

OTC2017

OFFSHORE TECHNOLOGY CONFERENCE
1-4 May 2017 \ Houston, Texas, USA \ NRG Park
2017.otcnet.org



LIBRA PROJECT

Production Development Projects: NW Region

Osmond Coelho Jr., Libra Project, Petrobras

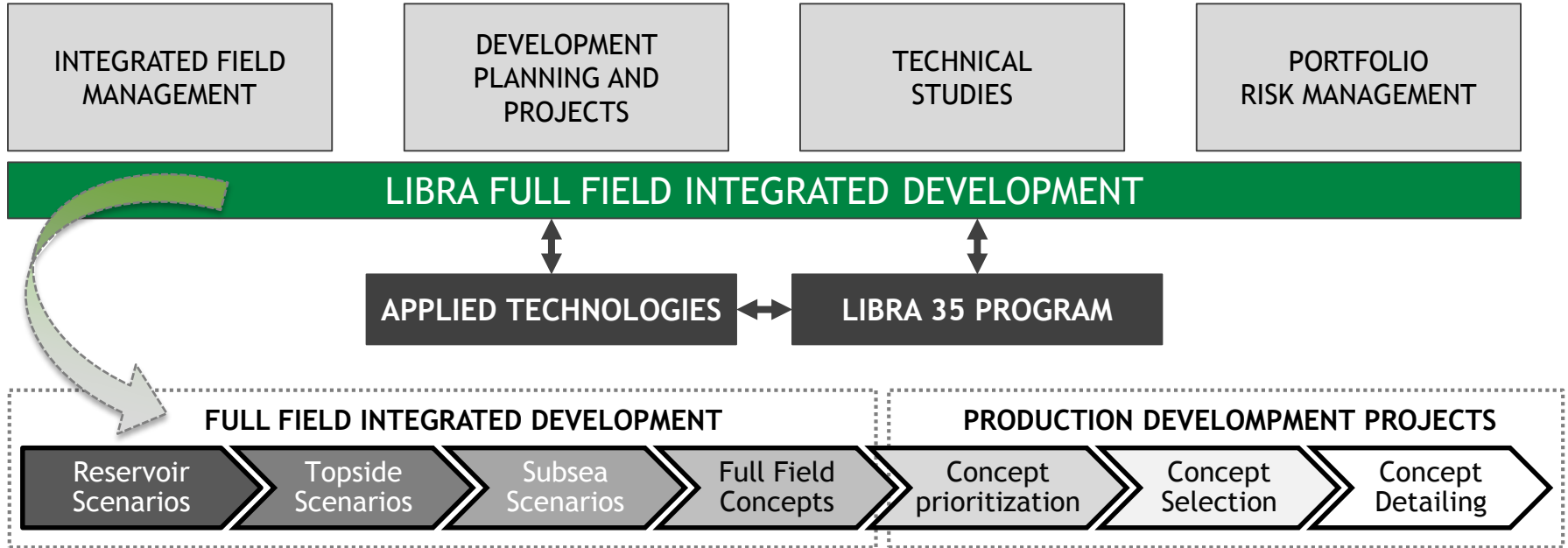
Joint Venture Operator



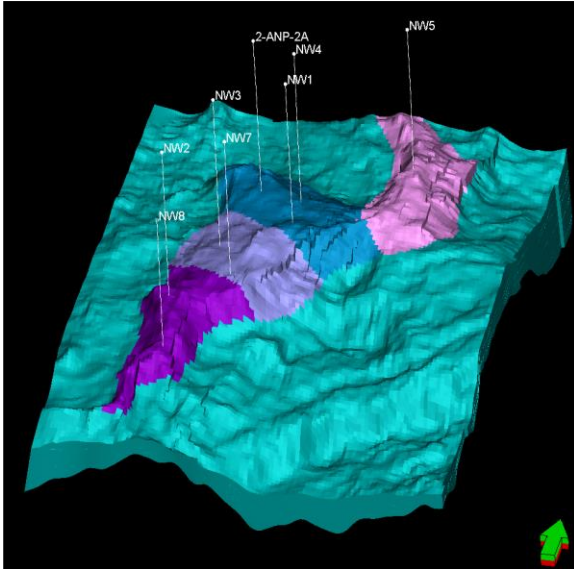
LIBRA FULL FIELD OPTIMIZATION MANAGEMENT

