

# Marginal Field Development Concept

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# Agenda

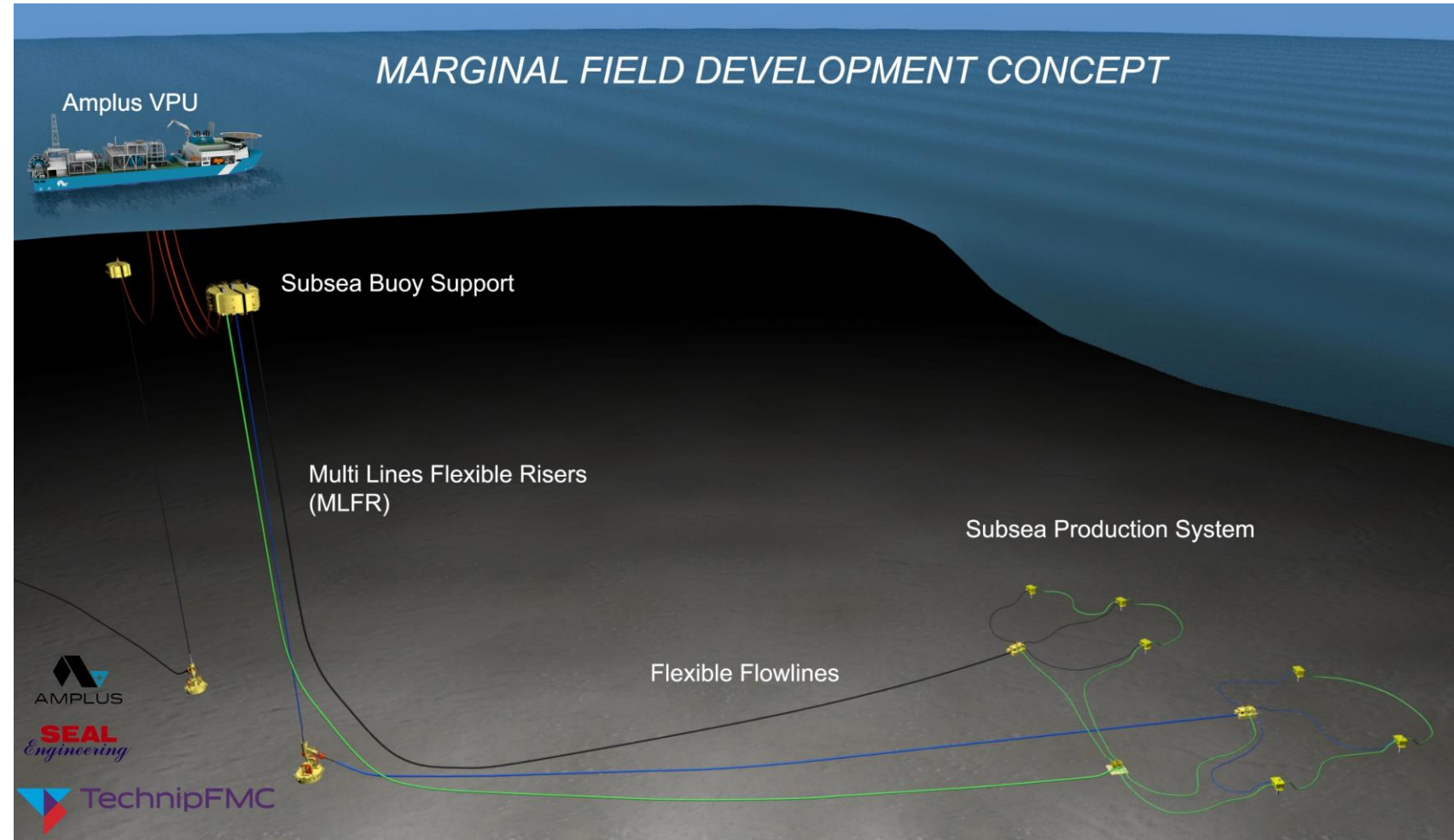
- ▶ **Foraging System Overview**
- ▶ **DP FPSO**
- ▶ **Multi-Lines Flexible Riser System**
  - Riser Description
  - Preliminary Analysis
  - Outline Installation & Re-location Procedure
- ▶ **Subsea Production system**



# Foraging System Overview

## ► Concept Premise:

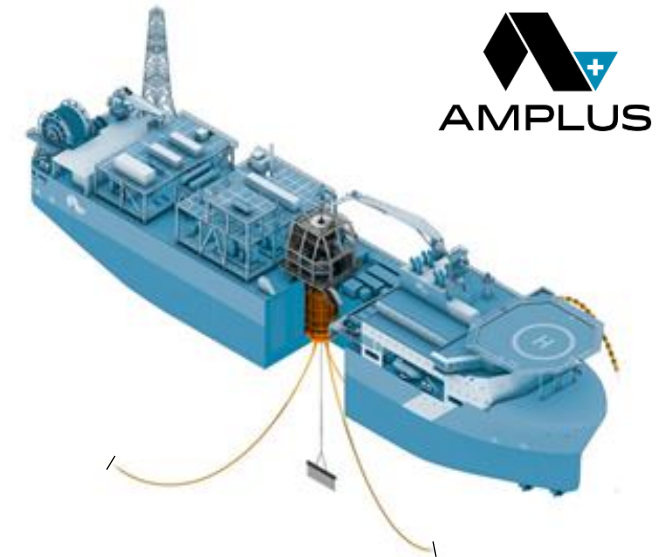
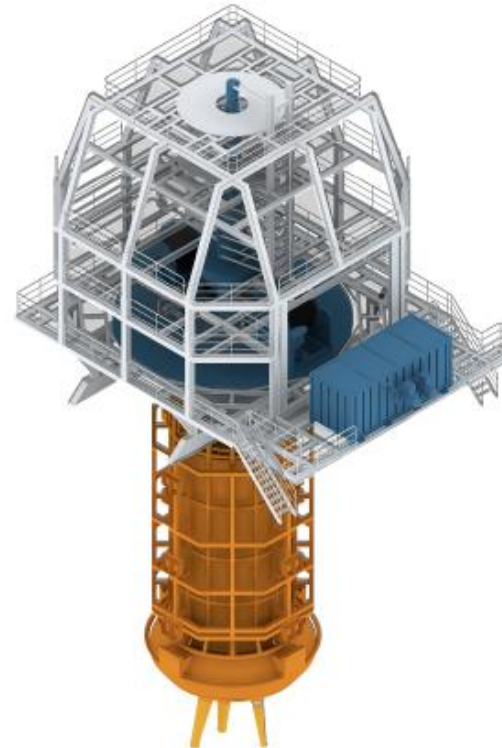
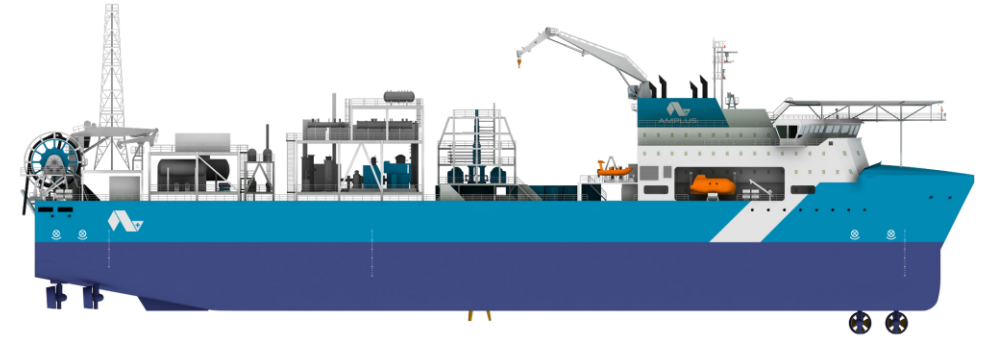
- 'Foraging' system, incl.:  
DP FPSO + SURF & SPS
- Targeting small pools
- DP FPSO
  - No Anchor / mooring deployment
- Multi-Lines Flexible Risers
  - Design for recovery / re-location
- Flexible Flowlines
  - Flowline Integrated Manifold (FLIM)
- Subsea Production System



