

 **2014 OFFSHORE TECHNOLOGY CONFERENCE ASIA**  
25-28 March 2014 • Kuala Lumpur, Malaysia  
Kuala Lumpur Convention Centre  
"Meeting the Challenges for Asia's Growth"

## OTC-24705-MS


### Upgrade of Spar Topsides with Comprehensive Facilities Sand Management System

Y. Loong, Murphy Sabah Oil Co. Ltd.  
H. Rawlins and D. Goo, eProcess Technologies

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### PRESENTATION OBJECTIVE

To share an effective surface sand management solution and lesson learnt



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## OUTLINE

Presentation Objective  
Field Overview  
Sand Production and Effects  
Sand Control Options  
Principle of Cyclonic Desander  
Design of Wellhead Desander on SPAR with Solids Handling System  
Wellhead Desander Performance  
Operations and Maintenance Challenges

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## FIELD OVERVIEW

- Oil and Gas field with FPSO, SPAR and Subsea Wells
- 24 wells on SPAR
- FTLs between FPSO and SPAR
- All topsides process facilities on FPSO



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## SAND PRODUCTION

- Jan 2010, failure of sand screen completion at one of the wells and the field started producing 1-2 ton of sand per day
- Well choked back
- Damaged choke valve, diverter valves, FTL and FPSO swivel
- Frequent clean out at HP Separators on FPSO



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## SAND CONTROL OPTIONS

Long Term Option - Re-complete the affected wells with enhanced downhole sand control on the lower completions

Short Term Option - Implement Topsides Sand Management System

### Project Objective

Remove, to the highest possible degree, the produced sand that passes downhole equipment and reaches the surface, as soon as practicable in the process flow.

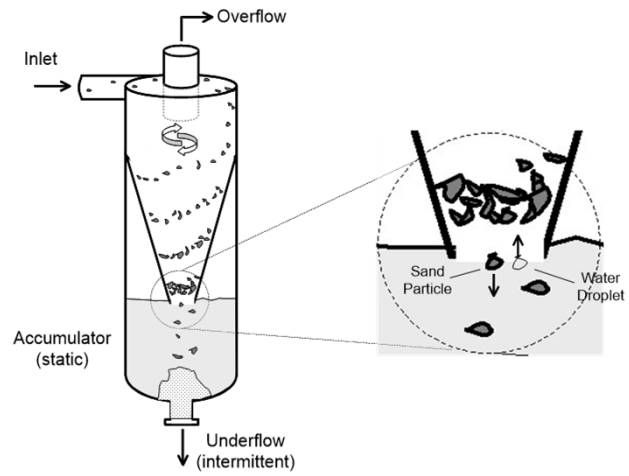
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### PRINCIPLE OF CYCLONIC DESANDER



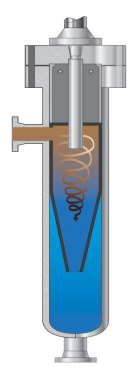
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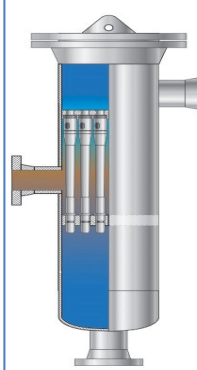
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### CYCLONIC DESANDER TYPE



#### Insert Style (Single Cone)

- Multiphase applications
- One insert per vessel
- Smaller/lighter vessel
- Interchangeable insert of various sizes for variable turndown
- No fluid partitioning
- Max. Particles Size : 1"-2"
- Solid Concentration:5 % wt



#### Liner Style (Multi Cone)

- Liquid applications
- Multiple liners per vessel
- Larger vessel
- Change quantity of liners for variable turndown
- Unequal fluid partitioning
- Max. Particles : 0.1"-0.2"
- Solid Concentration 0.25 % wt

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## Wellhead Desander System Design

### Wellhead Desander Design Basis

- Total throughput of 16 KBFPD and 16 MMSCFD of gas on each well
- Vessel Design Pressure is 232.7barg and ANSI CLASS 1500#.
- Tie-in flange is 4-1/16" API 6BX 10,000 Flange
- Able to remove 98% of solid particle larger than 20 microns with optimum pressure drop across desander
- Able to maintain desander performance under different flow rate (customize the desander liner to individual well condition)
- Able to remove average sand load of 285 pptb and at extreme case 2000 pptb
- Minimum desander vessel & accumulator size

