

NEW DESIGN FOR HYBRID RISER CONCEPTS

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Ultra Deep Water Fields| When? And How?

Ultra Deep Water: 3000 - 4000m



➤ High Capex → Not compatible with present low oil prices



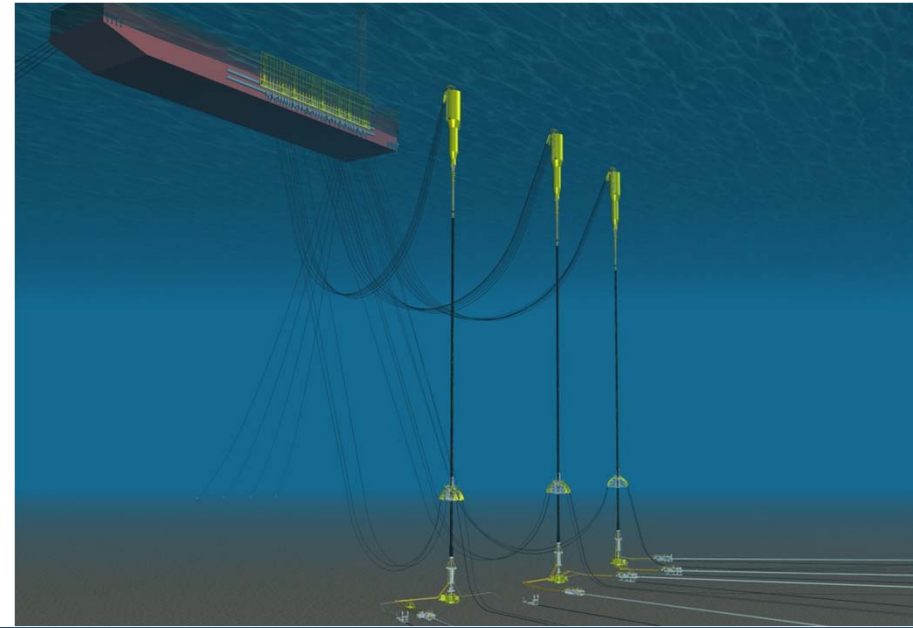
➤ High technological barriers → Today : Time for R&D activities

What will tomorrow ultra deep water risers look like?

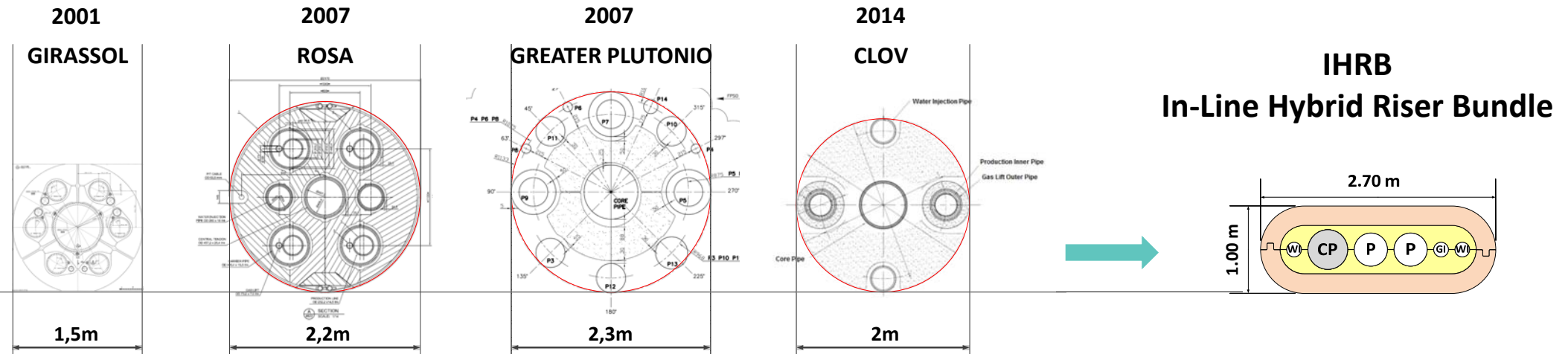


→ **HYBRID RISER TOWERS** are part of the **FUTURE**

- Self standing structure
- Simplified layout
- Easier installation by towing with light vessels
- Flow-assurance capabilities



