



# Reference list

## FPSO, FSO, FLNG

Revised May 2016



## Large Harsh Environment FPSO

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2016	Alta-Gotha	Norway	Aibel/Lundin	Confidential	Concept development

*Project description:*



FPSO concept development in connection with a field development project. The project involves customization of BE reference FPSO for two different production rates and storage capacity 1 & 1.5 MMbbl.

## Njord B FSU concept study

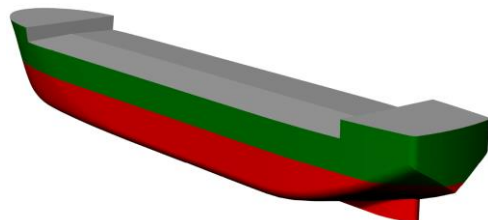
Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2016	Njord B	Norway	Statoil	20 000 +	Concept Study/ Pre-FEED

*Project description:*



As part of a total life extension of the Njord Field, Brevik Engineering is developing three different concept for storage and export of crude. The concepts are:

- Refurbishment of the existing Njord B
- Conversion of a trading/shuttle tanker
- A bespoke new-build FSU



The work includes concept development up to concept selection and pre-FEED study of the selected concept. This work will be basis for the FEED and detailed yard specification for the selected concept.

## Navion Saga FSU- Redeployment

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2015	Confidential	UK	GM/Teekay	3 000	Feasibility study for redeployment

*Project description:*



Feasibility study to clarify structural integrity and modification requirements for redeployment of the Navion Saga FSU from Norwegian sector to UK sector in North Sea. The study involved Naval Architecture-, Steel Structure-, Mechanical- and Process-disciplines.

## SM1650

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2014-15	Generic	Brazil	NOV	12 000	Concept development and basic design

*Project description:*



Design and basic engineering for a new built generic spread moored FPSO. Storage capacity is 1,65 mmbbl, topside 27 000 t. The FPSO was developed as an alternative to converted VLCC for the Libra oil field, however it is suitable for the whole Brazilian continental shelf. BE was responsible for all design and engineering including outline topside lay out.

## Gas FPSO

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2014-15	Confidential	Confidential	Confidential	10 000	Advisory and resources to clients project.

*Project description:*

The project was run in-house at clients premises. BE provided resource and advisory services.

## Sea Lion Field development

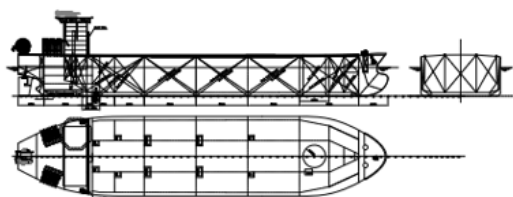
Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2013-15	Sea Lion	UK	Premier Oil	17 000	Feasibility studies, facility design and basic engineering

*Project description:*



**Feasibility Studies exploring 4 different FPSO** concepts including both conversions and new built FPSO design

Design and basic engineering of a **bespoke new build turret moored FPSO**. BE engineering was responsible of all design and engineering work except for topside layout and topside modules. The FPSO was designed to accommodate for split hull and top-side construction contract.



**Feasibility studies an FSO solution** to be combined with a TLP. The studies included 5 design options, all based on a modified trading tanker design.

## Martin Linge FSO

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2012-13	Martin Linge	Norway	Omni	11 000	Pre-Feed Design Work Offshore

*Project description:*



**Basic engineering and technical safety work** related to all on board systems (including cargo handling) on an FSO for the Martin Linge Field.

The FSO was based in SHI hull design and the work was performed in cooperation with SHI, APL(NOV) and Omni Offshore

## Banyu Urip

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2011-13	Banyu Urip	Indonesia	Sembawang Shipyard	20 000	Basic design for conversion



*Project description:*

Conversion of a 1993 built VLCC into a floating storage and offloading unit. Input to the project is a concept study performed in 2010. The project involved all basic design activities involved in complete class package to ABS. All disciplines are covered, i.e. Naval Architecture, Structure, Marine Systems, EIT and Technical Safety

## Modular Capture Vessel (MCV)

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2010-15	Generic Gulf of Mexico	USA Gulf of Mexico	American Eagle Tankers	20 000	Concept design, basic design for conversion, conversion follow-up



*Project description:*

**Conversion** of two Aframax tankers to combined Tankers/FPSOs. The project is an outcome of new regulations in US sector after the Macondo blow out. The vessels can on a short notice change operation from trading tankers to FPSOs and process oil from large oil spill from a blow out. The client is Marine Well Containment Company, a consortium with 14 major Oil Companies operating in US sector.

The work has included concept development, candidate vessel survey, basic design and follow-up of conversion design.

