Santos Basin Pre-Salt Cluster

How to make production development technically and economically feasible.

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Introduction - Pre-Salt

Santos Basin Pre-Salt Development Strategy

Technological Challenges

Economical and Logistics Challenges

Commercial Strategies

Conclusion

Questions
164,000,000 years ago …

Earth Planet as today
It was like this approximately 120 million years ago.

Inter tidal and Sub tidal stromatolites – Australia – recent sedimentation
Pre-Salt – Reservoirs
Santos Basin Pre-Salt Cluster

Production to date: 7 bi boe
Actual Production: 1.6 MMboepd
Producing Wells: 542
Area: 7,000 km²

Tupi
1,200 km²
5 a 8 bi boe

Kuwait = 17,000 km²
Katar = 11,000 km²
Some Location Details

Evaluation Plans approved by ANP
Parati – 1-RJS-617
Tupi – 1-RJS-628
Carioca – 1-SPS-50
Caramba – 1-SPS-51
Guará – 1-SPS-55

Evaluation Plans being prepared/under negotiation
Bem-Te-Vi – 1-SPS-52
Júpiter – 1-RJS-652
Iara – 1-RJS-656
General Data - Tupi Area

- Petrobras (65%), BG (25%), Petrogal (10%)
  - Heterogeneous layered carbonates – microbiolates with variable reservoir quality
  - Water Depth about 2,200 m
  - Salt layers with thickness – up to 2,000 m
  - Well tests indicate potential flow rates of 15-20 k bopd
  - API: 28-30°

- Oil viscosity around 1 cP
- GOR around 230 m³/m³
- Initial pressure 580 kgf/cm²
- Low TAN (Total Acid Number)
- CO2 in the associated gas (Tupi: 8 - 12%)
- Concern with flow assurance due to wax deposition in pipes
Selected Area for the Pilot: 115 km²
- Area of the Appraisal Plan: 1974 km²
- The main reservoir in the Pre-Salt is known as the SAG reservoir.
- Two other carbonate reservoirs are found in the area (RIFT, COQUINAS).
- The preliminary estimates for the recoverable volume for the whole Tupi area are between 5 and 8 billion bbl.
• Petrobras (65%), BG (25%), Petrogal (10%)

• Area of the Appraisal Plan: 300 km²

• The preliminary estimates for the recoverable volume for Iara area are between 3 and 4 billion bbl

• Water Depth about 2,230 m

• Reservoir Depth about 6,080 m

• API: 26-30°
Pre-Salt Integrated Development Plan (PLANSAL)

Program Planning, Monitoring and Management

- Exploration Subprogram
- Production Development Subprogram
- Production Infrastructure Subprogram
- Oil Transfer, Transportation and Utilization
- Gas Transfer, Processing, Transportation and Commercialization Subprogram

Environmental Licensing Plan

- Joint Ventures Management Plan
- Unitization Plan
- Critical Resources Availability Plan
- Technology Development Plan
- Human Resources Plan

- Logistics
- Oil Transportation and Utilization
- Gas Transportation and Marketing
- Transportation
- Oil Transportation– E&P
- Gas Transportation – E&P

- Equipments and Drilling Services, Logistic, Wells and Submarine
- Equipments and Services for Pipelines, Floating Productions Units and Facilities
- CO2 use
- Use and storage of gas
- Reservoir Drainage
- Concepts of Floating Production Units
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<td>Implementation of “X” production units (Replicant FPSOs)</td>
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<td><strong>Objective</strong></td>
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<td>• Area Delimitation</td>
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<td>• Analyse reservoir flow</td>
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<td>• Fractured Well performance</td>
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<td>• Complete sampled core</td>
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<td>• Material analysis X CO2</td>
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<td>• Analyse water and gas/CO₂ injection behavior</td>
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<td></td>
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<td>• Test adjustments on FPU related to CO₂</td>
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<td>• Test improvements in well projects</td>
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<td>• Apply previous dominated concepts and technologies with necessary adjustments to reach a significant production by 2017</td>
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<td>• Aggregate innovative technical solutions to optimize project performance</td>
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<td><strong>Phase 1A</strong></td>
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<td><strong>Significant production level</strong></td>
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Development Strategy by Phases

Phase 0: Information Acquisition

- Appraisal Wells + EWT Tupi + 7 EWTs in other areas + Tupi
- Anticipated Pilots

Phase 1: Definitive Development

- Phase 1a: 8 FPSOs + Gas Transp.1a + Oil Transp.1a + Infra + Oil Utilization1a + Gas Commercialization 1a
- Phase 1b: “N” FPUs + Gas Transp.1b + Oil Transp.1b + Oil Utilization1b + Gas Commercialization

Programs:

- BMS – 11 Tupi
- BMS – 9 Carioca
- BMS – 10 Parati
- BMS – 9 Guará
- BMS – 21 Caramba
- BMS – 8 Bem-Te-Vi
- BMS – 11 Iara
- BMS – 24 Jupiter

Significant production level

Phase 0: Information Acquisition: Appraisal Wells + EWT Tupi + 7 EWTs in other areas + Tupi & Anticipated Pilots
Production Design

1st Oil: March/2009

- 2 Well Production: 3-RJS-646 and P1
- Expected Flow: 14,000 bpd
- Test Duration: 15 months
Pilot Project Scope

Production Pilot
5 producers; 2 water injectors; 1 gas injector
Connected to a Spread Mooring FPSO
Production start-up scheduled for December, 2010. CO2 will be separated and reinjected in the reservoir. Gas will flow to Mexilhão (shallow water gas field, through a 200 km gas pipeline),
Capacities:
100,000 bopd and 4MMm3/day (gas)
Main goal: investigate recovery mechanisms and well geometries.
Gas exportation for the Tupi Pilot
Technological challenges

