FPSOs Present and Future Workshop

Presentations

Session III

Panel of FPSO Contractors

June 7, 2000

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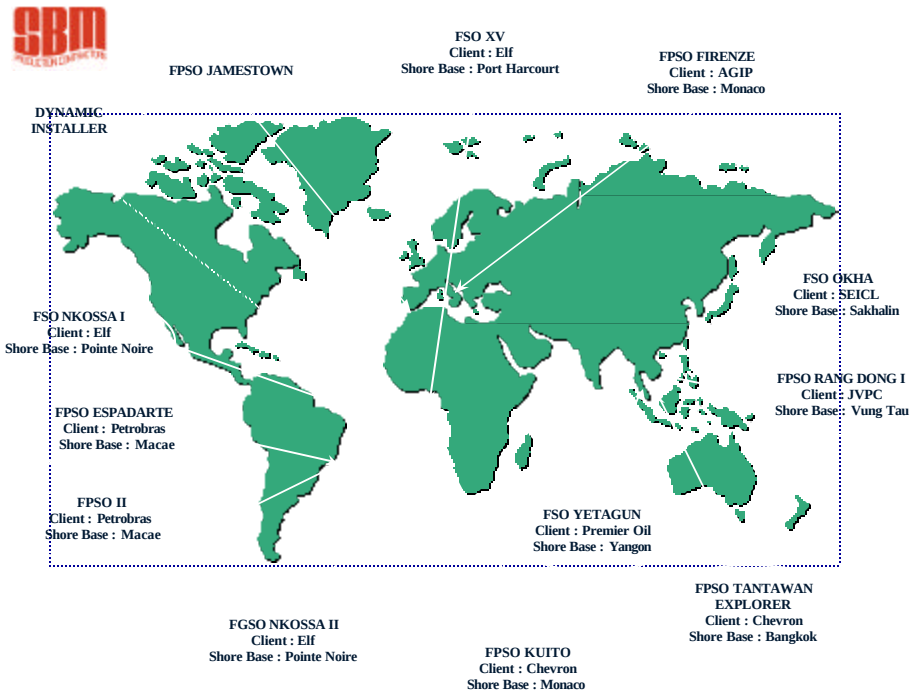
Rik Scott

SBM Production Contractors

SBM PRODUCTION CONTRACTORS



SUMMARY OF SBM PRODUCTION CONTRACTOR'S FLEET

UNIT NAME	YB	LOCATION	CLIENT	DWT X 1000	TYPE	J.V.	START YEAR
FSO XV	'75	NIGERIA	ELF	270	FSO	-	1993
NKOSSA I	'73	CONGO	ELF	269	FSO	-	1996
NKOSSA II	'92	CONGO	ELF	48.6	FGSO	MAERSK	1996
TANTAWAN EXPLORER	'76	THAILAND	POGO	137	FGSO	-	1997
FPSO II	'68	BRAZIL	PETROBRAS	127	FPSO	-	1997
FPSO FIRENZE	'72	ITALY	AGIP	139	FPSO	SAIPEM	1998
RANG DONG I	'78	VIETNAM	JVPC	149	FPSO	MHI (x2)	1998
OKHA	'99	RUSSIA	SAKHALIN ENERGY	146	FSO		1999
KUITO	'79	ANGOLA	CHEVRON	225	FPSO	SONANGOL	1999
JAMESTOWN	'57	-	-	41	FPSO	-	-
YETAGUN	'79	MYANMAR	PREMIER OIL	81	FSO	-	2000
ESPADARTE	'75	BRAZIL	PETROBRAS	290	FPSO	-	2000

MANNING ON PAYROLL (2000)

	W. EUROPE	OTHER EXPAT.	LOCAL	ON BOARD
MONACO	40	0	0	40
PORT HARCOURT (inc. Lagos – 4)	2	0	31	33
CONGO	2	0	5	6
BANGKOK	2	1	10	13
MACAE	2	0	9	11
VUNG TAU	3	1	8	11
YANGON	1	0	1	2
FSO XV	10	8	52	35
NKOSSA I	11	31	16	29
NKOSSA II*	0	0	0	0
TANTAWAN EXPLORER	22	26	32	40
FPSO II	10	30	36	38
FPSO FIRENZE	68	0	0	34
RANG DONG I	18	40	14	36
FLEET RESERVE	11	0	0	11
DYNAMIC INSTALLER	26	26	0	26
KUITO	35	35	16	43
OKHA	0	2	0	2
ESPADARTE	35	21	39	47
YETAGUN	11	4	34	24

