

Technology and front end in MMO

Technology and front end in MMO Specialists at your service

Maintenance, modifications and operations represent a growing market for Aker Solutions as existing offshore and land-based installations mature. Our major front-end engineering and design (Feed) and modification projects in the MMO area include drilling upgrades, tie-ins, low-pressure production upgrades, water injection upgrades and swivel replacements.

Vast experience with MMO projects for the oil and gas industry has enabled us to develop technology and front end specialist teams. These collaborate closely with our corresponding teams in field development (FD), achieving synergies to the client's benefit in both FD and MMO projects.

Having in-house technology and front end specialist teams at our disposal benefits you as our client in every area from efficiency to price and technical solutions.

These specialist services are staffed by highly qualified experts in the specific areas, and are incorporated in MMO projects as required and when performing stand-alone projects/studies.

Technology and front end

We are experiencing a big demand for specialist services related to MMO because our clients need to get work done on their existing platforms and plants.

We have world-class technology groups at key locations around the North Sea, performing advanced analyses on behalf of international oil companies. Our technology groups collaborate closely with the study teams at these locations, enabling clients to make precise evaluations of the scope, cost and technical implications of planned modifications to offshore platforms and land-based plants.

Front end services

When an oil company needs to award a large engineering, procurement, construction and installation (EPCI) modification project, the Feed study often serves as the tender basis for contractors. That makes it crucially important for the scope,

price, technical solution and planned execution. We perform a large number of MMO-related studies every year.

Our study groups should be your preferred choice when you need somebody to take on challenging study work, from initial idea to feasibility and choice of concept. We deliver studies which clearly present the scope of your EPCI project, cost estimates, risk profiling, technology gap analysis and technical evaluation of the concepts studied.

Owing to the significance of the Feed, it is important that a study group has the relevant expertise. We acknowledge the complexity of your Feed and have made it possible to draw on technical expertise from all our locations. When receiving a Feed assignment, we establish a study team which embraces all the necessary expertise, be it in platform upgrades, tie-ins or other challenging modifications.

Your preferred choice for world-class front end expertise in MMO is located in Aberdeen, Stavanger, Bergen, Trondheim and Kristiansund.



Technology services

We have concentrated our technology specialists in hubs around the North Sea in order to create environments in which people thrive and share their knowledge.

These groups make us a world-class performer for structural analyses, including riser, structural fire, hydrodynamic, inspection and global analysis as well as reanalysis of floaters and fixed installations.

We also deliver technology services spanning from flow assurance to three-dimensional laser scanning, hazard and operability (Hazop) and asset management.

Our specialists often play a vital role in ensuring progress with larger projects, solving complex issues efficiently and precisely in order to achieve optimum solutions.

The technology services we offer to the MMO market include:

- riser and umbilical analysis
- structural reanalysis
- structural fire analysis
- structural analysis
- structural inspection and maintenance programme (SIMP™)
- inspection and maintenance technology
- technical integrity management services (TIMS)
- 3D laser scanning
- advanced hydrodynamic analysis
- weight and stability services
- asset management
- flow assurance
- dynamic process simulations
- Hazop analysis
- functional safety instrumented systems

For more information on our technology and front end services in MMO, please contact

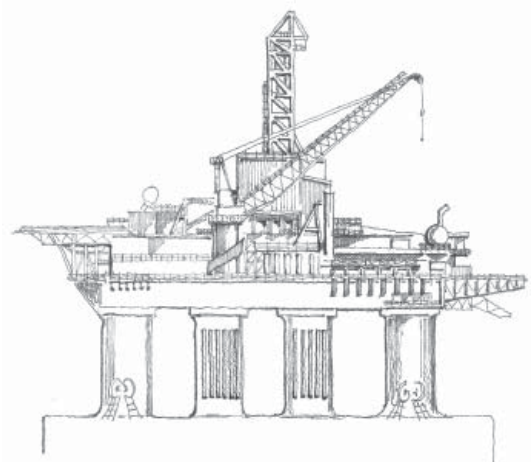
Stavanger

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Visit us at
www.akersolutions.com



Front end studies in MMO

From opportunity to defined concept

We help to define the scope, price and technical consequences of modification or maintenance projects, and bring our clients through all decision gates until feasibility is confirmed or the concept defined.

The main objectives for our front end group are to:

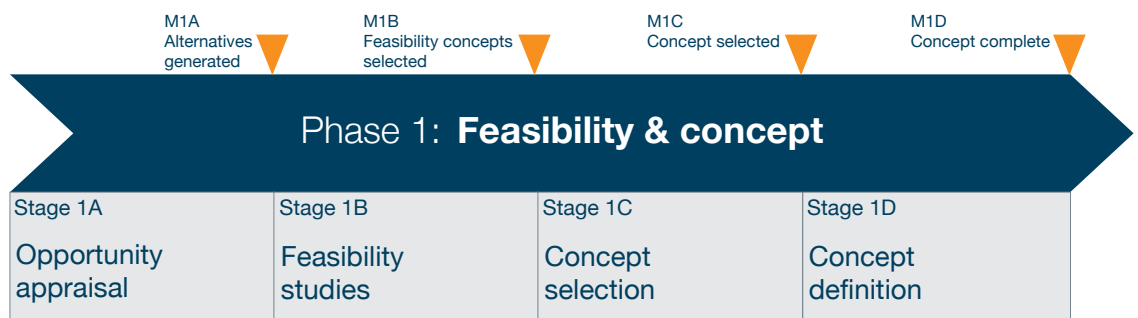
- support client modification processes
- maximise the value of client assets
- develop the concept, cost estimates and execution plan for the project

We use a staged process developed to accommodate client decision gates. A proven project execution model is our guide to success.

We deliver optimum modification solutions through a combination of screening and evaluation of available products and technologies. Purpose-designed process systems, risers and transport systems are delivered, along with any kinds of support facilities.

Front end study deliverables also include:

- cost estimates
- risk profiling
- technological gap analysis
- technical evaluation



For more information on our front end studies capabilities, please contact

Stavanger

Geir Endresen, manager, on +47 92 43 16 01 or at geir.endresen@akersolutions.com

Bergen

Rolf Monsen, manager, on +47 99 60 97 83 or at rolf.monsen@akersolutions.com

Trondheim

Kristian Risdal, manager, on +47 99 61 79 49 or at kristian.risdal@akersolutions.com

Visit us at www.akersolutions.com



“A guided study execution with a proven record of success”

