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INTRODUCTION

Over the last 5 years, Zee Engineering Consultants has been enhancing the capabilities of carrying out Conceptual and Detail Engineering for the design and the Installation of floating systems such as FPSO, FSO, SPM, Mooring, and Flexible Pipe Lines. Zee has invested in advanced software, provided training to in house personnel and recruited experienced technical staff to undertake such projects. Zee is committed to continue to provide advanced training to its in-house engineers and has an arrangement with local universities specializing in Ocean Engineering to absorb bright young recruits. This enables Zee to maintain a well balanced team mixing experience with fresh ideas and enthusiasm.

The current Zee Marine department comprises of;

- Marine Engineers
- Structural Engineers
- Naval Architects
- Pipeline Engineers

Zee is a multidiscipline Engineering Consultancy Company, hence has the capability to compliment the Marine team with related services such as Process, Mechanical, Electrical and Instrumentation.

SERVICES

Consultancy

Consultancy services include the following:

Offshore Installation of Jackets and Topsides

- Load out
- Pile Drivability
- Jacket On-Bottom Stability
- Transportation, Sea fastening,
- Barge strengthening
- Lifting / Upending

FPSO, FSO

- Topside facility design
- Barge conversions and modifications
- mooring; spread / with SPM
- Structural deck strengthening, Jambonizing

Rigid Pipelines

- 3D Time Domain Dynamic Analysis
- Start up, lay, termination
- Lifting, repair
- Shore approach

Flexible Pipelines

- 3D Time Domain Dynamic Analysis
- Flexi lines, Risers
- Jumpers
- Design of appurtenance

Training

- ORCAFLEX / ORCALAY

ZEE has developed capabilities for providing support and training for Orcina products from ZEE KL office. Training is been provided by local engineers who are engaged in consultancy work using this software hence can provide efficient support.

Orcina software is primarily used fro the 3D time domain simulations of flexible offshore structure such as mooring systems, flexi risers, jumpers, pipelay, etc.

RECENTLY COMPLETED FSO AND MOORING PROJECTS

- **ENHANCEMENT AND REFURBISHMENT OF FPSO SEAGOOD I**
For Labroy (Singapore) and Pulau Kancana Raya (Indonesia)



The FPSO was chartered by Santos (Sampang) Pte Ltd (Indonesia) to be operative in the Oyong field. Enhancement to the FPSO included jambonizing (20 m longer) and the top side facilities re-engineered for 3-phase processing. Complete scope was undertaken by Zee including construction assistance and supervision at Labroy ship yard at Batam.

- **OFFSHORE OFF LOADING FACILITIES FOR CONDENSATE AND LPG**
Betara Complex development

The operator for this project is PetroChina International Jabung Ltd (Indonesia). The EPCC contractors were Chioda and Sempec. Zee was responsible for the complete offshore scope which included submarine pipelines, process platform, Dolphins, FSO mooring and the off loading systems.