Main objective:

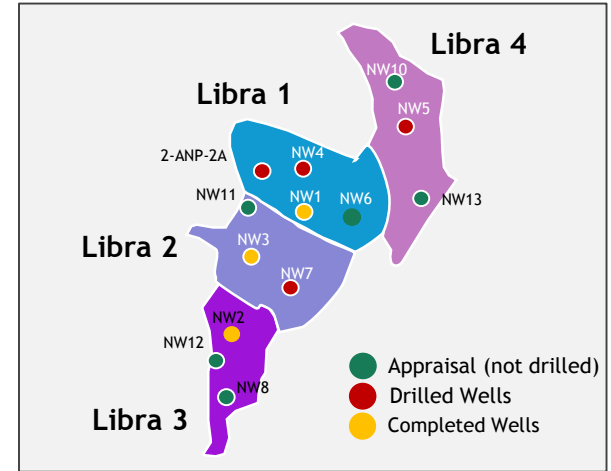
- Optimize Libra development by maximizing HSE Best Practices and improving economical results



LIBRA NW AREA - INTEGRATED DEVELOPMENT PLAN

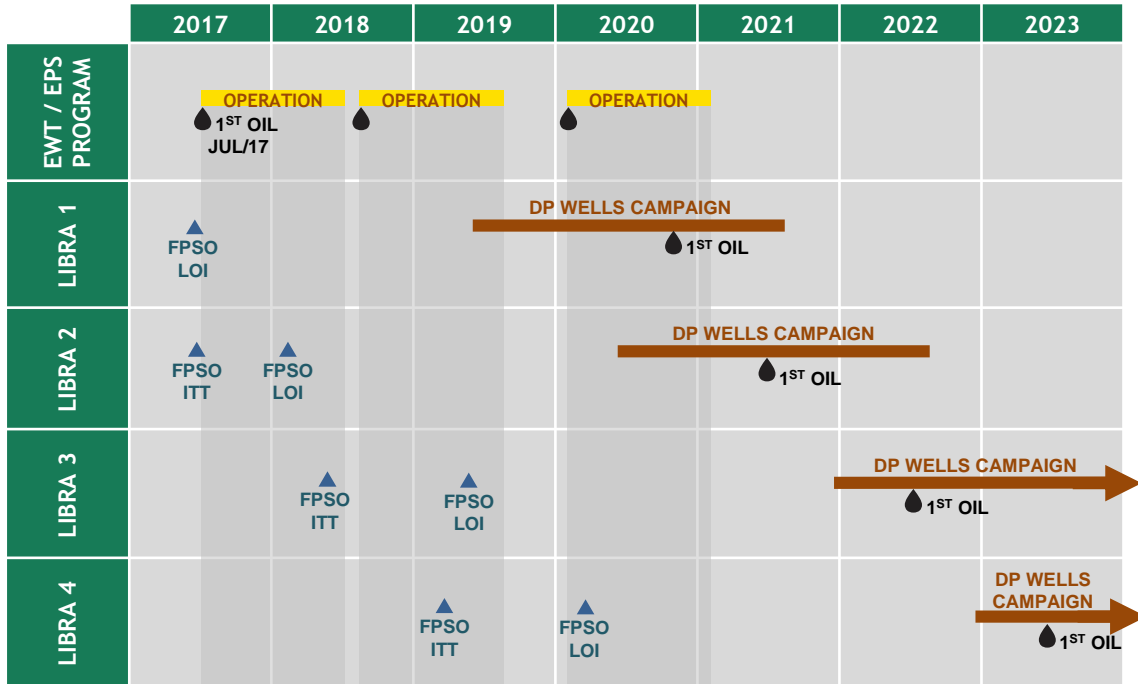


| RESERVOIR DATA |
|-------------------------------|
| Pre-Salt Microbial |
| Aptian Carbonates |
| 27 API Oil |
| Reservoir Depth 5,300 m |
| GOR 415 scm/scm |
| CO ₂ content ~ 40% |