Front end studies in MMO

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2010	2010	Statoil	Pan Pandora tie-back to Gullfaks C or Visund FEED (Class D)
2009	2010	Statoil	Gullfaks A drilling facility upgrade (Greenfield and brown field upgrade) FEED
2009	2010	Statoil	Kristin low pressure production (LPP) & tie-back Q&K satellite to Kristin FEED
2009	2010	Statoil	Åsgard minimum flow feasibility & concept studies
2009	2010	Statoil	Åsgard A swivel replacement FEED
2009	2010	Statoil	Heimdal depressurisation study (Class B&C)
2009	2009	Statoil	Gudrun tie-in to Sleipner FEED
2009	2009	Statoil	Marulk tie-in to Norne FEED
2009	2009	DetNorske	Draupne WHP concept study
2008	2009	Statoil	Gullfaks A&C upgrading of SPM 1&2 (Single point mooring system) life time extension study
2008	2009	Statoil	Heidrun PPL FEED
2008	2009	Statoil	Snorre A upgrading of existing drilling modules w/options. Brown field study. FEED
2007	2008	Dong	Oselvar WHP feasibility/concept/FEED
2007	2008	Norske Shell	Draugen redevelopment - power - concept study
2007	2008	Statoil	Heidrun PPL, B, C and FEED studies. Modifications related to increased gas capacity
2006	2007	ConocoPhillips	Eldfisk II feasibility
2005	2006	Statoil	Snorre/Vigdis IOR FEED
2004	2005	Statoil	Statfjord late life pre-engineering

Riser and umbilical analysis

Fatigue, VIV and interference

Umbilicals (life-supporting cables for your sub-sea equipment) and risers need to be designed for each specific oil and gas field, since conditions vary dramatically between them. Our expertise helps to design riser and umbilical configurations to optimise your cross-section and to ensure safe operation throughout a field's producing life.

We perform global strength analysis, including operational and accidental conditions as well as fatigue, vortex-induced vibration (VIV) and interference analysis. Before challenging conditions arise, you need to know how your risers will behave and what they can withstand. Optimising your configurations at an early stage with a fit-for-purpose field architectural design will help to maintain focus on the individual riser or umbilical.

Our specialists perform all kinds of analyses using a combination of standard software packages for slender marine structures and specialised programmes – such as Bflex for detailed analysis of interactions and utilisation of the different layers in a flexible riser. Deep insight into a wide variety of structures and their complex wear and tear scenarios makes us one of the market leaders for risers and umbilicals.

Areas of expertise include:

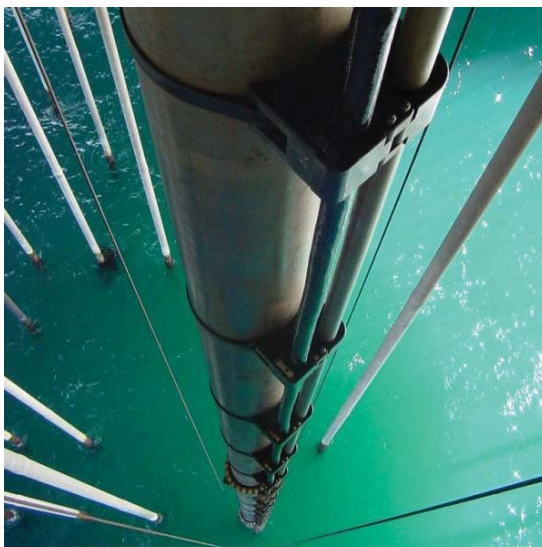
- field development studies
- global strength analysis, connected and disconnected
- detailed fatigue analysis for flexible risers, Bflex
- VIV analysis
- on-bottom stability analysis
- free-span analysis
- crossing analysis
- interference analysis
- wear analysis
- installation analysis
- J-tube pull-in analysis
- coupled analysis for interface details
- flexible and steel catenary risers.

Tools include:

Flexcom
Vivana
Shear7
Bflex
Abaqus
Usfos
Hyber
Orcaflex.

For more information on our riser analysis capabilities, please contact Svein Rune Nøttveit, manager, on +47 90 03 22 19 or at svein.rune.nottveit@akersolutions.com

Visit us at www.akersolutions.com



“One highly experienced and dedicated team covers your riser and umbilical needs both today and tomorrow”

Riser and umbilical analysis

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2010	ongoing	BP	Oselvar riser caisson on Ula
2010	ongoing	Repsol	Montanazo and Lubina, catenary from jacket, 161m
2009	ongoing	Eni Norge	Goliat, 3x pliant wave configurations, 400m from FPSO
2008	2008	Statoil	Troll B, Pliant wave configuration, 325m from semi
2008	2009	BP	Block 31, 2020m carbon fibre reinforcement, 4x lazy wave configs from FPSO
2008	2008	Eni/Nae, Allied	Oyo, lazy wave configuration, 350m from FPSO
2008	2008	Statoil	Morvin, pliant wave configuration, 300m from semi
2008	2008	Statoil	Vega, pliant wave configuration, 370m from semi
2008	2008	Statoil	Gjøa, 2x pliant wave configurations, 370m from semi
2007	2007	Reliance	MA-D6, pliant wave configuration, 1150m from FPSO
2006	2006	Murphy Oil	Kikeh, 2x lazy wave and 2x jumper configurations, 1350m from SPAR/FPSO
2006	2006	ExxonMobil	Saxi Batuque (Kizomba C), 3x lazy wave configurations, 720m from FPSO
2006	2006	Chevron (STAR)	Agbami, 4x lazy wave configurations, 1500m from FPSO
2006	2006	ExxonMobil	Marimba North (Kizomba A), lazy wave configuration, 1180m from FPSO
2006	2006	BP	Block 18, lazy wave and jumper configuration, 1310m from FPSO
2004	2004	ExxonMobil	Deepwater power cable (generic), lazy wave configuration, 1524m from FPSO
2004	2004	Total	Rosa, 4x lazy wave configurations, 1350m from FPSO
2003	2003	ExxonMobil	Kizomba B, lazy wave configuration, 1015m from FPSO
2002	2002	ExxonMobil	Kizomba A, lazy wave configuration, 1182m from FPSO

Structural reanalysis

Consistent, predictable and safe

An offshore structure is designed for a certain production life and specific operational conditions. However, conditions change during operation and incidents occur. That demands constant attention to safeguard uptime and production flow.

We deliver the complete reanalysis package to make sure that your structure stays in production as long as possible. When you sign a frame agreement for reanalysis with us, the structural integrity of your fixed and floating installations will be handled by some of the most experienced reanalysis engineers in the business.

We work on a project basis as well as under frame agreements. This ensures flexibility for our customers, since it provides both long- and short-term solutions.

Signing a frame agreement with us gives you all the benefits of a stable relationship.

A structural reanalysis agreement will typically cover the following aspects:

- development and maintenance of structural in-place models
- development and maintenance of structural fatigue and redundancy models
- rapid reanalysis of the structures in the event of damage
- reanalysis of the structures in the event of significant changes to topside weight and/or ballast
- assessment of the significance of changes in environmental design criteria
- development and maintenance of a weight monitoring system
- development and updating of the structural inspection strategy and programme
- assessment of structural inspection results
- annual summary report on asset integrity

We have in-depth knowledge of prevailing offshore standards and regulations, and a broad base of specialist personnel.

Our structural calculations and analyses are performed using the leading industry-standard software packages.

