

IOP - research

Bluewater Energy Services



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Agenda

Bluewater Energy Services

History

IOP support

Examples of PhD research

FPSO LIVE

U-DP

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Bluewater Energy Services BV



- Independent Group
- Privately owned
- 1100 Employees, some 500 offshore
- 30 years in business this year
- HQ in Hoofddorp, The Netherlands
- Offices in UK, USA, Nigeria, Angola, South Africa, Malaysia and Russia

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Bluewater Core Business



SPM

Single
Point
Mooring system



CALM

Catenary
Anchor
Leg
Mooring buoy

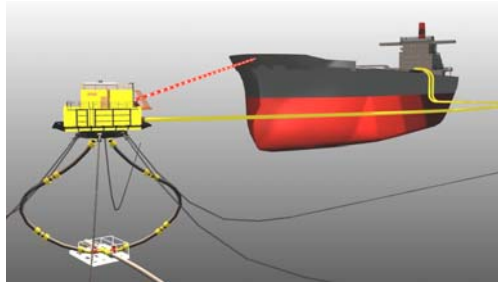


FPSO

Floating
Production
Storage
Offloading unit

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SPM - Buoy Systems

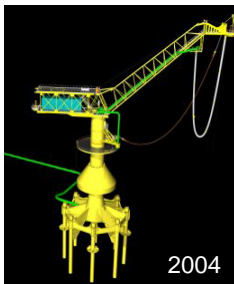


CALM

Over 100 systems supplied

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SPM - Tower Mooring System - Arctic

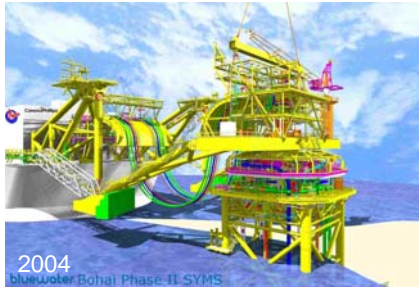


Tower Loading Unit

ExxonMobil Sakhalin 1

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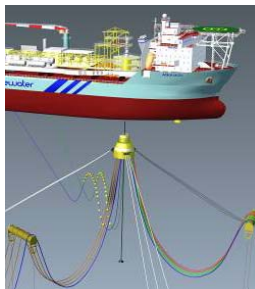
SPM - Tower Mooring System



Soft Yoke Mooring Tower
ConocoPhillips Peng-Lai China Bohai Phase II

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SPM - Turret Mooring Systems



Turrets and Swivels
Over 15 turret systems, over 150 swivel systems supplied

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FPSO Owner and Operator



Uisge Gorm (1995)
Amerada Hess
Fife field UK



Glas Dowl (1997)
PetroSA
Sable field SA



Jotun (1998)
ExxonMobil
Jotun field Norway



Bleo Holm (1999)
Talisman
Ross field UK



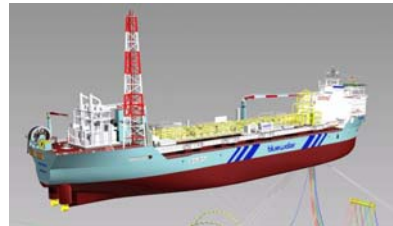
Haewene Brim (1999)
Shell
Pierce field UK