Stability calculation has been followed up until final approval from ABS based on new vessel lightship weight

## Knarr FPSO (Jordbær Field Development)

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2010-15	Jordbær	Norway	BG Norge AS	12 000	Pre-FEED study. Various verification studies and owners engineer work



*Project description:*

### **Turret modification**

Verification of modifications of the Turret mooring table to accommodate the increased riser loads.

### **3<sup>rd</sup> party verification study**

Structural analysis based FEM. Verification of Samsung HHI FEED with special attention to design of fatigue critical details exposed to harsh environment wave loading. Extensive stochastic fatigue analysis

### **Hydrate remediation study**

Compilation and review of the hydrate remediation strategies. The study included a review of the fluid composition and the development of a hydrate remediation strategy

### **Pre-FEED study**

Pre-FEED study for development of FPSO for the Jordbær Field. Works include all disciplines, naval architecture and stability, hull and structural design, marine and utility systems, living quarter design, safety design. Weight and cost estimates and input to overall field development plan developed



## LamSon FPSO Turret Cantilever

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2011-12	LamSon	Vietnam	NOV (APL)	2 000	Basic design of turret cantilever



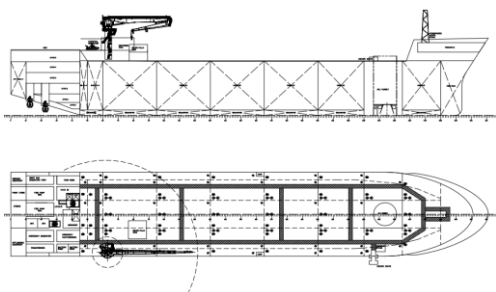
*Project description:*

Basic design project, structural design of cantilever for turret.

Design work included structural drawings for classification approval and structural analysis. Work included structural interface with hull and turret

## Mariner & Bressay FSO

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2010	Mariner & Bressay	UK	Aker Solutions Statoil	1 000	Concept Study



*Project description:*

Concept studies for marine and utility systems, cargo arrangements and cargo system design with descriptions, power and heat generation, mechanical sizing and load list with MEL input, UFD/PFD/HFD's, line sizing and temperature decay evaluation. <http://www.tu.no/artikler/aalborg-far-forerlos-elbuss/320961atasheets> for the main equipment.

## Cash FLNG

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2010-11	Cash / Maple	Australia	PTTEP	9 000	Pre-FEED Study



*Project description:*

**Pre-Feed study** for a complete FLNG, including PFDs & heat and mass balances, layout and piping studies, turret and mooring specification, LNG storage tank selection, hull design, offloading system design, marine & utility systems, material handling, modularisation & topsides integration studies, preparation of Design Basis, preliminary Design Philosophies, constructability review/shipyard visits, cost estimate, project execution plan.

Due diligence for three FLNG concepts for the Cash Maple field.

## Ichthys FPSO

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2009-11	Ichthys	Australia	Aker Solutions Inpex	35 000	Concept and FEED



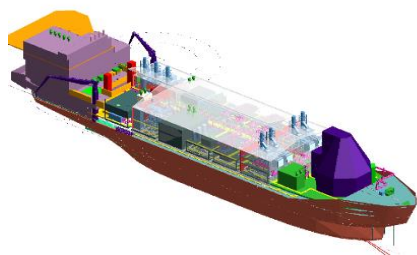
### Project description:

Concept design of FPSO for Australian waters.

FEED study for development of condensate FPSO for Western Australia. Work includes global and local strength analysis and structural design, hull design, marine and utility systems design. HVAC design.

## Shtokman FPU

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2009-11	Shtokman	Russia	Aker Solutions SDAG	8 000	FEED



### Project description:

FEED study for development of FPSO hull for Barents Sea / Shtokman Field. Work included global strength analysis, structural design, ice load and ice berg strengthening calculations, weight calculations.

## Petrojarl Cidade de Rio Das Ostras

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2007-08		Brazil	Teekay Norway		Basic Design for conversion



### Project description:

Conversion of tanker M/T Che Guevara to FPSO for Brazilian waters. Complete design package for conversion at yard. Mooring analysis, motion analysis, stability analysis, installation of power module, process module, offloading, metering, deck cranes.



## Dhirubhai I FPSO

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2006-08	Dhirubhai I	India	Aker Floating Production	70 000	Concept, FEED and detail design



*Project description:*

Concept, FEED study and detail design related to conversion of a tanker to FPSO for operation at Dhirubhai Field, offshore India. Work includes interface design, technical safety, marine/cargo systems, HVAC, hull structure, mooring and deck layouts, helideck design, design of topside modules and procurement activities.

Technical specification for fabrication contract including supporting design documents issued to client. Applicable documents issued and approved by Class.

## Skarv FPSO

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
2005-08	Skarv	Norway	Aker Solutions BP	8 000	Pre-FEED and FEED



*Project description:*

Conceptual study related to new build FPSO. Hull design, hull structure and weight calculations. Assistance to technical specification.

