LNGo™ System Overview
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Distributed LNG
Demand Side Markets

Local, low-cost alternate fuel source for diesel, propane, and heating oil users

E&P Equipment: Drilling/Fracturing
- Significant per gallon equivalent fuel savings to diesel
- High horsepower equipment (>6% of 1800 unit fleet use CNG/LNG)

Mining, Rail, and Marine
- Significant fuel cost savings
- High horsepower equipment (>1,000 gpd per unit typical) (i.e. 700 mining units in PRB)

Retail/Utility LNG Supply
- Low cost, low risk market seeding
- Early cash flow accelerator market for large scale plants under construction (30-60 months)

Typically distanced from large LNG supplies
**Distributed LNG**

**Supply Side Markets**

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**Flares**
- Eliminate environmental concerns and monetize flares
- Flares are typically associated gas or lower value processed gas (requires optional gas pre-treatment)
- 5.2 TCF/yr flared worldwide = ~180 million gpd of LNG

**Stranded Wells**
- Monetize stranded wells by converting to LNG
- Typically found in newly developed gas fields or at the edge of existing fields with immature gas gathering infrastructure
- LNGo provides low cost, short term alternative to pipelines

**Gas Pipeline / Gathering Systems**
- Pressure control for pipelines
- LNG production for power generation
- Debottleneck gathering systems
- Back-up supply for pipeline outage, high demand periods or interrupted service

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Local, low-cost gas supply to produce LNG to offset diesel and propane

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LNGo System
Overview

• Modular system converting natural gas to liquefied natural gas (LNG)

• Micro-scale, point of use
  • LNGo LP system – up to 7,000 GPD (11 tpd)
  • LNGo HP system – up to 30,000 GPD (48 tpd)

• Re-deployable, skid mounted design with small footprint

• Dresser-Rand and Siemens industry proven technologies and service

• Liquefaction cycle uses feed gas as fuel*, refrigerant, and liquefied product
  * If power module is included.

• Self powered available - easy to permit
## LNGo System
### Base Equipment

<table>
<thead>
<tr>
<th>Feed/Flash Booster – FFCM</th>
<th>Primary Compressor Module - PCM</th>
<th>Process / Chiller – PRM/MCM</th>
<th>Controls &amp; MCC</th>
</tr>
</thead>
</table>
| Elevates the pressure of the feed gas and the returning flash to the optimal liquefaction pressure. | Compressor provides the main compression energy required by the efficient turbo-expansion process.  
- Proven D-R MOS™ reciprocating compressor technology  
- Non-lubricated cylinders and packing (no process contamination)  
- VFD with induction motor for process turndown | Turbo-expansion with pre-cooling refrigeration loop. This closed loop natural gas concept means working fluid is integral and utility needs are minimized.  
- Cooling and product phase change from gas to liquid  
- Mechanical chiller with stainless cryogenic heat exchangers and evaporative cooling  
- Turbo-expander and Joule-Thompson (J-T) valve (methane refrigerant) | Complete control of all modules of the LNGo LP and HP systems. Remote capable control logic with wireless instrumentation and transmitters used wherever advantageous and code compliant. |

<table>
<thead>
<tr>
<th>LNGo-LP</th>
<th>N/A</th>
<th>4 Throw / 4 Stage</th>
<th>Ammonia as cooling media</th>
<th>Integrated into power module where applicable</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>LNGo-HP</th>
<th>4 throw / 2 stage</th>
<th>2 throw / 2 stage</th>
<th>Propane as cooling media</th>
<th>Separate module or in client control room</th>
</tr>
</thead>
</table>
# LNGo System

## Optional Equipment Overview

<table>
<thead>
<tr>
<th></th>
<th>Gas Conditioning Module - GCM</th>
<th>Power Module</th>
<th>LNG Storage</th>
<th>Balance of Plant</th>
</tr>
</thead>
</table>
|                     | Gas cleanup system with drying in order to remove CO₂ and water from the incoming feed gas stream. Clean, dry gas insures optimal liquefaction performance. Additional conditioning module available for laden gas depending on composition.  
• Removes CO₂, H₂O, and heavy hydrocarbons (C3+) | Option to be grid-independent and a fully self-powered liquefaction system. This is achieved by leveraging the waste gas stream for power generation.  
• High tech, low emission rich burn with NSCR catalyst  
• D-R Guascor natural gas powered 1 MW power system  
• Purge flow from cleanup module is blended into the fuel supply to power the Guascor engine  
• D-R Enginuity® Control and Monitoring Systems  
• No flaring required. Purge flow from gas conditioning is blended into the fuel supply to the Power Module. | Storage strategies provided to accommodate the client’s needs. From bullet to atmospheric tanks with vapor recovery, any storage need can be addressed through a network of approved vendors. | Project resources to provide procurement execution of all project details such as site preparation, cryogenic pumping, boil-off gas recovery etc.  
Gas clean-up  
• NGL removal equipment as required for NGL removal. This is dependent on gas composition provided by customer. |

