THE HIGH PRESSURE EXPANDER PROCESS (HPXP™) TECHNOLOGY

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BACKGROUND

- ExxonMobil has developed a high-efficiency expander-based liquefaction technology called High Pressure Expander Process (HPXP™).
- HPXP™ distinguishes from other expander-based processes by leveraging advances in turbo-machinery to reduce size and weight while enhancing efficiency and train capacity.

INCENTIVES

- **Design and Execution Efficiency**: Potential for standardization and modularization
- **Versatility**: On-shore and off-shore, large train sizes, varying gas compositions
- **Compactness**: Reduced size, weight, and layout compared to MR technologies
- **Efficiency**: Similar to SMR technologies, highest among expander-based technologies
- **Design Simplicity**: Single phase refrigerant loops (no liquids)
- **Operational Benefit**: No refrigerant import/storage, reduced frictionation, simpler start-up

Liquefaction Technology Options

- Dual N2 Expander Cycle (NZXP)
- Dual Mixed Refrigerant (DMR)
- High Pressure Expander Process (HPXP™)

3.5 MTA Floating LNG Facility and Operating Conditions

- Cylindrical floaters eliminates turret
- Staged approach for field development
- Topside process modules construction
- Inert air cooled Trent 60 (55 MW)
- Process fluid cooled to 21°C
- Gas Composition: ~96 mol% C1, ~5 mol% N2
- Liquification to -148°C

**HPXP™ ADVANTAGES IN FLOATING LNG APPLICATION**

<table>
<thead>
<tr>
<th> </th>
<th>N2XP</th>
<th>DMR</th>
<th>HPXP™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity, MTA</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Trains</td>
<td>3 x 33%</td>
<td>1 x 100%</td>
<td>2 x 50%</td>
</tr>
<tr>
<td>Motions</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Trent 60s</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Feed Gas Compressors</td>
<td>-</td>
<td>-</td>
<td>12 MW (motor driven)</td>
</tr>
<tr>
<td>Main Exchanger</td>
<td>BAHX</td>
<td>APC1 SWHE</td>
<td>BAHX</td>
</tr>
<tr>
<td>Refrigerant Import</td>
<td>Not Required</td>
<td>C2 &amp; C4</td>
<td>Not Required</td>
</tr>
<tr>
<td>Largest Line Size</td>
<td>36 in</td>
<td>64 in</td>
<td>32 in</td>
</tr>
<tr>
<td>Total Lng, MTP</td>
<td>12,800 m³</td>
<td>13,300 m³</td>
<td>11,200 m³</td>
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<tr>
<td>Relative CAPEX</td>
<td>156%</td>
<td>149%</td>
<td>100%</td>
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</tbody>
</table>

**STANDARD HPXP™ CONCEPT**

- **Feed Compression-Expansion**
  - Increase single train production capacity by up to about 30%
  - Key ‘lever’ for HPXP™ standardization: capable of processing a broad range of gas compositions without change in design

**TECHNOLOGY SUMMARY AND HPXP™ APPLICATION SPACE**

<table>
<thead>
<tr>
<th></th>
<th>Sub-Gas</th>
<th>Lng-Gas Low-End</th>
<th>Lng-Gas High-End</th>
<th>Feed Compressor Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2</td>
<td>27%</td>
<td>65%</td>
<td>30%</td>
<td>3.5 MTP</td>
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<tr>
<td>LNG Power</td>
<td>10.1</td>
<td>12.2</td>
<td>13.3</td>
<td>2.9 MTP</td>
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<tr>
<td>HPXP™</td>
<td>3.5</td>
<td>2.9</td>
<td>2.8</td>
<td>3.5 MTP</td>
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</tbody>
</table>

- **Onshore and Floating LNG Applications**
  - No liquid refrigerant in primary or sub-cooling loop
  - No refrigerant transport, handling, and storage
  - Modularization to enable execution efficiency

**SELECTED REFERENCES**


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