# Amplus Versatile Production Unit

## ► Amplus VPU 360

- DP 3 Classification
- 360.000 bbl oil storage capacity
- 40,000bpd process capacity
- Double hull
- FES Disconnectable Turret System
- Full 360° weathervanning

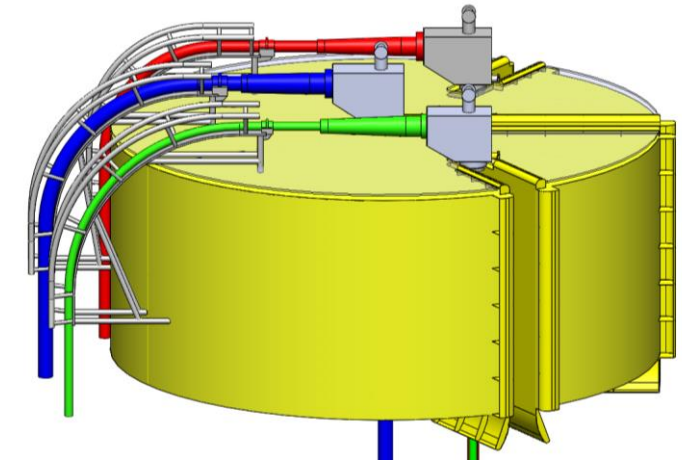
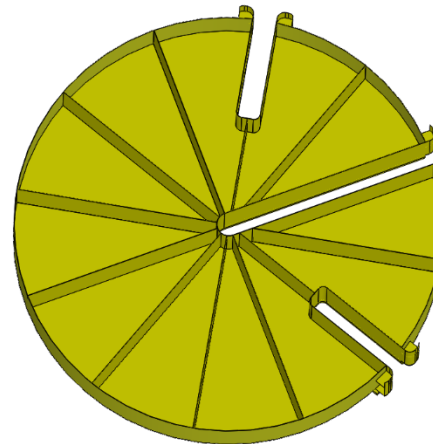
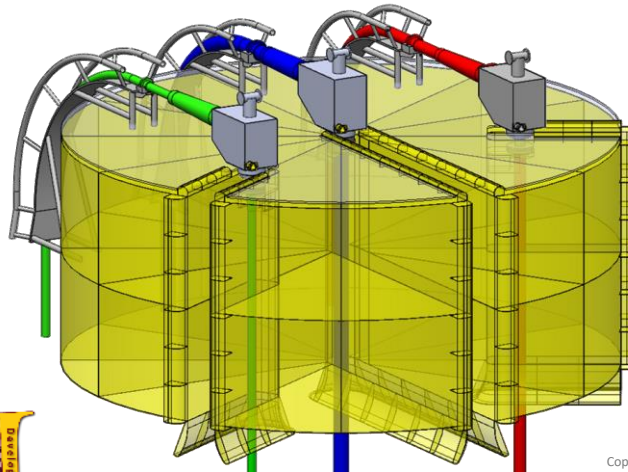
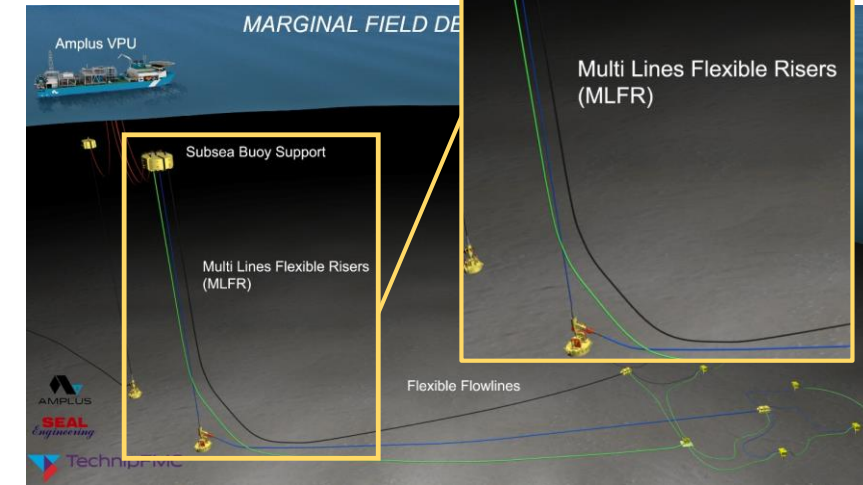
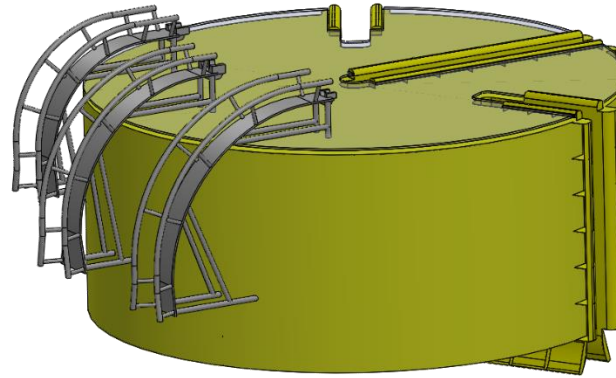




# Multi-Lines Flexible Riser System

## ► Riser Description

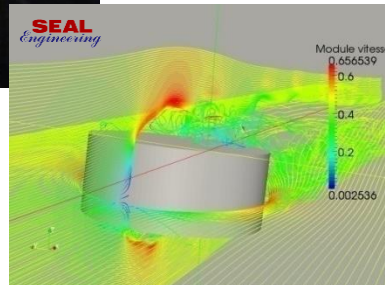
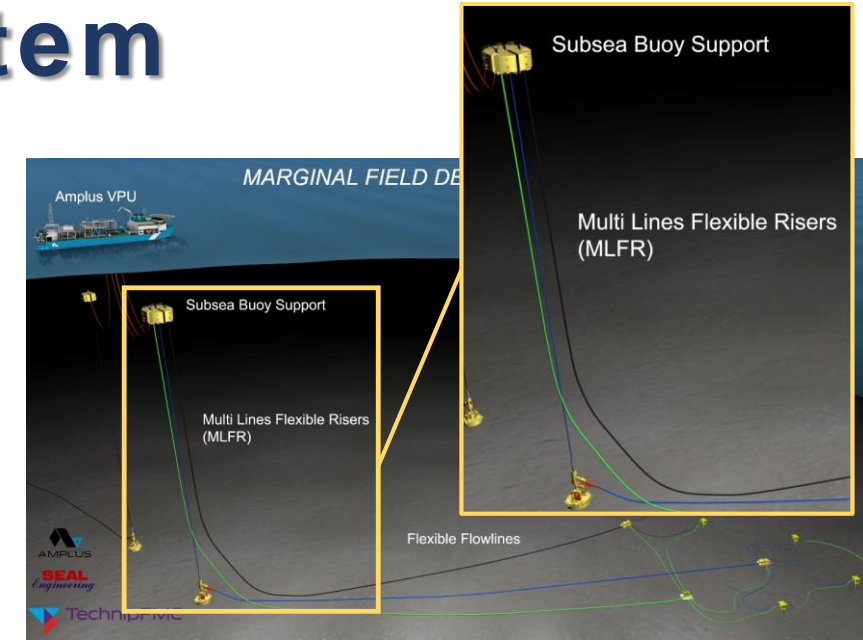
- 1600m WD, WoA Case Study
- Flat Buoy
  - Steel Weight: 350t
  - Displacement: 910t
  - Dimensions:
    - Diameter: 14,5m
    - Height: 6m
  - Compartments: 24 off (12 x 2 levels), 32 to 41m<sup>3</sup> per cpt



