Panel 1
Technical Perspectives on Gas Interchangeability and Quality
“Gas Quality & Interchangeability 101”

FERC Conference
Washington, D.C.
February 18, 2004

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Objectives

Provide technical perspective regarding:

- LNG Quality – Purity of LNG
- Hydrocarbon Dewpoint – Relationship to LNG Imports
- End User Interchangeability Issues
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- LNG storage, -255°F @ atmospheric pressure
- High pressure LNG pumps to pipeline pressure
- Open Rack Vaporizer units convert LNG into natural gas
- Sea water pumped to vaporize LNG
- Custody transfer meters gas transmission to Pipeline / Market

Simplified Schematic
Offshore LNG Regasification Terminal

- LNG Carrier
- Concrete Gravity Based Structure with Internal LNG Storage Tanks
- High Pressure Pump
- LNG Vaporizer
- Transfer Meter
- Sea Water Pump
- Natural Gas Sub-sea Pipeline

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Natural Gas Interchangeability
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LNG Composition Examples

High quality natural gas

<table>
<thead>
<tr>
<th>Composition</th>
<th>Methane</th>
<th>Ethane</th>
<th>Propane</th>
<th>Nitrogen</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low Btu Content</td>
<td>96.18%</td>
<td>3.39%</td>
<td>0.34%</td>
<td>0.01%</td>
<td>0.08%</td>
</tr>
<tr>
<td>Low Btu Content</td>
<td>92.19%</td>
<td>6.45%</td>
<td>0.03%</td>
<td>0.00%</td>
<td>0.43%</td>
</tr>
<tr>
<td>Moderate Btu Content</td>
<td>92.19%</td>
<td>10.74%</td>
<td>0.92%</td>
<td>0.49%</td>
<td>0.02%</td>
</tr>
<tr>
<td>High Btu Content</td>
<td>88.77%</td>
<td>7.38%</td>
<td>2.61%</td>
<td>0.34%</td>
<td>1.21%</td>
</tr>
<tr>
<td>Very High Btu Content</td>
<td>85.98%</td>
<td>8.69%</td>
<td>3.47%</td>
<td>0.01%</td>
<td>1.84%</td>
</tr>
</tbody>
</table>
Benefits of LNG Imports
Impact on Combined Gas Stream

Medium Btu Content LNG

+5% Change in Wobbe Index = 1398*

*No industry consensus on an appropriate level
Key Issue – End User Gas Interchangeability

Burner tip characteristics

- Burner Temperatures - Temperature control & NOx Emissions
- Flame shape & stability
- Incomplete Combustion – HC & CO Emissions

Domestic Natural Gas
HHV = 1020 Btu/SCF

LNG (High BTU Content)
HHV = 1160 Btu/SCF

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Benefits of LNG Imports
LNG vs. Wobbe Index

Wobbe vs GHV & SG

Pipeline Gas, 1,332
LNGJ, 1,375
LNGK, 1,397
NG, 1,439
LNG+3%N2, 1,377
LNGF, 1,335
LNGG+4%N2, 1,345
LNGB

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Summary & Path Forward

Summary

✓ LNG is a clean, high quality source of energy for the US
✓ HC Dewpoint is a preferred solution for P/L Operations
✓ End User Interchangeability
  ✓ Most LNG supplies fall within end user flame requirements
  ✓ Previously conducted tests generally document LNG interchangeability
  ✓ Additional testing may be required on a case-by-case basis

Path Forward

✓ Establish a standardized process for the gas industry to use to review LNG imports.
✓ FERC is the appropriate agency to establish this process

Natural Gas Interchangeability
FERC, 18-Feb-04
## References

1. Dominion Cove Pint LNG, LP, Docket No. CP01-076, CP01-077, RP01-17-01, CP01-156-000, and CP-01-156-001, July 16, 2003

2. GTI, *2003 Collaborative Project: Interchangeability of International Liquefied Natural Gas (LNG) with Domestic U.S. Pipeline Natural Gas*, Phase II – Industrial and Commercial Burners, Turbines and Microturbines


LNG Projects
ChevronTexaco – Port Pelican and Baja California

Port Pelican
- Gravity Based Structure (x2)
- 1.6 BSCFD
- 40 miles offshore Louisiana

Baja California Offshore LNG
- Gravity Based Structure (x2)
- 700MMSCFD expandable to 1.4 BCFD
- 13 KM offshore Tijuana

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Benefits of LNG Imports
Impact on Combined Gas Stream

Very High Btu Content LNG

Dewpoint temperature decreases significantly

High Heating Value  Wobbe Index  Dewpoint, deg F @ 920 psig
Benefits of LNG Imports
Impact on Combined Gas Stream

Very Low Btu Content LNG

- High Heating Value
- Wobbe Index
- Dewpoint, deg F @ 920 psig