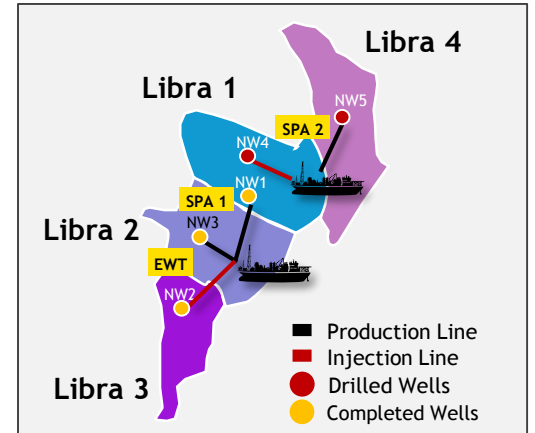


- Current base case → 4 FPU's (WD = 2,100m);
- Objective → anticipation, with an acceptable level of risk;
- Sequence based on availability of reservoir information;

LIBRA EWT DE-RISKING CAMPAIGN (NW AREA)

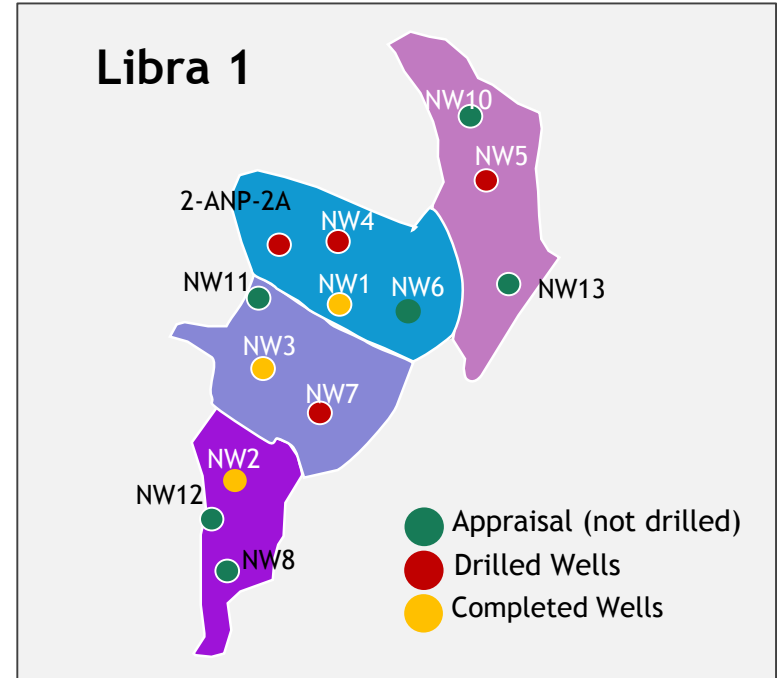


Ref: Forecast Apr/17, Petrobras Business Plan 17-21 and Libra Business Plan 2017



LIBRA-1 → ACCELERATING PRODUCTION AND GATHERING INFORMATION

| MILESTONES | | OBJECTIVES |
|-----------------------|-----------|---|
| Conceptual Definition | Jul, 2015 | <ul style="list-style-type: none"> ▪ Schedule driven project, ▪ Early production to anticipate cost recovery (NPV), ▪ 1st test for water injection and WAG on the field, ▪ Information to optimize development of NW area, ▪ Information to accelerate the incorporation of reserves. |
| Project Sanction | Set, 2017 | |
| 1 st Oil | 2020 | |