For more information on our structural reanalysis capabilities, please contact

Bergen

Gunnar Bremer, manager, on +47 90 85 15 34 or at gunnar.bremer@akersolutions.com

Stavanger

Eirik Engevik, manager, on +47 957 45 693 or at eirik.engevik@akersolutions.com

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“A stable relationship leads to better solutions”

Structural reanalysis

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2008	2009	Talisman	Varg A - Lifetime extension study
2007	2008	StatoilHydro	Gullfaks 2030 - ultimate limit state (ULS) and fatigue limit state (FLS) analyses
2007	2008	StatoilHydro	Troll A - ULS and FLS analyses
2007	2007	StatoilHydro	Statfjord late life, ULS and FLS analyses
2007	2007	StatoilHydro	Veslefrikk B - FLS analyses
2006	2008	StatoilHydro	Crane pedestals - several structural analyses for crane exchange

Structural fire analysis

Challenge previous thinking

Optimising passive fire protection (PFP) means reducing offshore work.

PFP is often extensively used for structures on both new and existing offshore installations.

Many reasons exist for minimising the amount of PFP:

- high purchase and installation costs
- complicates inspection
- complicates modifications
- substantial maintenance costs
- weight issues.

We provide an analysis method which identifies and documents safe solutions while reducing the amount of PFP.

Typical steps during the PFP design process are:

- run fire simulation
- propose PFP layout
- compute temperature and structural response
- propose optimal PFP design layout

Our method takes account of research and development results over recent years, including:

- better knowledge about the behaviour of different hydrocarbon fires
- international standards for the behaviour of materials at high temperatures
- analysis of structures exposed to extreme (accidental) loads
- specialised analysis tools

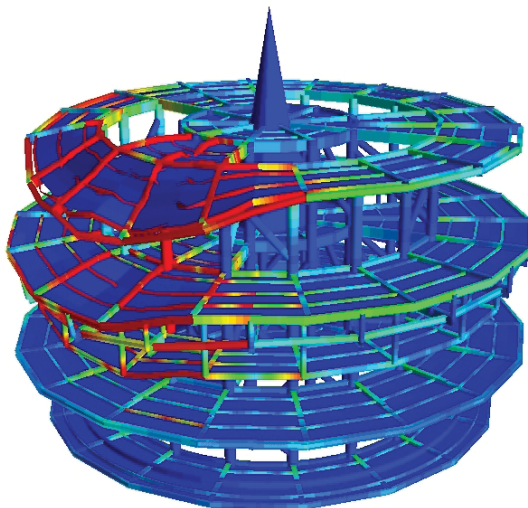
Tools include:

Kameleon FireEx
Fahts
Usfos
Sesam

III. Structural response to a jet fire

For more information on our structural fire analysis capabilities, please contact Christian Overland, manager, on +47 95 94 96 07 or at christian.overland@akersolutions.com

Visit us at www.akersolutions.com



“Optimise your fire protection”

Structural fire analysis

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2010	ongoing	Statoil	Gullfaks C
2009	ongoing	ConocoPhillips	Tor platform
2009	2009	Total	Usan FPSO flare
2009	2009	StatoilHydro	Snøhvit
2008	2009	APL	Nexus FPSO
2008	2009	APL	APL turret system study
2008	2009	BP	Skarv FPSO
2008	2009	BP/SBM	SBM Skarv turret
2008	2008	StatoilHydro	Troll C LPP
2007	2008	StatoilHydro	Gjøa floater
2006	2007	StatoilHydro	Snorre A
2006	2007	BP	Ula D platform
2005	ongoing	BP	Ula P platform

Structural inspection and maintenance programme - SIMP™

Extending service intervals on floaters

New oil resources need to be found to meet the world's ever increasing demand for energy. As such discoveries are made in ever deeper waters, floating exploration and production facilities become increasingly necessary.

Floating facilities such as semi-submersibles and FPSOs are normally designed to classification society rules and subject to regular inspections. Introducing our SIMP™ provides a specific detailed maintenance and inspection programme for fatigue-prone areas to increase structural reliability.

Our method is based on solid engineering experience combined with the use of sophisticated finite element analyses. The following elements are considered:

- history of the rig (operations and modifications)
- inspection history of welds
- global analyses and local finite element analyses of fatigue-sensitive details
- inspection programme for next class period.

The method is known as SIMP™ (Structural inspection and maintenance programme).

SIMP™ in brief

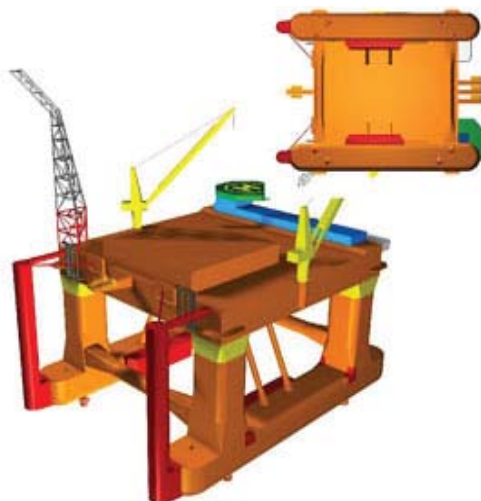
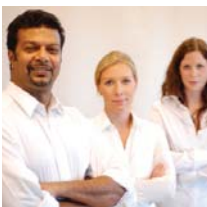
- SIMP™ helps to monitor and assess structural integrity, including the fatigue capacity of the structure
- Rigs beyond their design life (FUI>1) normally need inshore inspection of the hull at 2.5-year intervals (DNV class requirement for harsh environment)
- With SIMP™, the renewal survey (RS) interval is maintained at five years
- SIMP™ inspection scope is based on the structural reliability analysis technique, which accounts for the effect of inspection, maintenance and fatigue life estimates
- The inspection scope is re-assessed for each class period, depending on previous inspection results
- SIMP™ increases the structural reliability of the rig, and has the potential to reduce costly downtime for the owner

References

DNV, LR, Odfjell Drilling, Statoil, Fred Olsen Energy/Dolphin, Songa Offshore, Petrofac

For more information on our SIMP™ capabilities, please contact Jermund Andreassen, manager, on +47 99 29 70 17 or at jermund.andreassen@akersolutions.com.

Visit us at www.akersolutions.com



“Minimise recertification downtime while maintaining required reliability level.”

Structural inspection and maintenance programme - SIMP™

Reference list

Start year	End year	Client	Project title
2008	2010	Dolphin Drilling Ltd	SIMP™ on Borgny Dolphin
2008	2009	Songa Offshore	SIMP™ on Songa Dee
2008	2009	Petrofac Ltd.	SIMP™ on Northern Producer
2007	2008	Dolphin Drilling Ltd	SIMP™ on Borgholm Dolphin
2006	2006	Dolphin AS	SIMP™ on Bredford Dolphin
2006	2006	Odfjell Drilling	SIMP™ on Deepsea Delta
2005	2005	Odfjell Drilling	SIMP™ on Deepsea Bergen
2004	2005	Dolphin Drilling Ltd	SIMP™ on Port Reval
2004	2005	Dolphin Drilling Ltd	SIMP™ on Borgsten Dolphin
2004	2005	Dolphin Drilling Ltd	SIMP™ on Byford Dolphin
2004	2004	Odfjell Drilling	SIMP™ on Deepsea Trym
2003	2004	Dolphin AS	SIMP™ on Borgland Dolphin
2003	2004	Dolphin AS	SIMP™ on Bideford Dolphin
1998	1999	Statoil	SIMP™ on Veslefrikk B

Inspection and maintenance technology

Technical integrity solutions

We provide technical integrity services for life-cycle management of structures as well as mechanical and static process equipment through four business areas:

- asset integrity management
- advanced NDT inspection
- in-service inspection
- fabrication and weld inspection.