Munin (2001)
Statoil
Lufeng field China

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New FPSO Aoka Mizu



Aoka Mizu
Nexen
Ettrick field UK
2009

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Conversion Projects

MT Hanne Knutsen

Bluewater (2005)
to be converted to FPSO



LNGC Gandria

GolarLNG / Bluewater
(August 2008)
to be converted to FSRU

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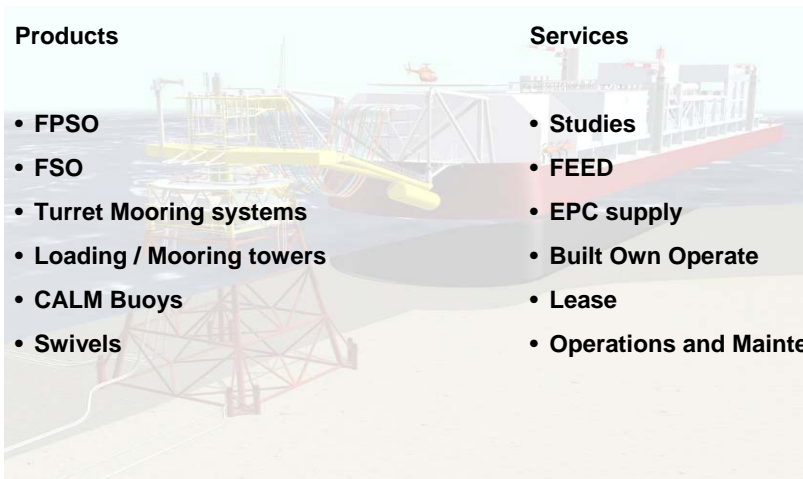
Bluewater Products and Services

Products

- FPSO
- FSO
- Turret Mooring systems
- Loading / Mooring towers
- CALM Buoys
- Swivels

Services

- Studies
- FEED
- EPC supply
- Built Own Operate
- Lease
- Operations and Maintenance



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IOP support

IOP

- fits with BES approach for JIP Funded Research
- non-competitive research
- no focus on product development
- technology enabler
- not limited by strict time line
- results are reviewed by (PhD) committee

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IOP Example 1: FPSO LIVE

FPSO LIVE Research area

- In adequate prediction of fatigue load on FPSO hull structures
- Monitoring systems for fatigue load is lacking



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FPSO LIVE Project Organisation

Project Partners

Bluewater

Marin

DnV

**Continuation of FPSO fatigue JIPs (Integrity + Capacity)
AND Continued by the Monitas JIP, headed by Marin**

Financial support from Dutch Government IS

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Background

Determination of Fatigue status of hull requires guidance:

Guidance for offshore inspection planning

Guidance for conversion work in life-time extension programs



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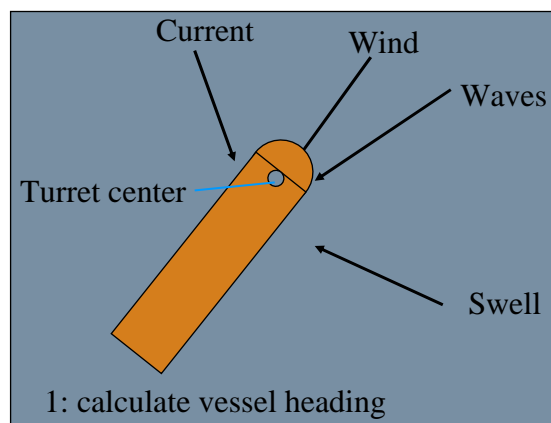
Objective FPSO LIVE

Development of fatigue guidance :

- Investigate physics of fatigue/load accumulation
- Validation with full-scale measurement data and model test data
- Implementation in “practical” long-term model
- Development of minimum monitoring system

Approach

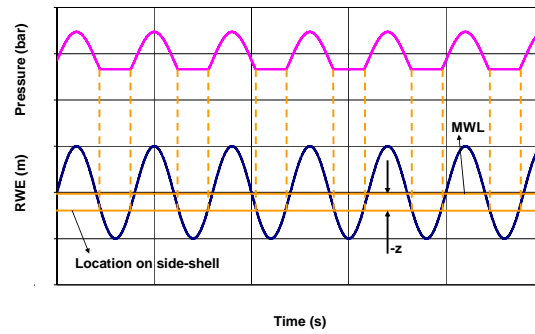
- Environmental data
- Calculate orientation of vessel per sea-state & loading condition
- Evaluate short-term stress responses at fatigue hotspot per sea-state & loading condition
- Calculate long-term stress distribution (time-domain, intermittent wetting)
- With SN curve, determine fatigue life