Hybrid Riser Towers| History



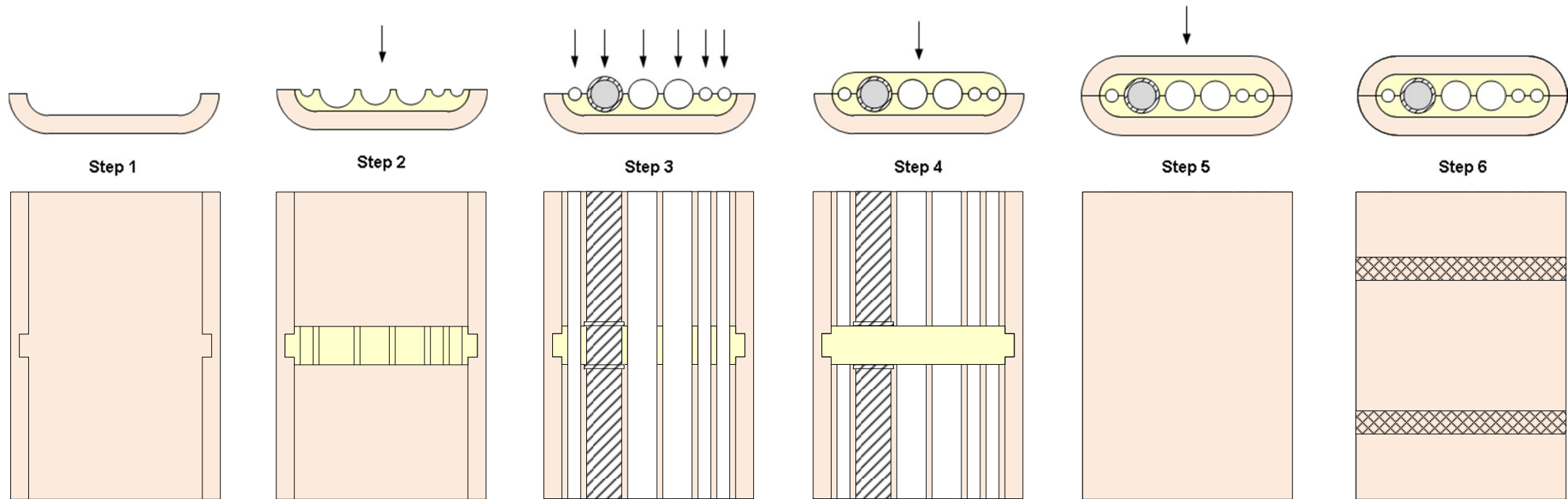
Challenges of Ultra Deep Waters:

Construction: Onshore sites cost and availability...

- ➡ What about near shore construction on a Barge
 - Key parameter: Bundle cross section for easier assembly...
- ➡ Let's try to minimize the number of layers !