Our focus is on optimising life-cycle maintenance and reducing inspection costs for offshore oil and gas operators through:

- total technical integrity management solutions
- development and use of advanced technologies and methods
- access to extensive knowledge, expertise and experience.

Areas of expertise:

- project management
- maintenance and inspection analysis
- static and dynamic structural analysis
- QA/QC and NDT inspection
- materials technology
- welding technology
- monitoring technology

For more information on our inspection and maintenance technology capabilities, please contact Ronny Øye, manager, on +47 93 05 73 67 or at ronny.oye@akersolutions.com.

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“Find all the defects and degradations before they become critical”

Inspection and maintenance technology

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2008	ongoing	Statoil, BP, Shell, Teekay etc.	Various installations - Advanced NDT, Eddy current/RFT tube inspection
2003	ongoing	Statoil	Tampen - In-service inspection and NDT, Maintenance and inspection engineering
2007	ongoing	Statoil, Odfjell Aker Drilling etc.	Various installations - Advanced NDT, Phased array/TOFD
2004	ongoing	Dong	Various installations - Maintenance and inspection engineering
2003	ongoing	Statoil	Halten Nordland - In-service inspection and NDT, Maintenance and insp. engineering
2000	ongoing	DNV	NDT inspection
2000	ongoing	Statoil, Shell, Teekay, BP etc.	Various international installations - Advanced NDT, Vibration and stress measurement
1996	ongoing	Statoil, Exxon, Shell, BP etc.	Various international installations - Advanced NDT, Thermographic inspection
1995	ongoing	Statoil	Mongstad - In-service inspection and NDT, maintenance and insp. engineering
1991	ongoing	BP	Various installations - Maintenance and inspection engineering
2009	2010	Statoil/GDF	Gjøa - Maintenance and inspection engineering
2006	2008	Statoil	Various installations - Research and development (TAIL, PYRAMID, HOIS2000)

Technical integrity management services (TIMS)

Condition-based maintenance

TIMS is a multidisciplinary service which brings together a unique package of expertise and tools to help you achieve optimum asset performance.

It will improve planning and preparation for the next generation of integrated operation (IO), and supports quicker and better-informed decisions in a distributed organisation. This is based on making information available to the different disciplines throughout the field's producing life, independent of location.

A culture change is needed, from asset repair to asset reliability.

The overall objective is to maximise production, reduce downtime and predict degradation.

To ensure safe, reliable and efficient operation, effective collaboration between all involved disciplines is crucial.

Typical scope of work

- Initiation meeting – what's in it for you?
- CBM study with participants from Tims team in dialogue with customer
- Narrow-down meeting with decision for further work
- Implementation of agreed CBM strategy and philosophy
- Implementation of pilot or demonstrator to assist in decision-making and of a people process for a full Tims roll-out.

Partnership to provide a complete service

- Our own group, with 30 years of experience in maintenance and modification solutions
- IBM, utilising its service oriented architecture (SOA), reference semantic model (RSM) and integrated information framework (IIF) solutions to integrate information. Ease the decision-making process
- SKF provides comprehensive CBM services for all rotating equipment

For more information on our TIMS capabilities, please contact Jarle Daae, manager, on +47 41 29 76 67 or at jarle.daae@akersolutions.com.

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Or you can contact our partner at IBM, Arild Kristensen, manager, on +47 90 53 25 91 or at arild.kristensen@no.ibm.com

Or you can contact our partner at SKF, Tor Morten Olsen, manager, on +47 97 12 34 83 or at tor.morten.olsen@skf.com

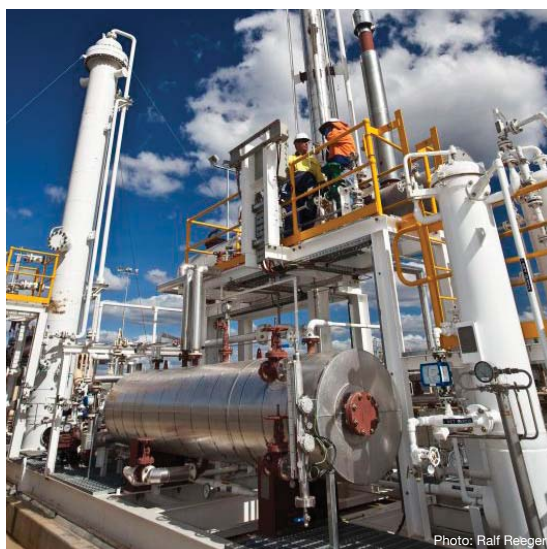


Photo: Ralf Reeger

“From asset repair to asset reliability”

Technical integrity management services

Sample CBM web portal

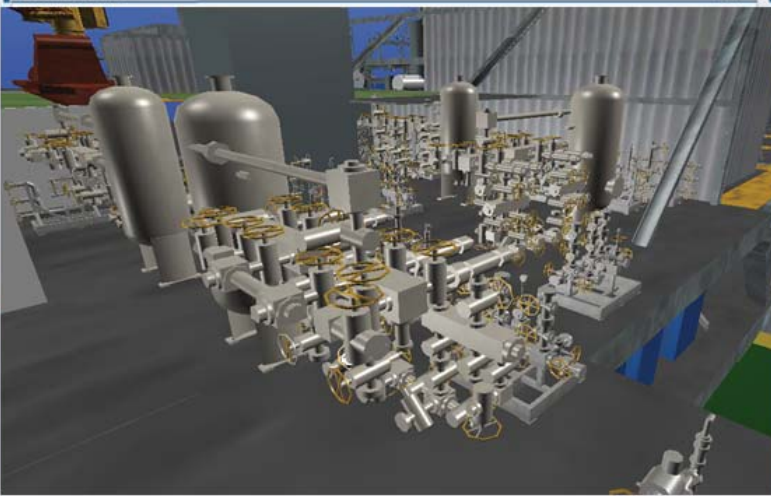
Welcome Mr. Demo

Home Engineering Reliability Review Change Management

SmartPlant Enterprise for Owner Operators

SmartPlant Enterprise for Owner Operators | History Back Forward

Information Viewer



Correlated Data

Correlated Properties	Name	Value
Inspection	MTBF:	289,809 h
	Criticality:	Low
	Maintenance Cost:	54717.85
	Loss Of ProductionCost:	164153.55
	Meridium Identifier:	MER0006
Maximo	Functional Location:	FL0000001 m
	Hazardous Service:	Yes, due to Liquid
	Seal Manufacturers Code:	QB05
Engineering	Name:	PMP-4543
	Description:	Reflux Pump A
	Pump Suction Pressure Maximum:	20.4 bar
	Power At Estimated Efficiency:	35.5 kW
	Head In Discharge Vessel:	355.4 m
	Estimated Efficiency:	60 % m
	Ambient Temperature Minimum:	6.7 m
NPPA:	Ambient Temperature Minimum:	77.8 m kg
	Seal Type:	Tandem m

