DRL ENGINEERING

- Operation offices in Houston and Kuala Lumpur
- Core team of experienced professionals
- Worldwide experience of leading practices

“Providing best industry practices”
EXPERIENCE – OFFSHORE PROJECTS

- Petronas Bokor Phase 3 EOR VE Study
- Murphy Kikeh DTU Spar – Options Studies for EOR Facility
- Owner Engineer assist on Falklands TLP development
- BC Petroleum ROC Oil – FPSO PMT Conversion Team at KSL Yard
- Talisman Kinabalu Redevelopment – Concept Select studies
- Talisman BK-D Platform VE Process & Facility Studies
- Newfield Blk 310 Sour Gas Platform FE Studies
- Twinza PNG FE Studies Pasca NGL Recycling & FSO Development
- Newfield East Piatu Platform VE Process & Facility Studies
- MP225A Subsea Tie Back Host Modifications
- Petronas Baronia Platform VE Studies
- PM lead for Murphy Azurite FDPSO Decommissioning
- North Rankin B Project Close Out Benchmarking

- EM of Petrofac FPSO Engineering for Aker in KL
- Start-up Operator - PSC Bid Functional Basis & Cost Estimate
- Husky Energy – Madura FPSO Owner Engr & ITT Tender Prep
- Talisman Kinabalu Platform Debottlenecking FE and Owner Engr
- Hess North Malay Basin Platform VE & FE Concept Design Studies
- Ophir RSC Peer Review and PM Support Services
- ALNG LNG Hub Concept Design
- SK Energy B15 Concept Select to Pre-Feed Design Package
- CNOOC Liwan CPF Platform Cost Reduction Study
- Enquest Tj Baram RSC Ph 1 PM Services
- KBB Project Close Out Report
DEEPWATER EXPERIENCE

- Stones Gulf of Mexico FPSO Project Health Check
- BHP Mad Dog 2 Gulf of Mexico Semi Submersible Project Health Check
- Shenzi TLP Topside Lead Position
- Browse FLNG Near Field Cost Estimate
- Noble Tamar FLNG OE Program Risk Assessment
- Gumusut and Malikai Decommissioning Cost Estimates
- Brunei - Merpai / Meragi Sub Sea Tie Back Cost Estimate
- KPOC KME Subsea Tie Back Project Health Check
- KME Development Scenario Cost Estimates
- Woodside Lambert Subsea Tie Back Project Health Check
- Malikai Final Investment Decision Cost Estimate
- Majoram and Rosmari Tension Leg Platform Cost Estimates (Malaysia)
- Inpex Abadi Full Field Development Cost Estimate System Selection
- Brunei Laksa FPSO Cost Estimate
- INPEX ICHTHYS Project – Cost & Schedule Impact Assessment
- Sea Lion Tension Leg Platform Project Health Check
- Woodside Persephone Subsea Tie Back Project Health Check
- Kekek Development Cost Estimate
- Kikeh – Gumusut Subsea Tie Back Decommissioning Cost Estimate
- FLNG Cost and Schedule Benchmarking
- Exmouth Plateau System Selection Cost Estimates
- Limbayong Cost Estimates for Option Selection
- Noble Equatorial Guinea Basin – Option Analysis
- Noble Energy Leviathan DW FPSO & FPU Field Dev & PMT team
# DRL Core Activities

1. **Concept Engineering**
2. **Engineering Studies**
3. **Value Engineering & Cost Reduction**
4. **Project Benchmarking & Cost Estimating**
5. **Project Management**

**Onshore and Offshore Oil and Gas Projects**

"Providing best industry practices"
DRL Concept Engineering Focus:

• Project Feasibility Assessment (Commercial and Technical);
  • Concept Identification & Selection:
    ➢ Export routes
    ➢ Process & Technology Options, Layout Studies;
    ➢ CAPEX / OPEX / Product Revenue Evaluation
  • Concept Optimisation:
    ➢ Engineering definition, Cost Sensitivities, Schedule
  • Debottlenecking Studies;
  • Risk Evaluation (Commercial and Technical);
  • Workshop Facilitation/Participation

DRL apply a stepwise ‘gate’ process to the Concept Select process to avoid recycle
DRL specializes in bringing discoveries to fruition through a methodical and systematic Conceptual Engineering process.