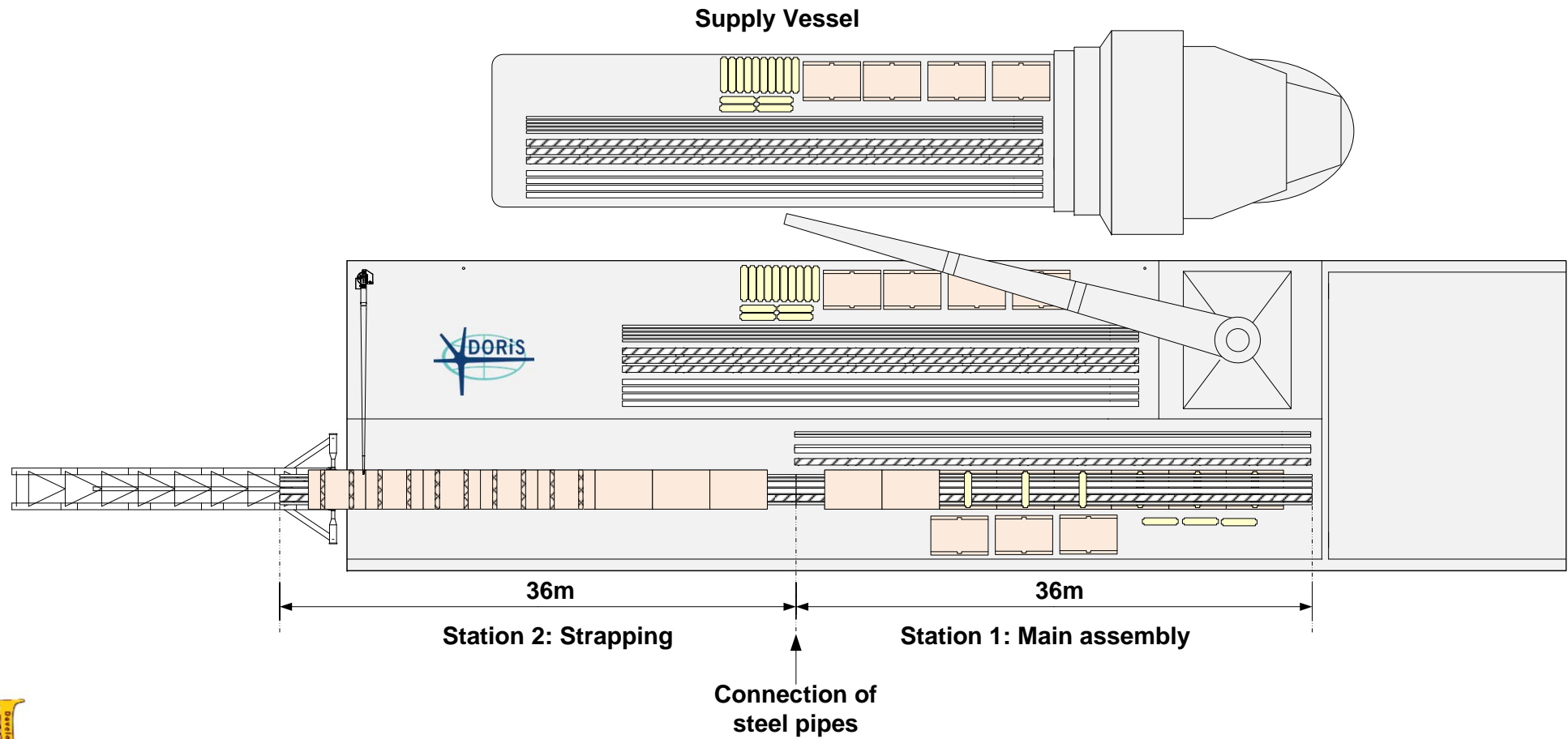
IHRB | Assembly Principle



Each element is lowered by cranes and positioned on the assembly line inside the lower buoyancy foam module.

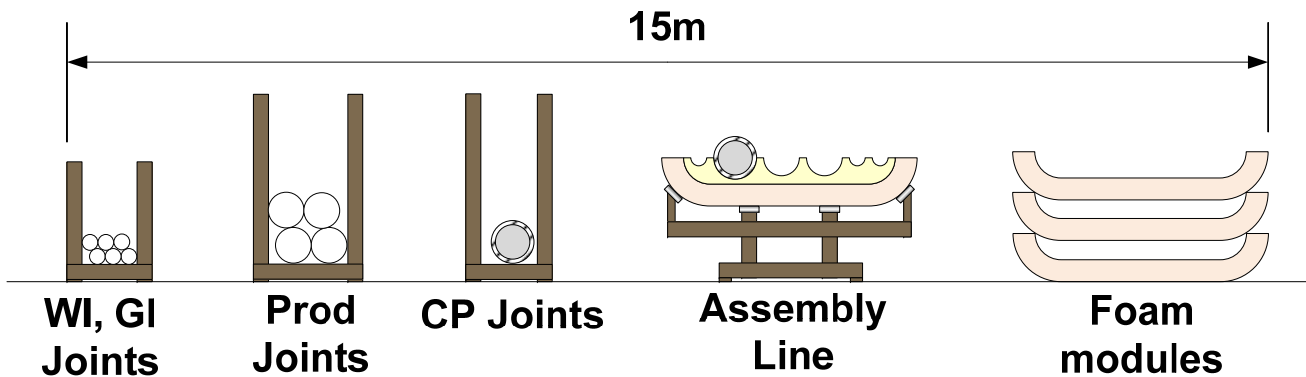
IHRB | Assembly Layout

On a typical Barge



IHRB | Assembly Set Up

- Assembly line with temporary storage nearby: about 15 m required width.



- Length of the construction line can be adapted depending on the size of the chosen barge.

➡ Simple set up due to only one layer

Top and Bottom assemblies:

First end assembly:

- Assembly buoyant with sufficient length of pipes to go back on the barge through the stinger to be connected to the Bundle

Second end assembly:

- Connection on a side platform between bundle and buoyant assembly.