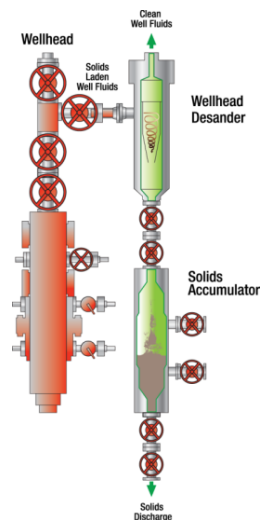
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## DESIGN OF CYCLONIC DESANDER



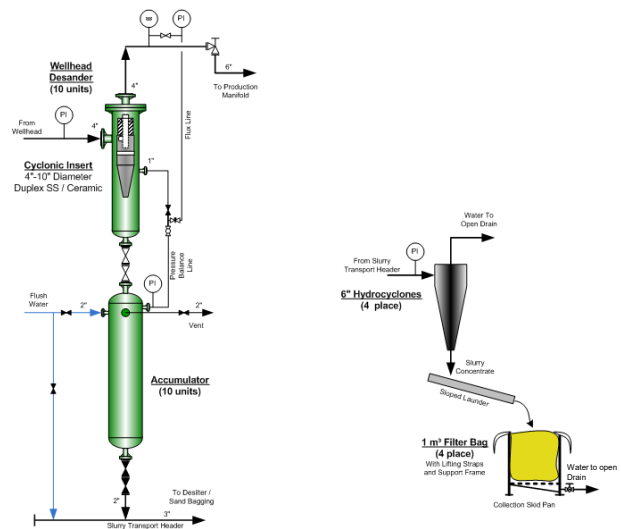
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### WELLHEAD DESANDER AND SOLID HANDLING SYSTEM



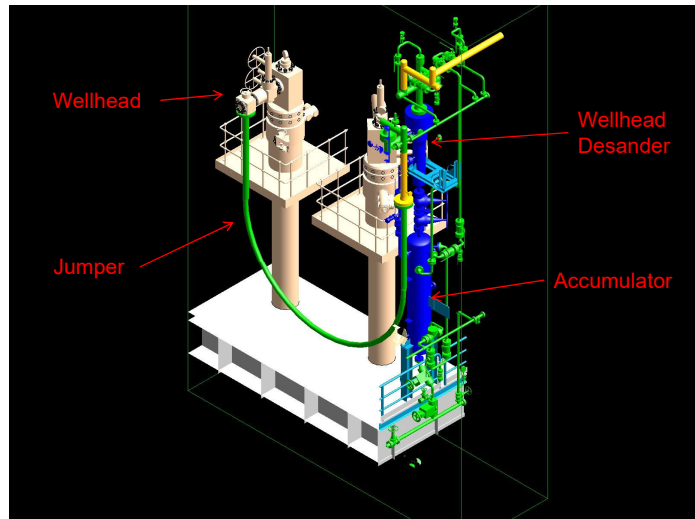
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### WELLHEAD DESANDER



