An Economic Solution to Small – Mid Scale Liquefaction

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Energy & Power

- Formed 2000, Independent (Privately Owned)
- 120 Personnel Based in London, Wales & Hong Kong
- Consultants to the Oil & Gas Industry (Oil Companies & Contractors)
- Due Diligence/Design Audits/Owner’s Engineer (Client Support Teams)
- Feasibility Studies/Conceptual Design/FEED/Detailed Engineering
- Extensive Expertise in LNG Projects Worldwide (Onshore and Offshore)
Contents

- INCREASING NEED FOR MID RANGE LNG PLANTS:
  - Why – to monetise stranded gas (flared gas, CBM)
  - Why stranded – focus has been on expensive large scale plants

- PROTEUS LNG TECHNOLOGY:
  - An innovative solution for small to mid range plants
  - Description
  - Comparison with other processes
  - Costs
  - Benefits

- BUSINESS OPPORTUNITIES
  - Energy companies
  - Suppliers & Contractors

- NEXT STEPS & CONCLUSIONS
History of PROTEUS LNG

- Invented by GasConsult
- Energy & Power undertook partnership with inventors
- Process IP protected by Patent
- Process systems developed using Energy & Power’ multidiscipline expertise
- Due Diligence of PROTEUS LNG completed by DNV in 2007
- Rigorous modelling of process undertaken
- Pilot plant Design, FEED, HAZOP, QRA completed
- Full economic model developed
- Market review highlighted need for a more flexible process
- Modular PROTEUS LNG concept developed e.g. remote locations / FLNG
Emerging Mid Scale LNG Market

- Rapid growth has led to “Stranded Gas” and flare gas opportunities
- Small scale LNG market is expanding
- Production 30 – 3,000 t/day (10,000 – 1,000,000 t/year)
- PROTEUS LNG offers low (lifecycle) cost solution
- Opportunities for new energy companies and suppliers
PROTEUS LNG Process

- SIMPLE;
  - Lower CAPEX due to low equipment count
  - Lower hydrocarbon inventory
  - Easier operation and maintenance
  - Improved Safety

- HIGH THERMODYNAMIC EFFICIENCY
  - Approaching complex mixed refrigerant processes
  - Lower OPEX

- OVERALL LOWER PRODUCTION COST
  - Increased profit
STILL NEED CONVENTIONAL GAS PRE-TREATMENT (PURIFICATION);
AMINE WASH, MOLECULAR SIEVE DRYING – ALL INDUSTRY STANDARD;
# Specific Power (kW/TPD LNG)

<table>
<thead>
<tr>
<th>LIQUEFACTION PROCESS</th>
<th>SPECIFIC POWER kW/TON PER DAY</th>
<th>INCREASED LNG PRODUCTION PER UNIT OF FEED GAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Expander Cycle</td>
<td>25-35</td>
<td>Base line 0%</td>
</tr>
<tr>
<td>Double Expander Cycles</td>
<td>20-25</td>
<td>+7%</td>
</tr>
<tr>
<td><strong>PROTEUS LNG</strong></td>
<td>13-20</td>
<td>+ 10%</td>
</tr>
<tr>
<td>Cascade Cycle</td>
<td>13-14</td>
<td>+11%</td>
</tr>
<tr>
<td>Mixed Refrigerant Cycle</td>
<td>12-13</td>
<td>+12%</td>
</tr>
</tbody>
</table>
Production Costs (Liquefaction Only)

- **CAPEX**
  - $US 220 – 250 per ton/year
  - $US 220 – 250 million for 1 million t/year (3000tpd) plant
  - $0.3 MMBTU based upon 1 million t/year plant
  - FOB Basis
  - Modular Construction
  - Liquefaction Unit Only, excludes gas treatment, storage, export and utility systems

- **OPEX**
  - $0.4 MMBTU based upon 1 million t/year
  - Liquefaction only

- **PRODUCTION COST**
  - $0.8 MMBTU based upon 1 million t/year
Opportunity to Monetise Gas

- Flared Associated Gas From Oil Production;
- Small Offshore Gas Fields;
- Coal Bed Methane or Coal Seam Gas;
- Waste Site Methane and Biomass;
- End of Pipeline (Pipeline ‘Extension’);
- Sustainability (Diesel Displacement)
- Transport fuel solutions
- Off Grid supply opportunities
Next Steps

- **Build and Operate Demonstration Plant**
  - 10 tpd (12000 Nm³/d feed gas), ½ Road Tanker/d
  - Budget $US 5 million
  - Currently Seeking Participants;

- **Seeking Potential Investors**
  - For IP
  - For Execution

- **First Commercial Plant Scheduled for 2012**
Conclusions

PROTEUS LNG OFFERS

- A simple liquefaction process leading to:
  - Lower costs – Capital & Operating
  - High Efficiency – more production per unit of feed gas
  - Shorter Schedule – earlier production, improved cash flow
  - Improved Safety – if used with no external refrigerants
  - Uses Proven Equipment

CREATES OPPORTUNITIES

- Enabling technology for monetising small gas reserves or flared gas
- New entrants into LNG production and supply business

PROPOSALS

- We offer conceptual designs and cost studies for development of your gas reserves
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