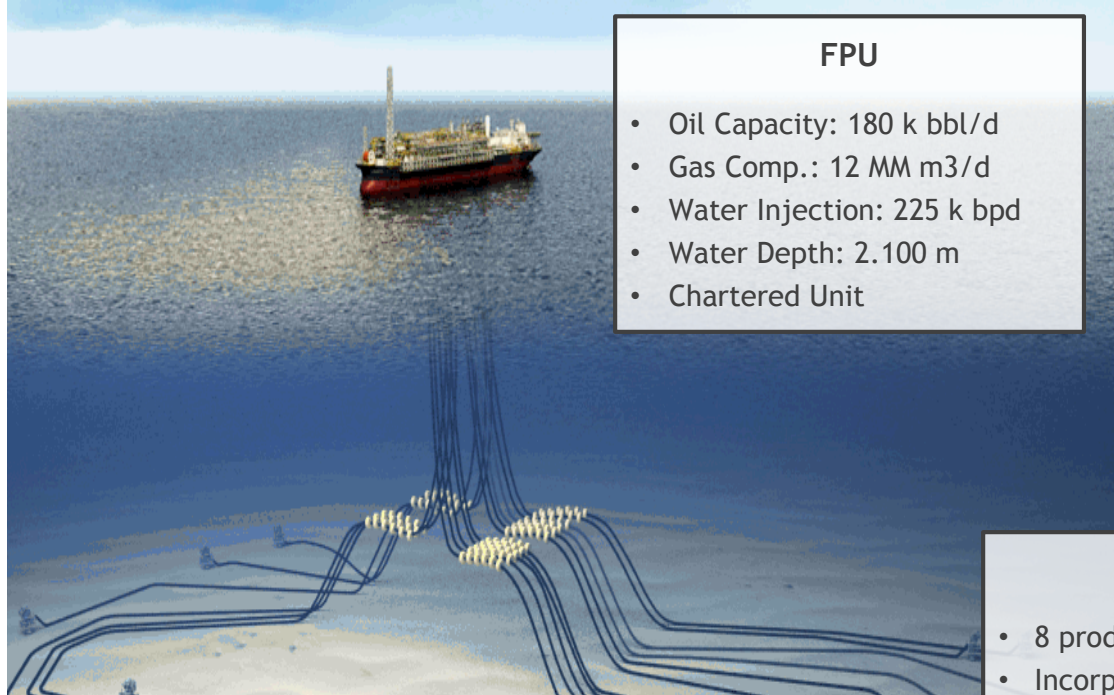
Ref: Forecast Apr/17 and Petrobras Business Plan 17-21

LIBRA 1 - PILOT PROJECT: TECHNICAL ASPECTS

(STANDARD PRE-SALT PROJECTS SOLUTION)

SUBSEA & FLOW ASSURANCE

- 2nd generation of std. pre-salt X-Trees
- Full Gas reinjection
- Water Alternating Gas injection wells (WAG)
- Rigid or Flexible lines



FPU

- Oil Capacity: 180 k bbl/d
- Gas Comp.: 12 MM m³/d
- Water Injection: 225 k bpd
- Water Depth: 2.100 m
- Chartered Unit

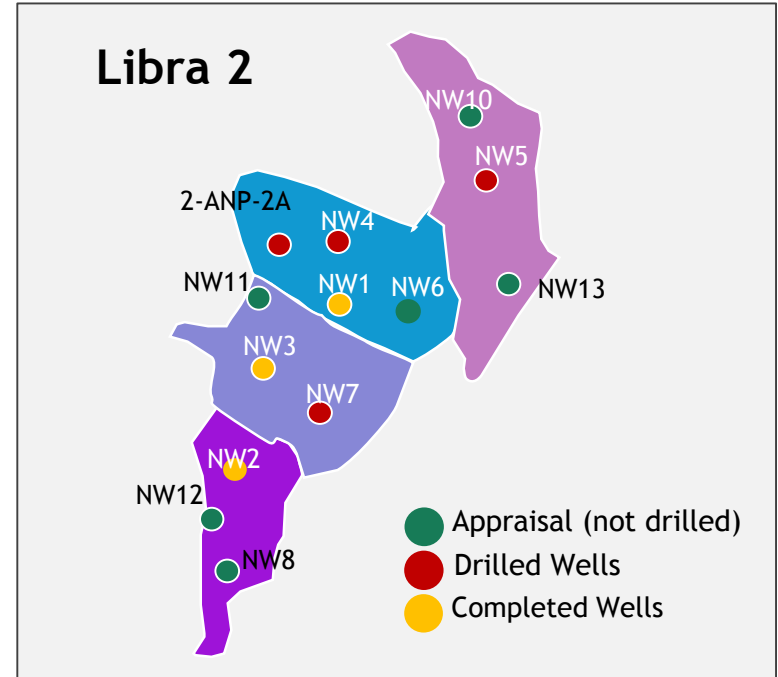
WELLS

- 8 production and 9 injectors.
- Incorporation of 4 appraisal wells
- Intelligent Completion (2/3 zones)