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Description</th>
<th>Quantity</th>
<th>Storage Type</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNGo-LP</td>
<td>Molecular Sieve Pressure Swing Absorption (PSA)</td>
<td>One (1) required</td>
<td>Vertical or Horizontal</td>
<td>Scope as defined by customer.</td>
</tr>
<tr>
<td>LNGo-HP</td>
<td>Temperature swing Absorption (TSA)</td>
<td>Two (2) required*</td>
<td>Vertical or Horizontal</td>
<td>Scope as defined by customer.</td>
</tr>
</tbody>
</table>

*Dependent on gas composition

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Page 7 2015-07-30 Walhof / Distributed LNG Solutions
# LNGo System
## Performance Overview

### Inlet Conditions

<table>
<thead>
<tr>
<th></th>
<th>LNGo LP system</th>
<th>LNGo HP system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psig</td>
<td>35 - 50</td>
<td>615 – 1,200</td>
</tr>
<tr>
<td>Barg</td>
<td>2.4 – 3.4</td>
<td>42.4 – 82.7</td>
</tr>
<tr>
<td>Gas Flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMscfd</td>
<td>.781</td>
<td>2.500</td>
</tr>
<tr>
<td>NM3/Hr</td>
<td>970</td>
<td>3,104</td>
</tr>
</tbody>
</table>

### LNG Production Information

<table>
<thead>
<tr>
<th></th>
<th>LNGo LP system</th>
<th>LNGo HP system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gal/day</td>
<td>7,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Liter/day</td>
<td>26,498</td>
<td>113,562</td>
</tr>
<tr>
<td>Ton/day</td>
<td>11</td>
<td>48</td>
</tr>
</tbody>
</table>

### Delivery Conditions

<table>
<thead>
<tr>
<th></th>
<th>LNGo LP system</th>
<th>LNGo HP system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psia</td>
<td>~30</td>
<td>~30</td>
</tr>
<tr>
<td>Bara</td>
<td>2.07</td>
<td>2.07</td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>°F</td>
<td>-253</td>
<td>-253</td>
</tr>
<tr>
<td>°C</td>
<td>-158</td>
<td>-158</td>
</tr>
</tbody>
</table>

### Power

<table>
<thead>
<tr>
<th></th>
<th>LNGo LP system</th>
<th>LNGo HP system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP</td>
<td>~1,341.02</td>
<td>~2,682.044</td>
</tr>
<tr>
<td>kW</td>
<td>~1,000</td>
<td>~2,000</td>
</tr>
<tr>
<td>Power Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid</td>
<td>Base</td>
<td>Base</td>
</tr>
<tr>
<td>On site</td>
<td>Option</td>
<td>Option</td>
</tr>
</tbody>
</table>
LNGo LP System
General Arrangement

Configuration for markets with pipeline quality gas input at 50 psia shown

Conditioning module
Molecular sieve removes CO₂ and H₂O. The purge flow, with C₂ and above, is blended into the fuel supply to the Guascor engine

Power module
Genset driven by Guascor 1MW engine consumes purge gas from mole sieve to power unit

Process module
Delivers 7,000 gpd (11 tpd) LNG

Compressor module
MOS™ compressor drives efficient process

Enginuity® control and monitoring systems
**Primary Compressor module**

MOS™ compressor drives efficient process

**Feed/Flash compressor module**

MOS™ compressor drives efficient process

**Process module**

Delivers up to 30,000 gpd (48 tpd) LNG

**Power module**

2 x Gensets driven by Guascor 1MW engine consumes purge gas from mole sieve to power unit

**Conditioning module**

Molecular sieve removes CO₂ and H₂O. The purge flow, with C₂ and above, is blended into the fuel supply to the Guascor engine.