Information


Name	Type
Delete Plant - Grids	3D Model
and Maintenance-1-0001	3D Model
Every Stage 1	3D Model
01-U02-001	2D Model
00000	Field Change Request


Page 1 of 2

Maintenance Data

Id	Description	Mode	Part	Cost	Downtime	FailureDate
EID0000000517	SEAL LEAK ON PUMP	External Leakage Process Medium	Casing	20506.972		10/5/1991 12:00:00 AM
EID0000000520	REPLACE SEAL	External Leakage Process Medium	Seals	14050.851		8/15/1992 12:00:00 AM
EID0000000522	SEAL LEAKING IN PUMP	External Leakage Process Medium	Seals	53384.534		2/7/1993 12:00:00 AM
EID0000000523	REPLACE SEAL	External Leakage Process Medium	Bearing(s)	15861.751		1/8/1994 12:00:00 AM
EID0000000523	REPLACE SEAL	External Leakage Process Medium	Seals	15861.751		1/8/1994 12:00:00 AM

SFBR510-1





3D laser scanning Remodelling existing structures

We perform laser scanning, establish a master grid and offer remodelling/3D solutions for offshore installations, land-based power plants and modules. The 3D Cad result can be presented in various Cad formats, including the industry standard 3D PDMS.

We enable access to TruView data on our web portal.

Our 3D laser scanning group consists of 40 engineers and a number of consultants. This team was established in 1995 by experienced surveyors, giving you the benefit of a long and proven track record.

Our goal is to establish a 3D model which is as exact as possible by focusing on high quality in our scanning and remodelling performance.

We are at the forefront in utilising the latest hardware and software solutions.

Hardware includes:

- Getac, fully rugged scanner laptops
- One Leica C10
- Three Leica HDS6100
- 21 Leica total stations

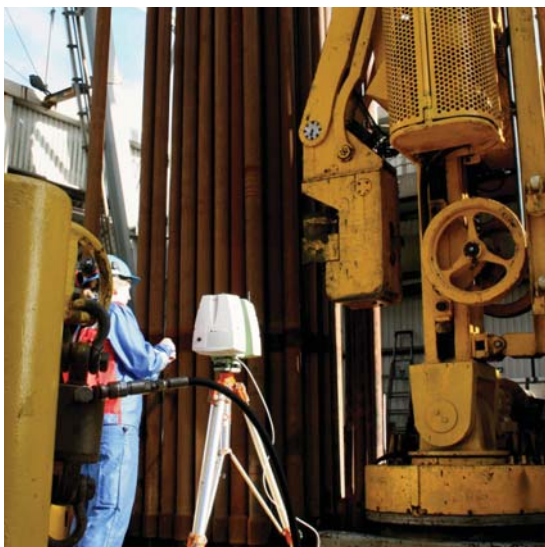
We can also rent two C10 units at short notice.

Software includes:

- SC4W
- Survey Explorer
- Bentley 3D Microstation
- PipeElements
- DgnPdms
- Leica Cyclone
- Leica Cloudworx for PDMS
- Bentley Cloudworx for Microstation
- FI XFactor
- NavisWorks

For more information on our 3D laser scanning capabilities, please contact Georg Gaard, on +47 41 68 98 93 or at georg.gaard@akersolutions.com.

Visit us at www.akersolutions.com



“We remodel reality”

3D laser scanning Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2009	ongoing	Shell	Ormen Lange, scanning and remodelling of various compressors and skids
2009	2009	Statoil	Brage, wellhead area scanned and remodelled
2008	2008	Statoil	Grane, scanning and remodelling of modules
2008	2008	Rosenberg verft	Ekofisk C (ConocoPhillips), jacket and bridge landings scanned and remodelled
2008	2008	Shell	Draugen GBS, laser scanning and ongoing remodelling of selected GBS levels
2008	2008	Statoil	Oseberg B, laser scanning and remodelling of drill floor and the pump room
2007	ongoing	BP	Valhall, Ula, Tambar, Flank N&S
2007	2008	Statoil	Troll B&C, areas scanned and remodelled for LPP project
2006	2007	ConocoPhillips	Eldfisk A&B, established complete PDMS 3D model based on scanning and remodelling
2006	2006	Statoil	Snorre A, minor area scanned and remodelled
2005	2005	ConocoPhillips	Ekofisk bridge landing and 2/4-M jacket, scanned to verify position, long range scan
2005	ongoing	Statoil	Statfjord late life project; large number of areas have been scanned and remodelled

Advanced hydrodynamic analysis Solving complex problems in a demanding marine environment

The world's growing demand for energy continues to push companies further offshore into increasingly challenging waters, such as deep-water or Arctic (very shallow).

Floating exploration and production facilities need motion, mooring and stability analyses to determine safe operating conditions. The structures supporting the drilling and production equipment need accurate prediction of wave loads to determine strength and fatigue capacity, and operators need predictable and reliable performance.

We have an experienced and well-established hydrodynamics team. With a combination of experience gained from projects all over the globe, great theoretical knowledge and continuous learning through such means as joint industry projects, our staff have the background and the latest tools to provide the answers and solutions our clients need.

Our personnel are experienced in both evaluation and modification of existing structures as well as the development and evaluation of new concepts. We help our clients to find and document optimum solutions through advanced analysis, knowledge of rules and regulations, and use of our know-how.

So we can help you whether your floating production system faces increased wave-heights, rising topside weight is causing stability concerns, or you need to deal with other challenges to your marine structure.

Typical services include:

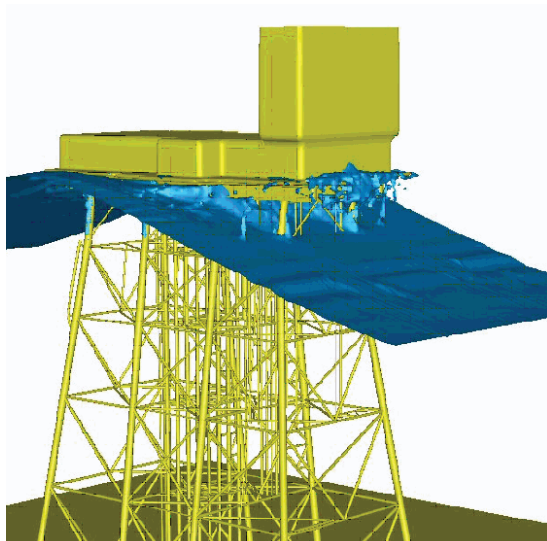
- advanced flow simulations (CFD)
- air gap analysis
- marine operations simulations
- motion analysis
- mooring analysis
- stability analysis
- wave-impact analysis (WISR).