# Multi-Lines Flexible Riser System

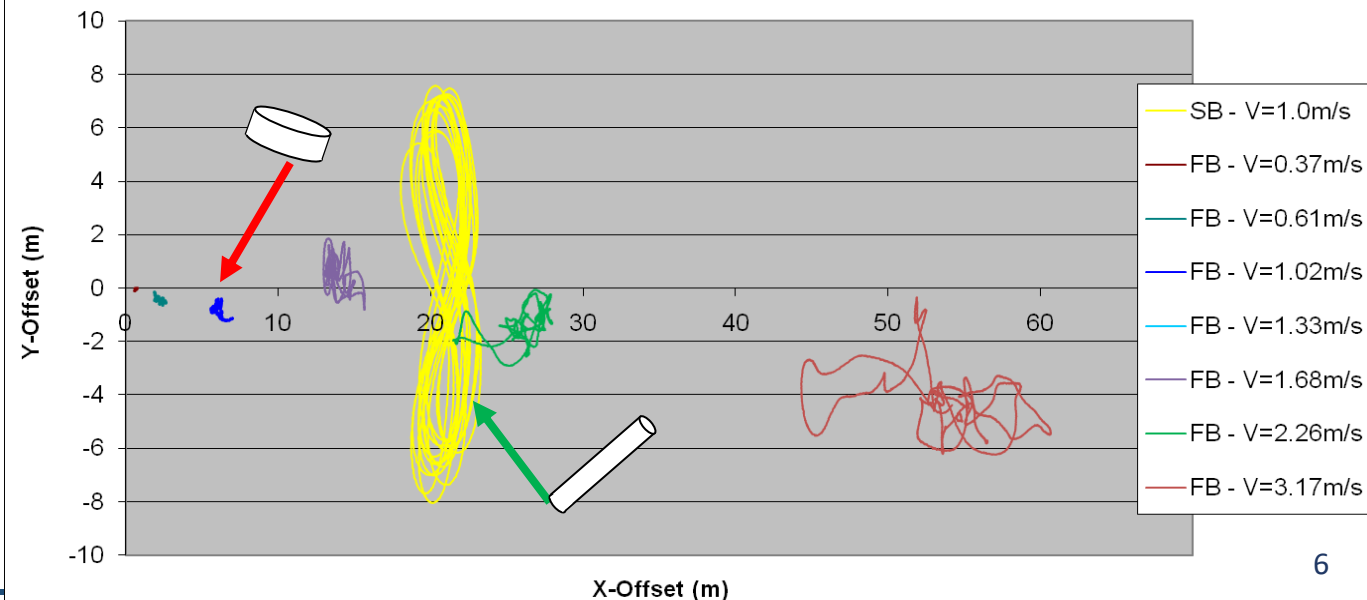
## ► Riser Description

- 1600m WD, WoA Case Study
- Flat Buoy
  - Extensive Basin & Wind-tunnel Test Campaigns
  - Numerous CFD simulations & validations
  - Very stable buoy concept (OMAE2011-49329, ISOPE 2011)



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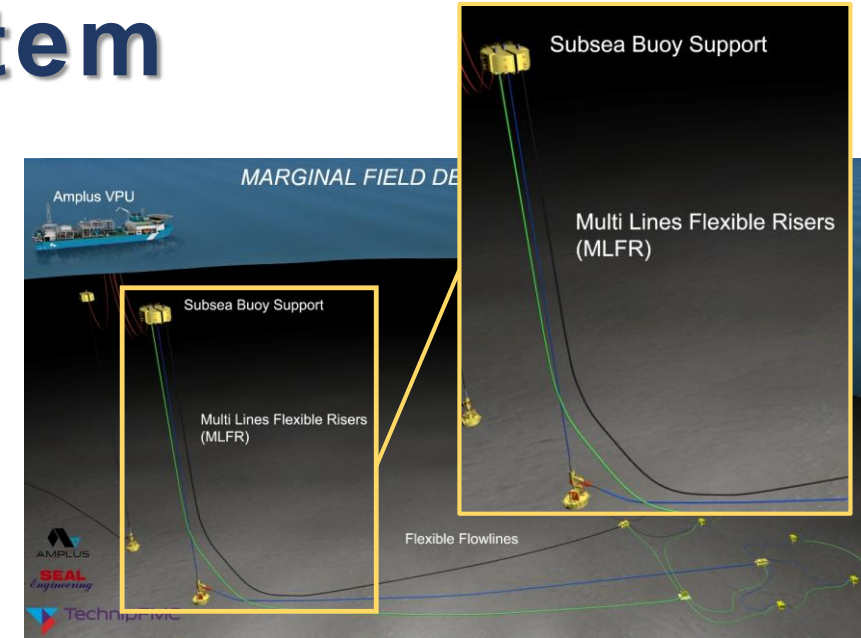
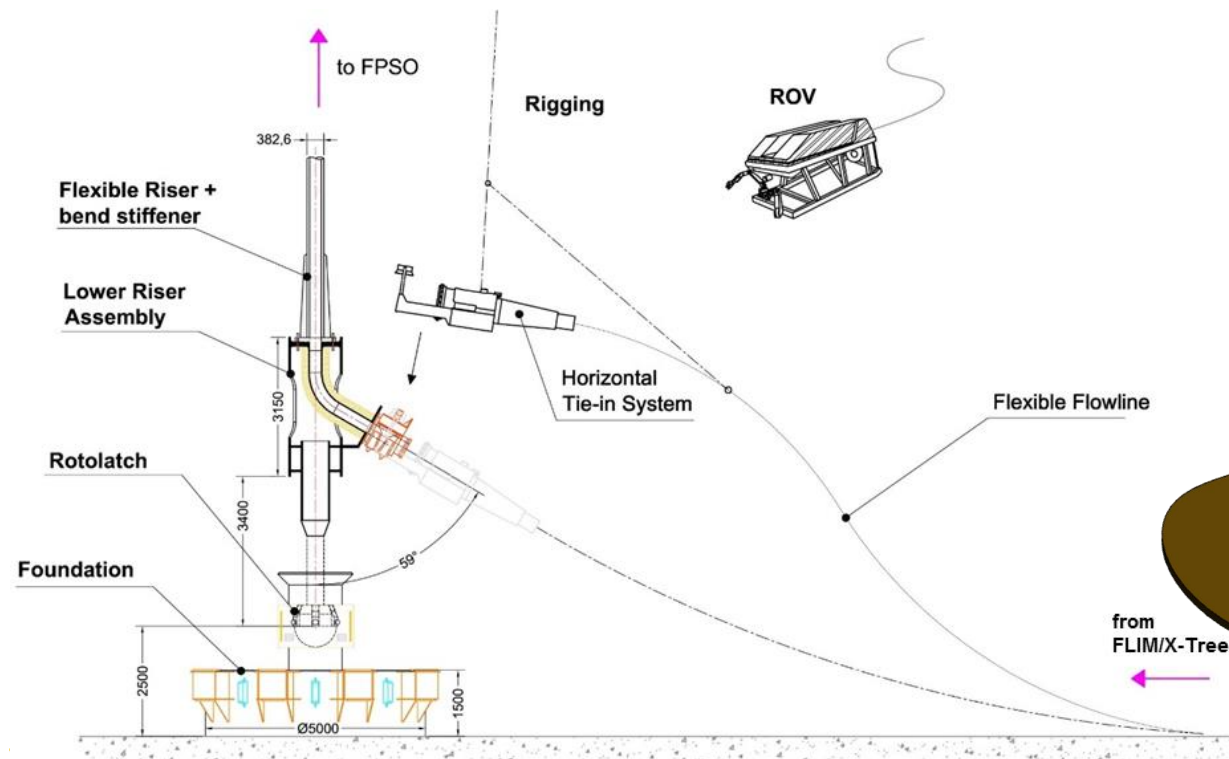
Slender Buoy Vs Flat Buoy Offset =  $f(V_{\text{current}})$