DRL methodology and experience includes brownfield as well as greenfield, de-bottle necking and increased oil recovery projects.
Concepts are identified, screened and defined – function, scope, cost and schedule are established.
Equatorial Guinea Basin

DRL personnel led the Front – End Studies and Option Selection
Field Building Blocks

The Value Chain / Building Block Approach

Each building block adds value and forms the “Value Chain”
Alba Condensate – EG, W Africa

DRL personnel developed the Front End Design for this major Condensate recycling Project
CONCEPTUAL FE DESIGNS

Deepwater Concept Options
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ONSHERE AND OFFSHORE OIL AND GAS PROJECTS

“PROVIDING BEST INDUSTRY PRACTICES”
Dynamic Simulation

Dynamic Simulation experiences;

- Dynamic modelling of production tubing, multi-phase risers, pipelines, piping networks – transient and steady state operating modes
- Slug flow analysis in pipelines, flowlines and risers
- Gas lift optimisation and well unloading
- Gas pipeline dynamic response and line pack analysis
- Topsides dynamic process modelling – startup, shutdown, ramp up, ramp down, blowdown and staggered flare operation
- Compressor train modeling for verification of controls response to upset (antisurge and capacity control, train, load sharing, interstage feed controls)
Dynamic Simulation

- Dynamic Simulation
• Dynamic Simulation

Pipeline Pressure & Flow Rate Trends for (4000 psi, 120 MMscf/d)

**Close GM01 Case**

**Open GM01 Case**
Flow Assurance Studies

- **Flow Assurance experiences;**
  - Fluid characterization (match lab analysis data)
  - Transient analysis to determine pipeline operability, slugging during normal/turndown conditions and pigging modes of operation
  - Definition of associated offshore/onshore facilities such as slugcatcher sizing, slug suppression controls
  - Compositional tracking (e.g. MEG tracking) within a multiphase pipeline
  - Wax deposition prediction (e.g. Wax Deposition Rates, “no touch time”, restart procedures)
  - Pipeline cooling rate, impact on high pour point production and pipeline restart procedures
  - Hydrate management for the pipeline, including hydrate expectancy, hydrate control philosophies and inhibitor storage and injection requirements
  - Pressure surge for HIPPS consideration
  - Pipeline Internal Corrosion Study
Flow Assurance Studies

- **Projects**
  Fluid Characterization & Flow Assurance
Flow Assurance Studies

- **Projects**
  - Hydraulic & Corrosion Study

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**Figure 6.1.1**: Pressure Profile for Various Pipeline Sizes

**Figure 6.2.1**: Erosional Velocity Ratio for Various Pipeline Size

**Figure 6.5.1**: Hydrate Curve

Appendix 1: Sensitivity study of H₂S concentration vs estimated corrosion rate
DRL CORE ACTIVITIES

1. CONCEPT ENGINEERING
2. ENGINEERING STUDIES
3. VALUE ENGINEERING & COST REDUCTION
4. PROJECT BENCHMARKING & COST ESTIMATING
5. PROJECT MANAGEMENT

ONSHORE AND OFFSHORE OIL AND GAS PROJECTS

“PROVIDING BEST INDUSTRY PRACTICES”
DRL Value Engineering Focus

• Functional Basis Optimisation;
  • Process Simplification
    • Technology & Equipment Selection;
      • Fit-for-Purpose Design Approach;
        • Application of Codes and Standards;
          • Layout Optimisation;
            • Sparing Philosophy;
              • Design Margins;

‘Scope is the biggest driver of Cost’ – DRL has the experience to identify the cost drivers for a specific concept or design and the know-how to apply the best industry practices to reduce costs without loss of functionality.
Layout efficiency is a key factor in cost effective developments.

PCSB Baronia Topsides
Reduced from 12,400 MT to 9,200 MT
DRL works with Clients, not just for Clients, to achieve the best possible results for their projects.
NMB VE STUDY – TOPSIDES OPTIMIZATION

BASE CASE DESIGN

DECK BOX SIZE = 98m X 47m
DECK BOX HEIGHT = 24m
JACKET DIMS AT TOP = 68m x 47m
TOPSIDES FOOTPRINT = 17427m²

VE OPTIMISED DESIGN

DECK BOX SIZE = 82m x 22m
DECK BOX HEIGHT = 24m
JACKET DIMS AT TOP = 74m x 22m
TOPSIDES FOOTPRINT = 7405m²

OVERALL TOPSIDES AREA REDUCTION
ORIGINAL FOOTPRINT 17427m² - OPTIMIZED FOOTPRINT 7405m²

AREA REDUCTION - 10022m²

POTENTIAL WEIGHT SAVINGS BASED ON 700 kg/m² FOR BULKS AND STEELWORK ONLY

Approx. 6000Te+
TML Bunga Raya BK-D VE STUDY – TOPSIDES OPTIMIZATION

LAYOUT - AREA REDUCTION AND POTENTIAL WEIGHT SAVINGS

OVERALL TOPSIDES AREA REDUCTION
(WITH REMOVAL OF COOLER DECK)