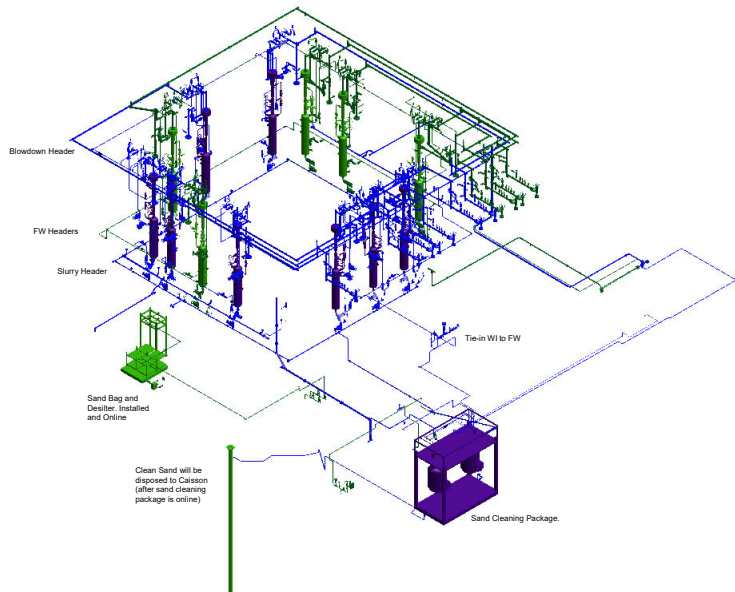
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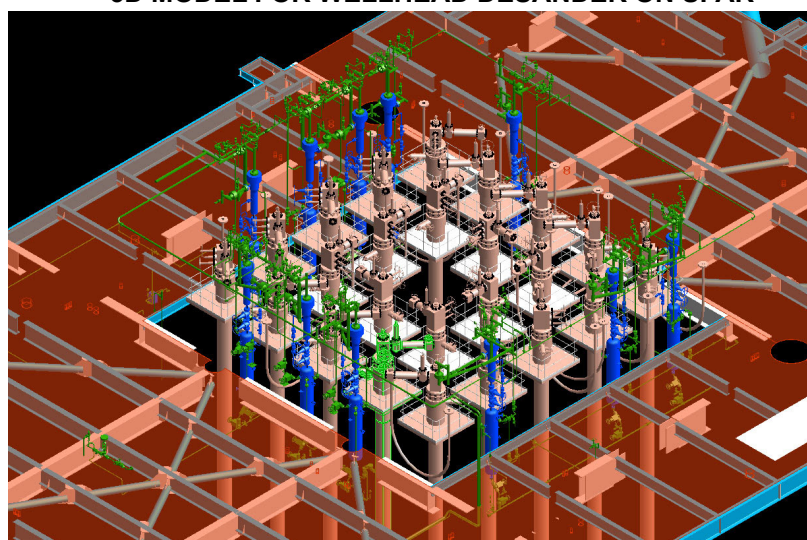
### WELLHEAD DESANDER AND SAND CLEANING PACKAGE

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### 3D MODEL FOR WELLHEAD DESANDER ON SPAR

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### Cyclonic Insert Size Selection

	Units	Well A	Well B	Well C	Well D	Well E
Pressure	psig	1349	1010	1396	1541	1389
Liquid Flow	BPD	16173	12068	7458	3917	3476
Gas Flow	MMSCFD	9.8	5.5	4.5	3.9	3.4
Gas Void Fraction	%	56%	36%	55%	62%	65%
Insert Size	inch	10	10	8	6	6
Pressure Drop	psi	41	23	37	46	37
Separation Size	micron	19	23	16	14	14
Solids Recovery	%	93%	92%	94%	94%	94%

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### DESANDER PERFORMANCE SIMULATION

		SIMULATION DATA SHEET			WELLHEAD DESANDER	
		Client: MURPHY PM1003			Rev:	A
		Project: KIKEH DTU WHD PHASE 1			Date:	23-Nov-11
		Application: Wellhead Desanding			By:	CDS
		Tag No.: PS21			Ref. No.:	PM1003
PROCESS DESIGN CONDITIONS						
		Case 1	Case 2	Case 3		
Oil/Condensate Flow Rate	BPD	8000.0	12000.0	16000.0		
Water Flow Rate	BPD	200.0	300.0	400.0		
Gas Flow Rate	MMSCFD	9.000	10.5	10.0		
Inlet Pressure	psig	1438.0	1438.0	1438.0		
Design Pressure (max.)	psig	3297.0	3297.0	3297.0		
Inlet Temperature	°C	60.0	60.0	60.0		
Design Temperature (max.)	°C	93.3	93.3	93.3		
Inlet Solids Concentration	ppmv	2480.0	2480.0	2480.0		
Required Outlet Solids Conc.	ppmv	4	4	4		
Required Separation Size	micron	16.0	16.0	16.0		
FLUID/SOLID PROPERTIES DATA						
Gas Density	kg/m <sup>3</sup>	90.00	90.00	90.00		
Gas Viscosity	cP	0.0133	0.0133	0.0133		
Gas Compressibility	-	0.92	0.92	0.92		
Liquid Mix Density	kg/m <sup>3</sup>	783.9	783.9	783.9		
Liquid Mix Viscosity	cP	0.78	0.78	0.78		
Fluid Mix Density	kg/m <sup>3</sup>	312.3	312.3	312.3		
Fluid Mix Viscosity	cP	0.260	0.260	0.260		
Gas-Liquid IFT	dyne/cm	23.4	23.4	23.4		
Solids Density	kg/m <sup>3</sup>	2650	2650	2650		
Solids Particle Size	micron	PSD	PSD	PSD		
WELLHEAD DESANDER SELECTION & PERFORMANCE						
Wellhead Desander Model	-	WH110	WH110	WH110		
Vessel Design Type/Rating	-	ANSI 1500W	ANSI 1500W	ANSI 1500W		
Number of Operating Units Req.	-	1	1	1		
Inlet Gas Void Fraction	Vol. %	68.0	68.0	68.0		
Inlet Fluid Velocity (superficial)	m/s	15.2	22.9	30.5		
Effective Pressure Drop	psi	15.0	33.6	59.8		
Calculated Solids Recovery	%	92.95	94.15	94.77		
Calculated Outlet Solids Conc.	ppmv	174.9	145.1	129.7		
Separation Size (D99)	micron	18.5	14.7	12.5		

