High Capacity FLNG Gas Expander Process

Heinz Bauer (Presenter), Linde, Pullach, Germany
Frank Hänsel, Cryostar, Hésingue, France
Stefano de Simone, BHGE, Florence, Italy
How it all began → cLNG

- work expansion of nitrogen in the vapor phase only
- combination of two expanders operating in different temperature ranges
- no suction drums for compressors
- no pumps
- nitrogen is readily available also in remote locations
- nitrogen does not raise safety concerns
Case Study: $\text{N}_2$ Expander, GazMétro 400 t/d

- design challenges for booster compressors
  - parallel/serial
  - HP/LP location
- warm expander 2,800 kW TC 400
- cold expander 700 kW TC 200
- concept limited to ~ 1,000 t/d
Case Study: \( \text{CH}_4/\text{N}_2 \) Expander, Stuttgart 120 t/d

use of a \( \text{CH}_4/\text{N}_2 \) mixture instead of pure \( \text{N}_2 \)

process safety comparable to pure \( \text{N}_2 \) systems
Linde Methane/Nitrogen Process

- two expanders operating in the same pressure profile
- parallel HP booster compressors
- balanced expander duty
- US patent 9,841,229 granted on 12/12/17
- process efficiency comparable to cLNG
# Equipment for LIMEN™

<table>
<thead>
<tr>
<th>Capacity per train (mtpa)</th>
<th>Shaft power per expander (MW)</th>
<th>Expander model (Cryostar)</th>
<th>Gas turbine driver (BHGE)</th>
<th>GT power @ 7°C (MW)</th>
<th>Recycle compressor (BHGE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.60</td>
<td>7.4</td>
<td>TC400/90</td>
<td>LM2500+G4 or PGT25+G4</td>
<td>&gt;31</td>
<td>2BCL1006</td>
</tr>
<tr>
<td>0.95</td>
<td>11.6</td>
<td>TC500/110</td>
<td>LM6000PF+</td>
<td>52</td>
<td>2BCL1206</td>
</tr>
<tr>
<td>1.35</td>
<td>16.6</td>
<td>TC600/130</td>
<td>LM9000</td>
<td>70</td>
<td>2BCL1406</td>
</tr>
</tbody>
</table>
Conclusions

• The novel **LIMEN™** process can be used to design FLNG processes with a total capacity of up to 2.5 mtpa LNG, if two trains with 1.25 mtpa each are implemented.

• Thus, the equipment count and plot requirement can be **significantly reduced** compared to competing technologies.

• The thermodynamic **efficiency** is on the same level as a well designed N₂ expander process.

• A **major contribution** to this convincing concept is rotating equipment from Cryostar (e.g. TC600/130) and BHGE (e.g. LM9000 combined with 2BCL1406).