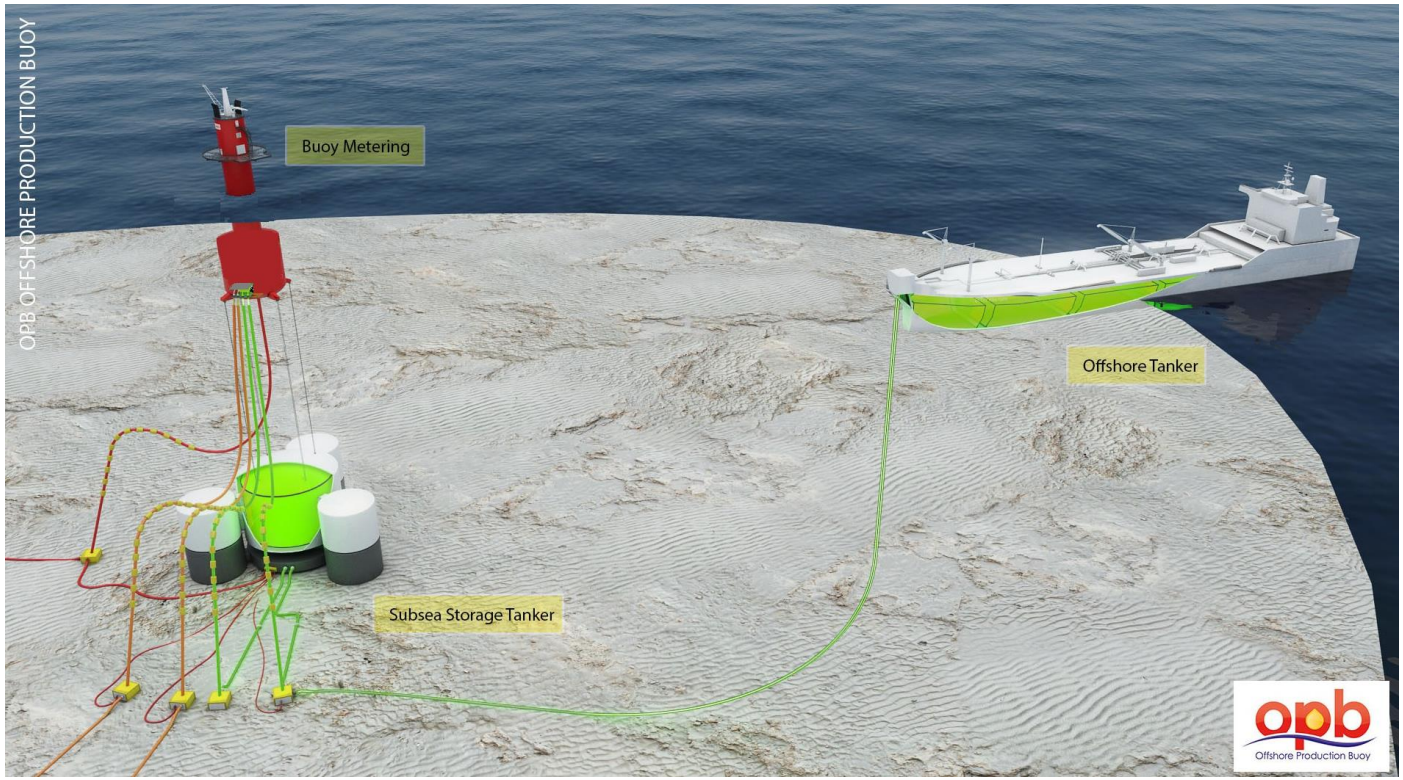
Offshore Production Buoy

Taking Onshore Processing Offshore

Standalone

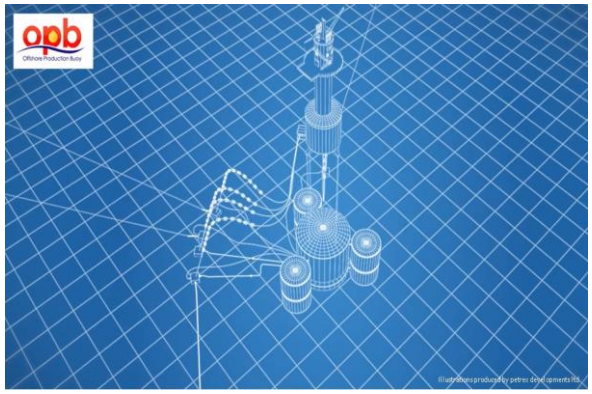
Unmanned

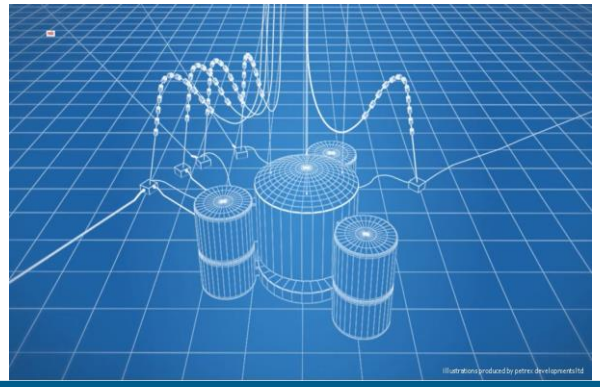
Reusable



John Woods – May 2017

What is an OPB System ?