ON PAYROLL	W. EUROPE	OTHER EXPAT.	LOCAL	TOTAL
	309	**225**	**303**	**837**

SBM Production Contractors: Operational Performance Record

Records from 25/8/81 until 03/31/2000

Unit*	Type	Client	Country	First oil	To	Days in operation	Down time (days)	Down time (%)	Up time (%)	Oil produced/ received (bbls)	Gas produced	Number of offloads
Rang Dong I	FPSO	JVPC	Vietnam	09/01/1998	03/31/2000	578	7.42	1.3	98.7	16,290,218	n/a	34
FPSO Firenze	FPSO	Agip	Italy	03/03/1998	03/31/2000	760	21.60	2.8	97.2	10,224,947	n/a	33
FPSO II												
Marlin Field	FPSO	Petrobras	Brazil	11/06/1999	03/31/2000	147	0.04	0.0	100.0	2,406,284	n/a	7
Marlin Field	FPSO	Petrobras	Brazil	08/14/1997	10/07/1998	420	15.35	3.7	96.3	877,619	n/a	8
West Linapacan	FPSO	Alcorn	Philippines	05/15/1992	01/05/1996	1331	14.00	1.1	98.9	?	n/a	?
Cadlao Field	FPSO	Amoco/Alcorn	Philippines	08/25/1981	11/30/1991	3750	3.00	0.1	99.9	7,027,790	n/a	45
Tantawan Explorer	FPSO	Pogo/Chevron	Thailand	02/01/1997	03/31/2000	1155	3.35	0.3	99.7	6,804,345	84,877 mmScf	18
Nkossa II	FGSO	Elf Congo	Congo	11/11/1996	03/31/2000	1237	1.00	0.1	99.9	n/a	645,000 MT Propane 498,000 MT Butane	199
Nkossa I	FSO	Elf Congo	Congo	06/09/1996	03/31/2000	1392	1.10	0.1	99.9	87,869,686	n/a	88
FSO XV	FSO	Elf Nigeria	Nigeria	02/28/1993	03/31/2000	2589	4.00	0.2	99.8	172,652,700	n/a	201
FPSO VI												
Espadarte	FPSO	Petrobras	Brazil									
OPL 98 Antan Terminal	FPSO	Ashland Petroleum	Nigeria	02/05/1986	07/21/1998	4550	2.60	0.1	99.9	77,068,580	n/a	?
Kuito	FPSO	Chevron	Angola	12/21/1999	03/31/2000	102	10.80	10.6	89.4	4,532,944	n/a	5
Okha **	FSO	Sakhalin En. Invest.	Russia	07/07/1999	03/31/2000	148	40.75	27.5	72.5	1,060,723	n/a	2
TOTALS						**18,159** (days)	**125.01** (days)	**0.7**	**99.3**	**386,815,836**		**640**

Cumulative operating experience: **49.8** **(years)**
Uptime: **99.31%**

* Excluding units that await commissioning for first assignment: Jamestown, Espadarte and Yetagun
** Okha only operates approximately 6 months per year.

DESIGN / FABRICATION STANDARDS USED FOR SBM FPSO/FSO'S SAFETY AND ENVIRONMENTAL PROTECTION

- **CLASSIFICATION RULES (ABS):**
  Ship : Steel vessel rules & FPSO guide;
  Topsides : Offshore facilities guidelines (API);
  Mooring : Guide for FPSO systems.
- **IMO RULES:**
  Solas, Marpol, Modu, Loadline etc.
- **HAZID & HAZOP REVIEWS:**
  Covering: Layout, Safety features, Operability & isolation of all Hydrocarbon and high pressure systems.
- **VARIOUS SAFETY STUDIES:**
  Fire & Explosion analysis, gas dispersion
  Escape / Evacuation / Rescue
  Lifting operation, Smoke ingress, Storm contingency.
- **QA (ISO 9000) SYSTEM:**
  Also covering a suite of internal procedures such as criticality analysis and inter-discipline checking.
- **OCIMF RECOMMENDATIONS:**
  Mainly covering mooring and offloading.
- **INHOUSE EXPERIENCE**
- **OPERATORS FEEDBACK**