@2.00, @=4.00, @R=1.00 | STP=14.696 psia, 60°F, 28.96 g/mol, 73.4 dyn/cm | (1) A / (2) A / (3) A | @WHD, Ver:2.00 - © eProcess Technologies 2011

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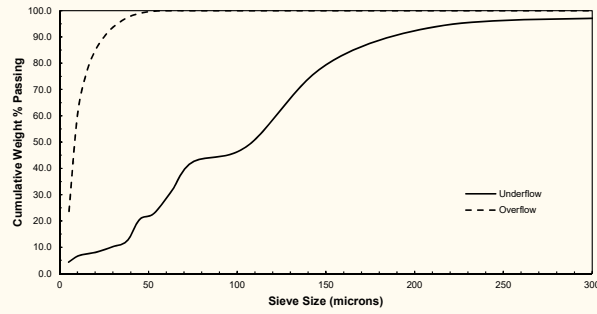
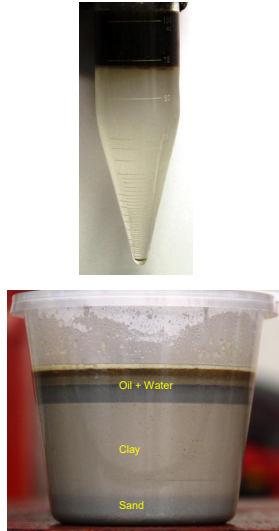
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### WELLHEAD DESANDER PERFORMANCE



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### WELLHEAD DESANDER PERFORMANCE

Well	Date Installed	Date Decommissioned	Liner size	Est. Oil Gain (Bopd)	Vol Sand @ WHD (avg)	Sand Vol after WHD
			Inch		Kg/day	
1	14-Oct-11	-	8	901	130 - 290	- 0.05% - 0.1% sand production after WHD
2	15-Nov-11	19-Oct-12	10	3290	350 - 1137	- 0.05% - 0.15% sand after WHD
3	9-Mar-12	-	8	0	130 - 495	- Sand traces after WHD
4	9-Mar-12	2-Apr-12	10	0	-	
5	12-Apr-12	10-Feb-13	10	1100	180 - 559	- 0.15% - 0.5% after WHD (at avg 0.25% mud)
6	2-Apr-12	28-Aug-12	8	0	140 - 260	- 0.2% - 0.8% after WHD (mud & sand)
7	2-Feb-13	-	6	1000	300-600	
<b>Total</b>				<b>6291</b>	<b>400 - 2741</b>	

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### OPERATIONS AND MAINTENANCE CHALLENGES

- Sand production fluctuates
- Dedicated manpower to operate and manage the produced solids
- Unexpected higher sand volume
- Eroded cyclonic inserts
- Eroded desander vessel
- Insert Material selection



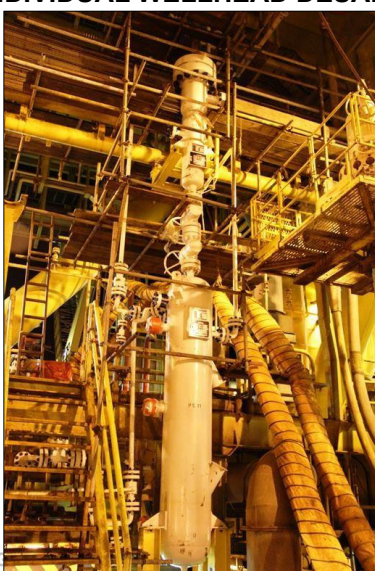
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### INDIVIDUAL WELLHEAD DESANDER