IHRB | Construction Site

Simple assembly allows nearshore assembly on a shallow water barge

- Low spread cost

Any sheltered area is acceptable:

- No length limitation
- Low risk
- Local content cost limited



Verification Of Key Parameters

This new concept can be found surprising at first guess ...

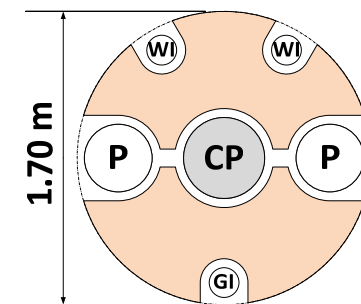
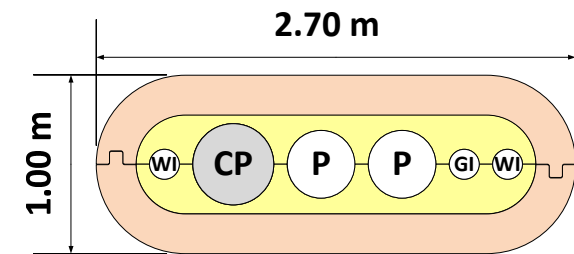
Hydrodynamic and cost studies have been performed to verify the following criteria:

➤ Design Drivers:

- Feasible in 4000 m water depth
- In place hydrodynamic behavior as good as circular concept

➤ Cost Drivers:

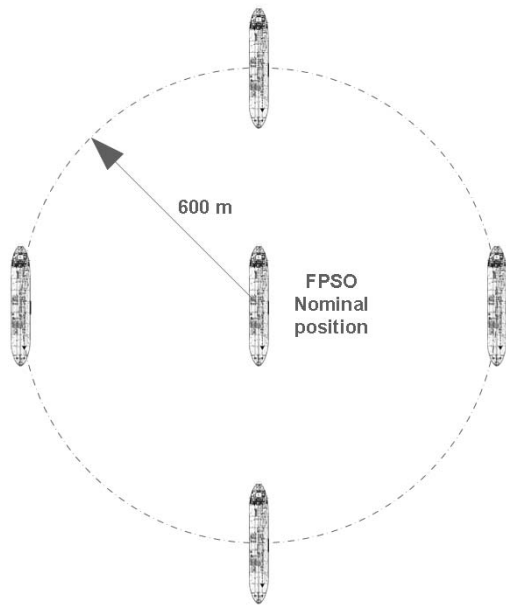
- Material Take Off comparable to circular concept
- Low construction cost



Design Driver | Hydrodynamic Behavior

Study Case Description:

