Petrobras
Technology Developments

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Petrobras Overview
Technology Development
Main Achievements
Conclusions
An Integrated Oil And Gas Company

Total Investments: US$ 7.7 billion/year (average 2004-2010)

R&D Investment: US$ 245 million/year

Proved Reserves: 11.6 billion boe (SEC)
Average daily production: 2.03 million boe

Production wells: 15,834
Production platforms: 98

Net Revenues
US$ 30.8 billion

16 Refineries (5 outside Brazil)
Installed Capacity: 2.103 million bpd
Output of Oil Products: 1.736 million bpd

Vessels: 50 (own fleet)
Pipelines: 27,120 km

Service stations
Brazil > 5.000
Argentina > 700
Bolivia > 80

Fertilizers
Plants – 5
Avg daily production:
Ammonia – 2141 ton
Urea – 2437 ton

Natural Gas Sales:
39 million m³/d

Thermoelectric Energy
Plants: 7
Installed Capacity: 1,766MW

Dec 2003
Argentina
Average Production: 121 M boe/d
Proven Reserves: 463 MM boe

Venezuela
Average Production: 79 M boe/d
Proven Reserves: 305 MM boe

Ecuador
Avg Production: 6 M boe/d
Proven Reserves: 45 MM boe

Peru
Avg Production: 13 M boe/d
Proven Reserves: 100 MM boe

Bolivia
Avg Production: 31.5 M boe/d
Proven Reserves: 695 MM boe

Argentina
Average Production: 121 M boe/d
Proven Reserves: 463 MM boe
American sector of the Gulf of Mexico
(Petrobras participation - 225 blocks)

- Petrobras E&P en EUA
- Houston
- New Orleans
- Mexico

**Western Gulf**
- WD: 650-2,300 feet
- TD: 17,000-23,000 feet TVD
- PBR equity new prospects 100%

**Deep Shelf Gas**
- TD: > 27,000 feet TVD
- Average PBR equity: 30%

**Eastern GoM**
- WD: 7,500 feet
- TD: > 17,000 feet TVD
- PBR equity new prospects 100%

**Cascade play**
- WD: > 7,000 feet
- TD: > 27,000 feet TVD
- Average PBR equity: 25%

**Discoveries**
**Prospects**
**Petrobras Operator**
More than 80% in Campos Basin

Petrobras E&P in Brazil

Reserves (Dec 31, 2003)
- Proven reserves of 10.4 billion boe (SEC)
- Reserve life of 17 years
- Internal Reserve Replacement of 157%

Production (2003)
- 1.791 million boed (1.540 million bpd oil)
- 5 year CAGR of 8.6% (8.9% oil)

Exploratory Area
- 125.7 thousand km² (total)
- 83.9 thousand km² (net)
Petrobras Proved Reserves

Proved Reserves: 11.6 billion boe (SEC)
Petrobras' 2003 Proven Reserves

Brazil
- 10,4 MMM BOE (86%)
  - Onshore: 56%
  - Offshore (0-400m): 23%
  - Offshore (400-1000m): 11%
  - Offshore (> 1000m): 10%

International
- 1.2 MMM BOE (14%)
  - Onshore: 0.7%
  - Offshore (0-400m): 12%
  - Offshore (400-1000m): 0.3%
  - Offshore (> 1000m): 87%

Total
- 11,6 MMM BOE
  - Onshore: 48%
  - Offshore (0-400m): 22%
  - Offshore (400-1000m): 21%
  - Offshore (> 1000m): 9%

Dec 2003
Petrobras' 2003 Production

Brazil

1,8 MM BOE/d (88%)

- Offshore (0-300m): 20%
- Offshore (300-1000m): 5%
- Offshore (> 1000m): 17%
- Onshore: 58%

International

0.24 M BOE/d (12%)

- Offshore (0-300m): 2%
- Offshore (300-1000m): 2%
- Offshore (> 1000m): 6%
- Onshore: 92%

Total

2,04 MM BOE/d

- Offshore (0-300m): 29%
- Offshore (300-1000m): 4%
- Offshore (> 1000m): 16%
- Onshore: 51%

Dec 2003
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Research and Development Center

CENPES

- R&D Investments
  - 1999 to 2003 - US$ 1 Billion
  - 2004 to 2010 – US$ 2 Billion
- Total area: 122000 m²
- 137 Laboratories
- 30 Pilot Plants
- Ongoing expansion: plus 180000 m²
- 1560 employees
- 11 Technology Programs
- 500 R&D projects

Since 1963
Petrobras Technological System

- Government Policies
- Standards and Regulations

- Petrobras Strategic Plan
- Business Market Tendencies
- Business Plans
- PETROBRAS TECHNOLOGY COMMITTEE
  - Technology Scenarios
  - Intelligence Networks
- STRATEGIC COMMITTEES
  - Gas & Energy
  - Upstream
  - Downstream
- OPERATIONAL COMMITTEES
- Critical Evaluation
- PROJECTS PORTFOLIO
- Technological & Managerial Guidelines and Criteria
Technology Programs