Overall Equipment Height: 7.5 m

Overall Equipment Wt: 6 T

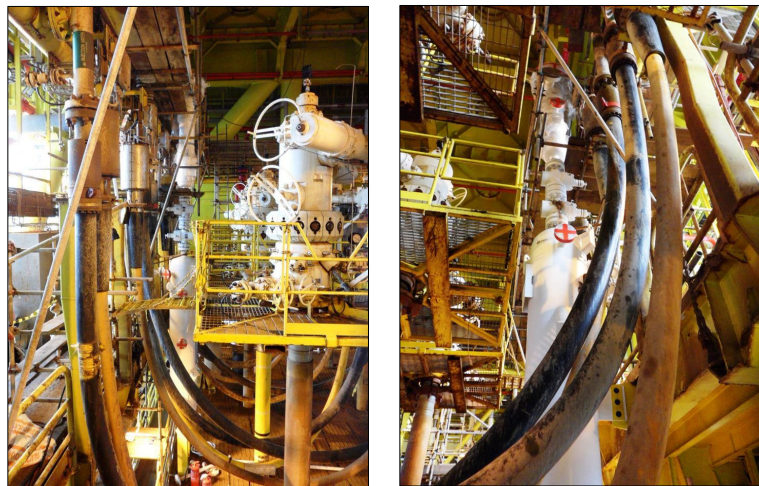
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### INDIVIDUAL WELLHEAD DESANDER



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### DESILTER AND SAND FILTER BAG



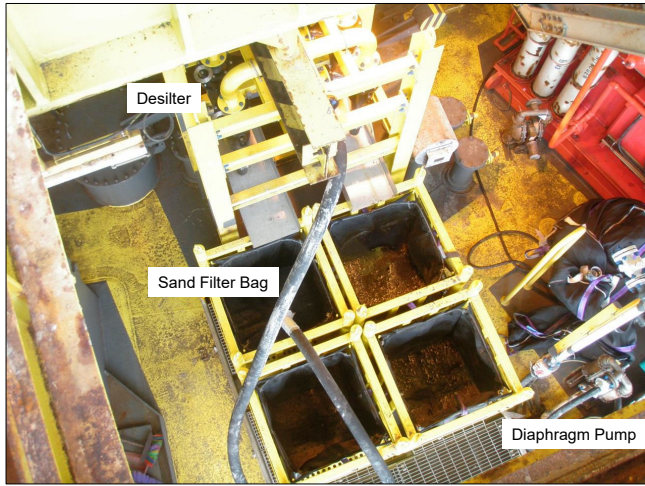
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### DESILTER, SAND FILTER BAG, AND DIAPHRAGM PUMP



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### DESILTER AND FILTER BAG IN OPERATION



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### COLLECTED SAND



Wet Sand



Filtered Sand



Dry Sand



Measuring Kits

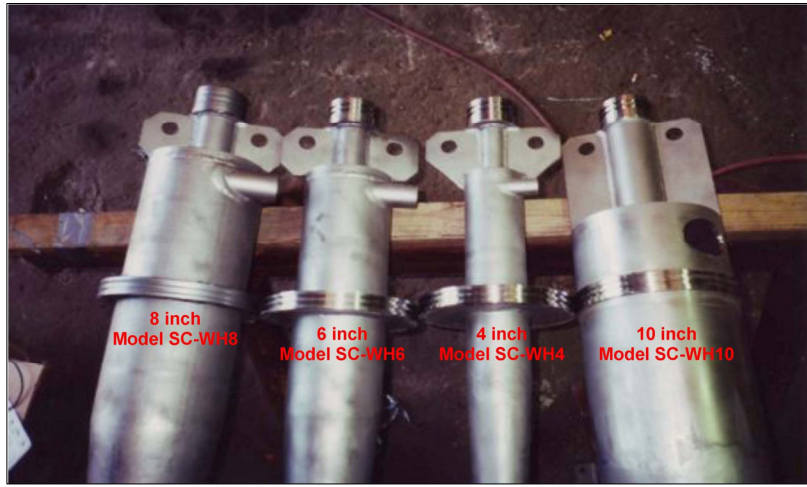
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### INTERCHANGEABLE INSERTS



8 inch  
Model SC-WH8

6 inch  
Model SC-WH6

4 inch  
Model SC-WH4

10 inch  
Model SC-WH10

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### Thank You & Questions