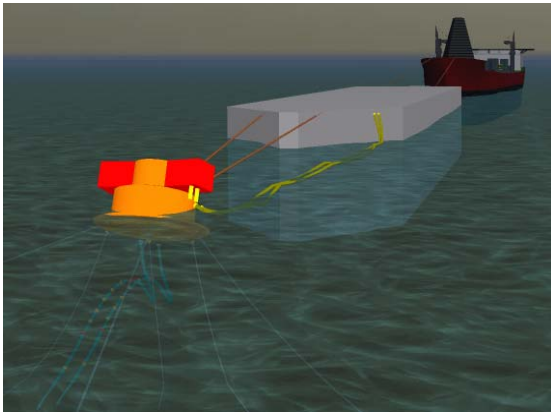
LPG Offloading Terminal



Condensate Offloading Terminal

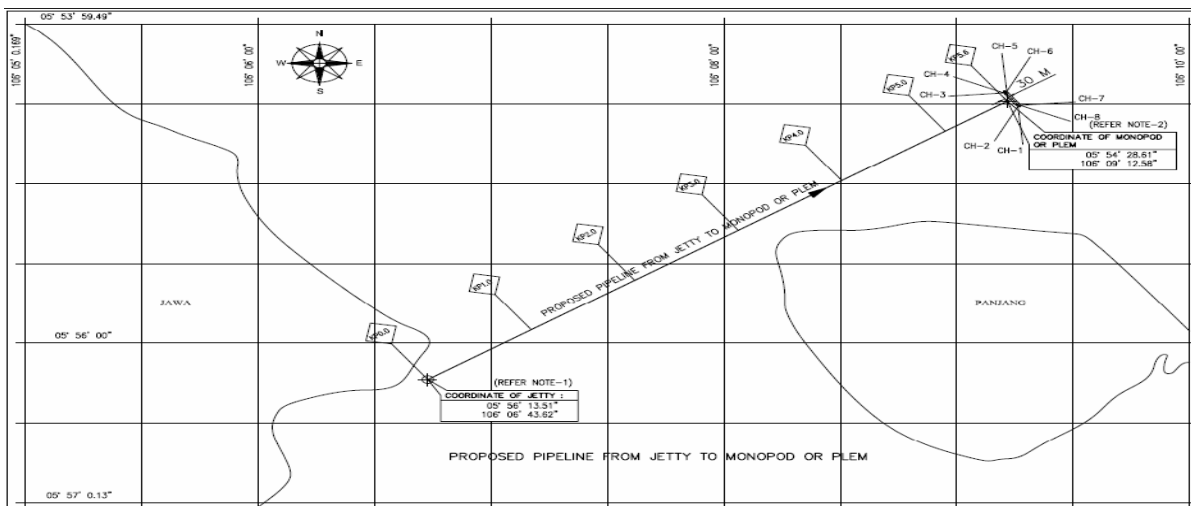
RECENTLY COMPLETED FSO AND MOORING PROJECTS

- RELOCATION OF TUBAN OFF LOADING TERMINAL**
For PetroChina International Jabung Ltd (Indonesia)



FEED study was carried out to relocate the crude offloading facilities. The project involved the design of a new submarine pipeline, PLEM and sizing the flexible and floating hoses for SPM, FSO and Tanker. 3D Time domain random wave analysis was carried out for the complete system.

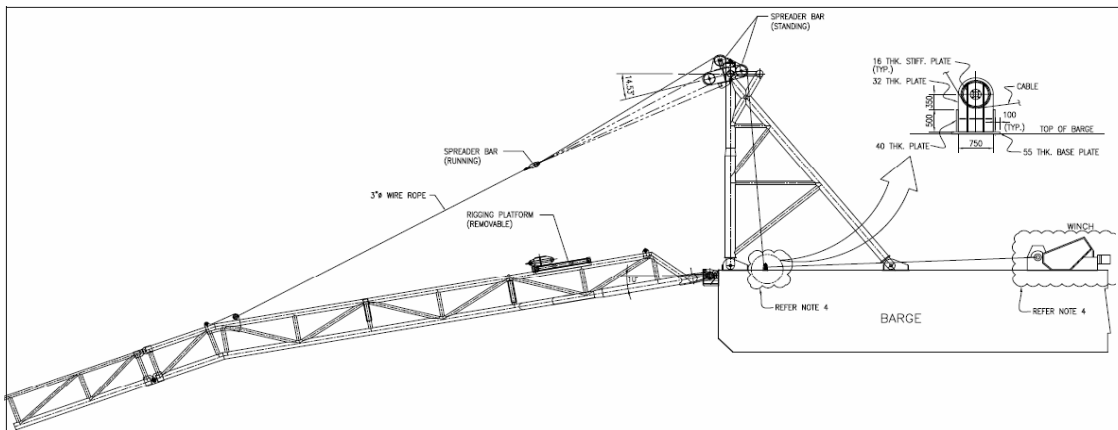
- DEVELOPMENT OF FLOATING LPG STORAGE FACILITIES**
For PT Bukaka Teknik Utama (Indonesia)



FEED study was carried out for the storage of LPG offshore and transportation to a jetty facility onshore. Zee was contracted to carry out FEED and detail engineering for the project. At the FEED stage detail study was carried considering OPEX and CAPEX to arrive at the most economic way of transporting LPG from FSO to shore.

