LPG at the Time of Disaster: How It Works in Case of Emergency

Makoto Arahata
Arahata LPG Consulting Co., Ltd.
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Disasters are Realities

Disasters could happen anytime and anywhere
Normal life/business could be disrupted

Backgrounds of the cases are various
Natural Disasters
Human Failures
Conflicts
Disasters are Realities

- Earthquakes
- Tsunamis
- Hurricanes, Tornadoes
- Floods
- Landslides & Mudslides
- Severe Thunderstorms/Lightning
- Winter Storms / Ice Storms
- Large Scale Fires / Wild Fires
Lifeline at the Time of Disaster

- Road/Railway Transportation
- Electricity Supply
- Gas Supply
- Telecommunication Network
- Water Supply

How to restore normal life
How to make your society resilient to the disaster

Increased need for reliable source of energy for customers’ devices
LPG: Exceptional Energy

Characters of LPG

• Fuel for all purposes: Cooking, Engine Fuel (on/off road)
• Distributed: Fuel in the out-of-grid
• Portable: Fuel for Camping, BBQ
• Versatile fuel: For Residential, Commercial, Industrial & Petrochemical use
• Clean
• High in Calorie
Be Better Prepared & Give More Room to LPG in Case of Natural Disasters

Centralized energy distribution networks are more prone to failure during natural disasters

- LPG can be moved easily to the areas/locations where it is needed
- It meets easily first/basic needs of the affected population
- It supports well emergency/recovery backup activities and systems
  - Cooking appliances & facilities with cylinders of bulk
  - Mobile LPG-Air systems to replace the vital natural gas networks/sources which are damaged
Cooking

Cooking: 50kg cylinder for about 6 days

For 70 persons
- Propane consumption: 1.3kg/h
- Used time per day: 3 hours
- Number of cook stoves: 2
- Propane consumption: 7.8kg/day

11 March 2011 Disaster in Japan
Electricity

Portable LPG generator

• Output: 700w
  (smart phone: about 90 units)
• LPG consumption: 0.5kg/h
  (12kg/day)
• Used time per day: 24h
Electricity

Stand-by LPG generator

- Fuel consumption
  42kwh~50kwh/8~10kg/h
- Fuel specification (propane basis)
- Environment restriction (emission, noise)

<table>
<thead>
<tr>
<th></th>
<th>Alternator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Rated Output</td>
<td>40KVA</td>
</tr>
<tr>
<td>LPG Engine</td>
<td></td>
</tr>
<tr>
<td>Fuel Consumption</td>
<td>8.6kg/h</td>
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<tr>
<td>Supply Pressure</td>
<td>2.8kPa</td>
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<tr>
<td>Rated Output</td>
<td>42kWh</td>
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</tbody>
</table>
Electricity

Distributed LPG generator

- 5MW～80MW
- LPG + Diesel (pilot)
- 25MW <
  Gas turbine engine
  Co-generation

- Gas turbine
  30MW
  LPG 6.9Ton/h
  56,000Ton/Y (8,000h)
  Efficiency 33.6%

LPG is fit for fuel of the distributed electricity generators.
Substitute for Natural Gas

For Sustainable Natural Gas System

Appliances can be restarted in affected areas by LPG
LPG-Air (Propane-Air) systems enable LPG to substitute for natural gas in the place where natural gas supplies were broken down or suspended due to maintenance.

Substitute for Natural Gas

Substitute Natural Gas System

- Easy to bring in this mobile system and set it up.
- 3,620 units including 3,300 units in Japan
Centralized distribution networks need maintenance.
Natural Gas networks get damaged by natural disaster.

SNG system can minimize damage and loss.
Unique LPG Vaporizer

- no hot water, no electricity for heating.

LPG vaporized: 200kg/h
Saved Electricity: 28kWh
Operating Hours: 2,000 hours
Saved Electrical Consumption: 19,600kWh (35%)

More than 1,000 units operating in Japan & other countries
- CO₂ cut, less energy cost operation
Local LPG shops educate the school children about propane. The children enjoy meals cooked by propane in the class.
Thank you for your attention

m.arahata@arahata-lpg.co.jp
Appendix
<table>
<thead>
<tr>
<th>Propane Appliances</th>
<th>Consumption of propane (kg/h)</th>
<th>Used time per day (h)</th>
<th>Necessary number of units</th>
<th>Propane consumption per day (kg/day)</th>
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</thead>
<tbody>
<tr>
<td>Cook stove</td>
<td>1.30</td>
<td>3</td>
<td>2</td>
<td>7.8</td>
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<tr>
<td>Rice cooker</td>
<td>0.71</td>
<td>1</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For 70 people</td>
</tr>
<tr>
<td>Heater</td>
<td>0.42</td>
<td>24</td>
<td>5</td>
<td>50.4</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For 170 m2 room</td>
</tr>
<tr>
<td>Generator</td>
<td>0.50</td>
<td>24</td>
<td>1</td>
<td>12.0</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.85kVA</td>
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<tr>
<td>Water boiler for shower</td>
<td>2.10</td>
<td>3</td>
<td>1</td>
<td>6.3</td>
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<tr>
<td>Water boiler for bath</td>
<td>0.80</td>
<td>0.17</td>
<td>1</td>
<td>0.1</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>160 litter of water</td>
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<td></td>
<td></td>
<td>78.1</td>
</tr>
</tbody>
</table>
Typical Applications for LP Gas

Simplified Flow Diagram of Propane - Air (SNG)

- Feeder Gas Tank
  - P: 30% ~ P: 70%
  - B: 70% ~ B: 30%

- Vaporizer
  - 0.45 ~ 0.9 MPa

- First Stage Regulator
  - 0.3 MPa

- Air Compressor

- Mixer

- Calorimeter

- Gas Consuming Equipment

- Cushion Tank

- Governor
Substitute Natural Gas System
Capacity: 400m³/h, GHV: 50.2MJ/m³ (Factory in Vietnam)

Thanks to its high calorie, LPG can substitute for natural gas.
Portable LPG generator

- Outdoor use
- Disaster preparedness
- Stand-by use

LPG (Propane) Power Generator
With a composite cylinder
LPG emergency kits

- Kitchen set
- Stand-by generator
- LPG bulk tank
- Portable generator
- Gas distribution port
Schools become Shelters

• The Yokohama city government supplied to the high schools in the city gas grid area the emergency propane kit of four 50 kg propane cylinders and a cook stove for each school as disaster preparedness scheme.
• We can cook typical Japanese simple meal (rice ball) for one thousand persons for 5 days by one 50kg propane cylinder.
• One person need two rice balls per meal three times a day.

Nittsuta Junior High School in Yokohama City in Kanagawa prefecture