# Multi-Lines Flexible Riser System

## ► Riser Description

- 1600m WD Case Study
- Flat Buoy
- Lower Riser Assembly & Foundation

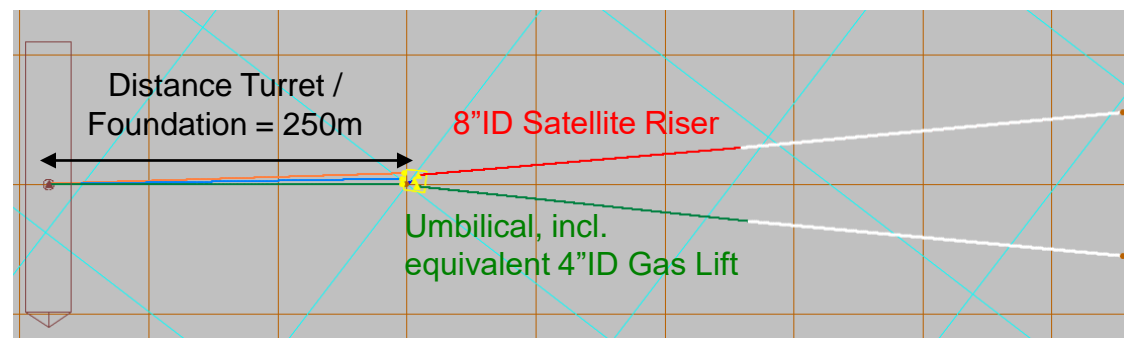




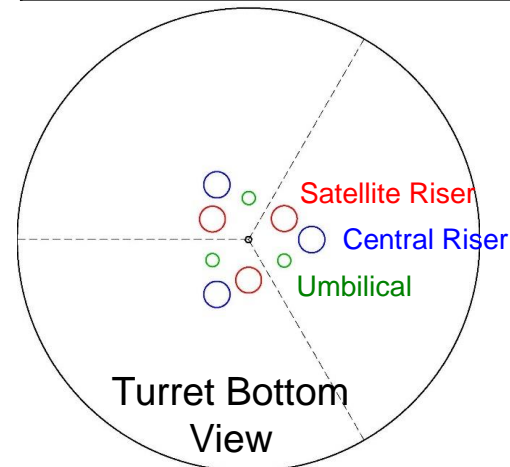
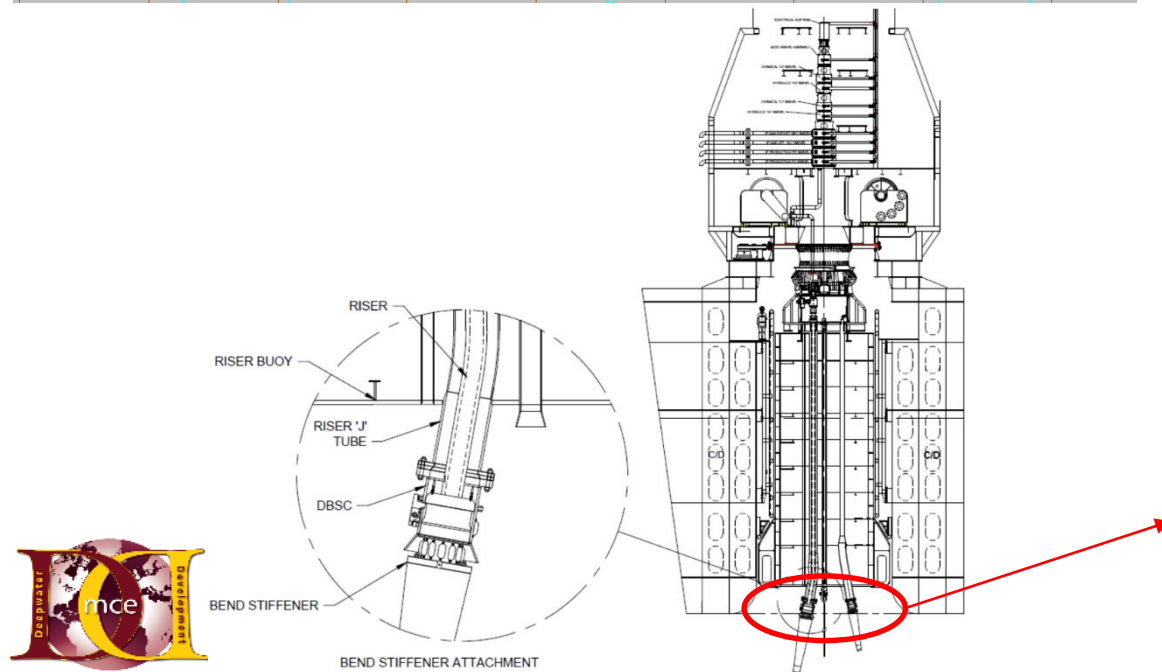
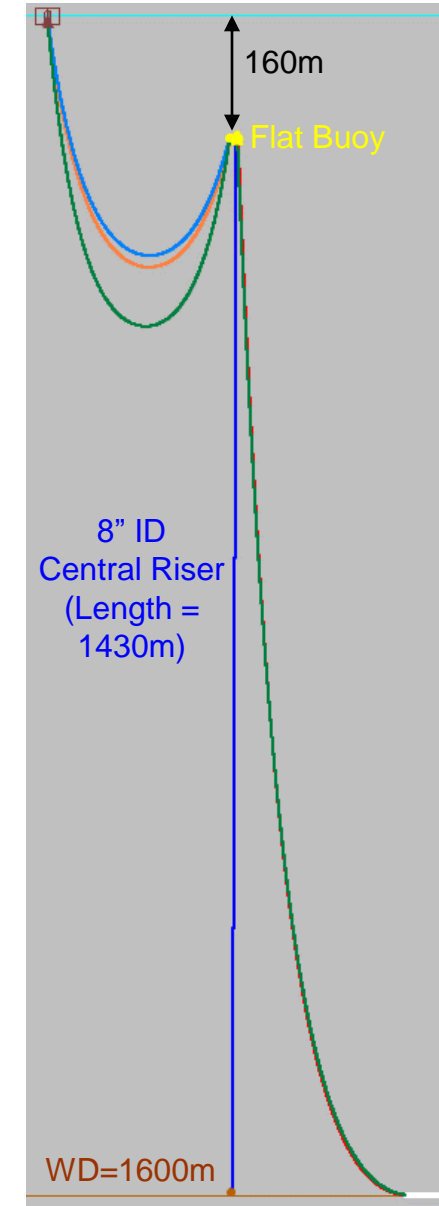
# Multi-Lines Flexible Riser System

## ► Preliminary Analysis (in progress)

### ■ Nominal Configuration



Parameter		Unit	Value
Jumper Lengths	8"ID Production	m	600
	8"ID Water Injection		570
	Umbilical		750
Flat Buoy	N° of Flooded Cpts	-	2
	Net Uplift	t	485
Effective Tension @ Foundation		t	116