LIBRA-2 → STARTING DEFINITIVE DEVELOPMENT

| MILESTONES | | OBJECTIVES |
|-----------------------|-----------|--|
| Conceptual Definition | Jun, 2017 | Production development for NW region optimizing Libra 1: <ul style="list-style-type: none"> • FPU separation pressure • CO₂ separation technology • Reduced FPU weight |
| Project Sanction | Feb, 2018 | |
| 1 st Oil | 2021 | |

Ref: Forecast Apr/17 and Petrobras Business Plan 17-21



LIBRA 2: ALTERNATIVES STUDIES

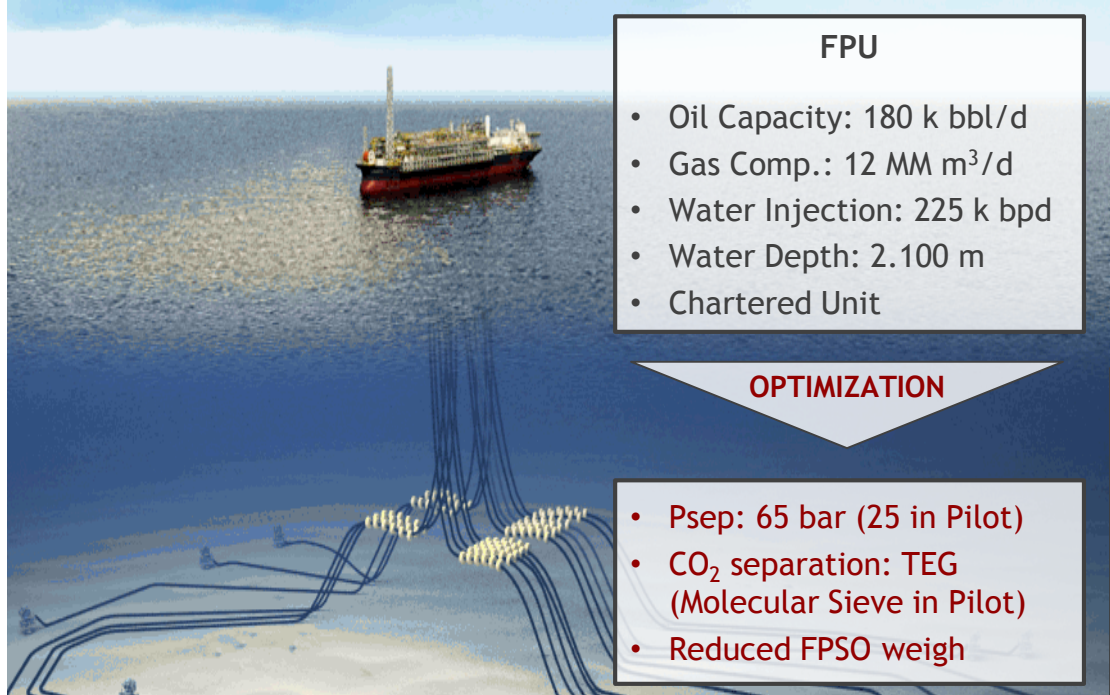
| RESERVOIR | FPU | | | SURF | | WELL |
|--|----------------------|------------------------------------|---------------|--|-----------------------------|------------------------|
| Optimization | Gas Mgmt | FPU Capacity | Sep. Pressure | Riser configuration for production and injection | Umbilical | Injection wells design |
| <ul style="list-style-type: none"> # of wells (spacing); Wells schedule; EOR; Completion strategy. | Full gas Reinjection | 180 kbpd 12MM m ³ /d | 25 bar | Flexible in lazy wave | Thermoplastics | 12 ¼” |
| | | 120 kbpd 8MM m ³ /d | | SLWR Steel Lazy Wave Riser | | |
| | Gas export | 225 kbpd 15MMm ³ /d | 65 bar | Flexible FHC Free-Hanging Catenary | STU - Steel Tube Umbilicals | 8 ½” |
| SELECTION BASED ON HIGHER IMPACT ON NPV | | | | ALTERNATIVES TO BE ANALYZED ONLY FOR SELECTED CASE | | |



