A Collaborative and Structured Approach to the Execution of Brownfield Projects – A Case Study of Neptune Gas Lift

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Australia and the GOM represent Conventional production heartlands

Conventional production (FY15, BHP Billiton share)

- **Gulf of Mexico**: 100 kboe/d
- **Trinidad and Tobago**: 18 kboe/d
- **North West Shelf**: 78 kboe/d
- **Bass Strait**: 85 kboe/d
- **International, other**: 25 kboe/d

**Petroleum Underlying EBITDA (US$ billion)**

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<th>Year</th>
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<th>Conventional</th>
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<td>FY10</td>
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Note: Conventional volumes, BHP Billiton share. Based on FY15 actual production. Size of bubbles scaled to production rates.
BHP Billiton Petroleum Operated Projects

- Liverpool Bay: 1996
- Zamzama: 2003
- Angostura: 2005
- Neptune: 2008
- Pyrenees: 2010
- Macedon: 2013

- Griffin: 1994
- Ohanet: 2003
- Stybarrow: 2007
- Shenzi: 2009

BHP Billiton operated assets
Our operational experience and capability are a competitive advantage

**Project delivery best-in-class**
- Neptune: Best-in-class schedule
- Macedon, Pyrenees, Stybarrow: Close to industry average
- Angostura, Shenzi: Slightly over industry average

**Industry leader in drilling**
- Majors vs. Mid-tier: BHP Billiton has superior drill time compared to competitors

**Superior facility uptime**
- Shenzi: 100% facility uptime
- Macedon: 90% facility uptime
- Minerva, Pyrenees, Neytue, Angostura: 80% facility uptime

**Shenzi productivity best-in-class**
- Shenzi: 80% facility utilization
- A, B, C, D, E: Lower facility utilization

Notes:
- Competitors n=58, Financial Years 2007-2013. Variances to last board-approved plan
- Sources: BHP Billiton analysis, competitor data by Independent Project Analysis (IPA)
- Deepwater Gulf of Mexico, sub-salt, post-moratorium
- Sources: Rystad, Offshore Oil Scouts Association (COSA), BHP Billiton analysis

Source: BHP Billiton analysis
Fit-for-Purpose Toll-Gate

Identification
• Identify, develop and compare investment alternatives to determine the preferred alternative

Select
• Select and optimise the configuration and scope to derive the selected development option

Definition
• Detail and refine the selected development option and plan for execution

Execution
• Implement the project execution plan to meet the approved execution phase key performance indicators

Operation
• Operate the project and undertake a Post Investment Review
Successful Brownfield Projects

- PU Engineering team input into existing facility requirements and SIMOPs
- Ensuring Contractors are setup to succeed in the planning and execution of the work on the facility
- Project Management and Engineering expertise of Brownfield Projects
- PU Engineering and Operations supporting commissioning and leading start-up activities
- Central Engineering providing specific technical support
Brownfield Project Planning

- Begin Engineering and Planning Early – such as site surveys during FEED
- Engage Production Units throughout the Project in HAZID’s, POB planning, logistics and resource sharing
- Identify shut-in critical activities and target execution of that work in planned shut-ins
- Design equipment and infrastructure for installation on a producing facility, such as bolted connections and pre-fabricated spools where possible
- Develop timeline for any regulatory submissions early

Shenzi Water Injection Shut-In Durations
Prior to installing the Riser Pull-in Equipment on Shenzi for Water Injection, a survey of the existing facility was taken. The survey identified pre-existing installation padeyes in the central column that had to be removed.

Utilization of a laser survey at one of our existing facilities in Trinidad as the first step in a new Brownfield Project there.
Neptune Field Example: Gas Circulation

Background:

- Atwater Fold Belt play in deepwater GOM (> 6,000’ WD)


- Began seeing signs of start-up issues that required a form of gas lift. Kicked engineering off on Gas Circulation concept in Summer 2014.
Problem Statement and Evaluation

- Ongoing start up issues
- Subsurface modeling in May 2014 predicts emergence of slugging issues in late life, which is expected to continue through the remaining field life.
- A basis of design was developed in July 2014 and FEED initiated.
- Several concepts identified to aid start-up and alleviate slugging.
- Concept Select engineering progressed for Gas Circulation and Hybrid options.
- The simple Gas Circulation option was selected as it provided the greatest value (lowest capex cost and shortest schedule) with the least amount of technical risk.
- Project approved in October 2014
Hybrid Riser Base Option, Backup to Gas Circulation
Neptune Gas Circulation Execution

- Fabrication complete Dec 14.
- Components tested onshore prior to mobilization
- Offshore campaign duration of 1 month.
- System ready for start-up end of Feb 2015, start-up mid-March 2015.
Neptune Gas Circulation Performance

- Apparent increase in production, final effect being studied
- Better start-up performance
- Helps mitigate late field life slugging issues
Gas Lift Basis of Design:
15 MMscf/d at 2000 psig discharge