FEED study related to new build FPSO for operation at Skarv Field. Hull design, structural design and weight calculations. Follow-on engineering of hull detail design at Samsung Heavy Industries construction yard.

## Åsgard A FPSO

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
1995-05	Åsgard	Norway	Aker Maritime Statoil	45 000	Concept design, FEED, construction and operation support

*Project description:*



**Concept development** of FPSO hull design, structures and marine system.

**FEED design** of complete FPSO including class approval. All hull disciplines included. The work was performed in cooperation with Aker Maritime and Hitachi Zosen shipyard.

**Construction follow-up** at yard and commissioning and completion at Aker Stord.

**Operational support** for Statoil during 6 first years of operation, covering all tasks related to hull design

## Norne FPSO

Year:	Field:	Shelf state:	Client:	Man-hours	Scope:
1994-05	Norne	Norway	Aker Maritime Statoil	25 000	Concept, FEED, construction and operation support

*Project description:*



**Concept development** of first FPSO hull design purpose built for Statoil.

**FEED design** of complete FPSO including class approval. All hull disciplines included

**Construction follow-up** at yard and commissioning and completion at Aker Stord.

**Operational support** for Statoil during 7 first years of operation, covering all tasks related to hull design

## FEED studies performed 1993-2005

FEED projects are normally projects developed to a level that EPC contracts may be signed. Documentation shall be approved by third party. The work scope for FEED studies have varied between multidiscipline studies, covering all hull and marine related disciplines and studies related to one or a few disciplines

<u>Year:</u>	<u>Project title:</u>	<u>Field:</u>	<u>Area / country:</u>	<u>Client:</u>	<u>Project description:</u>
2004-2005	Alvheim FPSO	Alvheim	North Sea (N)	Aker Kværner / Marathon	Hull structural reinforcement
2000-2001	Ramform Banff	Banff Field	North Sea (UK)	PGS Production AS	Hull structural reinforcement
2000-2001	FSO Apollo Nordic	Canadian waters	Canadian waters	Ugland Nordic Shipping AS	All disciplines
1997-1999	Jotun FPSO	Jotun Field	North Sea (N)	Kværner Engineering / Esso	Hull design, marine and hull structures
1997-1998	Ramform B380	Banff Field	North Sea (UK)	Petroleum Geo Services	Hull structural design, marine systems
1996-1997	Snorre II FPSO	Snorre Field	North Sea (N)	Saga Petroleum / Aker Maritime	All disciplines
1994-1995	Tentech 700	Generic	Generic / North Sea	Aker Maritime	All disciplines
1992-1993	Tentech 700	Generic	Generic / North Sea	Maritime Group / Tentech Int.	All disciplines
1995	Captain FPSO	Captain Field	North Sea (UK)	Texaco / Aker Maritime	All disciplines
1995	Varg FPSO	Varg Field	North Sea (N)	Saga Petroleum / Aker Maritime	All disciplines
1993	Tentech 700	Generic	Generic / North Sea	Maritime Group / Tentech Int.	All disciplines

## Pre-FEED studies performed 1993-2005

Pre-FEED projects are performed to determine the overall design principles, establish philosophies and ensure that a FEED can be commenced. Principal documentation may be reviewed by third party for approval in principle. The work scope for pre-FEED studies have varied between multidiscipline studies, covering all hull and marine related disciplines and studies related to one or a few disciplines.

<u>Year:</u>	<u>Project title:</u>	<u>Field:</u>	<u>Area / country:</u>	<u>Client:</u>	<u>Project description:</u>
2008	M/T Promise conversion	Brazilian Water	Brazil	Transpetrol Ltd	2008
2003	FPSO	Generic	Generic	Hitec Framnæs AS /Bluewater	2003
2000-2001	Tentech FPSO Gulf of Mexico	Generic / Gulf Of Mexico	Gulf of Mexico (US)	Aker Maritime AS	2000-2001
1999	FPSO Barge	West of Africa	West of Africa	Aker Maritime AS / Exxon	1999
1998	Tentech Bayu Undan	Bayu Undan Field	Australia	TIGA Joint Ventur / Aker Maritime	1998
1998	Tentech 760 Lavrans	Lavrans Field	Haltenbanken / Norwegian Sea	Aker Maritime / Statoil	1998
1997	Tentech 760	Lavrans Field	Haltenbanken / Norwegian Sea	Statoil / Aker Maritime	1997
1997-1999	Tentech Buoyform	Generic	Norwegian Sea	Aker Maritime / Statoil	1997-1999
1997-1998	Tentech Standard	Generic	Generic / North Sea	Aker Maritime	1997-1998
1996	Snorre FPSO	Snorre Field	North Sea (N)	Saga Petroleum / Aker Maritime	1996
1996	Jotun FPSO	Jotun Field	North Sea (N)	Kværner Engineering	1996
1995-1996	Ramform B380	Generic	Generic / North Sea	Petroleum Geo Services	1995-1996



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