Nearshore Regasification Terminals and FSRUs
Results for our customers

As the worldwide demand for natural gas imports increases, the technical and regulatory challenges and the scale of the investment required to facilitate successful delivery of regasification projects requires an unbiased partner with a comprehensive understanding of the local requirements, the LNG value chain and associated technologies.
WorleyParsons and their specialist subsea division, INTECSEA, are recognized industry leaders in the provision of nearshore regasification systems and floating storage regasification units (FSRUs) services. Our specialist teams in Melbourne, Singapore, Houston and London have over 30 years’ experience furnishing services from opportunity evaluation studies and concept/technology selection, through to FEED and EPCM for greenfield and brownfield LNG developments.

We offer a cohesive service that considers the LNG logistic chain, regasification, storage and mooring technology, site selection, natural gas transfer to shore via subsea pipeline, shore crossing, onshore receiving facilities custody transfer and tie-in to existing networks, as well as synergies to existing facilities such as power plants and other natural gas consumers.

Many customers seek our early involvement in their projects, and we are regularly consulted on issues such as concept screening, gas demand, and site selection. To help in this, we maintain a world-class cost database with data sourced from actual projects.

Specific areas of expertise include:

- LNG regasification technology studies
- Hull integration of topside process equipment
- Selection of candidate LNG carriers for conversion into FSRUs, FSUs
- Vessel hydrodynamic analysis for design of mooring systems
- Nearshore mooring design and breakwater design
- Coastal modeling, including sediment transportation dredging and
- Side-by-side and tandem offloading technology selection
- Hydrodynamic analysis of vessel interaction between floating LNG
- Regasification vessel and LNG carriers in side-by-side/tandem configuration
- Contracting strategy evaluations
- LNG supply logistics and planning
- Offshore and Onshore pipeline design including shore crossing
- Scoping and supervision of geotechnical, geophysical and metocean studies
- Regasification facility uptime/availability evaluation
- Gas demand and supply studies
- FSRU conversion and new build engineering
Capability overview

Regas Technology
Nearshore and floating regasification technology requires specialist knowledge to address marinization, modularization and maintainability issues. Our integrated process engineering teams have worked with *SCV, *ORV, *AAV, *IFV Propane, IFV Glycol, Smart-Air™, Steam and Open loop and Close loop vaporization systems.

LNG Offloading
Comprehensive studies into all currently available LNG offloading technologies have been undertaken by WorleyParsons allows a complete insight into the optimum LNG offloading solution for any project. This is also supported by extensive simulation and model test experience.

LNG Storage
The WorleyParsons specialist teams have a broad range of experience and knowledge of LNG containment systems; onshore, offshore GBS and LNG containment systems. By understanding the relative strengths of each system we can recommend the most suitable systems to suit each project.

Subsea Infrastructure
WorleyParsons/INTECSEA can provide solutions for all aspects of subsea infrastructure, including PLEMs, PLETs, HIPPS and subsea pipelines Riser systems, and shore crossings.

Permitting/Regulatory/HSE
Through WorleyParsons Environmental Group’s EIS and regulatory project experience available in most local offices around the world, WorleyParsons can provide valuable insight and guidance through the permitting and regulatory process.

Small Scale Regasification
The implementation of small scale LNG and hub and spoke models are part of our Select offering. WorleyParsons have developed a novel offshore regasification terminal based on a steel barge gravity foundation design with small LNG storage suitable for shallow water depth of up to 15m. This concept has been developed for regasification needs of less than 100mmSCFD.
**Gas to Wire Technology**

With WorleyParsons Power Group we can integrate utility scale power generation on board FSRUs and can take full advantage of waste heat recovery for regasification and inlet air cooling. This capability is supported by our experience in subsea cabling technology and the design of smart power grid network system.

**Financial Assessments**

WorleyParsons undertakes comprehensive financial studies including assessment of CAPEX, OPEX, NPV, cashflow monte carlo simulations and tolling tariffs. Comparative assessment of project scenarios allows for objective comparison of technologies, future demand.

**Mooring System Design**

WorleyParsons has designed mooring and riser system for the oil gas industry around the globe and offers the whole range of mooring systems design experience, from jetties to single point moorings, spread moorings, turret and disconnectable buoy moorings for shallow water to medium and ultra deepwater applications.