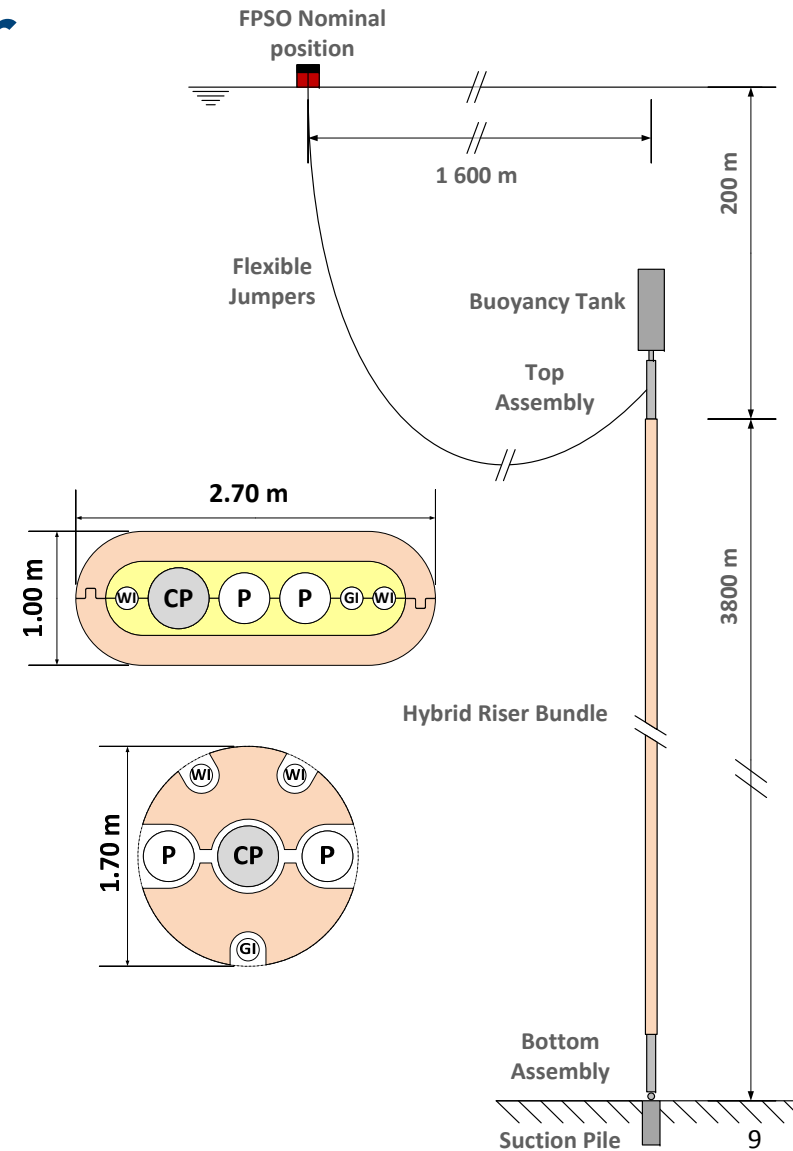
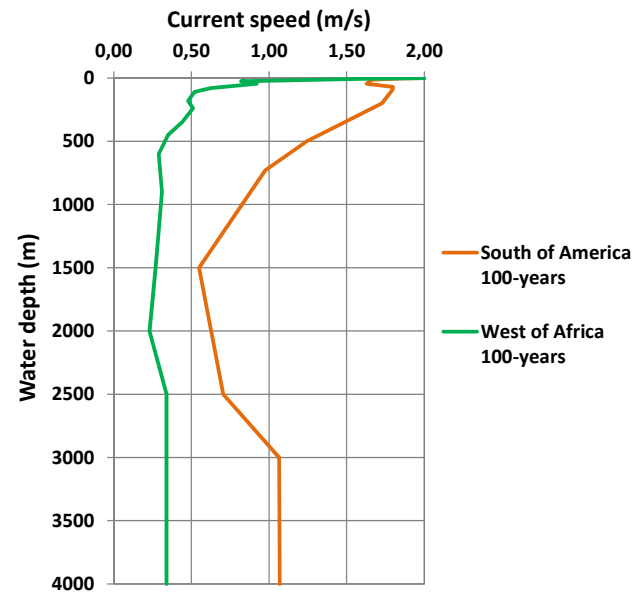
FPSO extreme offsets:
15% of Water Depth



Current Profiles:

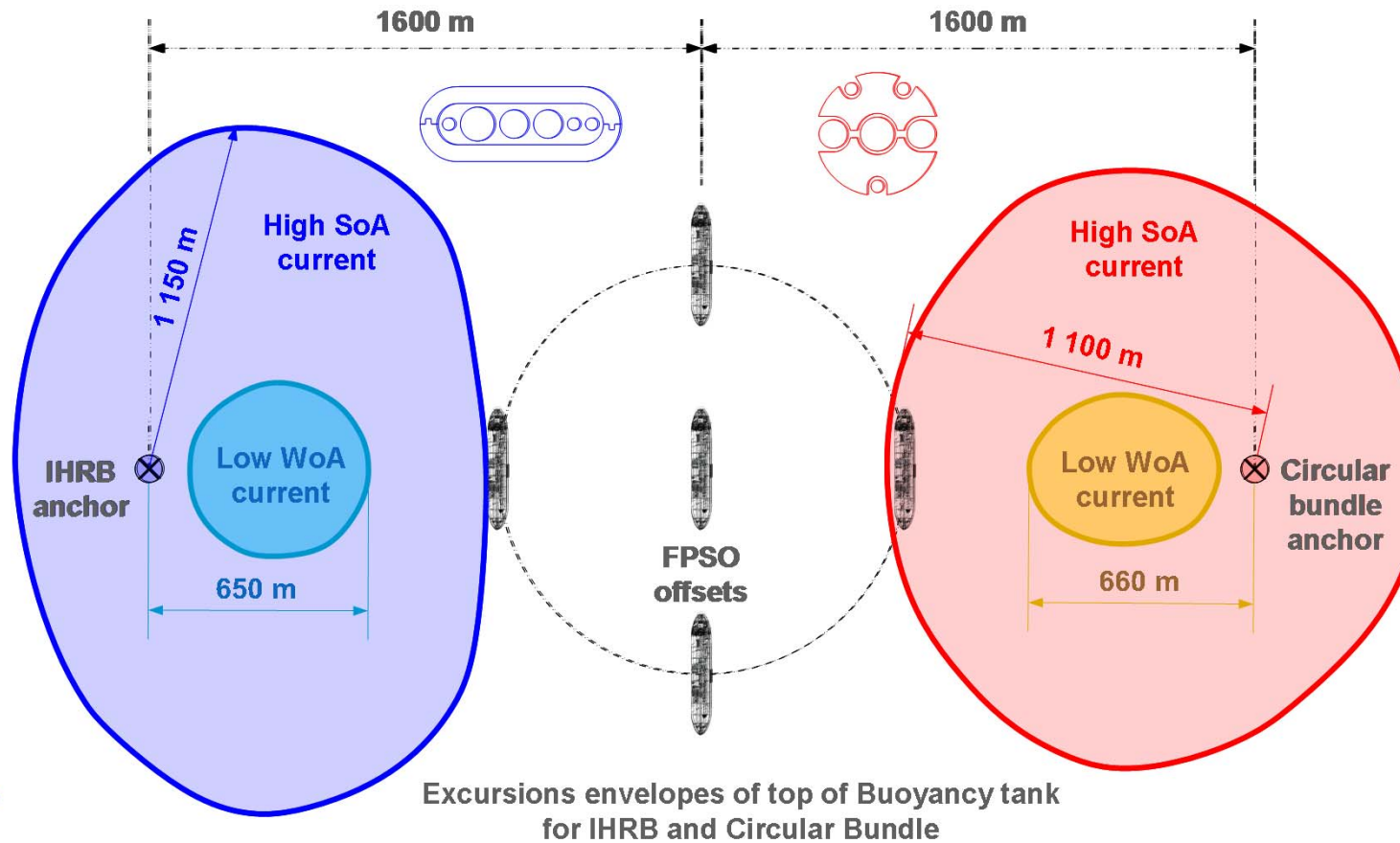
High currents as in South of America
Lower currents as in West of Africa