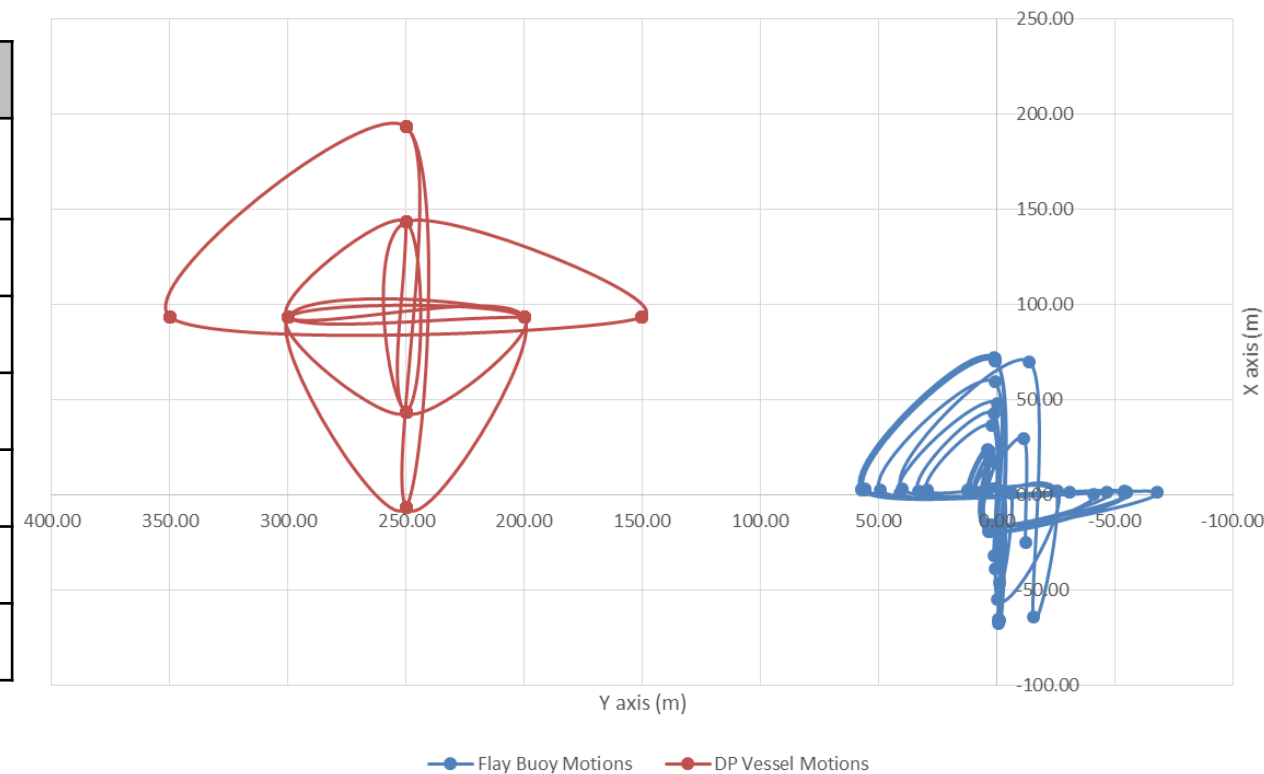
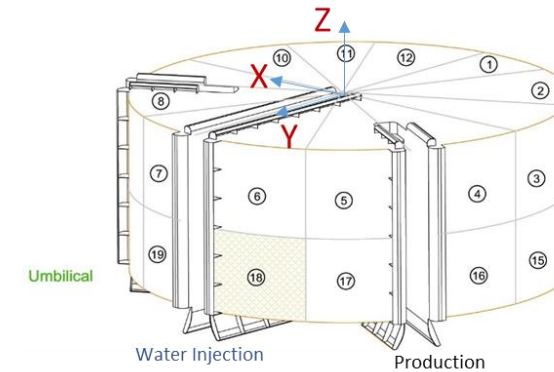


# Multi-Lines Flexible Riser System

## ► Preliminary Analysis (in progress)

### ■ Main “Extreme” Results (100 years conditions)

- No Contact between Flexible Lines
- Min Tension @ Foundation = 70t
- Max Tension @ Foundation = 172t

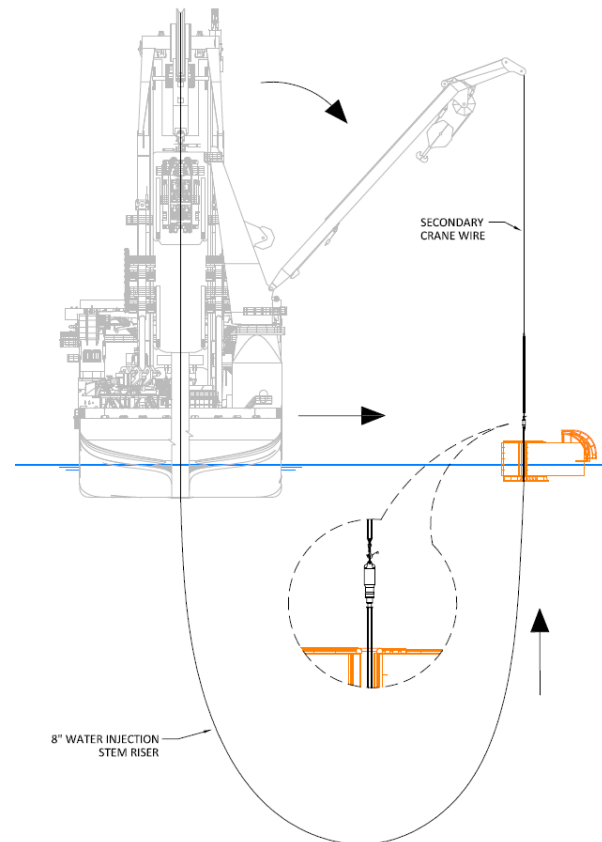


Load Cases	Flat Buoy Rotations (deg)					
	Around X-axis		Around Y-axis		Around Z-axis	
	Min	Max	Min	Max	Min	Max
Max Operating / Extreme	-1.3	0.2	-2.7	-2.2	-17.3	17.1
Buoy Flooded 1	-6.8	-5.1	1.5	<b>4.8</b>	-14.8	16.1
Buoy Flooded 2	2.2	<b>6.3</b>	-8.6	-6.3	-16.6	14.4
Buoy Flooded 3	<b>-8.2</b>	-3.7	<b>-9.7</b>	-6.4	-16.6	14.4
Free Hanging	-8.1	-6.9	-2.1	4.3	<b>-28.5</b>	<b>18.1</b>