**Synergies**

The integrated team approach for nearshore terminal design allows the project to take advantage of synergies that arise from project specific natural gas consumer needs such as waste heat recovery and inlet air cooling, for power plants. Onshore Power generation used on board the FSRU or on jetty mounted terminal.

**Onshore Receiving Facilities**

WorleyParsons utilizes local offices and High Value Engineering centers for preliminary and detailed design of Onshore Receiving Facilities (ORF), including piping, power generation, safety systems, pipeline tie-in, metering and custody transfer.

**Onshore Pipeline/Tie-in**

WorleyParsons onshore pipeline teams available in most of our office locations provide a project integrated approach to onshore pipeline design issues that are resolved best locally such as right-of-way, pipeline routing and tie-in into existing infrastructure.
Capability overview

FSRU New Build and Conversion Engineering
Our experience from over 70 FPSO and FSO allows us to offer all facets of new build and conversion engineering, which is provided by the specialist team of naval architects and marine engineers. Including structural assessment, specifications, stability, utility system design, topside and process integration, conversion and supervision, contracting, procurement support, conversion design preparation of work packs, Class approval support and site inspections.

Coastal Modeling/Navigational assessment
WorleyParsons Coastal Engineers/Scientist and Master Mariners offer:
• Advanced analysis of coastal processes
• Metocean data assessment
• Vessel handling and navigational assessments
• Dredging design and advice
• Marine geological, geotechnical and environmental
• Marine operations and port advisory services

Hydrodynamic Analysis
A core skillset at WorleyParsons and INTECSEA is hydrodynamic modeling and is undertaken with industry leading software and experienced naval architects able to work through challenging hydrodynamics problems.

Often the work is used to undertake availability and uptime assessments for LNGC/FSRU offloading.
World-class capabilities

World leading independent engineering service provider to the FRSU and nearshore regasification market.

WorleyParsons has executed more than 50% of the worldwide nearshore regasification projects (planned and in operation).
“We deliver global projects locally, i.e. to provide our customers access to world-class LNG specialist capabilities, we blend regional and technical expertise to tailor project execution to best suit the project and customers. The nearshore regasification excellence centers in Melbourne and Singapore work in collaboration with our local offices using WorleyParsons Global standard work practices, platforms and systems.”

John Manning, Global Sector Lead, Melbourne

Our Differentiators

**Experienced Specialist Team**
High value, low overheads, fast turnaround.

The same team has been involved in 27 offshore and nearshore storage and regasification terminals out of 40 projects worldwide.

**Local/global Execution**
Local offices in 43 countries, workshare to specialist execution.

Able to meet local content requirements.
Local contract to fabricators, stakeholders, customers.
Relevant local execution experience.
One Contract with Customer gives access to worldwide specialists network.

**Project CAPEX Data Base**
Excellent selection of CAPEX information to benchmark against.

Up to date CAPEX database for onshore, nearshore and offshore storage and regasification projects. Benchmarked against worldwide project references.
**Tolling Economic Models**

Allows comparison best for project concept and technology for like bases using tolling tariff as the criteria.

In-house estimation of tolling tariff (IRR and NPV) for different concepts, at P50 level during concept selection considering terminal availability and associated logistic chain implications.

**Independent Advice**

Unbiased advice, no patents, no equipment vendor preference.

All necessary technical expertise readily accessible in-house.

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**OPEX Metrics**

Representative assessment of through lifecycle cost.

Crewing rates, lease rates, Consumables, maintenance, logistic chain models.
Project experience

1. Cabrillo Port FSRU
CUSTOMER: BHP BILLITON
DATE: 2005-2007
LOCATION: CALIFORNIA, USA
- FEED Design of regas facility
- New technology development
- Offloading availability
- Specialized Tug design
- Under water noise assessments
- Detailed regasification technology comparisons and studies
- In depth study of regasification marinization aspects

2. Oceanway
CUSTOMER: WOODSIDE
DATE: 2008
LOCATION: CALIFORNIA, USA
- Peer review of oceanway FSRU concept
- Support to deep-water port license application
- Review LNG offloading systems

3. Jamaica LNG Storage and Regasification (SRT)
CUSTOMER: JAMAICA GOVERNMENT
DATE: 2011
LOCATION: JAMAICA
- Owner’s Engineer for SRT Build, own, operate, transfer contract in Portland Bright, Kingston
- Concepts explored and site selection
- Acted as Owner’s Engineer for Bid Evaluation of EPC Contractors

