FPSO Training Course

Workshops 1 - 4

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CASE STUDY NUMBER 1

MARGINAL FIELD SOUTH CHINA SEA

Case study number 1: field details

S. China Sea – Marginal field

- Recoverable reserves in the range 50-100 million bbls;
- Main production parameters:
  - Oil 50,000 bbls/day;
  - API 19 degrees;
  - Low GOR<50 scf/bbl;
  - Water injection required ~ @1.25 x maximum production;
  - Wells will need ESPs or HSPs to lift the wells.
- Field life expected to be in the range 5 $_{P(90)}$ -10 $_{P(10)}$ years;
- Environment: Deep-water circa 500 metres; area subject to tropical cyclones (typhoons) Non- cyclonic 100yr Hs~5-6metres; cyclonic 100 yr >Hs10metres;
- Export of oil by an (unmodified) trading tanker (i.e. not a shuttle tanker) - gas burned as fuel when available;
- Operator is small independent Australian listed company with limited cash flow from other non-operated assets; this will be their first operated project.

Case study number 1: Key drivers & risks

- Drivers
  - Good HSE performance;
  - Fit for purpose, cost effective facility;
  - Early start-up;
  - High operating uptime;
  - Cost effective power generation with limited gas availability.
- Risks
  - **This will be the first operated asset and first FPSO for the Operator;**
  - Late start up of production impacting development economics;
  - Production uptime due to weather risks (e.g. disconnection & reconnection for cyclones);
  - Failure of ESPs or HSPs and high change-out costs will undermine project economics.

CASE STUDY NUMBER 2

LARGE FIELD WEST AFRICA

Case study number 2: field details

Large Field in West Africa

- Recoverable reserves in the range 250 - 500 million bbls;
- Main production parameters;
  - Oil 150,000 bbls/day
  - API 35 degrees
  - GOR1000 scf/bbl
  - Water injection required ~ @1.25 x maximum production
- Field life expected to be in the range 15 $_{P(90)}$ -25 $_{P(10)}$ years;
- Environment: Deep-water circa 1,500 metres; area subject to 100 yr Hs< 5 metres; area is prone to unpredictable squalls of up to 45knots and various directions;
- Export of oil by an (unmodified) trading tanker (i.e. not a shuttle tanker) to US - gas exported by pipeline to shore for fuel in new gas fired power generation facility (will be major contributor to Coastal state's regional power generation capacity);
- Will be developed by a leading independent oil company with FPSO experience (on smaller projects);
- This project will be one of the company's key projects underpinning growth over the next 5 years.

Case study number 2: key drivers & risks

- Drivers
  - Good HSE performance;
  - High quality facility designed to operate for a design life of 25 years with minimal downtime (no dry-docking);
  - Good performance and delivery of gas from start-up (gas production reliability);
  - High operating uptime - focus on design & equipment selection to deliver high uptime.
- Risks
  - Late start up of production impacting development of gas to power onshore;
  - Delivering good quality information to contractors at end of FEED and start of execution phase.

CASE STUDY NUMBER 3

N NORTH SEA (UKCS) MEDIUM SIZED FIELD

Case study number 3: field details

N. North Sea medium sized field (UKCS)

- Recoverable reserves in the range 150-200 million bbls;
- Main production parameters;
  - Oil 100,000 bbls/day
  - API 35 degrees
  - Moderate GOR<500 scf/bbl
  - Water injection required ~ @1.25 x maximum production
  - All produced water to be re-injected
- Field life expected to be in the range 10 $_{P(90)}$ -15 $_{P(10)}$ years;
- Tie-in possibilities in the area – but not expected to be confirmed at time of sanction;
- Environment: Water depth circa 150 metres; area subject to harsh near West of Shetland conditions 100yr Hs~16 metres;
- Export of oil by shuttle tanker - gas generally dried and exported – some burned as fuel for power generation;
- Operator is an independent oil company without any specific FPSO experience.

Key drivers & risks

- Drivers
  - Good HSE performance;
  - High confidence in meeting compliance requirements without unexpected cost & schedule increases;
  - Strong emphasis on equipment specification to ensure compliance, reliability & high operating uptime;
  - Zero liquid discharges and minimum emissions.
- Risks
  - Limited competition amongst providers for such a facility;
  - Meeting compliance requirements without unexpected cost & schedule increases;
  - Maintaining control over cost benefit decisions on selection/sparing of key equipment items.

Workshop 1~ Strategy development

Assume that you are the Operator of the field i.e. the Oil company.

How would you expect the project to be executed?

Develop:

a) An outline execution strategy for your project;

b) An outline plan for how the Operator would procure the FPSO; define the main contractor and main sub-contractors for the procurement of the FPSO.

