2 offshore loading terminals for condensate and gas. The project included 3 pipelines (6", 9" & 12") shore to loading facilities. The scope included detail and installation engineering.

- Anoa AGX Compression Phase 4 Project (Indonesia)
  Operator Premier Oil

  Complete multidiscipline facility engineering for FEED+, Construction / installation planning, Early tie-in detailed engineering and ITB documents for EPCI

- Santos Production Barge Modifications (Indonesia)
  Operator Santos

  Brownfield project on modifications of the Seagood Production Barge topside systems. SOW includes Multidiscipline detailed engineering for all modifications / additions, Construction support and Start-up & operating procedures.

- KE-38 MOPU Project (Indonesia)
  Operator Pertamina

  Fast track project (engineering to first gas) within 6 months utilizing second hand equipments/rig to install temporary MOPU adjacent to existing wellhead platform. SOW includes Topside Engineering, Partial Hull Engineering and Start-up and Operating procedures.

- Colombo Port Expansion project (Sri Lanka)
  Operator Colombo Port Commission, EPCC contractor Leighton

  The project involved the installation of SPM and import 36" line from SPM to shore. The scope included Installation engineering and supervision.

- Labuan Water Pipeline Project (Malaysia)
  Operator Labuan water authority, EPCC contractor Leighton.

  The project involved the installation of 36" pipeline to transport water from the mainland to the Labuan Island. The scope included installation engineering and supervision.

- KLO pipeline Replacement (Indonesia)
  Operator Chevron Indonesia, EPCC contractor Dwisatu Mustika Bumi.

  The project involved the replacement various segment of corroded infield pipelines form 4" to 12". Scope included detail design and Installation engineering.

- Pipeline from BPCR to BPCL Uran (India)
  Operator M/s Bharat Petroleum Corporation, EPCC Contractor Punj Lloyd.

  The project involved the installation of 10" pipeline with 2 shore approaches and a sector in shallow water subjected to heavy currents. Scope included detail and Installation engineering.

- Tanzania SPM replacement (Tanzania)
  Operator Tanzania & Zambian Government. EPCC Contractor Leighton.

  The project involved the installation of SPM and 2 lines 28" & 24" from SPM to shore with over 2 km of shore approach. Scope included the Installation engineering including conceptual shore pull design.

- Rerouting of 18 km of pipeline (Indonesia)
  Operator PT Pertamina Hulu Energy West Madura Offshore.

  The 24" pipeline had to be rerouted to be away from the shipping line. The scope included, Concept development, and FEED.

- KE Field Development (Indonesia)
  Operator PT Pertamina Hulu Energy West Madura Offshore.

  The project included the FEED study for 4 new Well Head Platforms and modifications to the Process Platform and the related pipelines.

- UL Field Development (Indonesia)
  Operator PT Pertamina Hulu Energy West Madura Offshore

  The Project included the FEED study for

- Filanovsky Field Development (Russia)
  EPCC Contractor Bumi Armada (Malaysia)

  The project included the installation of 8 pipelines from 12" to 20" in very shallow waters. Scope Installation Engineering.

- A.P.H Offloading Facilities (Malaysia)
  Operator Asian Petroleum Hub. EPCC contractor Kencana KL

  The project involved the installation of an SPM and offloading lines 2 nos 48" from SPM to shore. Scope included Conceptual and FEED.

8.0 COMPANIES WORKED FOR

8.1 Oil & Gas Companies

PETRONAS

PETRONAS

TOTAL

TOTAL

REPSOL YPF MAXUS

CONOCO

CONOCO

ARCO

ARCO

BP. ARCO

PremierOil Natuna Sea Limited

PREMIER OIL

PERTAMINA PHE WMO

PERTAMINA

GSPC

GUJERAT PETROLEUM

PetroChina 中国石油

PETROCHINA

中国石油天然气集团公司

CHINA NATIONAL OIL COMPANY

KANGEAN ENERGY

Santos

SANTOS

JNS

JAPEX

KODECO ENERGY CO., LTD

KODECO ENERGY

ओएनजीसी ongc

ONGC

BG INDIA

BRITISH GAS

8.2 EPC / Installation Contractors

MCDERMOTT

KENCANA HL

LEIGHTON

SAIPEM

PUNJ LLOYD

HYUNDAI CONSTRUCTION

SEMBAWANG SEMBCORP

BUMI ARMADA

PT MEINDO

TL OFFSHORE

HEEREMA MARINE CONTRACTORS

AKER KVAENER

9.0 BRIEF CV'S OF KEY PERSONNEL

Herman Perera - CEng M.I Structure E. Chartered Structural Engineer (U.K),
Senior Engineering Consultant and Technical Director ZEE Engineering

26 years experience in Design, Project Management and Construction. Including 20 years in offshore structures. Experience includes detail design and engineering, computer simulation, design verification, fabrication engineering and Recertification Engineering.

Cecep Hendra - MSc Civil, Engineering Manager

15 years experience in Structural, Pipeline and Marine Engineering covering range of activities in the Offshore and Onshore Oil & Gas industry, and general Civil, Structural Engineering. Experience also includes the design of Floating Structures, Umbilicals and Flexi Lines.

Dennis Yao Yu - Ph.D. Soil Specialist, Geotechnical and Foundation Engineering

30 years experience in Consultancy and engineering design for onshore and offshore foundations and geotechnical issues including e.g. earth stability, building settlement, retailing wall, excavation, tunnelling, railway tracks, soil structure interaction, suction piles, gravity bases, drag anchors and bored/driven piles.

Wong Loong Ching - MEng Chemical and Process Engineering (Hons) University of Exeter, United Kingdom, Lead Process Engineer

13 years experience as a Process Engineer in the Oil and Gas Industry. Over the last 13 years, Wong has been exposed to all aspect of process and safety engineering. He have been significantly involved in process design/simulation/safety.

Agus Budiono - BEng Naval Architecture & Shipbuilding, Lead Pipeline/Marine Engineer

13 years experience as a Pipeline and Marine Engineer in the Oil and Gas Industry. Attended extensive training courses in Jakarta and Kuala Lumpur on theoretical and computer simulation of submarine pipelines and mooring systems.

Mohd Izzuan B. Zaharudin - CEng, Project Manager

9 years experience in Civil, Structural, Pipeline and Marine Engineering covering range of activities in the Offshore and Onshore Oil & Gas industry. Other experiences include Project Management, Proposal Preparation (Technical & Commercial), Client Communication and Engineering Team Coordination and Trouble Shooting.

Akhmad Rafiudin - CEng, Structural Engineer

9 years experience in Structure, Pipeline and Marine Engineering. He also has a wide range of knowledge in structural analysis software's and design and has completed many projects for Zee in structure analysis.

Fajar Rachmadiarto - BEng Ocean Engineering, Lead Naval Architect/Marine Engineer

9 years experience in Naval Architecture and Marine Engineering, with vast experience in design of Floating structures, Umbilicals and Flexi lines, also experience in Pipeline and Mooring Design.