RECENTLY COMPLETED FSO AND MOORING PROJECTS

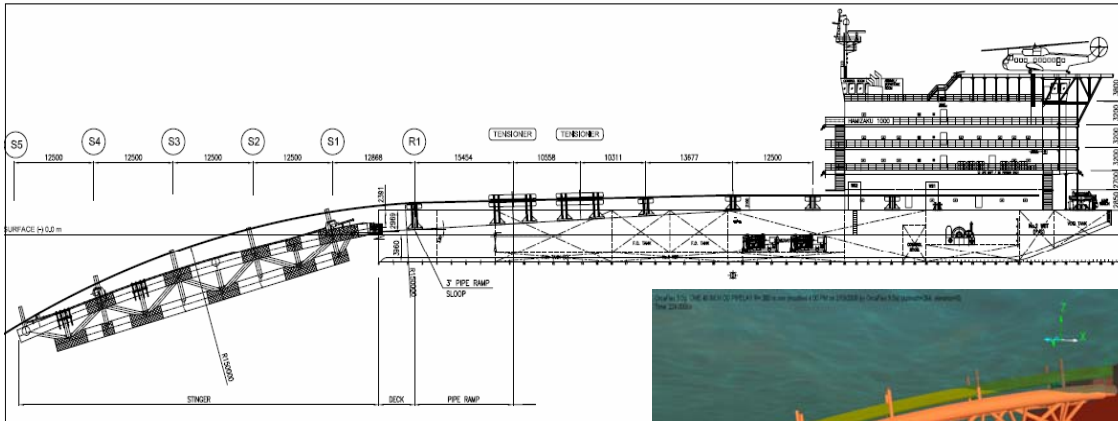
- **DESIGN OF FIXED STINGER
For T.L Offshore (Malaysia)**



Zee designed the 60 Meter "Fixed" Stinger for DLB Enterprise III. The project included the detail design of the Stinger and the related deck strengthening.

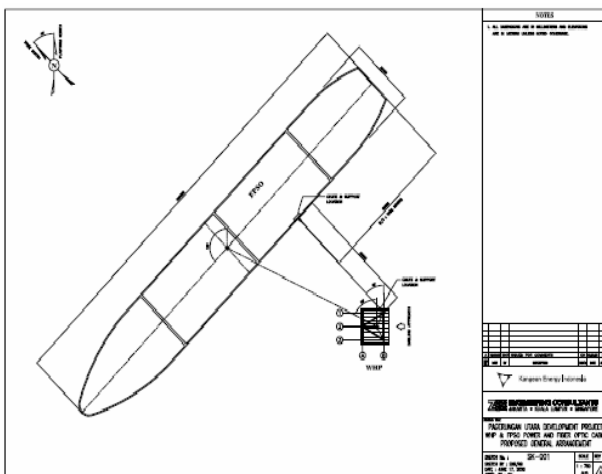
ONGOING FSO AND MOORING PROJECTS

- **STINGER DESIGN FOR HAMIZAKU 1000T DLB**
For OME Synergy Sdn Bhd.



The project included the conceptual and detail design of the pontoon type stinger. HAMIZAKU will be the first DLB to carry Malaysian Flag.