4. FSRU Due Diligence
CUSTOMER: ORIGIN ENERGY
DATE: 2013
LOCATION: SOUTH AMERICA
- Technical due diligence on FSRU Supply Agreement and Terminal Services Agreement

5. Mejillones Bay GNL
CUSTOMER: BHP BILLITON
DATE: 2007
LOCATION: CHILE
- Peer Review of feasibility
- Risk based technology and concept selection
- CAPEX and OPEX review

6. WorleyParsons Marinized Regas Module
CUSTOMER: STX
DATE: 2010
LOCATION: FRANCE
- WorleyParsons, jointly developed with SOFREGAZ a marinized regasification module, capacity 700mmSCFD.
- IFV propane loop technology
- Based on proven, reliable equipment and components

7. Quantum LNG Metocean Study
CUSTOMER: QUANTUM
DATE: 2013
LOCATION: GHANA
- Concept selection and techno-commercial feasibility study of an offshore LNG regasification terminal
8. PetroSA FSRU  
**DATE:** 2012-2013  
**CUSTOMER:** PETROSA  
**LOCATION:** SOUTH AFRICA  
- Pre-Bid engineering for FSRU conversion and supply

9. Mozambique Nearshore Regas  
**DATE:** 2012  
**CUSTOMER:** MGC MATOLA GAS COMPANY  
**LOCATION:** MOZAMBIQUE  
- Concept selection and techno-commercial feasibility study of onshore and nearshore regasification terminal  
- Risk-based technology and concept selection  
- CAPEX and OPEX estimates

10. Malta FSRU Project  
**DATE:** 2013  
**CUSTOMER:** BUMI ARMADA BERHAD  
**LOCATION:** MALTA  
- Pre-Bid engineering for FSRU conversion and supply

11. Egypt FSRU Project  
**DATE:** 2013  
**CUSTOMER:** BUMI ARMADA BERHAD  
**LOCATION:** EGYPT  
- Pre-Bid engineering for nearshore regasification terminal and FSRU conversion and supply

12. Cyprus FSRU Project  
**DATE:** 2013  
**CUSTOMER:** BUMI ARMADA BERHAD  
**LOCATION:** CYPRUS  
- Pre-Bid engineering for FSRU conversion and supply

13. Bahrain LNG Import Terminal Project  
**DATE:** 2013  
**CUSTOMER:** GALWAY GROUP/NOGAHOLDING  
**LOCATION:** BAHRAIN  
- Concept selection and techno-commercial feasibility study of an offshore LNG regasification terminal  
- Pre-FEED/FEED level design of mooring system, ORF, subsea pipeline, LNG offloading, breakwater and jetty design, and met-ocean data modeling  
- CAPEX and OPEX estimates  
- Development of the offshore LNG terminal bid package
14. India East Coast Floating LNG Regas
   DATE: 2012
   CUSTOMER: H-ENERGY
   LOCATION: INDIA
   • Concept selection and techno-commercial feasibility study of an offshore LNG regasification terminal
   • Risk-based technology and concept selection
   • CAPEX and OPEX estimates

15. Kakinada FSRU
   DATE: 2012-2013
   CUSTOMER: GDF SUEZ
   LOCATION: INDIA
   • Concept selection and techno-commercial pre-feasibility study of an offshore LNG regasification terminal
   • Pre-FEED level design of mooring system, ORF, Subsea Pipeline, LNG offloading, Sediment transport modeling, breakwater and jetty design, met-ocean data modeling
   • Navigational Risk assessment and review

16. FSRU Economics India
   DATE: 2013
   CUSTOMER: ICF INTERNATIONAL
   LOCATION: INDIA
   • Site selection review and commentary on FSRU viability at the site locations
   • CAPEX and OPEX estimates

17. Pre-Feasibility 1MDB
   DATE: 2011-2012
   CUSTOMER: ROCDO LNG REGASIFICATION TERMINAL
   LOCATION: PENINSULA, MALAYSIA
   • Commercial and technical feasibility of LNG Regasification Terminal in Peninsular Malaysia
   • Gas Demand assessment for the Malaysian peninsular
   • Life cycle cost estimates, including CAPEX and OPEX development

18. Melaka Jetty Island Regas Terminal (Lekas)
   DATE: 2010-2012
   CUSTOMER: PETRONAS GAS BERHAD
   LOCATION: MELAKA, MALAYSIA
   • Offshore based regasification jetty for receiving and regasification of LNG
   • P&IDs and equipment specification development