ORIGINAL FOOTPRINT 8530m² - OPTIMIZED FOOTPRINT 5890m²

AREA REDUCTION - 2640m² (31%)

POTENTIAL WEIGHT SAVINGS BASED ON 750kg/m² FOR BULKS AND STEELWORK ONLY

Approx. 2000Te PLUS equipment weight reductions (250 Te)
GOM DW Semi Host - Slimdown

Deck Footprint Comparison

Integrated Deck design.
Add main dimensions here

Alt. Deck design and Phase 2B.
Add main dimensions here

Our Layout

Deck Height
Lower Deck Footprint
- 26' 3" (8m)
- 50,034 sq. ft. (4650 M2)
- 43,621 sq. ft. (4054 M2)
- 93,655 sq. ft. (8704 M2)

Upper Deck Footprint

Total

Delta Footprint = 55,500 sq. ft. +60% larger
Delta Volume = 2,112,278 cu. ft. (59,900 m3)
Example – Deck Layout Efficiency

**Contractor X - Base Case Deck Design**

- **Main Steel Dimensions**: 388’-0” x 282’-0”
- **Deck Split**: 3
- **Upper Deck Footprint**: 109,416 sq. ft. (10165 M2)
- **Lower Deck Footprint**: 115,605 sq. ft. (10740 M2)
- **Total**: 225,021 sq. ft. (20905 M2)
- **Topside Dry Weight**: 23,600ST

**DRL Deck Design**

- **Main Steel Dimensions**: 309’-0” x 240’-6”
- **Deck Split**: 2
- **Upper Deck Footprint**: 78,577 sq. ft. (7300 M2)
- **Lower Deck Footprint**: 87,187 sq. ft. (8100 M2)
- **Total**: 165,765 sq. ft. (15400 M2)
- **Topside Dry Weight**: 19,600ST

**Delta Footprint**: 63,934 sq. ft. (5856 m²) Base Case Topside Layout - 40% Larger
- **Topside Weight Savings**: 4000ST
- **Hull Weight Savings**: 3000ST

Slide 30
Topsides Layout Upper Deck
Topsides Layout Lower Deck
DRL has knowledge of a wide range of low cost technical solutions and are impartial to select the best available for the required application.
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ONGSHORE AND OFFSHORE OIL AND GAS PROJECTS

“PROVIDING BEST INDUSTRY PRACTICES”
DRL Benchmarking and Cost Estimation

• Scope Benchmarks for;
  ➢ Total Installed Power, Throughput, Topside Weight,

• Cost Benchmarks for;
  ➢ Topsides by weight, pipelines, moorings, subsea,

• Schedule Benchmarks for;
  ➢ Overall project, FID to first cut steel, Fabrication,

and many more.
DRL has collated an extensive database of real project information and developed a structured methodology for project analysis – the result is a powerful set of tools for project benchmarking and measurement.
Correctly applying the appropriate set of metrics to a project can show the project performance, identify areas for improvement and reveal risks.
DRL’s benchmarking can be tailored to be concept specific for key factors; platform type, fabrication location, scale, water depth and more.

**NEW BUILD FPSO**
Mooring Cost per Meter (Lines x Water Depth) in US$ Estimated Date
Money 2011 vs. Installed Length in meters
BENCHMARKING YOUR PROJECT

DRL can analyze, benchmark and cost estimate your project given minimal conceptual information or based on detailed design engineering.
MORE THAN BENCHMARKING

TRAINING
- Data Collection
- Benchmarking Metrics
- Project Concepts
- Cost Efficiency
- Estimating Tools

COST ESTIMATING
- Estimating Tools
- Scope Development
- Cost Development
  (Deep Water, Shallow Water, Brownfield & Subsea)
- Regional Norms

SCHEDULE BENCHMARKING
- SCHEDULE BENCHMARKING EXECUTION DURATION vs CAPACITY

PEER ASSISTS & INVESTMENT DECISION
- Providing Global Advice:
  - Scope
  - Execution Strategy
  - Cost and Schedule
  - Identify Opportunities & Risks

SCOPE BENCHMARKING
- SPAR DEVELOPMENTS TOPSIDE WEIGHT vs. CAPACITY

COST BENCHMARKING
- SPAR DEVELOPMENTS HOST COST vs. CAPACITY
DRL cost estimates are established based on data of actual achieved costs on previous projects.