Reservoir Characterization and Engineering

- Facies definition from seismic data.
- Internal reservoir characterization, with focus on the main heterogeneities.
- Secondary recovery: technical feasibility of water and gas injection.
- Geomechanics of the surrounding rocks with depletion.
Well Drilling and Completion

- Deviation of the wells into the salt zone.
- Hydraulic fracture in horizontal wells.
- Wellbore materials, resistant to high CO2 content.
- Slow penetration in the reservoir.
- Extended Reach Wells.
Subsea Engineering

- Qualification of risers for water depth of 2,200 m, with CO2 and high pressure.
- Scenario for riser towers, SCRs with lazy wave and other technologies.
- Qualification of thermal insulated flowlines for water depths of 2,200 m.
- Flowlines for high pressure gas injection
Technological challenges

Flow Assurance and Artificial Lift

- Preventing hydrate formation
- Wax deposition in long pipelines.
- Scaling control
- Temperature management along the lines
Floating Production Units

- Mooring in water depths of 2,200 m
- Interaction with the riser’s system
- Scenario for platforms with direct access to the wells (SPAR, FPDSO).
Logistics for the Associated Gas

- More suitable materials for equipment dealing with high CO2 concentration gas streams.
- Gas pipeline larger than 18” in water depth of 2,200 m.
- Long distance to shore (300 km).
- Scenario for new technologies offshore: LNG, CNG, GTL, GTW, etc.
Technological challenges

Environment Protection
- Cuttings collection
- Use of zero discharge systems
- Produced water re-injection
- Massive use of green drilling fluids
- HSE management
Petrobras Technological Corporate Programs

- Propes
- PROCAP 3000
- PROFEX
- PRO-SAL
- PRAVAP
Objective:
Develop and disseminate technologies to incorporate reserves and to develop the production of the recent discoveries in the pre-salt section.

Projects’ Portfolio:
Well construction for the pre-salt section (drilling fluids, cement resistance, stimulation techniques, geomechanical model, liner drilling, well control in the salt zone, multilaterals).

Geosciences (chemical stratigraphy, core-log-test integration, geomechanical model and fracture distribution, pre-salt imaging, seismic attributes)

Reservoir Engineering: Recovery optimization
Petrobras global strategy

- Fast track projects culture: Golfinho, PLANGAS, 1st DP FPSO, ...
  - DP FPSO for the Extended Well Test already under conversion
  - Tupi Pilot FPSO has already been chartered, by the Tupi Consortium.

- Wide standardization program:
  - Drilling, completion and subsea hardware (trees, lines, ...)
  - FPU design → hull and production plant whenever possible;

- High Local Content policy

- Key suppliers policy
  - Long term contracts with Service Companies.
  - “Batch orders” for long lead items.
  - Current negotiations for rigs, vessels, ...

- Alternative solutions for gas transportation (LNG, CNG, GTW,...)
Economic Challenges

CAPEX TYPICAL DISTRIBUTION

- Residual Value
- Processing Plants
- Exportation
- Gathering
- FPU
- Completion
- Drilling
- Abandonment

- 19% Residual Value
- 31% Drilling
- 18% Abandonment
- 20% FPU
- 9% Gathering
- 1% Completion
- 0% Exportation
- 2% Processing Plants
Main Commercial Strategies

- Production Platforms:
  - High Local Content
    - Use of new infrastructure for hulls
    - Modules manufactured in existing sites or prepared at low investment;
  - Competitiveness in cost and schedule
    - Sequence of 8 standard FPSO units;
    - Standard FPSO hulls construction made by experienced companies;
    - Standardization of FPSO’s Top sides whenever possible;
Main Commercial Strategies

- **Subsea Rigid Pipelines:**
  - Ultra deep water
    - Brazilian industry is investing to supply high strength steel pipe;
  - Few number of suitable pipeline lay down vessels in the Market;
    - EPCI Contracting Philosophy and anticipate slot acquisition;
    - Construction of new vessel in Joint venture with experienced operator;

- **Drilling rigs**
  - On going contract strategy
    - 25 drilling rigs under construction to be received by 2012;
    - Analysing extra units in global market;
  - New rigs demand after 2013 and on
    - High Local Content;
    - Competitive basis with international market;
    - Evaluating brazilian infra-structure installed capacity;
Other Contract Strategy

- **Logistics**
  - 146 Vessels (PSV, AHTS, LH) and Helicopters:
  - Operation in pool regime;
  - Bids allowing the construction in Brazil;

- **Subsea Equipment and Vessels (PLSV):**
  - Long Term Contracts, with minimum consumption guarantee;
  - Incentives that encourage investments in expansion or newcomers;
  - Standard products and traditional suppliers;

- **Well Equipments and Services:**
  - Scale effect for rising competition;
  - Traditional suppliers will be invited to tender
  - Long Term Contracts (minimum consumption guarantee);
  - Incentives that encourage investments in expansion or newcomers
Petrobras has the worldwide recognized deepwater experience to address technical and commercial challenges for Pre-salt appraisal and development.

A new paradigm will be established for conceptual design applied to Santos Basin Pre-salt cluster production development and logistical support.

Tremendous opportunities for already installed and newcomers in Brazilian suppliers and service companies due to the scale provide by upstream portfolio.

Pre-salt will start production in 2009, with a steep ramp-up on the following years;

Pre-Salt will be a significant contribution to Petrobras production throughout next decade;

The next revision of our Strategic Plan will detail our future plans.
Thank you!

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Questions and Answers
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