# Multi-Lines Flexible Riser System

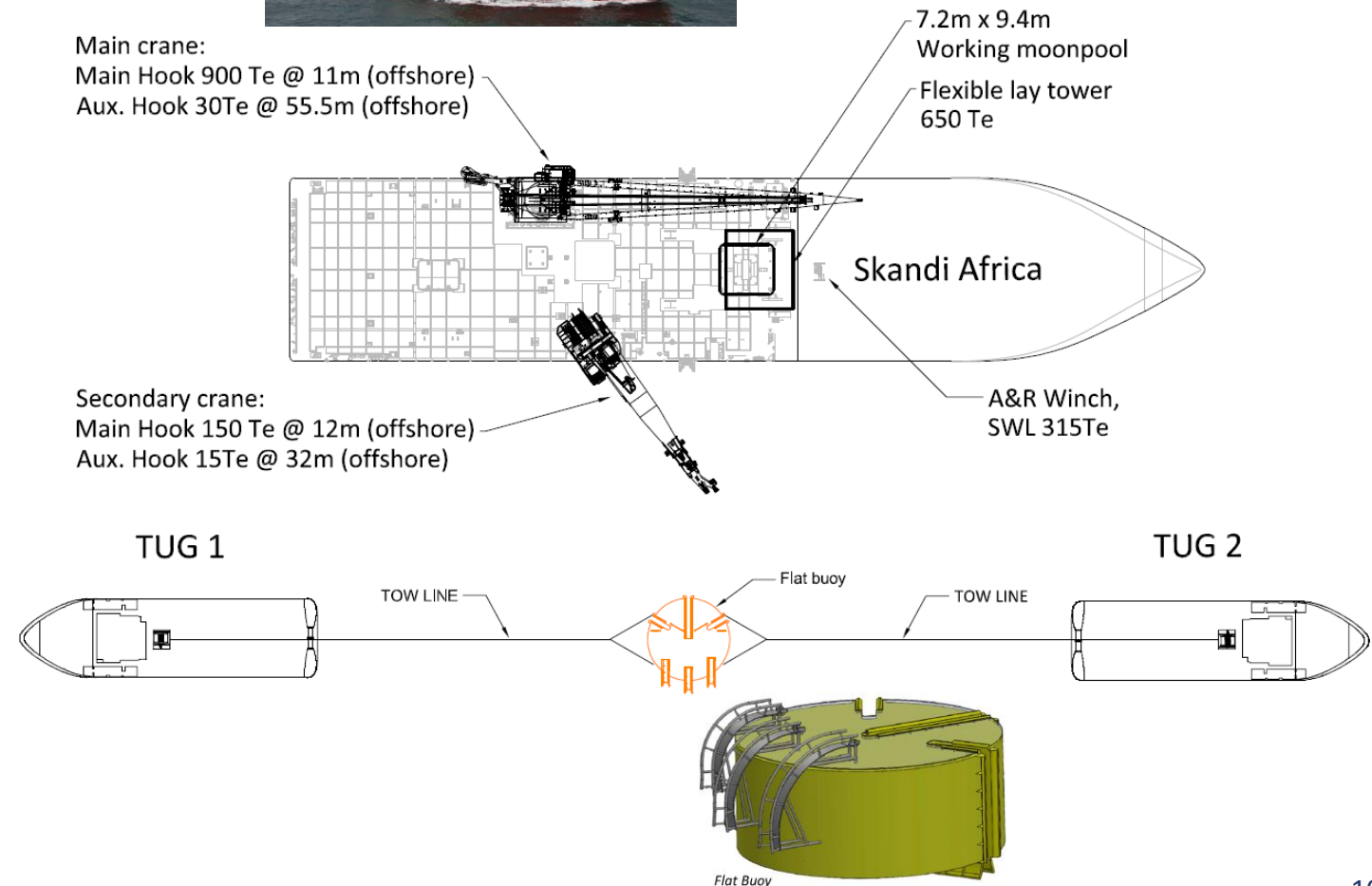
## ► Outline Installation Procedure

- Flexible Pipe-Lay Vessel & Flat Buoy on site
- Crane operator to engage WI Riser into Flat Buoy slot



Main crane:  
Main Hook 900 Te @ 11m (offshore)  
Aux. Hook 30Te @ 55.5m (offshore)

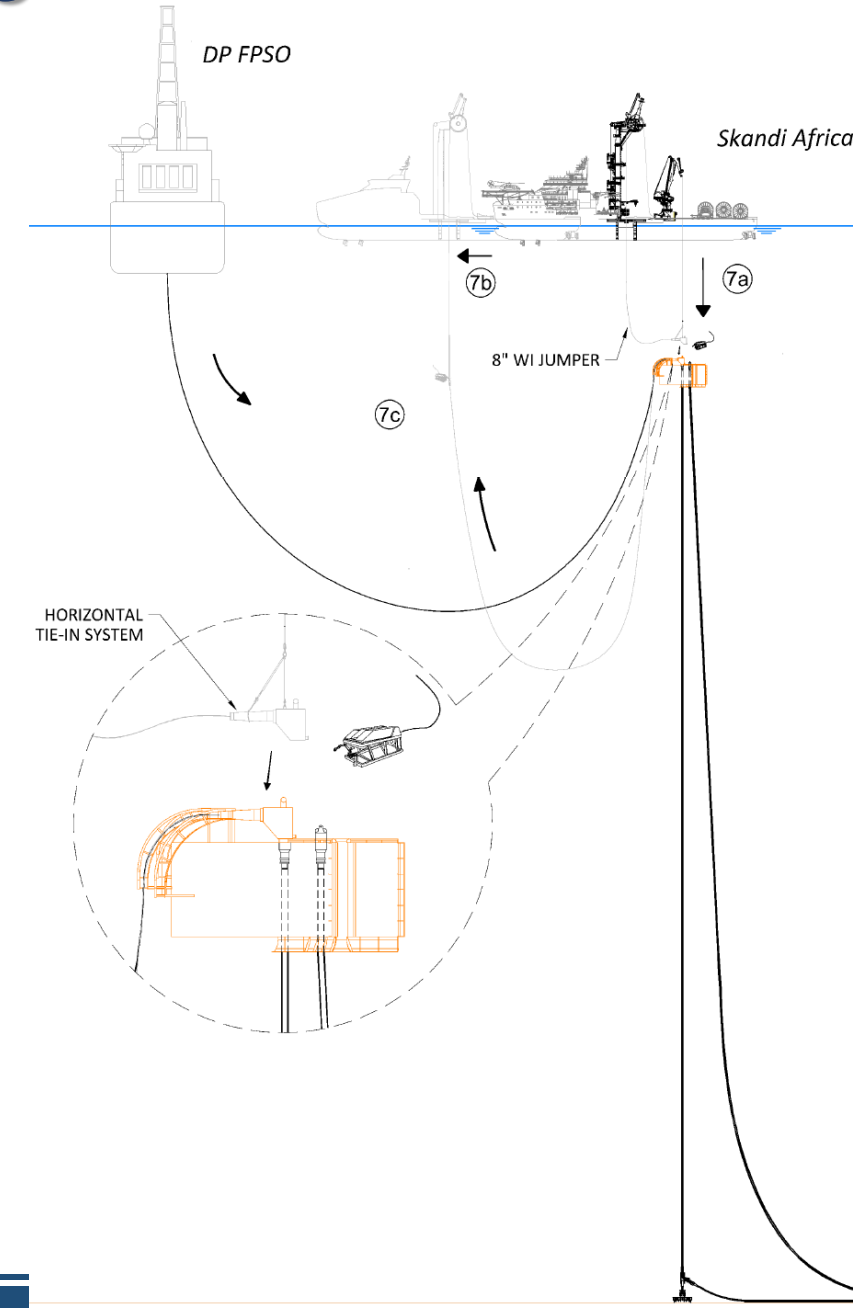
Secondary crane:  
Main Hook 150 Te @ 12m (offshore)  
Aux. Hook 15Te @ 32m (offshore)