19. LNG Import and Regasification Facility with Power Generation
    DATE: 2013
    CUSTOMER: YONGNAM
    LOCATION: SOUTH EAST ASIA
    • Pre-feasibility engineering services to assess the viability of LNG import and regasification with associated power generation facility

20. Bumi Armada FSRU
    DATE: 2013
    CUSTOMER: BUMI ARMADA BERHAD
    LOCATION: CONFIDENTIAL
    • Pre-Bid engineering for LNGC conversion
    • Subsea pipeline design
    • Regas unit design
21. Jakarta West Java Bay FSRU  
**DATE:** 2009-2010  
**CUSTOMER:** PERTAMINA-PGN JOINT COOPERATION (NUSANTARA)  
**LOCATION:** JAKARTA, INDONESIA  
- Development of Base load FSRU  
- Functional topside regasification (process) schematics and specifications  
- CAPEX and OPEX estimates

22. West Java LNG Import Terminal and Power Plant Feasibility Study  
**DATE:** 2014  
**CUSTOMER:** CONFIDENTIAL  
**LOCATION:** JAKARTA, INDONESIA  
- Concept selection and techno-commercial pre-feasibility study of an offshore LNG regasification terminal and power plant  
- CAPEX and OPEX estimates

23. Bangladesh FSRU  
**DATE:** 2012  
**CUSTOMER:** MPC  
**LOCATION:** CONFIDENTIAL  
- Development of Base load FSRU  
- Functional topside regasification (process) schematics and specifications review  
- CAPEX and OPEX estimates

24. LNG Import Terminal Feasibility Study  
**DATE:** 2014  
**CUSTOMER:** MEIYA POWER COMPANY  
**LOCATION:** BANGLADESH  
- Concept selection and techno-commercial pre-feasibility study of an offshore LNG regasification terminal and power plant  
- CAPEX and OPEX estimates

25. Philippines FSRU  
**DATE:** 2012  
**CUSTOMER:** FIRST GAS  
**LOCATION:** PHILIPPINES  
- Commercial and technical feasibility of LNG Regasification Terminal in Batangas Bay

26. LNG Regasification and Storage Study  
**DATE:** 2013  
**CUSTOMER:** CONFIDENTIAL  
**LOCATION:** PHILIPPINES  
- Concept selection and techno-commercial feasibility study of an offshore LNG regasification terminal  
- CAPEX and OPEX estimates

27. Pre-Feasibility Study for Regasification Terminal  
**DATE:** 2014  
**CUSTOMER:** DELOITTE /KOREA EAST-WEST POWER  
**LOCATION:** SOUTH KOREA  
- Concept selection and techno-commercial feasibility study of an offshore LNG regasification terminal  
- CAPEX and OPEX estimates
Our differentiators

Differentiator 1
Combined, empowered and technically capable people

Differentiator 2
Industry leadership in health, safety and environmental performance

Differentiator 3
Economics™ - delivering profitable sustainability

Differentiator 4
Outstanding operational and corporate performance

Differentiator 5
Focus on long term contracts and asset-based services

Differentiator 6
Success in project delivery - large and small

Differentiator 7
Comprehensive geographic presence
WorleyParsons is a leading global provider of professional services to the resources and energy sectors, and the complex process industries.

We cover the full asset spectrum, both in size and lifecycle, from the creation of new assets, to services that sustain and improve operating assets.

Our business has been built by working closely with our customers through long-term relationships, anticipating their needs, and delivering inventive solutions through streamlined, proprietary project delivery systems. Strong growth continues to characterize our performance both through organic development and through strategic acquisition as we strive to provide tailored services wherever our customers need us.

EcoNomics™ provides our customers with the systems, technologies and expertise to optimize and balance financial, social, and environmental outcomes, improving sustainability performance while enhancing profit and long-term viability.

WorleyParsons’ vision is to be a leader in sustainability by helping our customers capture new markets and business opportunities created by the new energy economy.

Zero Harm is our corporate vision for health, safety and the environment (HSE).

We are committed to our vision and apply it to all operations, at all times, in all locations, and at all levels of responsibility. We will actively work to align our expectations and behaviors to achieve Zero Harm in our dedication to continuous improvement. These expectations are reflected in our integrity management framework, OneWay™, and linked to our global systems and procedures.
Nearshore Regasification Terminals and FSRUs
Capability & Experience

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