OPERATING STANDARDS AND PROCEDURES USED FOR SBM FPSO's/FSO's OPERATION TO ENHANCE SAFETY AND ENVIRONMENTAL PROTECTION

- SAFETY POLICY
- SEP (ISM) ACCREDITATION
- DEDICATED SAFETY OFFICER
- PERMIT TO WORK SYSTEM
- SAFETY / MAINTENANCE ALERTS
- PLANNED MAINTENANCE
- LIST OF CRITICAL OPERATIONS
- TRAINING / COMPETENCE
- EMERGENCY RESPONSE PLANS
- DRUGS / ALCOHOL POLICY
- TEAM BUILDING / MOTIVATION
- BUDGET

Aksel Plener
Navion ASA

OTRC, FPSO Workshop

June 7 and 8, 2000
Houston, Texas

Presented by : Aksel Plener, Navion ASA

Navion ASA Introduction

- **Founded 2nd September 1997 after Statoil resolved to demerge its shipping and maritime technology business**
- **Core business areas: offshore loading, floating production and storage, and tanker shipping**
- **Owners: Statoil (80 per cent) and the Rasmussen Group (20 per cent)**
- **Location:**
  - **Main office in Stavanger, Norway**
  - **Project and regional offices in Aberdeen and Houston**

NAVION

Key figures Navion group

- Operating a total fleet of 56 vessels, of which 14 owned and 42 on timecharter
- 145 million tons transported annually
- 3000 voyages annually
- Turnover of 6 billion NOK
- Total assets of 13 billion NOK
- 145 employees

NAVION

Business ambitions

- Maintain and strengthen our leading position in offshore loading in the North Sea and pursue selective internationalisation
- Establish a leading position within lease based FPSO/FSO market
- To be a substantial provider of overall best shipping services to charterers

How to reach our ambitions

- Commitment to high quality and safe and environmentally friendly operation
- Combining shipping and offshore related skills and experiences
- Enhancing our strong position of innovative cost-efficient technical and commercial solutions for our customers
- In alliances with shipowners, offshore companies, technology companies and providers of complementary services
- Combination of own vessels, T/C vessels, COA's and spot chartering

Floating Production Range of services

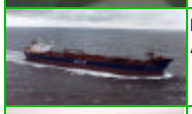
- Overall field development management
- Lease based floating production units (FPSO)
- Lease based floating storage units (FSU)
- Offshore operations
- Onshore support and logistics organisation