Intermittent wetting



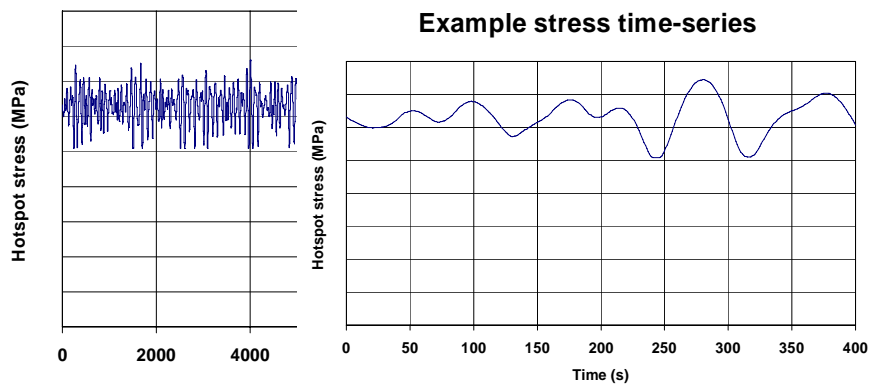
Pressure at location below MWL but intermittently emerged



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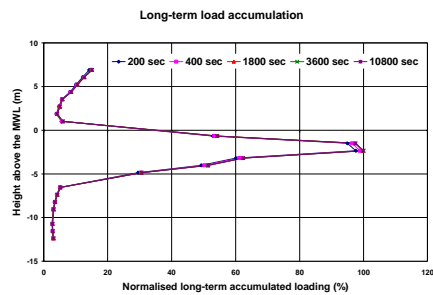
Long and short time-series

Example stress time-series



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Length of Time-series



Simulation time

10800 s: \pm half year

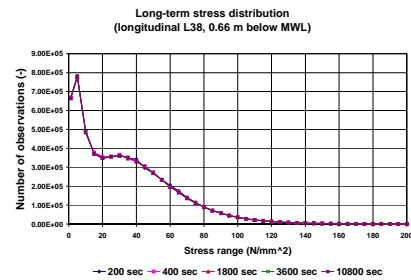
200 s: less than 2 hours

Simulation data

1500 sea-states

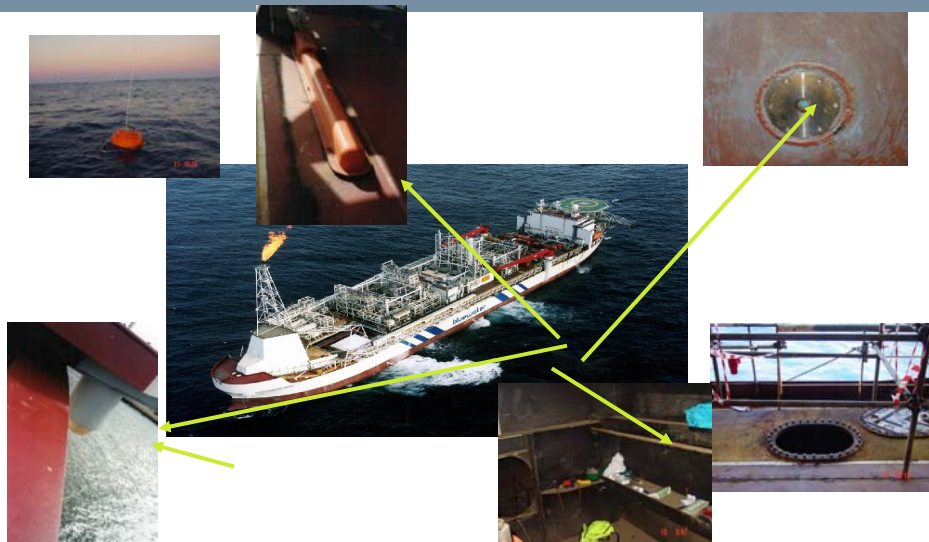
1 LC

21 Locations



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Validation using data FPSO Glas Dowl