# Multi-Lines Flexible Riser System

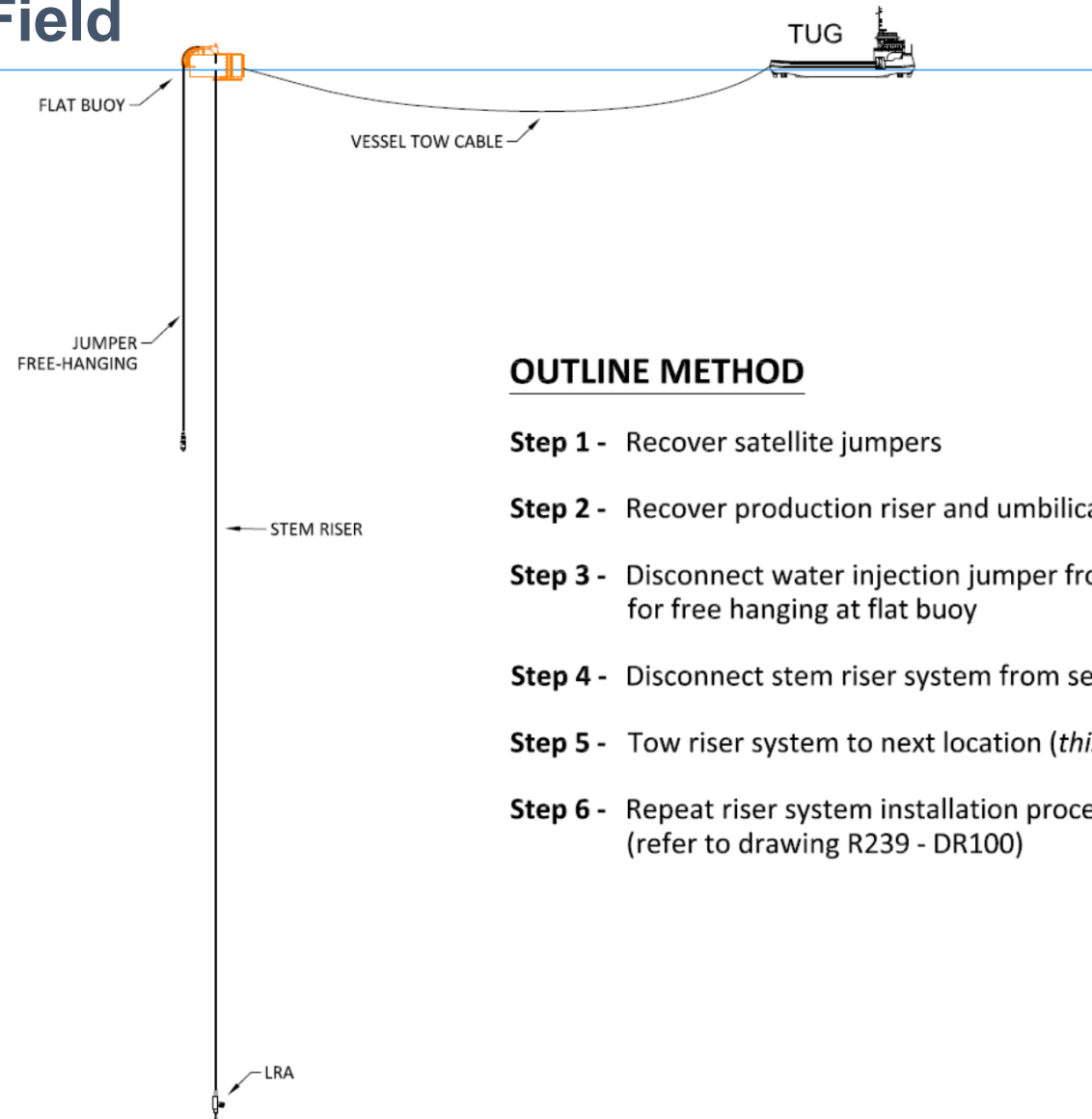
## ► Outline Installation Procedure (cont.)

- Riser pull-down & connection to Foundation
- Flexible WI flowline connection to Riser Base and lay-away toward SPS
- Satellite flexible riser 1st end connection to Flat Buoy and flowline lay-away to SPS
- Jumpers connection at Flat Buoy, deployment and transfer to FPSO



# Multi-Lines Flexible Riser System

## ► System Re-Set to Next Field



### OUTLINE METHOD

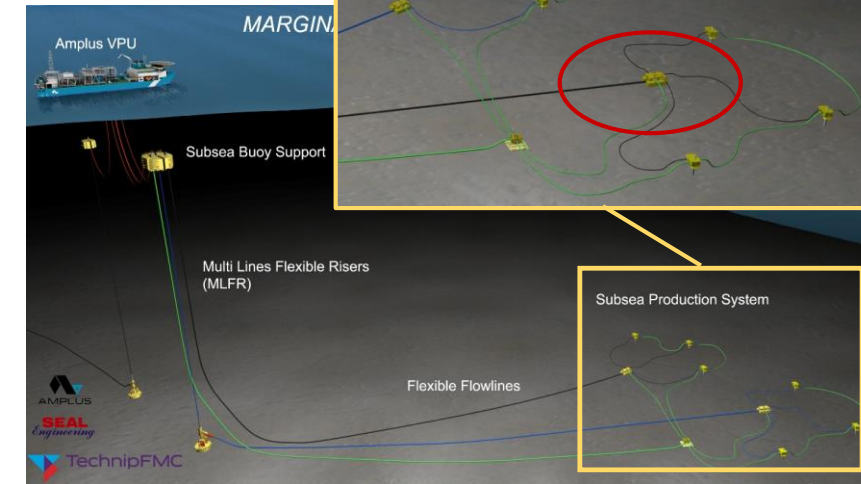
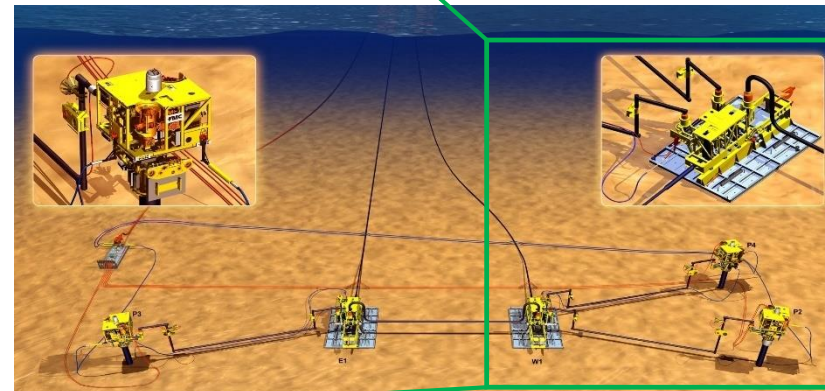
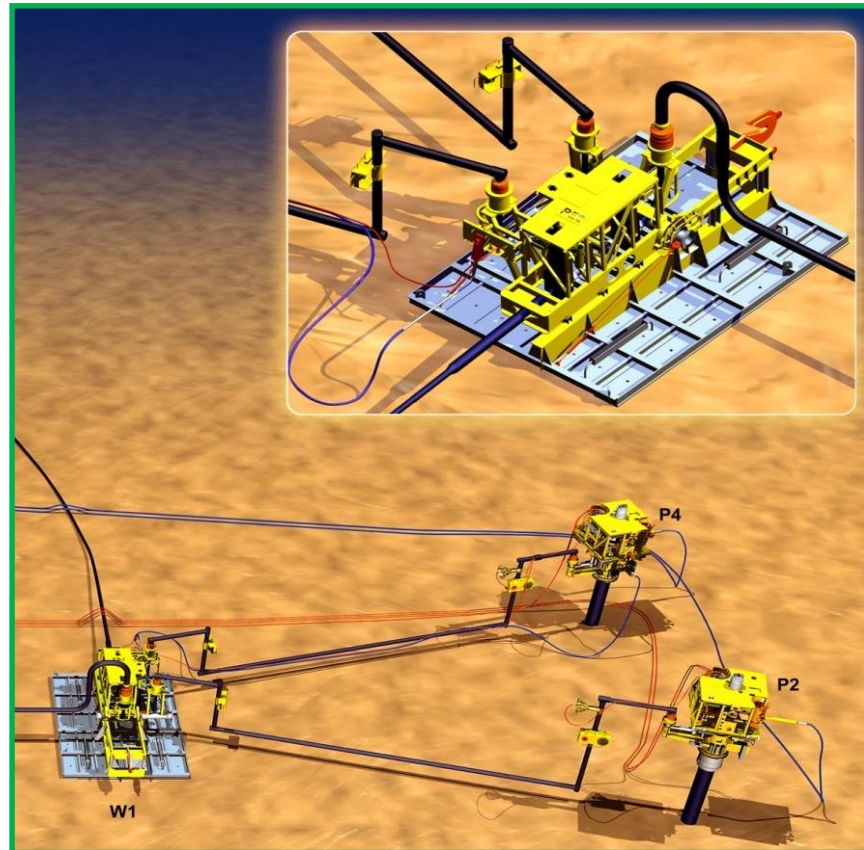
- Step 1** - Recover satellite jumpers
- Step 2** - Recover production riser and umbilical
- Step 3** - Disconnect water injection jumper from FPSO for free hanging at flat buoy
- Step 4** - Disconnect stem riser system from seabed foundation
- Step 5** - Tow riser system to next location (*this drawing*)
- Step 6** - Repeat riser system installation procedure (refer to drawing R239 - DR100)