FSO Polysaga

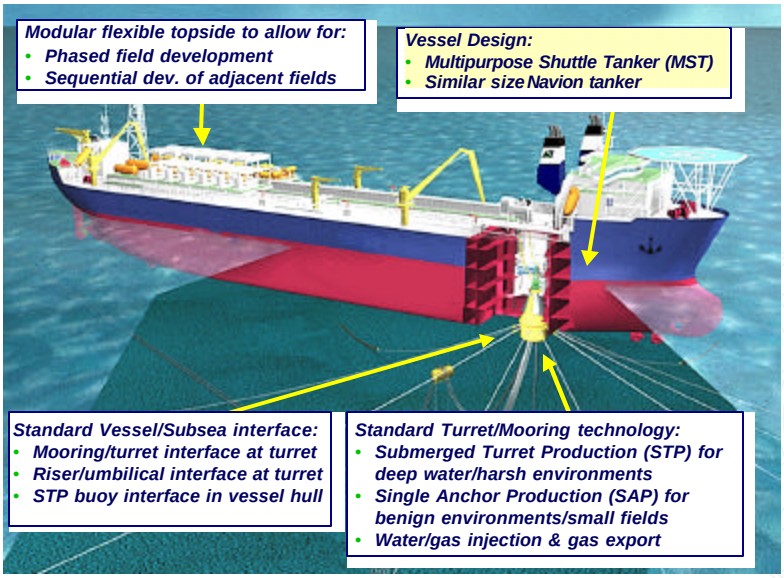
FPSO Navion Munin

FPSO Berge Hugin

Fleet of FPSO/FSO's

	Vessel Name Type	Operation	Field/Region	Client	Period
	Berge Hugin MST	FPSO	Pierce UK North Sea	Enterprise	1998-2013 (min. 2003)
		Extended Well test	Connemara Irish Sea	Statoil	1997
	Navion Munin MST	FPSO	Lufeng South China Sea	CNOOC/ Statoil	1997- 2002
	"MST 4" MST	FPSO	Under construction		
	Navion Scotia Aframax	FSO	Fulmar UK North Sea	Shell	1993-1997
		Tanker			1997-
	Polysaga Suezmax	FSO	Yme Norw. North Sea	Statoil	1995-2000 + options

FPSO Main components



MST Navion Munin

General:

- Built by Samsung Heavy Industries Company Ltd. Korea
- Delivered July 1997
- Class DNV +1A1 Oil Production and Storage Vessel
- Norwegian Flag (NIS)

Dimensions/capacities:

- Length overall : 252.0 m
- Breadth moulded : 42.0 m
- Depth moulded : 23.2 m
- Double hull with 3 x 6 centre tanks
- Deadweight : 101 220 t
- Storage capacity : 640 000 bbls
- Production capacity : 60 000 bopd (Lufeng field)

MST Berge Hugin

General:

- Built by Samsung Heavy Industries, Korea
- Delivered Jan 1997
- Class DNV +1A1 Oil Production and Storage Vessel
- UK Flag

Technical:

- Length overall : 252.1 m
- Breadth moulded : 42.0 m
- Depth moulded : 23.2 m
- Deadweight : 103 854 t
- Cargo capacity : 605 000 bbls
- Double hull with 3x6 centre tanks
- Topside weight, dry : 4 000 t
- Production capacity : 70 000 bopd
- Offloading rate : 6 000 m^3/hr
- Station keeping
  - 1 x 12 MW main propeller
  - 2 x 3,5 MW azimuth thrusters
  - 2 x 2,5 MW tunnel thrusters
- Mooring:
  - 8 x wire/chain/wire legs (118/120/118 mm)

Experiences with UK Safety Requirements for FPSOs

NAVION

- **OVERALL**
  - **Active process - the designer is guided through a process where:**
    - **Major Accidental Hazards (MAHs) are identified**
    - **Safety Critical Elements (SCEs) needed to control the MAHs are identified**
    - **An upper limit is established for when it becomes "unreasonable" to invest more money into improvement of a SCE (ICAF Value)**
    - **Operational input becomes part of the design work**

Experiences with UK Safety Requirements for FPSOs

NAVION

- **ALARP PRINCIPLE (As Low As Reasonable Practical)**
  - **Difficult to document, particularly when the hull is built up-front of starting a UK FPSO project**
  - **Unusual to be challenged to calculate "extreme" (progressive collapse) capacities of structures in order to demonstrate ALARP**
  - **Questionable if ALARP requirements will lead to identical safety levels for projects starting with:**
    - **Old trading tankers requiring significant conversions**
    - **New vessel designed for FPSO operations**

Bruce Crager

Oceaneering International Inc.

OCEANEERING'S EXPERIENCE RELATED TO FPSOS

FPSOs Present and Future
June 7-8, 2000

Bruce Crager
Senior Vice President
Oceaneering International, Inc.