LIBRA 2: TECHNICAL ASPECTS (PILOT CONCEPT WITH OPTIMIZATIONS)

SUBSEA AND FLOW ASSURANCE

- 2nd generation of std. pre-salt X-Trees
- Full Gas reinjection
- Water Alternating Gas injection wells (WAG)
- Rigid or Flexible lines



FPU

- Oil Capacity: 180 k bbl/d
- Gas Comp.: 12 MM m³/d
- Water Injection: 225 k bpd
- Water Depth: 2.100 m
- Chartered Unit

OPTIMIZATION

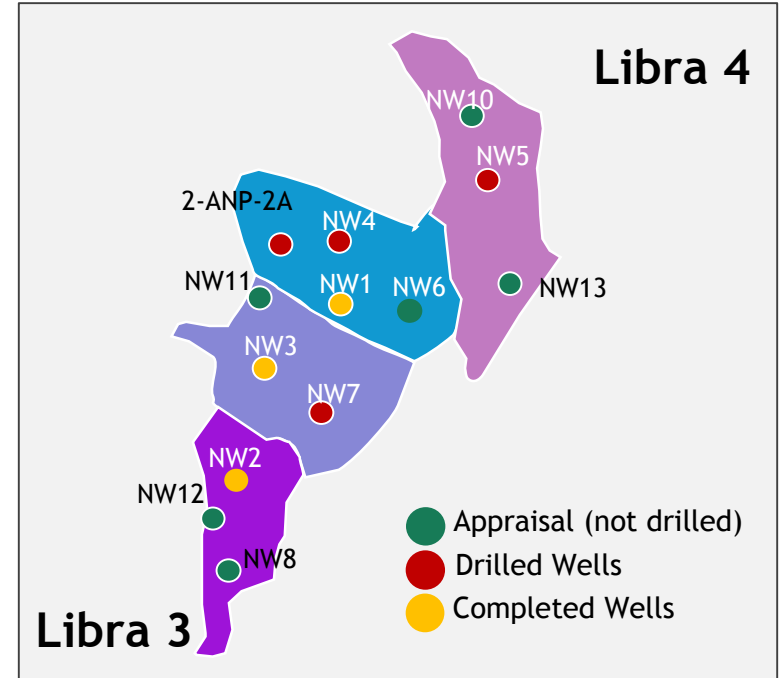
- Psep: 65 bar (25 in Pilot)
- CO₂ separation: TEG (Molecular Sieve in Pilot)
- Reduced FPSO weigh

WELLS

- 8 production and 9 injectors
- Incorporation of 3 wells from EWT
- Intelligent Completion (2/3 zones)

LIBRA-3 AND LIBRA-4 → REDUCING BREAK EVEN AND INCREASING NPV

| MILESTONES | | | OBJECTIVES |
|------------|-----------------------|-----------|--|
| LIBRA 3 | Conceptual Definition | May, 2018 | Production development for NW region including new concepts: <ul style="list-style-type: none"> • Subsea technologies; • O&G transport; • Accelerated ramp up; • LC solutions; • Production Optimization; • Well design; • Gas destination. |
| | Project Sanction | May, 2019 | |
| | 1 st oil | 2022 | |
| LIBRA 4 | Conceptual Definition | Mar, 2019 | |
| | Project Sanction | Mar, 2020 | |
| | 1 st oil | 2023 | |



Ref: Libra Business Plan 2017

PROJECTS RISKS AND OPPORTUNITIES



➤ Reservoir Uncertainties:

- Volume of Oil in Place
- Gas Breakthrough
- Recovery Factor

➤ Local Content:

- Level required not always feasible
- Local Content waiver negotiation is a key issue to allow projects implementation.

➤ Gas Use and Destination:

- Increase in the number of production systems
- Economic feasibility for gas exportation
- Technology improvement for gas management

LIBRA NW GAS HUB MAY BE AN OPTION FOR GAS EXPORT, MAINTAINING FLEXIBILITY FOR EACH PROJECT

Main objectives:

- Be a potential option for feasible gas export;
- Maintain flexibility for project implementation.