Software typically used includes:

- AutoHydro
- Comflow
- DeepC
- Flow-3D
- HydroD
- Mimosa
- Simo
- Wadam

For more information on our advanced hydrodynamics capabilities, please contact Lars Rønning, manager, on +47 97 52 63 45 or at lars.ronning@akersolutions.com

Visit us at www.akersolutions.com



“Understand how your structure responds in a marine environment”

Advanced hydrodynamic analysis

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2008	ongoing	Statoil	Veslefrikk B, dynamic mooring analysis
2010	2010	Odfjell	Deepsea Atlantic, hydrodynamic model
2009	2010	Statoil	Visund, simplified stability analysis
2009	2010	Statoil	Grane, conductor/guide hydrodynamic interaction
2009	2009	BP	Valhall DP, wave-in-deck analysis
2008	2009	ConocoPhillips	Eldfisk A and B, wave-in-deck analysis
2008	2008	ConocoPhillips	Mooring operability study for Arctic areas
2008	2008	Dolphin Drilling	Bredford Dolphin, airgap analysis
2008	2008	Statoil	Veslefrikk B, stability analysis
2008	2008	Odfjell	Deepsea Trym, inclining experiment
2008	2008	Odfjell	Deepsea Bergen, motion analysis
2007	2008	ConocoPhillips	Tor, wave-in-deck analysis
2004	2005	Total Norge	Frigg DP2, hydrostatic and towing
2004	2005	Total Norge	Frigg QP, hydrostatic and towing

Weight and stability services

Effects of changes to offshore structures in the operation phase

In order to document the structural integrity of offshore structures, updated information about weight and centre of gravity as well as margins must be available. This is required both by Norwegian government regulations (PSA activity regulations, section 23, and framework HSE regulations, section 28) and as the basis for customer decisions on new development concepts.

Our weight and stability services can be purchased stand-alone, as a third-party consultancy or as part of a frame agreement.

Working closely with our structural reanalysis group, our experts on stability and floaters, and other departments in our special technology services team, some 25 databases are maintained for installations on the NCS.

- continuous improvement of procedures and work instructions
- continuous focus on the importance of weight control in projects.

We provide an in-house presence with the disciplines involved, such as weight and stability, structural reanalysis, hydrostatics and hydrodynamic expertise, and cost control.

A focus on weight control at management level leads to better quality of deliverables, ensuring that the as-is database is more accurate. That in turn enhances safety.

Typical scope of work:

- provide updated information of weight and centre of gravity of lifted objects
- verification of weight databases
- continuous updating of weight databases with changes from maintenance and modification contracts and other projects
- update of lightship weight as input to stability
- import of standalone projects to weight databases
- input to cost control related to compensation models

Tools include:

- Mon
- Client computerised maintenance management system – CMMS (SAP, Workmate, etc)
- Aker Solutions operating system (PEM™)

For more information on our weight control capabilities, please contact Rune Ellefsen, manager, on +47 90 16 52 14 or at rune.ellefsen@akersolutions.com.

Visit us at www.akersolutions.com



“We manage weight changes on operational offshore installations until removal”

Weight and stability services

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2010	ongoing	Statoil	Norne Topside Mod.
2010	ongoing	Statoil	Linnorm to Njord Concept study
2008	ongoing	Statoil	GFA/GFB Cement
2009	2010	Statoil	Kristin LPP FEED
2007	2010	Statoil	Troll C LPP
2009	2009	Statoil	Njord
2009	2009	Statoil	Alve tie-in to Norne
2007	2008	Statoil	VFB 2020

We maintain and update weight databases for the following installations

Client	Installations
BP	Valhall QP, DP, PCP, WP, IP
	Valhall flank south, Valhall flank north
	Hod
	Ula Q, D, P
	Tambar
Statoil	Gullfaks A, B, C
	Troll A, B, C
	Brage
	Veslefrikk A, B

Asset management

Providing decision support

Our asset management group provides specialist services suited for operators of production plants. We aim to provide operation and maintenance support services for land-based and offshore facilities.

The team embraces a mix of personnel, ranging from experienced engineers with a number of years of operational involvement to young professionals with the latest theoretical knowledge.

Maintenance strategy

Our group provide advisory services for developing suitable maintenance strategies to fit the operator's operational philosophies and business goals. Vital elements include handling integrated operation and condition-based maintenance.

Maintenance engineering

This includes various analyses, such as criticality, risk-based inspection (RBI) and RSM, and the development of inspection and maintenance programmes. A tailor-made tool named Pyramid is normally utilised.

Production availability analysis

The Miriam Regina simulation tool is used for production availability analyses to achieve and maintain high production regularity on oil and gas fields, maximising the utilisation of producing assets and contributing to company profits.

Staffing analyses

Benchmarking maintenance performance, the number of inherent maintenance work-hours, staffing level per trade, Opex and life-cycle operating cost for:

- new plants - especially during the design phase when configuration changes are still possible to reduce operating and/or total life-cycle costs
- established plants - where the requirement is to identify excessive operating and maintenance costs
- design changes - where the requirement is to establish the effect of changes on work-hours and Opex.

Maintainability evaluations

Multi-disciplinary evaluations of maintenance activities for equipment will be applied to ensure easy change-out at global, regional and local scales. Selecting maintenance-friendly equipment/packages is essential for streamlined and efficient maintenance execution.

Our material handling philosophies are in line with governing standards and regulations, and are aligned with company operational philosophy and best industry practice.

For more information on our asset management capabilities, please contact Tom Svennevig, manager, on +47 46 40 22 48 or at tom.svennevig@akersolutions.com.

Visit us at www.akersolutions.com



“Providing decision support for managers of oil and gas fields utilising Aker Solutions knowledge, resources and state of the art tools”

Asset management Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2010	ongoing	Statoil	OREDA data collection
2009	2010	Det norske	Draupne staffing study
2009	2010	Statoil	Snorre B waste heat recovery robustness study - availability analysis
2009	2009	Statoil	Gudrun tie-in to Sleipner East - availability analysis, material handling philosophy
2009	2009	Shell	Ormen Lange subsea compression test site
2008	2010	ConocoPhillips	Greater Ekofisk area development FEED

Flow assurance

Reliable and safe fluid transportation

Flow assurance studies are carried out to permit reliable and safe fluid transport from wells to processing facilities. Such studies entail analysis of thermal, hydraulic and production issues arising from design, operation and maintenance of the total systems over the life cycle of the field.

Multiphase and dynamic simulations are performed using advanced software tools in:

- the design phases
- the operational phases (troubleshooting)
- late life with changes in compositions and flow rates

The flow assurance team in Norway consists of personnel in Oslo, Stavanger, Bergen and Kristiansund, but our international network can be utilised if required.

The scope of services embraces transient multiphase flow studies of pipelines, flowlines, risers and wells, including:

- pipe sizing
- slugging studies
- thermal studies
- artificial lift studies
- pigging simulations
- hydrate, wax, scale and corrosion control
- blowdown studies
- troubleshooting on operational issues
- technical audits and consultancy services.