OCEANEERING
00FW13

OCEANEERING MAJOR MOPS PROJECTS SUMMARY

- **FPSO Ocean Producer Gabon**
- **FPSO Ocean Producer Angola**
- **Captain Extended Well Test**
- **JPU Gulftide Conversion**
- **FPSO Zafiro Producer**
- **JPU Ocean Legend**

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FPSO EXPERIENCE SUMMARY

- Engineering
- Conversion / Life Extension
- Spread Mooring Systems
- Operations / Maintenance
- In-Field Modification

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U.S. GULF COAST CONVERSION PROJECTS

FPSO Ocean Producer	78,000 dwt	1991	Gulf Copper, Port Arthur
FPSO Zafiro Producer	278,000 dwt	1996	Pelican Island, Galveston
JPU Gulftide		1995	HAM, Pascagoula
JPU Ocean Legend		2000	F&G, Pascagoula

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FPSO OCEAN PRODUCER IN GABON

- Marginal Field, 15,000 bopd
- Very Shallow Water
- Asymetrical Taut-Wire Spread Mooring
- Low-Budget Conversion
- Accident and Incident Free

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FPSO OCEAN PRODUCER IN ANGOLA

- Catenary Mooring
- Low-Cost Operation
- Training & Integration of Angolans into Crew
- Accident and Incident Free

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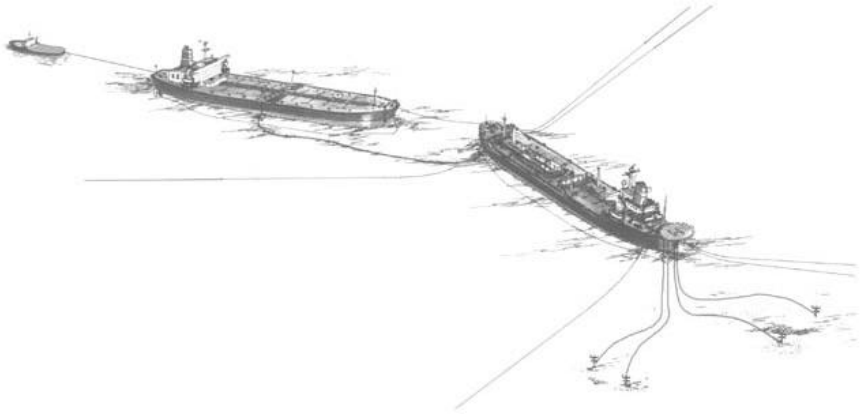
FPSO OCEAN PRODUCER, KIABO FIELD, ANGOLA



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OPERATING PHILOSOPHY AND PROCEDURES

- Safety Is Priority #1
  - Management Commitment
  - Qualified Crew
  - Proactive Safety Committee
  - Audit Program
- Plant Availability
  - Design & Conversion
  - Organization, Crew Qualifications
  - Maintenance Program
- Cargo Offloading
  - Tandem-moor, Bow-to-bow
  - Tug Assist for Shuttle Tanker
  - Floating Hose Transfer

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FPSO ZAFIRO PRODUCER

- Basic FPSO Parameters
- Permanent Spread Mooring
- Interface With Subsea Facilities
- Tandem-moor, Bow-to-bow Offloading
- Training & Integration of Guineans Into Crew

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ZAFIRO PHASED DEVELOPMENT

- Limited Initial Conversion Scope
- Schedule-Driven Project
- Phase 2 In-Field Upgrade

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ZAFIRO PHASE 2 UPGRADE

- Scope of Upgrade
- Procedures
- Performance and Results

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FPSO ZAFIRO PRODUCER WITH FSO AND SHUTTLE TANKER, DURING PHASE 2 UPGRADE

99JW69

PRINCIPAL CONCLUSIONS

- FPSOs may be operated safely and efficiently with acceptable environmental impact in both low-volume and high-volume production scenarios.
- Offloading to tandem-moored shuttle tankers from a spread-moored FPSO can be managed safely and without environmental damage.
- High plant uptime requires the right mix of design approach and standards, operator qualifications, and procedures / maintenance.
- In-field modifications can be performed aboard an FPSO with minimal production shutdown in high-volume scenarios.

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PRINCIPAL CONCLUSIONS CONT.

- FPSO conversions can be performed cost-effectively and safely in U.S. Gulf Coast shipyards.
- It Is Best to Base the Design on Functional Specifications.
- Cost and Schedule Overruns Are NOT the Norm for FPSO Conversions.
- Our West African Experience Indicates That FPSO Operations Do Not Require Government-based Regulatory Oversight. Adherence to Flag and Class Rules Provides an Adequate Formula for Success.
- Personnel Qualifications and Training Are the Most Important Factors in Successful FPSO Operations.

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