**Control module**

Houses all controls for system
LNGo LP System
Flow Diagram

Input – Processed natural gas

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>.781 MMSCFD</td>
</tr>
<tr>
<td>Temperature</td>
<td>60° F</td>
</tr>
<tr>
<td></td>
<td>15.5° C</td>
</tr>
<tr>
<td>Pressure</td>
<td>&gt; 50 psia</td>
</tr>
<tr>
<td></td>
<td>&gt; 3.4 bara</td>
</tr>
</tbody>
</table>

Output – Liquefied Natural Gas (LNG)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>7,000 GPD</td>
</tr>
<tr>
<td>Temperature</td>
<td>-253° F</td>
</tr>
<tr>
<td></td>
<td>-158° C</td>
</tr>
<tr>
<td>Pressure</td>
<td>30 psia</td>
</tr>
<tr>
<td></td>
<td>2.07 bara</td>
</tr>
</tbody>
</table>

* Dependent on gas composition and pressure

NG = Natural Gas
HX = Heat Exchanger (welded plate and frame)

LNGo ™ cycle uses methane as the fuel, refrigerant and liquefied product.
**LNGo HP System**

**Flow Diagram**

**Input – Processed natural gas**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>2.5 MMSCFD</td>
</tr>
<tr>
<td>Temperature</td>
<td>60°F 15.5°C</td>
</tr>
<tr>
<td>Pressure</td>
<td>&gt; 600 psia &gt; 41 bara</td>
</tr>
</tbody>
</table>

**Output – Liquefied Natural Gas (LNG)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>30,000 GPD* 48 TPD*</td>
</tr>
<tr>
<td>Temperature</td>
<td>-253°F -158°C</td>
</tr>
<tr>
<td>Pressure</td>
<td>30 psia 2.07 bara</td>
</tr>
</tbody>
</table>

* Dependent on gas composition and pressure

**LNGo™ cycle uses methane as the fuel, refrigerant and liquefied product.**
Many hours of operation since first liquefaction in Dec 2013
## LNGo System

### Reference List

<table>
<thead>
<tr>
<th>Item</th>
<th>State</th>
<th>Country</th>
<th>Units / Scope</th>
<th>Scope</th>
<th>Application</th>
<th>Commission date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NY</td>
<td>USA</td>
<td>1 x LP w/Genset</td>
<td>Demo plant at Dresser-Rand Painted Post facility</td>
<td>Demo plant</td>
<td>4Q / 2013</td>
</tr>
<tr>
<td>2</td>
<td>BC</td>
<td>Canada</td>
<td>1 x HP w/Genset</td>
<td>LNGo systems plus extended scope including building</td>
<td>LNG distribution</td>
<td>4Q / 2016</td>
</tr>
<tr>
<td>3</td>
<td>PA</td>
<td>USA</td>
<td>1 x LP w/Genset</td>
<td>Complete LNGo system</td>
<td>Gathering System</td>
<td>2Q / 2016</td>
</tr>
<tr>
<td>4</td>
<td>NJ</td>
<td>USA</td>
<td>2 x LP w/o Genset</td>
<td>Complete LNGo systems</td>
<td>Peak shaving</td>
<td>1Q / 2017</td>
</tr>
<tr>
<td>5</td>
<td>BC</td>
<td>Canada</td>
<td>2 x LP w/Genset</td>
<td>Complete LNGo systems</td>
<td>Stranded gas</td>
<td>2017</td>
</tr>
<tr>
<td>6</td>
<td>AB</td>
<td>Canada</td>
<td>1 x LP w/Genset</td>
<td>Complete LNGo systems</td>
<td>Stranded gas</td>
<td>2017</td>
</tr>
</tbody>
</table>
LNGo LP System
North East USA

Commissioned in August 2016
LNGo LP Systems (2)
North East USA

Commissioning January 2017
LNGo HP System
Northern Canada
LNGo HP System
Features and benefits

- 7,000 – 30,000 gpd (11 - 48 tpd) production - perfect size for local LNG production and demand
- Re-deployable (skid mounted and small footprint)
- Self-powered available - easy to permit
- Premier, proven Dresser-Rand / Siemens engineered product technologies
- Shortest cycle time order to operation
- Multi-market applications
- Worldwide service and support
Dresser-Rand and Siemens
Proven engineered technologies

- Proven MOS™ compressor technology
- High tech, low emissions Guascor natural gas engine power systems
- Cutting edge Enginuity Control and Monitoring Systems
The following codes and standards have been considered in the LNGo™ design

- NFPA 59A - Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG), 2013 Edition
- NFPA 56(PS) - Standard Fire and Explosion Prevention During Cleaning and Purging of Flammable Gas Piping Systems, 2012 Edition
- ASME Sect VIII Boiler and Pressure Vessel Codes, 2012 Edition
- AGA Purging Principles and Practice
- ASTM A105/A105M -12 Standard Specification for Carbon Steel Forgings for Piping Applications
- ASTM A312 / A312M - 12a Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic SS Pipes
- API 526 Flanged Steel Pressure Relief Valves, Fifth Edition 2002

International codes and standards will be considered as required for each project.
Distributed LNG Solutions Contact

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edward.woods@siemens.com

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