Current Profiles



Design Driver | Hydrodynamic Behavior

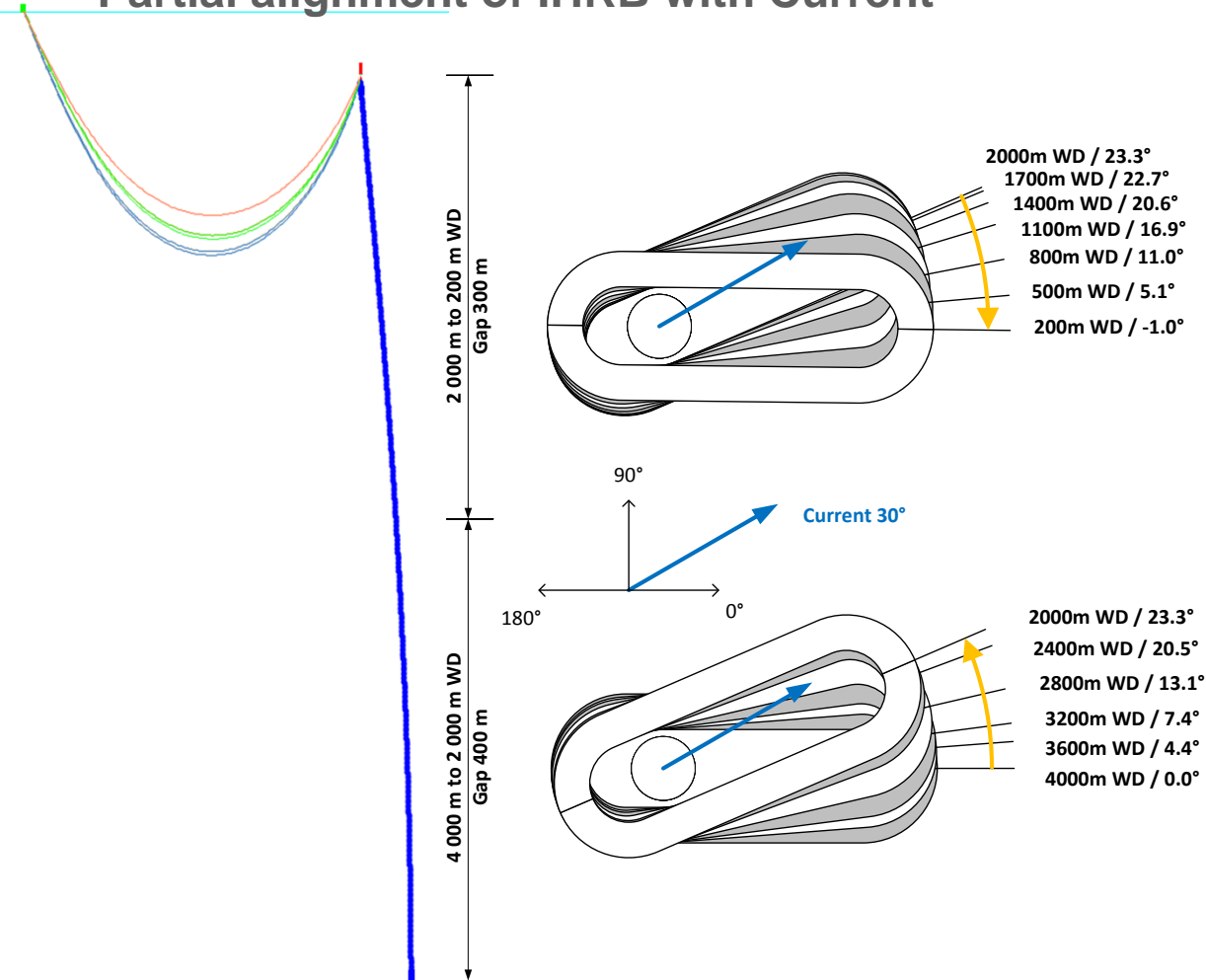
Excursion envelopes comparison for IHRB and Circular Bundle:



	IHRB BT excursion High SoA Current
	Circular bundle BT excursion High SoA Current
	IHRB BT excursion Low WoA Current
	Circular bundle BT excursion Low WoA Current

Design Driver | Hydrodynamic Behavior

Partial alignment of IHRB with Current



First Conclusions:

- Equivalent hydrodynamic behavior as Circular Bundle,
- Equivalent level of constraints in Core Pipe as for Circular Bundle.

- Construction possible whatever the location and the water depth...

What about the cost reduction?

Cost Driver | Evaluation assumptions

Item	IHRB	Circular Bundle
Water Depth	4 000 m	4 000 m
Offshore Site	200 km from coast	200 km from coast
Installation Method	Towing	Towing
Construction Site	Shallow water barge	Onshore Site in WoA
Assembly Method	Mechanical Connectors	Welding
Procurement	Same Material Take Off	Same Material Take Off