Software tools include:

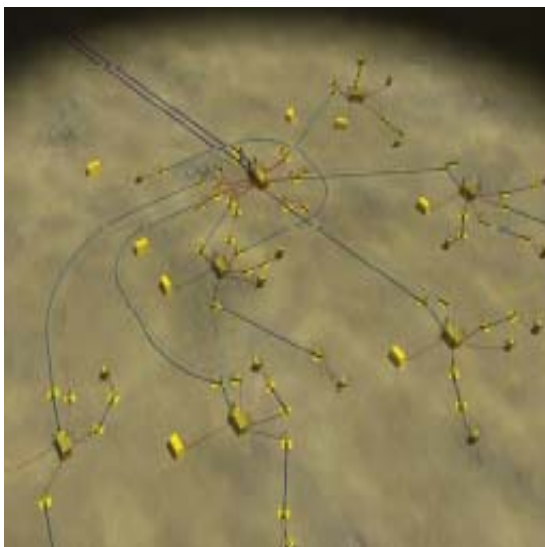
- Olga – for dynamic simulation of multiphase pipelines
- Aspentech Hysis Dynamics – for dynamic simulation of topside processing facilities
- PVT Sim – for generating pressure, volume and temperature (PVT) data

For more information on our flow assurance capabilities, please contact

Stavanger

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“Flow assurance is critical in every field development”

Flow assurance

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2010	2010	BP / DONG	Oselvar - Ula pipeline blowdown
2010	2010	ConocoPhillips	Greater Ekofisk - 2/7N-2/7S wellstream transfer
2010	2010	Gassco	Flow assurance support
2010	2010	ConocoPhillips	Greater Ekofisk Area Development - Flow simulations in topside flowline
2007	2010	Statoil	Tampen V&M: Snorre B - Overpressure protection of inlet configuration from high pressure in subsea wellstream production flowlines
2009	2010	ConocoPhillips	Greater Ekofisk Area Development - Choke collapse evaluations on EldA and EldS (new)
2009	2010	BP	Various minor projects regarding temperature estimation in connection with gas lifted wells on Valhall
2009	2010	Statoil	Gudrun Gas Segment Blowdown
2006	2010	BP	Skarv Flow Assurance
2008	2009	ConocoPhillips	Greater Ekofisk Area Development - Existing pipelines study
2009	2009	Dong	Oselvar Flow assurance verification
2008	2009	ConocoPhillips	Greater Ekofisk - 2/7N-2/7S wellstream transfer
2008	2008	Norske Shell	Hasselmus, well and pipeline parametric study
2008	2008	Norske Shell	Hasselmus, pipeline blowdown and inhibition
2008	2008	BP	Valhall Flanks Gas Lift, Production Pipelines
2008	2008	BP	Valhall Flanks Gas Lift, Annulus Blowdown
2008	2008	BP	Valhall Flanks Gas Lift, Gas Lift Pipelines
2008	2008	Burgundy	Malampaya oil Rim Flow Assurance evaluation
2007	2008	Statoil	Veslefrikk 2020 - Choke collapse
2007	2008	Norske Shell	Hasselmus reservoir tie-back to Draugen
2007	2008	ConocoPhillips	Slugging evaluations in multiphase pipeline
2006	2008	BP	Valhall Flanks Gas Lift, Production Pipelines
2007	2007	Lundin	Peik Flow Assurance
2006	2007	Statoil	Tampen M&M: Statfjord C - satellite production debottlenecking

Dynamic process simulations

Dynamic process simulations analyse the response in variables like pressure, temperature and flow rate during transients that could be caused by:

- Variations in the boundaries – rate, temperature, pressure and composition
- Fault situations – trips and leakage
- Operational problems
- Procedures – start-ups / shutdowns

The simulations may contribute to process design and verify design or result in redesign of:

- Compression systems
- Sea and firewater systems
- Water injection systems
- Control strategies
- Parameter tuning
- Procedures (Start-up, shutdown and trip)
- Choke collapse scenarios
- Safety systems e.g. flare system

Dynamic process simulations are performed using advanced software tools and are performed both in the design phases as well as in the operational phases.

Typical scope of work

- Design of new systems
- Verification of systems
- Analyses of new operating conditions
- Analyses for new rules and regulations
- Trouble shooting on operational issues
- Technical audits and Consultancy services

Software tools

- **OLGA** - for dynamic simulation of multiphase pipelines
- **Aspentech Hysys Dynamics** - for dynamic simulation of Topside processing facilities
- **PVT sim** - for generation of PVT data
- **Pipenet transient** – for transient analyses of flow in pipeline networks
- **ASSETT** – for dynamic simulation of topside processing facilities

For more information on our dynamic process simulation capabilities, please contact

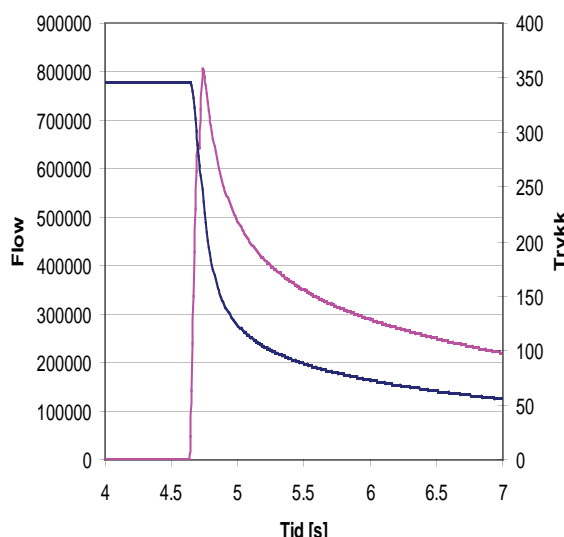
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“The real world
is dynamic”

Dynamic process simulations

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2010	2010	Statoil	Brage - Pressure Protection of Inlet Arrangement
2010	2010	BP / DONG	Oselvar - Ula pipeline blow down
2009	2010	ConocoPhillips	Greater Ekofisk Area Development - Choke collapse evaluations on EldA and EldS (new)
2009	2010	Statoil	Troll B Low Pressure Production
2009	2010	BP	Various minor projects regarding temperature estimation in connection with gas lifted wells on Valhall
2009	2010	Statoil	Gudrun Gas Segment Blowdown
2007	2010	Statoil	Tampen V&M: Snorre B - Overpressure protection of inlet configuration from high pressure in subsea wellstream production flowlines
2008	2009	ConocoPhillips	Greater Ekofisk development - Existing pipelines and choke failures
2006	2009	BP	Skarv Firewater system transient analysis
2008	2008	BP	Ula Power Upgrade - Capacity evaluation for the fuel gas scrubber
2008	2008	BP	Valhall Flanke Gas Lift - Minimum temperature calculations in vent system.
2008	2008	BP	Skarv Inlet Valve maloperation
2008	2008	BP	Skarv Seawater system transient analysis
2007	2008	Statoil	Veslefrikk 2020 - Choke collapse
2007	2008	Statoil	Statfjord Late Life - Dynamic compression simulations
2006	2008	BP	Valhall Flanks Gas Lift, Production Pipelines
2007	2007	Statoil	Gjøa Firewater system transient analysis
2006	2007	Statoil	Tampen V&M: Statfjord C - Satellite production debottlenecking

Hazard and operability analysis (HAZOP)

Identify safety and operational issues

HAZOP analysis is a reputable and well proven method for identifying safety and operational issues related to the design, operation and maintenance of a system.