- **PAGERUAN UTARA DEVELOPMENT PROJECT**



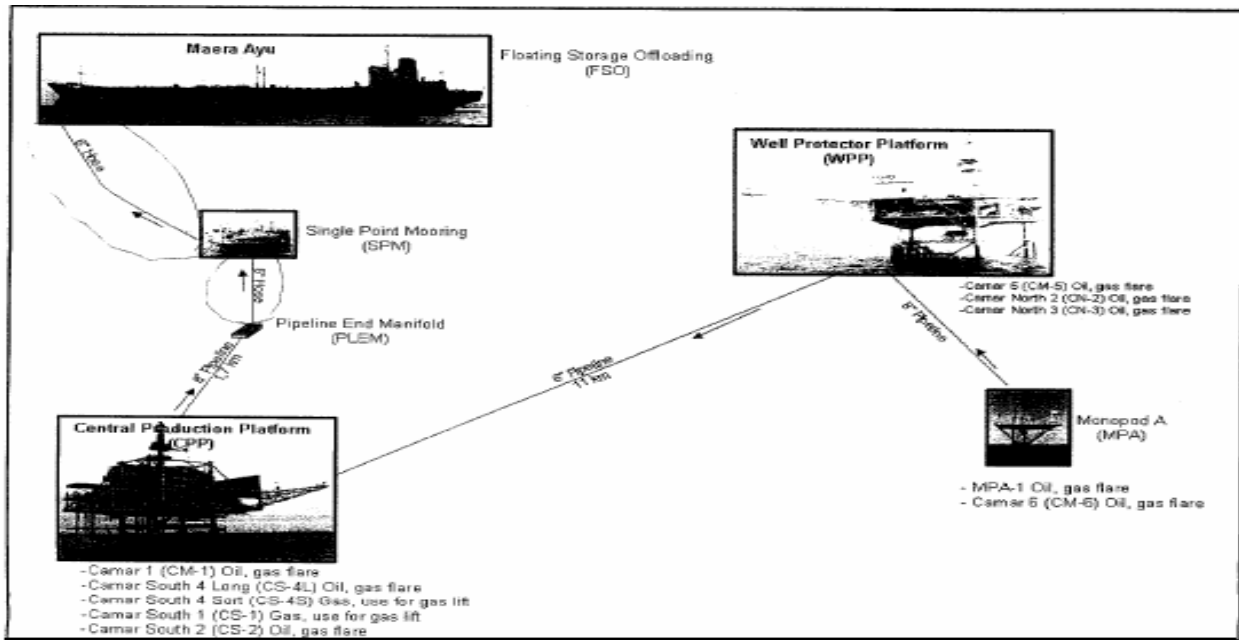
PT Kangen Energy (Indonesia) contracted Zee carry out conceptual and detail engineering for the following projects;

- To route power supply cables and offloading hoses at WHPF platform. The project includes the mooring study of the FSO moored along side the platform. At the FEED stage various options are to be considered.

- To carry out engineering for the installation of Flexible Hose between a jetty manifold to FSO. The length of the Hose is approximately 300 meters. The study includes the 3D time domain dynamic simulation of the FSO mooring system coupled with the Flexible Hose.

ONGOING FSO AND MOORING PROJECTS

- DESIGN OF FSO-SPM OFF LOADING SYSTEM**



Camar Resources Canada Inc Oil and Gas (Indonesia) contracted Zee to carry out conceptual and detail engineering of offloading system at Camar CPP platform. The study includes the simulation of the full mooring system comprising of PLEM, SPM, FSO AND TANKER to carry out an economic design of Hoses PLEM to SPM, and SPM to FSO.

RECENTLY COMPLETED OFFSHORE INSTALLATION ENGINEERING

- **HEERA REDEVELOPMENT PROJECT FOR ONGC (INDIA)**

EPCC contractor for this project were Punch Lloyd (India) and Sempec (Indonesia) The project included the design of 4 new well head platforms, 8 rigid pipelines, 3 flexible pipelines, 3 cables and the modification to 7 existing plat forms.



Besides detail engineering, Zee also carried out the installation engineering for the project, which included;

- A. Pipelines – Routing full installation engineering in time domain dynamic mode, pipeline crossing, emergency repair etc.
- B. Jackets and Top sides – Loadout, Sea fastening, On bottom stability, Pile drivability, lift, Upend etc

- **Betara Complex Development For PetroChina International Jabung Ltd (Indonesia)**



The EPCC contractor for offshore scope was Sempec. Besides detail engineering, Zee also carried all the installation engineering related to the offshore work, which included 3 submarine pipelines, Process Platform, Dolphins and the mooring of the FSO's