- **Scope**
  - **Production Capacity**
    - 9,600 barrels/day Oil/Condensate (exported via spike into Gas Line)
    - 800 mmscf/d Gas (Input Pressure 700psi Export 1,500 psi)
  - **Water Depth** 760m
  - **Hull Dry Weight** 10,662 tonnes
  - **Topside Dry Weight** 10,593 tonnes
  - **Total Installed Power** 36 MW
  - **Living Quarters** 50
  - **8 Tendons**
  - **Drilling via Tender Assist**
  - **Wellbay 6 slots**
  - **Cost Estimate to include** 3To.
  - **Gas Export Line Carbon Steel Riser Platform**
DRL cost estimates are established based on data of actual achieved costs on previous projects.
DRL has a suite of cost estimation tools to suit high level of detailed cost estimates for both new and brownfield projects.
DRL’s Deepwater Cost Estimating Model can compare project costs for different types of concept.
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ONSHORE AND OFFSHORE OIL AND GAS PROJECTS

“PROVIDING BEST INDUSTRY PRACTICES”
DRL Project Management Services

• Leadership Positions in Owner PMT
  • Project Management;
    • Engineering Management and Expertise;
    • Project Coordination;
  • Project Services:
    ➢ Cost Control;
    ➢ Planning / Schedule Control;
• Construction Management;
• Commissioning & Start-Up Services

DRL has taken up key roles in Owners Project Management teams for numerous Clients on offshore projects and regularly provide complete project management oversight for onshore projects.
Project Management – key elements:

- PODC – PLAN/ ORGANIZE / DIRECT / CONTROL

Project Management Services
- from CONCEPT THROUGH TO OPERATIONS

- Assess
- Feasibility
- VE Studies
- Select
- Definition and Execution

- Contracting
- Strategy
- Benchmark
- Costing
- Global Pricing

- Tender
- Documents
- Market
- Assessment
- Bidder PQ
- CP Planning

- Tender
- Evaluations
- Mechanical
- Completion
- Installation & Commissioning
ROC – DIALOGUE FPSO – KSL YARD PMT
DRL managing FPSO Shipyard Conversion
At Keppel Taus Yard, Singapore
The giant Leviathan field (17 TCF)
2000 Mmscf/d Gas Production FPSO

DRL Personnel – lead roles in Owner PMT

Steve Craig, PM
Chris Lyttle
Hull Delivery Manager

Colby Hafner
Safety QRA

Vince Page
Rotating Machinery
Overall Flow Scheme
LEVIATHAN FPSO

Spread Moored VLCC with SCR Riser System

2000 Mmscfd Gas Facility

28,000 MT Topsides
The earlier in design that layout safety is considered the more inherently safe you can make the facility.

Waiting on fire and blast studies can result in wasted engineering hours and expensive and less effective mitigations such as fire and blast walls.

We estimate a number of risks of each individual module relative to each other based on various design parameters early in design.

Major facility risks are comprised of the interactions of module risks with adjacent modules, risers, and manned areas.

Arranging modules in a way that minimizes the impact of these interactions is the key to an inherently safer layout.
• Using CRUX Layout Safety Software we can create and compare multiple layout options quickly and earlier in design than ever before.
• Visualize which modules are contributing to each risk.
• Create a facility specific layout philosophy.
• Address layout safety early to reduce project cost and increase inherent safety.
DRL PROJECT MANAGEMENT SUPPORT –

CENDOR FPSO - MALAYSIA

DRL Engineering
Manager for the Cendor FPSO Detailed Engg

John Matchett
DRL Engineering prepared the FEL 2 Engineering & Planning for DW Subsea tie-back on MP225A.
DRL PROJECT MANAGEMENT SUPPORT –

HUSKY MADURA FPSO

DRL – Providing PMT Assistance for:

- Value Engineering
- Lease Tender Contract Preparation
- Peer Reviews
PLAN THE WORK - WORK THE PLAN

“PROVIDING BEST INDUSTRY PRACTICES”