- Exploration
- Innovation in Fuels
- Refinery
- Environment
- Offshore Heavy Oil
- Deepwater
- Improved Oil Recovery
- Pipelines
- Optimization and Reliability
- Natural Gas
- Renewable Energies
- Improved Oil Recovery
Deepwater Technology Program

1,000m (3,300ft) 1986 – 1991 US$ 730 MM

2,000m (6,600ft) 1993 – 1999 US$ 760 MM

3,000m (10,000ft) 2000 – 2005 US$ 650 MM*

* 2003
Petrobras Records

Petrobras Installations
Campos Basin

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<tr>
<td>Subsea X-Trees</td>
<td>512</td>
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<td>Subsea Headers</td>
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<td>Subsea Flexible Flowlines (km)</td>
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<td>Umbilicals (km)</td>
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<td>Rigid Pipelines (km)</td>
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<td>Floating Production Units</td>
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<tr>
<td>Mono-buoys</td>
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Internacional Awards

OTC 1992

OTC 2001
Petrobras Overview
Technology Development
Main Results
Conclusions
Technological Development

Mooring Systems

- Polyester Cable
- Anchor
- Conventional Mooring

1 to 2.5 x WD
2.5 to 3 x WD
1 to 2.5 x WD
2.5 to 3 x WD
Technological Development

Xtmas Tree

Xtmas Tree for Deep Water in Campos Basin:

- Diverless
- Guidelineless
- Direct Hydraulic Control
- ROV Compatible Interfaces
- Vertical Connections
- Horizontal Trees for High Production Wells
Technological Development

First SCR installed in a SEMI (P-18) in the World – Sep/98

- An economical alternative for flexible pipes
- Extensive Instrumentation installed in P-18
Jubarte Field Pilot Project

- First oil in October 2002
- A 900 HP ESP pumped crude oil (°API=17) from a subsea well connected to a FPSO through a drill riser pipe
- The pump is over the X-Tree
- 1300 m water depth
- 1076 m of horizontal extension
- Open-hole Gravel Pack (OHGP) Completion
- Production peak ➔ 22000 Bbls/d
Test Site
Atalaia/SE

- Experimental support in an almost real scale to R&D projects in:
  - Artificial Lift,
  - Flow Assurance,
  - Automation,
  - Flow Measurement and Processing.

- UTVGL (Gas Lift Valve Dynamic Test Loop): Unique worldwide since tests are performed with natural gas instead of air or nitrogen

- Multiphase Flow Loop

- Two vertical test wells (50 m and 200 m depth)

- Metrological unit
Long Term View
Increase in Production and Reserves

Petrobras Production
BOE/d (en M)

Petrobras Proven Reserves
BOE (en MMM)
Main Challenges

PROCAP 3000

- Extended Reach, Multilateral, Long Horizontal and Intelligent Wells
- Drilling and completion in ultra deepwaters
- Subsea equipment and Sea Floor Processing for ultra deepwaters
- Hydrate and wax mitigation (flow assurance)
- Low API & High Viscosity Oil Production
- FPU concepts (dry and wet completion units)
- Mooring systems and anchoring devices
- Ultra deepwater production risers (rigid, flexible and hybrid), umbilicals and subsea connections
Investment Plan

53.6 MMM US$ between 2004-2010

6,6 MMM US$ of annual average investment in Brazil
1,1 MMM US$ international

Area

Brazil 46.1 MMM US$
International 7.5 MMM US$

Business Segment

E&P 21%
Gas & Energy 11%
Corporate 60%
Downstream 3%
Distribution 3%
Petrochemicals 2%
Petrobras HSE Performance

Lost Time Injuries Frequency

Oil Spills – m³
Technological Integration (2000 – 2004)

Modalities:
- Contracts and agreements with Universities and Research Centers with internal financial support
- Contracts with external financial support
- Networks of excellence

No. of contracts: 1521
Brazilian Institutions: 120
Investment: 135 MM US$
Affiliations: 27 (currently)

Modalities:
- Multi-client Projects
- Cooperating Research
- Strategic Alliances
- Technology Interchange

No. of contracts: 128
Institutions: 95
- Europe 43
- North America 45
- South and Central America 5
- Asia 2

Investment: 16 MM US$
Affiliations: 20 (currently)
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Conclusions

- Increase in reserves and production ➔ Technological developments for deep and ultra-deep water
- Technology to produce up to 2,000 m WD is available;
- Technological challenges to reach 3,000 m are close;
- Experience and results ➔ Expansion of these activities in Brazil and other countries
Thank You!