Workshop 2 ~ Global design & lay-out

What would the facility look like?

Explain key configuration choices.

Define:

a) Hull type, size and layout;

b) Type and arrangement of the mooring system & offloading systems;

c) Likely topsides size and lay-out.

Workshop 3 ~ Risk analysis

Assume that you will procure the FPSO as determined in Workshop 1

1. Identify your key commercial and technical **delivery risks** (e.g. top 10) for the FPSO scope;
2. How does your proposed strategy help to manage/mitigate these risks?
3. How would you plan to allocate these risks between the parties? Are the risks generally being managed by those parties best equipped to do so?

"The discipline of writing something down is the first step toward making it happen."

Lee Iacocca

Workshop 4 ~ Effective Commissioning and Start-Up

Assume that you will commission and start-up the FPSO as determined in Workshop 1

- Identify the five key risks
- Propose mitigations for them

Resources

Note: this data is for use as part of the case study exercise only. Delegates should develop their own reference data for real project situations.

Topsides weights (1of 2)

Project	Que$tor Topside Weights - Course Case Studies 1-3	Date	01-Nov-11

	Case study 1	Case study 2	Case study 3
Estimated topsides dry weight (tonnes)	3,305	9,750	6,925
30% contingency	992	2,925	2,078
Estimated topsides dry weight (tonnes) including a 30% contingency	4297	12675	9003

Basis of design			
	Case study 1	Case study 2	Case study 3
Oil rate (bbld)	50,000	150,000	100,000
GOR (scf/bbl)	50	1000	500
Gas rate (mmscfd)	2.5	150	50

Topsides weights (2 of 2)

Tagged Process Equipment (derived from Que$tor)				
	Item	Dry Weight (Te)		
		Case Study 1	Case Study 2	Case Study 3
1.1	Crude separation & stabilisation	230	410	270
1.2	Gas compression	0	410	140
1.3	Gas treatment	0	310	120
1.4	Water injection & seawater treatment	120	200	190
1.5	Power generation & distribution	500	720	500
1.6	Utilities	100	465	240
1.7	Manifolding	10	20	15
1.9	**TOTAL EQUIPMENT WEIGHT**	**960**	**2,535**	**1,475**

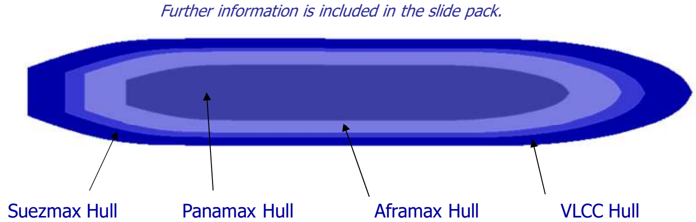
Material Bulks (derived from Que$tor)				
	Item	Dry Weight (Te)		
		Case Study 1	Case Study 2	Case Study 3
2.1	Primary steel bulks	660	1,880	1,500
2.2	Secondary steel bulks	1,050	3,430	2,640
2.3	Piping bulks	260	950	570
2.4	Electrical bulks	120	310	220
2.5	Instrument bulks	75	225	180
2.6	Miscellaneous bulks	180	420	340
2.7	**TOTAL BULKS WEIGHT**	**2,345**	**7,215**	**5,450**

Tanker Comparisons

Vessel Type	Typical Length (m)	Typical Breadth (m)	Deadweight range(mT) (1)	Storage range (bbls) (2)	Typical available topsides deck area (m2) (3)
Panamax	228	32	~70,000	450,000- 500,000	5,472
Aframax	250	42	70,000 -120,000	500,000- 850,000	7,875
Suezmax	274	48	120,000-200,000	850,00- 1,400,000	9,864
VLCC	333	58	200,000-325,000	1.4-2.4 mm	14,486

(1)Deadweights rangerepresent typical current new build sizes (vessel sizes may vary)
(2)Storage is based on deadweight and capacity @ SG = 0.85 (vessel storage volumes may vary)
(3)Any accommodation, turret & forepeak area is excluded – turret typically occupies 25 m of vessel length
(4)Note: L&B are generally mid range indicative numbers.

Further information is included in the slide pack.



Topsides weight/area densities

Topsides weight densities (empirical ranges – based on operating weight/m^2 of process deck area)

- *Harsh environment e.g. N Sea, West of Shetland, Atlantic Canada etc.*
  - ✓ *From <1.0Te/m^2 up to maximum of ~ 1.6Te/m^2*
- *Benign environment e.g. W Africa & SE Asia*
  - ✓ *From <1.0 Te/m^2 up to a maximum of 2.5Te/m^2*

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For further information on our services go to:
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Any questions?