- **Patented** system for exploitation of small, stranded oil reservoirs.
- Can be applied to early production, new field or brownfield development plus end of life decommissioning deferral.

- Principally consists of 2 elements;
  - Buoy – control, power generation and de-gassing
  - Tank – oil/water separation and oil storage
- Buoy is unmanned typically 28m diameter (12 m through waterline).
- 14,000 tonnes displacement.
- Size of system scalable to meet functional requirements.
- Autonomous – monitored remotely.

- Gas extracted and used for power generation (heating).
- Liquids pumped to tank.
- Tank is typically 200,000bbl storage.
- Gravity separation of oil and water.
- Heated liquids.
- Separated water received from tank, treated, monitored and discharged.

- Metering and oil export.
- Oil export route as required for field location (CALM, SAL or direct offloading).

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Applications

- New field development
  - Low CAPEX and OPEX unlocks previously uneconomic reserves
  - Buoy is re-deployable allowing CAPEX to be spread across fields
  - Field clusters can be processed in single (or multiple) buoy and stored / exported from one (or more) tank
- Early production scheme
  - Extended (e.g. 3-5 year) early production scheme to evaluate appropriate full field development solution
- Intermediate production system
  - Complement existing facilities by de-bottlenecking through pre-processing of well fluids to remove water and re-injection produced water.
- Abandonment deferral
  - OPB can maintain production from subsea infrastructure after larger, more expensive FPSO has become uneconomic or host has shut down

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Some Figures

Offshore Production Buoy

“Classic” OPB

• Processing Capacity	30,000 bopd, 45,000 blpd
• Gas handling	circa 9MMscf/d
• Hull diameter	28m
• Column diameter	12m
• Height	62m
• Waterline	35m
• Displacement	14,000 tonnes
• Storage	200,000 bbls oil
• Water depth	circa 100m (catenary) to 400m (tension tether)
• CAPEX	$160 million installed (excluding wells)
• OPEX	circa $20 million per year

Dimensions and displacement can be adjusted to meet functional requirements and environmental conditions.

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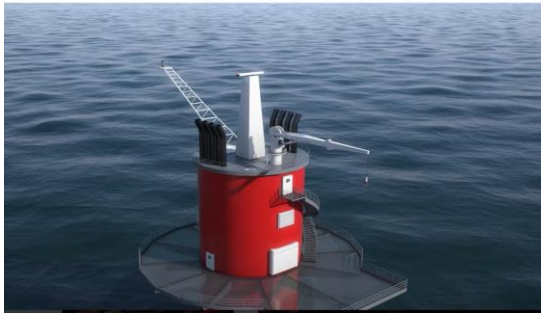
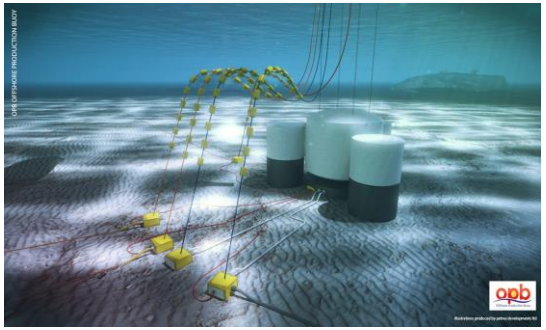
Key Features

- OPB system uses temperature based stabilisation
  - Produced fluids are heated and degassed in the buoy
  - Gas used for power generation and heating
  - Up to 6 ESP drives can be installed for artificial lift
  - Power for water injection if required



  - Processing located below waterline (patented blast relief system for protection of maintenance personnel)
  - Subsea storage tank heated to allow very efficient separation of oil and water
  - Separated water returned to buoy for monitoring and discharge
  - Processing in climate controlled environment allowing efficient waste heat management.
- Very stable platform
  - Tank testing conducted on generic design
  - Low sail area and narrow waterline profile
  - Catenary or tension tether moorings designed
  - Patented installation method for tank



- Low OPEX
  - Normally unmanned – 4 planned maintenance visits (walk to work) per year plus allowance for 4 unplanned
  - Very simple processing plant. Autonomous operation monitored and directed from onshore

Design Status

- Proof of concept report complete
- Design manuals being issued under licence (26 in total) for OPB elements and systems
- Tank test of concept conducted (variant and field specific tank testing required)
- Mooring design for catenary and tension tether progressed for various marine environments
- Number of patents developed for system.
- Market assessment conducted (worldwide) and variants to “Classic” OPB identified
  - Deep water
  - Gas handling
  - Energy conversion
  - Increased storage
  - Increased throughput
- Engineering and construction partner (ODE) has assessed process design
- ODE has completed tank design and operation review

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Next Steps

- Continue to develop the “Classic” OPB design
- Continue to engage with the market on variant designs
- Issue design manuals (under licence)
- Field specific studies
- Leading to concept select and development engineering

OPB engineering status is ready for field specific application evaluation

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Questions ??

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