Value Proposition

- Field gas management
- Gas export or end-of-life reservoir blowdown

Costs and Constraints

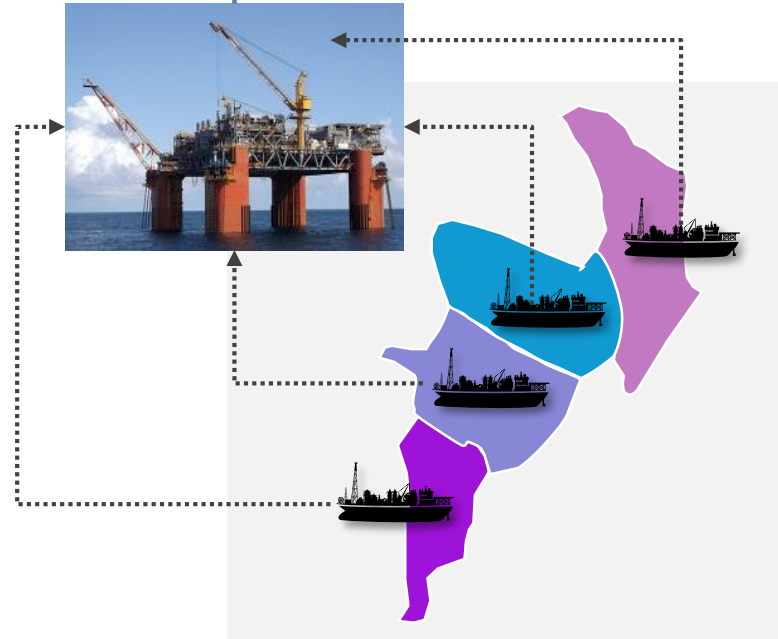
- Local build with minimum functional specifications
- CO₂ disposal: aquifer/selling/ EOR in other fields

Key Uncertainties

- Aquifer gas injectivity and storage capacity
- Gas market and regulatory rules

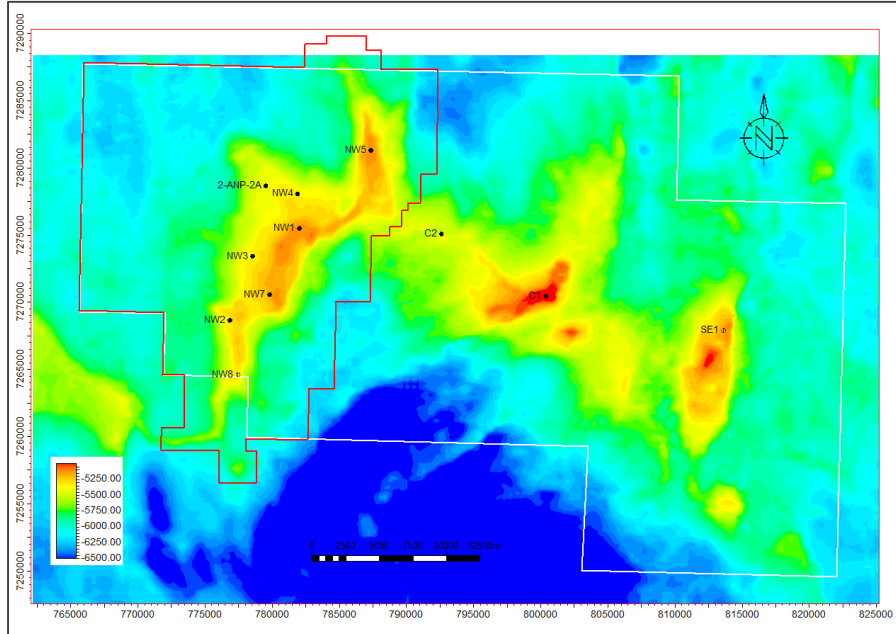
PIPELINE (ROTA 3) ←

CO₂ DISPOSAL ←



“The farther backward you can look, the farther forward you can see.”

Sir. Winston Churchill



Libra Structure



FPSO Pioneer de Libra (EWT Program)

Thank You



FPSO Sail Away (03.28.2017)

Joint Venture Operator

