Helix Producer I
Reusable, re-deployable Floating Production Unit
Agenda

1. The Disconnectable FPU vessel concept
2. Converting a train ferry into a Floating Production Unit
3. The Disconnectable Transfer System
4. Subsea infrastructure requirements
5. FPU Vessel and Topsides specifications
6. Short term Field Deployment
FPU Concept Rationale

• **Reduce storm-related downtime**
  – No property damage from storms
  – Minimal disconnection and reconnection lead time
  – Employees stay on FPU after disconnect - not dependent on helicopter evacuation
  – Maintenance and overhauls can be done during storm downtime, for longer production uptime

• **Cost-effective marginal field deployment**
  – Easier to relocate than permanent moored facilities
  – Takes advantage of existing subsea infrastructure
  – Ensures maximum production from fields that are still viable, but no longer cost-effective for permanent moored platforms
Disconnectable Transfer System (DTS)

**General Operating Philosophy**

- Disconnect when adverse conditions in which the unit cannot maintain the 60 ft watch circle are imminent or when Pitch & Roll Conditions force production to shut-in.
- FPU disconnects from risers, riser buoy is released, and buoy supports riser/umbilicals at about 130-feet below sea surface.
- FPU leaves site with entire crew intact to move from storm path. Routine maintenance is performed while disconnected.
Extreme Makeover

MV Karl Carstens roll-on roll-off train ferry

Helix Producer I
The Floating Production Unit is a new concept for the GOM, taking advantage of existing infrastructure to export produced oil and gas via a Disconnectable Transfer System.

Widening the HPI hull  
Reinforcing the main deck  
Installing production topsides
Croatia- Widening the hull

The FPU’s initial conversion phase involved adding two 10 meter wide sponsons to the hull, and converting shaft-driven propulsion to a DP2 system incorporating two retractable tunnel thrusters bow and three azimuth thrusters aft.
HPI en route to GOM
HP1 Leaving port for sea trials
Upon arrival at Kiewit Offshore Services’ shipyard, the main deck of the vessel was reinforced to accommodate the vessel’s production modules.
HPI Production systems
Production modules
The FPU's production topsides were pre-fabricated at the Kiewit shipyard in ten separate modules, for installation and interconnection onboard.
Flexible Engineered Solutions – FES (UK)
- Two 5-5/8” Flexible Production Risers (One future available)
- Two 6” Flexible Export Risers
- Two E/H Umbilical (One future available)
- ~ 200 mT Buoy (net buoyancy)
- Three Production Swivels
- Two Export Swivels

History
- Systems used on three other FPSO’s, DNV certified
The DTS hangoff frame was installed concurrently with the production topsides. DTS buoy was transported to production site and staged at a water depth of 150 feet for later retrieval.
Disconnectable Transfer System (DTS)

Departs with DP FPU

Disconnects with Buoy
Turret disconnect components
The vessel’s ballast tanks were flooded to initiate a 12-degree starboard list, allowing welding of the DTS hangoff frame below the water line without the use of divers.
Ballast tanks

- 6- Symmetrically placed Ballast Tanks are connected to the bottom keel portion of the buoy.
- The Ballast Tanks allow for more flexibility in the ballasting program.
- The installation of these ballast tanks provides the ability to trim the vertical attitude of the buoy to compensate for differences in the calculated and actual hang off weight of the risers and umbilicals.
- All construction and fabrication of ballast tanks were witnessed by Lloyd’s surveyor.
DTS buoy clump weight system

- The DTS has 147.26 Te net buoyancy.
- The permanent clump weight is 63.6 Te.
- Temporary chain Ballast of 108.84 reduces the net buoyancy to 38.42 Te of positive buoyancy.
- The 38.42 Te of buoyancy reacts against the 63.6 Te permanent clump weight.
- Environmental or incidental loads of 25.18 Te are needed to overcome the mass of the clump weight.
- Clump Weight coefficient of friction adds an additional 19.1 Te to clump weight on bottom stability.
- The worst case 100 Year Loop Current at 3.2 knots adds only 14.7 Te in drag coefficient to overcome an inertial 44.28 Te of clump weight mass and friction.
As the clump weight chains come in contact with the sea bottom, the leading edge link weight begins to be supported by the sea bed. This transfer of chain clump weight slows the descent of the buoy and provides for a “soft landing” during disconnect.
Because the Floating Production Unit does not store hydrocarbons, export lines are required to send oil and gas to shore.

This subsea infrastructure exists in the types of late-stage fields the FPU will produce at Phoenix.

This will also be required for marginal field development operations.
Subsea infrastructure - Phoenix Project
Flag State, Classing and Regulatory

- Bahamas Flag Vessel
- Vessel classed by Lloyds Register
- Class Notation: FOI-FL
- USCG approval in accordance with SOLAS and MODU safety rules
HPI Vessel specifications

Flag
Bahamas

Vessel Classification
Lloyd’s Register

Class Notation
OI 100A (1) Floating Production Unit
Multi-Purpose Unit, OIWS, PC, LI,
LMC, UMS, DP (AA), PCR

Certification
SOLAS, MARPOL, Loadline, ISSC,
ISM, ILO USCG certification based on
Compliance with US Code of
Federal Regulations (CFRs)

Thrusters
- Engines: 6 x MaK 2400 kW diesel generators
- Main propulsion: 3 x Ulstein Aquamaster azimuth thrusters,
  2,000 kW each
- Bow thrusters: 2 x Ulstein Aquamaster azimuth thrusters,
  1,500 kW each
- Aux thrusters: 2 x Thrustmaster hinged azimuth thrusters,
  1,500 kW each
- Tunnel thruster: 1 x Hundestad SPT 12, 2,000 kW

DP2 Positioning System
- Alstom SDP 22 dual-redundant positioning system
- 3 x dedicated TSS SG Brown reference systems
- Meridian gyro compass
- 2 x Sonardyne acoustic reference systems
- 2 x DGPS satellite positioning systems

Vessel Dimensions
- Length: 161 m
- Breadth: 29 m
- Draft: 8.6 m
- Deadweight: 14,316 mT
- Displacement: 24,085 mT @
  7.7 m draft
DP2 Dynamic positioning system

Base Station on Land for Differential Corrections

2 x DGPS

Hydroacoustic Positioning Reference (HPR)
**HPI Production Capacities**

**Processing Capacity**
- Max oil production: 45,000 BOPD
- Max gas production: 72 MMCFD
- Max water production: 50,000 BWPD
- Max total liquids production: 60,000 BFPD
- Gas export compression: 2,160 psig
- Oil export pumps: 2,160 psig

**DTS Turret Capacity**
- 5 I-tubes for 2 production / 2 export / 1 spare flexible risers
- 3 I-tubes for E/H umbilicals
- Swivel rating 5K
HPI short term field deployment scenario
Rapid response buoy development

- Alternative production buoy system fabricated for BP Macondo spill response
- Buoy design accommodates a single free-standing riser, to maximize deployment speed and functionality for future operations
- Following Macondo project completion, buoy remains in Helix inventory, standing by to respond to future requirements
Rapid response buoy fabrication
HPI produces first oil from Phoenix Field following BP Macondo project completion