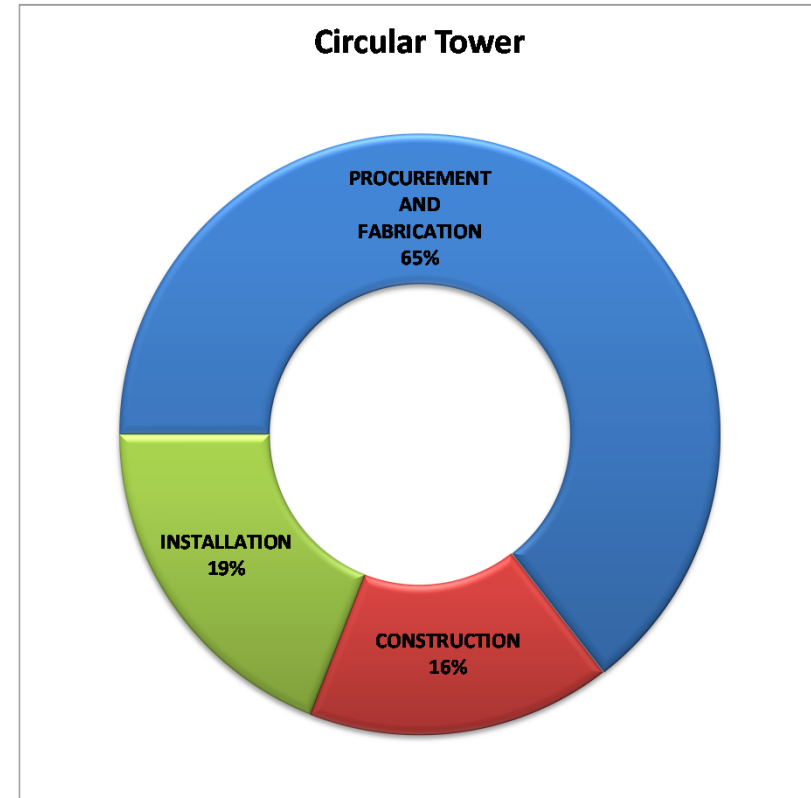
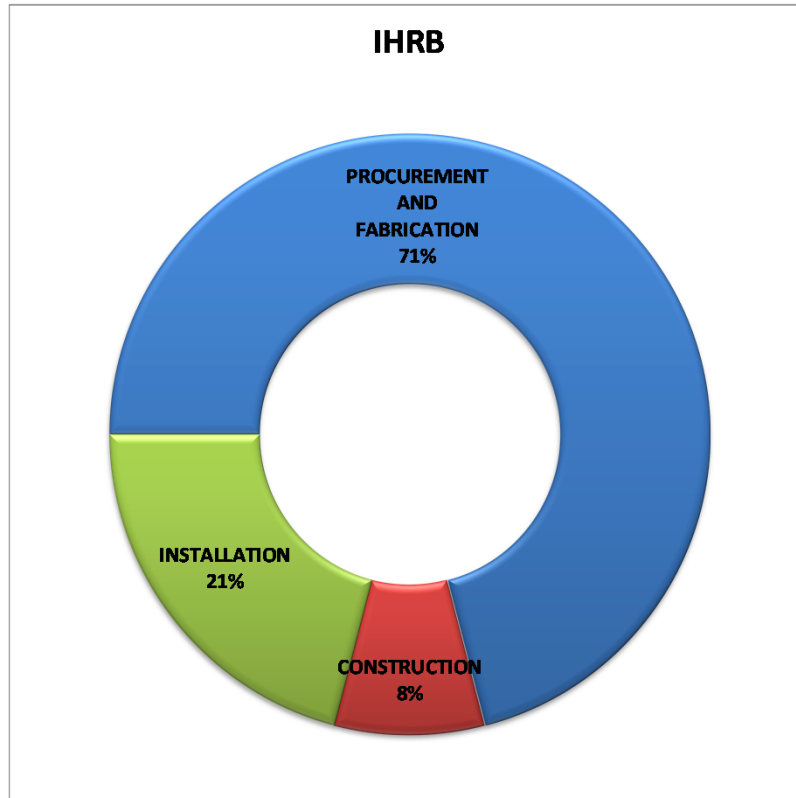
Cost Comparison :

- IHRB assembled on Shallow Water Barge
- Circular Bundle assembled on Onshore Site in West of Africa

➡ **Construction is the only key differentiator**



Cost Driver | Construction Cost Comparison

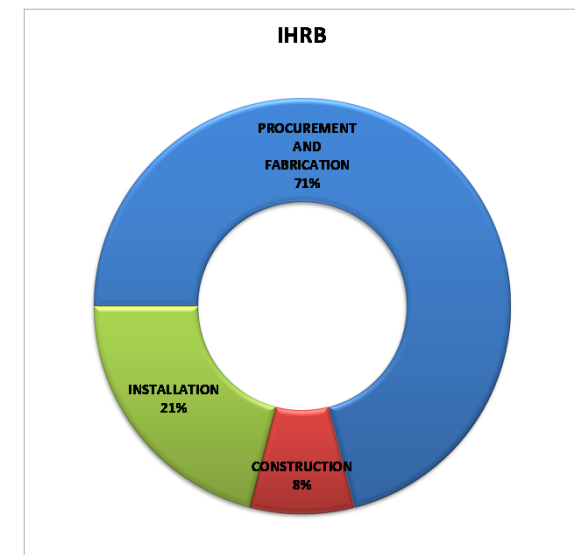


Conclusions

The IHRB Configuration allows an easy nearshore assembly;

Remote site followed by surface tow manages high local content cost;

→ This concept could be feasible and cost-effective for 4000m depth.



Thank You For Your Attention



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