Essentially, a HAZOP analysis provides a full description of a process and systematically questions every part of it to establish how deviations from the design intention might arise. This is done in a formal and objective way, based on pre-defined guide words.

Once identified, deviations and their consequences are assessed to see whether they might have a negative effect on safe and efficient plant operation. This technique ensures a systematic evaluation to identify potential problems/hazards.

HAZOP highlights include:

- systematic examination
- multidisciplinary study
- utilisation of operational experience
- safety as well as operational evaluations
- may indicate solutions to the identified problems
- considers operational procedures
- human errors
- led by an independent person
- results are recorded.

We have long experience of HAZOP, and house a team of experienced HAZOP facilitators who are able to help clients organise and perform such analyses. Staff in Stavanger can be supplemented by experienced HAZOP facilitators at our offices in Oslo and Bergen.

For more information on our HAZOP capabilities, please contact

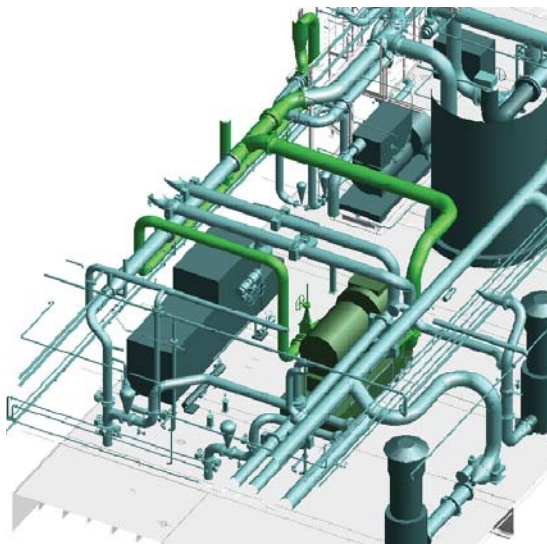
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“Providing the knowledge to facilitate HAZOPs”

Hazard and operability analysis (HAZOP)

Reference list

This list is not exhaustive

Start year	Client	Project title
2010	Shell	Ormen Lange
2010	Statoil	Gas lift
2010	Statoil	Crossover Vigdis WI pump to jet water
2010	Statoil	Snorre, dosing of chlorine dioxide
2009	Shell	Draugen (multiple)
2009	Shell	Ormen Lange (multiple)
2009	ConocoPhillips	GEAD (FEED)
2009	BP	Valhall pilot PW (FEED)
2009	Talisman	Gyda gas lift (FEED)
2009	Statoil	Sleipner, Gudrun tie-in FEED
2009	BP	Oselvar tie-in
2009	BP	Produced water treatment
2009	Statoil	Statfjord late life (multiple)
2009	BP	HOD booster pump
2009	Statoil	Sleipner, Alfa Vest (FEED)
2009	Talisman	Gyda gas lift compressor package, LMF Vienna
2009	BP	Valhall Flanke gas lift

Safety integrity level (SIL) analysis

Functional safety

The use of instrumented systems in safety applications is increasing. The IEC 61508 standard is widely used by industries – such as oil and gas, process, transport and aviation – which need highly reliable safety systems. We have incorporated IEC 61511 in our procedures and our project execution model (PEM) to achieve full compliance with functional safety principles as specified in IEC standards.

In order to determine the behaviour of an instrumented safety system, the design of its hardware and software needs to be fully assessed. IEC 61508 is the international standard for electrical, electronic and programmable electronic safety-related systems. It sets out requirements for ensuring that systems are designed, implemented, operated and maintained to provide the required safety integrity level (SIL). Four SILs are defined in accordance with the risks involved in the system application, with SIL 4 being used for the highest risks.

Guideline 070 from the Norwegian Oil Industry Association (OLF) is relevant to the NCS and referenced in the PSA regulations. Our procedures and PEM comply with OLF GL 070.

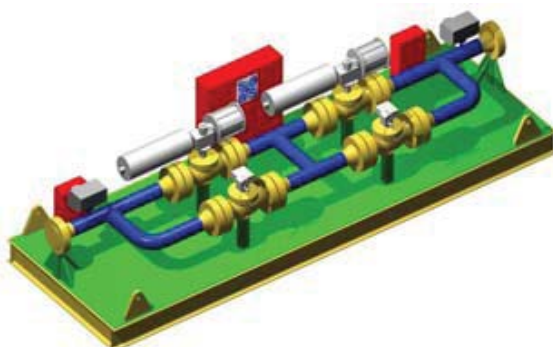
We can provide assistance with all aspects of IEC 61508, including:

- developing project specific methodology to incorporate IEC 61508/61511 in a project scope of work
- developing SIL requirements based on risk assessments
- developing safety requirement specifications (SRS documents)
- participating in the design process for safety systems to meet integrity requirements and the SIL
- calculating the probability of failure on demand (PFD) to verify the SIL
- conducting a functional safety assessment, third-party verification
- implementing and following-up in the operational phase

For more information on our SIL analysis capabilities, please contact

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“Achieving reliable safety functions with high integrity”

Safety integrity level (SIL) analysis

Reference list

This list is not exhaustive

Start year	End year	Client	Project title
2010	2010	Shell	Draugen - Produced water reinjection – Instrumented protective function review
2010	2010	Statoil	Kristin LPP FSA – 3rd party review of SIL analysis and SRS development performed in Bergen
2009	2010	BP	Ula V&M, Valhall V&M: Several LOPAs, SRS, Valhall PWRI: LOPA, SRS, IEC 61508/61511 compliance, Valhall Flank Gas Lift: LOPA, SRS
2009	2010	Statoil	Oseberg drilling upgrade project – SIL allocation, Safety requirement specification, vendor follow-up
2008	2010	ConocoPhillips	Greater Ekofisk area – SIL methodology, SIL allocation, SIL calculations, SRS development
2005	2008	Statoil	Statfjord late life project – SIL methodology, SIL allocation, SRS development
2005	2006	BP	Ula gas upgrade – SIL calculations, SRS development, Blane tie-in – SIL calculations, SRS development
2004	2007	Statoil	SFA/B/C overpressure protection system – Design development, SIL risk analysis, SRS
2004	2005	Statoil	Snorre A integrated over-pressure protection system – SIL calculations, SRS development
2003	2005	ConocoPhillips	Ekofisk 2/4 M wellhead and processing platform – SIS lifecycle activities: SIS methodology, hazard and risk analysis, SIL allocation, SRS development, SIL calculations
2001	2002	BP	SIL analysis Valhall injection platform