Deepwater Gulf Infrastructure … A Reliable Proposition?

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Overview of Major Sections

- Changing nature of Gulf production
- Deepwater aggregation theory
- Worsening weather patterns
- Deepwater pipeline architecture
- Repair, Design
- Reliability Considerations
Gulf of Mexico Annual Gas Production

*2004 – Some production lost due to Hurricane Ivan
*2005 – Significant production lost due to Hurricanes Katrina & Rita
Gulf of Mexico Annual Oil Production

*2004 – Some production lost due to Hurricane Ivan
*2005 – Significant production lost due to Hurricanes Katrina & Rita
Estimated Undiscovered Oil & Gas Reserves

10.5 BBO + 18.3 TCF

26.6 BBO + 132.1 TCF

3.8 BBO + 37.0 TCF

44.9 BBO + 232.5 TCF

* MMS 2005 Assessment, Pmean values

Estimated Undiscovered Technically Recoverable Oil & Gas Resources*
Federal OCS Areas
The Architecture of Aggregation
Aggregation: Reducing Risk for Everyone

- Producers toll across floating production systems and export systems
- Lower tolls due to economies of scale
- Williams assumes aggregation risks; lower than sum of individual risks
- Reduces cycle time and economic threshold for marginal prospects
East Breaks: Initial Justification

- 4 discoveries at time of sanctioning
- Original P_{50} reserves provide return of capital (to small single digit returns on capital)
- Initial justification: 1999 - 2000
East Breaks: Today and the Future

- 12 discoveries in dedicated area today
- Additional undedicated discovery in area
- 3 - 5 additional exploration wells planned next year
- Pipeline well situated for Alaminos Canyon development
- Earning a return in excess of cost of capital
Cyclical Hurricane Trend?
Conditions During 1995 - 2005

Hurricanes typically form here:
- Exceptionally warmer waters
- Low wind shear

Favorable Winds from Africa

Tropical Atlantic conditions have been in place since 1995. Accurate predictions of these conditions result in highly confident NOAA seasonal hurricane outlooks.
Global Temperature Trend

GLOBAL TEMPERATURE SINCE 1860

-0.8  0  0.2  0.4  0.6  0.8

1860 1880 1900 1920 1940 1960 1980 2000

2005
Recent Severe Weather


NOAA/NESDIS/NCDC

Actual damage amounts at the time of the event

Damage amounts normalized to 2002 using an inflation wealth index

Years (1980 - 2005)

Number of Events

Damage Amounts in Billions of Dollars

0 10 20 30 40 50 60 70 80 90 120 150

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Wave Vocabulary

- Wavelength
- Crest
- Amplitude
- Height
- Trough
Significant wave height, $H_s$, is approximately equal to the average of the highest one-third of the waves.
### Historical Snapshots

#### Recent Hurricanes (NOAA Buoy Data)

<table>
<thead>
<tr>
<th>Hurricane</th>
<th>Year</th>
</tr>
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<tbody>
<tr>
<td>Erin</td>
<td>1995</td>
</tr>
<tr>
<td>Felix</td>
<td>1995</td>
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<tr>
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<td>1995</td>
</tr>
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<td>Bertha</td>
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<tr>
<td>Floyd</td>
<td>1999</td>
</tr>
<tr>
<td>Ivan</td>
<td>2004</td>
</tr>
<tr>
<td>Katrina</td>
<td>2005</td>
</tr>
</tbody>
</table>

**Significant Wave Height, $H_s$ [ft]**

- **Typical Criteria:** 45 ft
Hurricane Katrina (27-30, Aug. 2005)  
Significant Wave Height (Hs)
Hurricane Ivan (15-16, Sept. 2004)

Significant Wave Height

Significant Wave Height (Hs), ft

Hours

45 ft Design Criteria

Deepwater
Deepwater

Offshore Booster & Spec-change Stations
Deepwater

Seafloor Tie-ins

Export to GA-A244

From Boomvang

From Nansen
Trunk Line Extension & Lateral Tie-ins

WILLIAMS "MOUNTAINEER" (OIL)

WILLIAMS "CANYON CHIEF" (GAS)

WYE (-5200')

18X16 TAPER JOINT

18"-DSAW

18" JUMPER

WYE

FROM BLIND FAITH PLATFORM (-6,000')

DEVILS TOWER SPAR MC 773 (WD - 5,610')

10,000' R.

18X18X14" LAT.

10,000' R.

18"-DSAW

16"-DSAW

FROM FUTURE PLATFORM

FUTURE TIE-IN

14Ø SCR

WYE

TO MP 261A PLATFORM

CHEVRON MP313 FIXED PLATFORM 300'

WYE (-5200')

18"-DSAW

18X16 TAPER JOINT

16"-DSAW

14Ø

WWE
MOORING / RISER ELEVATION (SHOWN FROM 3000')

FLEXIBLE JOINT BEING LOWERED INTO "BASKET"

PORCH SUPPORT

SCR (TYP.)

5-15 DEG. (TYP.)

MOORING LINE (TYP.)

RISER

Deepwater SCR
Preferred Deepwater Pipeline Repair

Oll/Grayloc Connectors
With Alignment Sleds
Pipeline Repair -- Top View of Jumper

Compliant Jumper

Bowstring Cylinder
Reliability-Driven Design

- Codes and regulations represent minimum criteria
- Selectively increase minimums & add capability where:
  - Inputs / criteria are approximated
    - Metocean data seems to be trending higher – 20 years ahead?
    - Hydrocarbon characteristics of future line contents can vary widely
  - Redundancy is low
    - SCR structure has zero redundancy
  - Consequence of failure is high
    - Pipeline shut in for any reason affects all who are connected
  - Flexibility to recover is valuable
    - Ability to isolate a problem area and keep the main system online
- Increased reliability often can come at low marginal cost
Other Keys to Reliability

- Standardized and systematized:
  - Design criteria
  - Equipment and Material Specifications
  - Execution processes (PLC, etc.)
- Limited menu of line sizes
- In-stock valves, pipe, connectors and specialty tools
- Repair plan execution readiness
- Up to date systems models for real time, line operations
- Experience and continuity of our people
- A culture of trust that intrinsically encourages introspection & pro-actively drives change (there’s a mouthful)
Upshot of Trends in Gulf Coast

- Weather increasingly more severe
- Oil supply increasingly scarce
- Energy demand growing globally
- Midstream services increasingly in demand
- Construction costs will be volatile
- Industry’s discipline will be tested
- High barrier to entry, low barrier to failure
- Returns must be commensurate
Building Our Deepwater Competencies

- Leadership
- Structural Engineering
  - SCR Design/Verification
  - Topsides
  - Hull & Mooring
- Hydraulics
- Cost Estimating
- Project Management
- Commercial Expertise
- Deepwater Operations
Lessons Learned from Katrina and Rita

- Incident Command System
- Timely pre and post storm assistance for employees and their families
- Alternative and backup communications, power and transportation systems
- Critical material and supply inventories and staging areas
- Execute agreements for nontraditional services and supplies before hand
- Secure dive boats early for post event offshore inspections
- Liaison with local, state & federal government agencies to expedite permits, variances waivers, etc
Questions?