# Subsea Production System

## ► SPS Generic Building Blocks

- Flowline Integrated Manifold (FLIM)

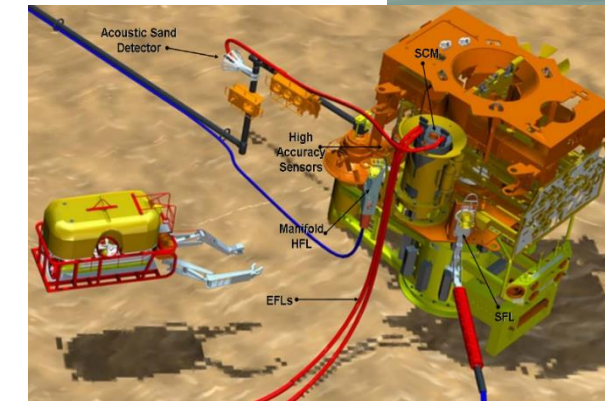
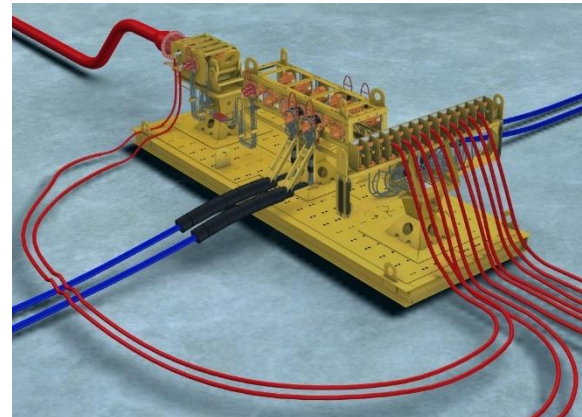
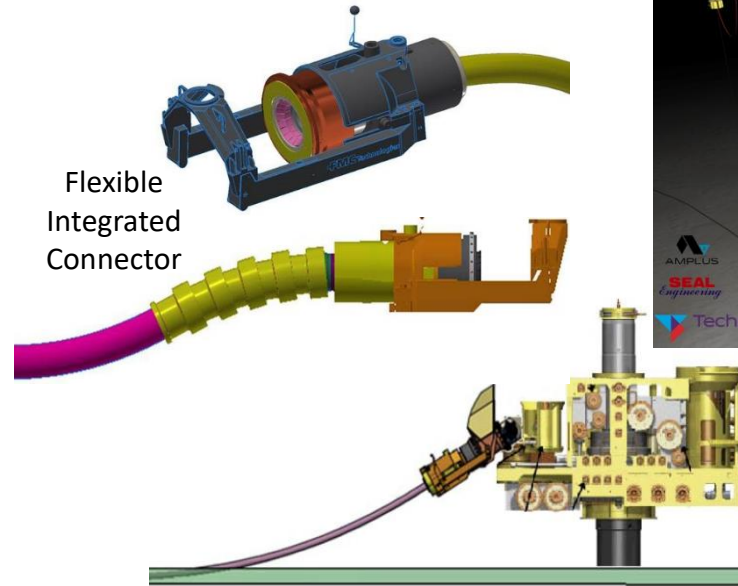
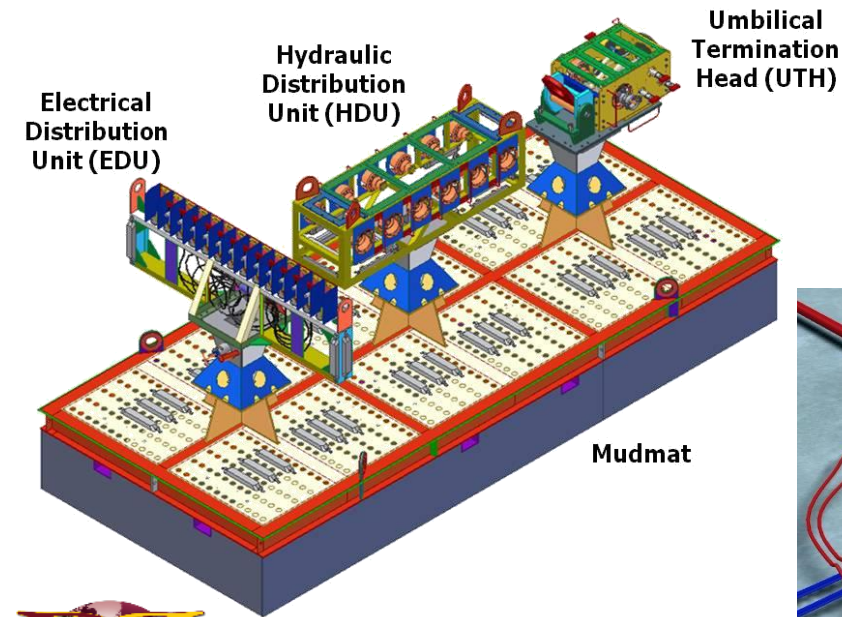




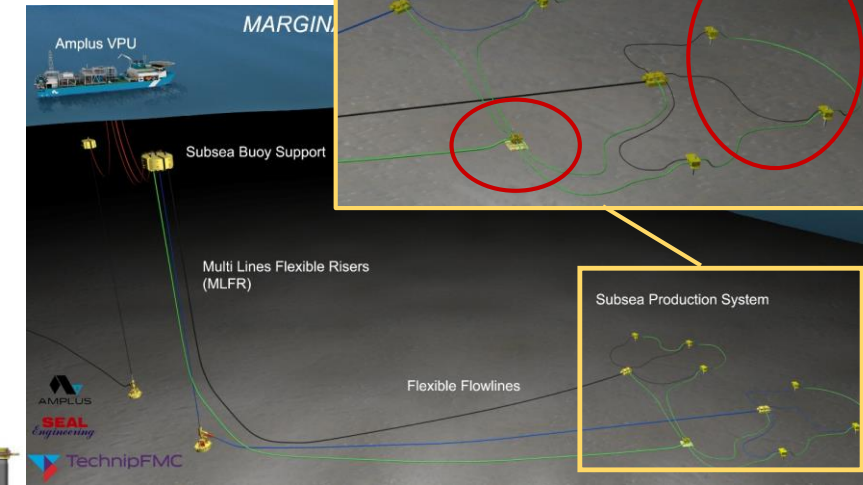
# Subsea Production System

## ► SPS Generic Building Blocks

- Flowline Integrated Manifold (FLIM)
- Subsea Tree
- Umbilical Termination Assembly



Enhanced Vertical Deepwater Tree (EVDT)





# MARGINAL FIELD DEVELOPMENT CONCEPT

## Thank You / Questions

Amplus VPU

Subsea Buoy Support

Multi Lines Flexible Risers  
(MLFR)

Subsea Production System

Flexible Flowlines



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