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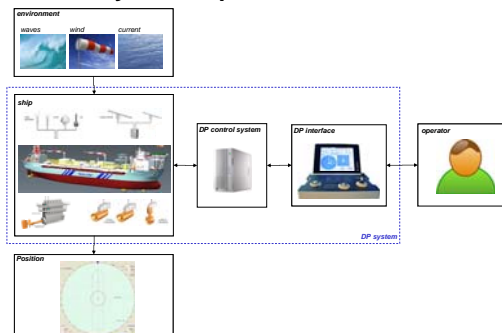
Results FPSO LIVE

- Fatigue model in time-domain has been developed and validated
- A long-term relation between different fatigue load responses exists
- The use of this relation potentially leads to monitoring system with a limited amount of well-chosen sensors

IOP Example 2: Ultimate Dynamic Positioning

UDP Research area

- Majority of DP incidents related to operator
- Long-term stationary DP operations are non-challenging for operators
- Operators lose concentration due to low workload
- Workload in an incident is generally too high to solve problem in time
- Availability of DP operators decreases



U-DP Project Organisation

Project Partners

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MARIN

Imtech
Marine
& Offshore

TU Delft
Delft University of Technology

Financial support from Maritime Funds

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Background

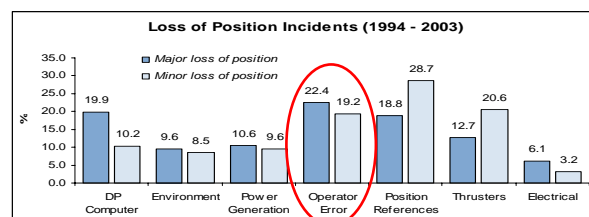
The Operator's Role

For long-term stationary DP operations, the operator's workload is extremely low

- Drilling
- Floating production
- Dredging (rainbowing)
- Diving / ROV support
- Offloading
- ...

• Industry practice: two operator on watch continuously

• Not challenging for operators



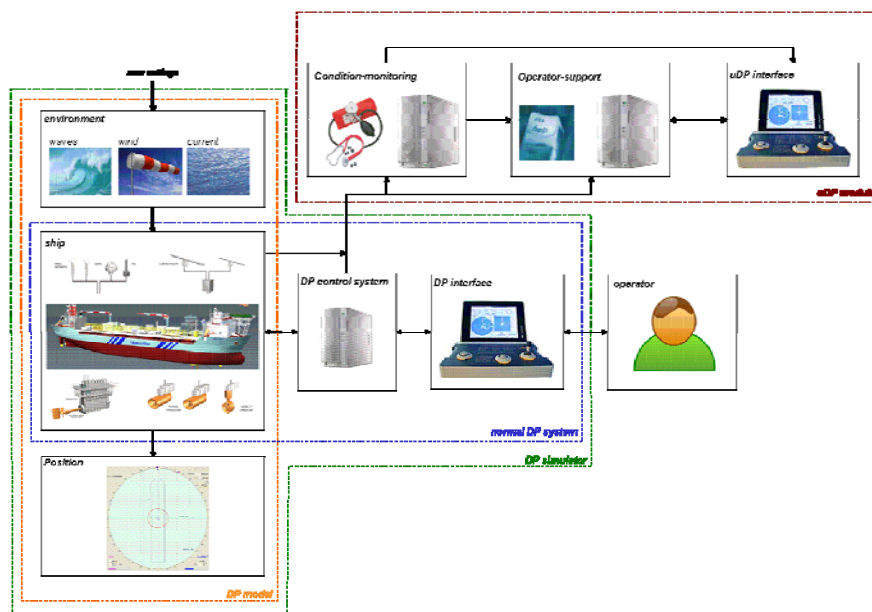
Objective UDP

Development of two additional systems to change the role of the DP operator:

- **Condition-monitoring**
 - Detect faults in an early phase
 - Operator can do other tasks at the bridge (unattended operation)
 - Operator called back to DP system in case a fault is detected
- **Operator-support**
 - Analyse detected fault to find root-cause
 - Quickly inform operator on system's status
 - Generate scenarios to solve problem
 - Simulation and evaluation of scenarios
 - Advice operator on how to solve problem

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Approach



On-going



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