Small Scale LNG – Are We There Yet?

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Have we reached a tipping point?

Stating the obvious…..

• Gas fuels are cleaner and generally well perceived by the public
• Delivered cost of gas fuels should be reasonable
• Small scale gas fuel receiving facilities must be competitive
• Must be able to build new or convert existing power plants at a reasonable cost
• Price Stability or Price Volatility?
No. 1 Nobody can predict the price of fuel
No. 2 Nobody can predict the stability of the fuel price

Wait… change that to: “Anyone can make a prediction, but nobody can SUCCESSFULLY predict either of these things”

So let’s just assume that we are all interested in gas fuels as a possible alternate to the LFO and HFO fuels we all know, and let’s also assume I’m not going to talk about hard costs! We believe fuel flexibility is, as it has always been, a big advantage in the energy business.
Let’s review: Pros and Cons of different gas fuels

- LNG – excellent engine performance, complex transport, complex infrastructure
- LPG – good engine performance, relatively easy transport and relatively easy infrastructure
- LEG – close to LNG. Due to current surplus in the US, LEG is actually available in the Caribbean and Central America (is anyone using it?).
- And we have one other possibility – methanol, but I will not be talking about it today.
LNG CONSUMPTION IN A POWER PLANT

- **200 MW plant** (baseload 8000 h/year)
  - 620,000 m³/year (=280,000 tonnes/year)

- **100 MW plant** (baseload 8000 h/year)
  - 310,000 m³/year (=140,000 tonnes/year)

- **50 MW plant** (baseload 8000 h/year); OR 100 MW (flexible baseload = 4000 h/year); OR 200 MW (peak load = 2000 h/year)
  - 155,000 m³/year (=70,000 tonnes/year)

Note: The volume of LPG or LEG would be about 13% lower than LNG (for the same energy content)
So…. Can we get gas fuels to this region? Sure seems like it!

How about LNG from AES Andres, right down the road?

How about LNG from New Fortress in Jamaica??

How about from Eagle LNG in Florida???

How about AES Panama????

EcoElectrica Puerto Rico?????

Let’s not forget Crowley with containers
So…. Can we get gas fuels to this region? Sure seems like it!

How about Ethane (LEG)?

(Powered by Wartsila engines)
So…. Can we get gas fuels to this region? Sure seems like it!

Many possible suppliers today for LPG!
What else do we need – a receiving terminal?

- Jetty or dock (or truck terminal)
- Storage
  - Flat bottom or Bullet Tanks?
- Regas
- Land to put it all…
HERE IS ONE TERMINAL STYLE USING BULLET TANKS

1. Truck loading
2. LNG storage
3. Regasification
4. Electrical and control system
5. Gas send out
**LET’S TALK BRIEFLY ABOUT GAS FUEL STORAGE TANKS**

<table>
<thead>
<tr>
<th>Tank type</th>
<th>Bullet tank (Double shell steel tanks)</th>
<th>Flat bottom tank (Single, double or full containment)</th>
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| **Capacity**       | Single tank 100 – 1200 m³  
Multiple tanks 10,000 – 20,000 m³ | 15,000 – 160,000 m³                                     |
| **Boil-off gas (holding mode)** | 0.05-0.15 % per day, but the tank is  
capable of handling the increased  
pressure for up to 1 month | From 0.05 % per day                                    |
| **Operating pressure** | 0.5 – 8 barg  
Atmospheric |                                                         |
| **Rollover monitoring needed** | No | Yes                                                     |
| **Manufacturing method** | Pre-fabricated in factory | On site                                                  |
| **Installation time on site** | Days to weeks | 24 – 36 months                                         |

We feel that bullets can be used up to about 20,000 m³. Above that go with flat bottom.
1 Unloading system
2 LNG storage
3 Boil-off Gas (BOG) system
4 Regasification
5 Electrical and control system
6 Gas send out
7 Truck loading
AND A THIRD POSSIBILITY FOR TANKS..... BARGE MOUNTED

1. Unloading system
2. LNG storage
3. Regasification
4. Electrical and control system
5. Gas send out
Good question. No easy answer. Depends on the power plant size, the delivery method, the round trip time to deliver, whether you have backup fuel, etc.

Let’s just say ~15 days, in round numbers…but it could be less!
Los Orígenes, 25 MW, 3 x Wartsila 20V34DF, installed 2011, expanded by 2 x 18V50DF (34 MW) in 2013
ADDITIONAL SMALL SCALE LNG CAPABLE PLANTS IN THE DOMINICAN REPUBLIC

Laesa

Punta Cana

Cerveceria Nacional

Quisqueya

Seaboard
Industrial Customer in Central America (Wartsila’s First LPG project)

- 2 x 20V34SG “GasCube” with CHP
- Commercial operation for approximately 1 year
- Operating on 100% LPG since startup
- Truck delivery, existing site fuel storage was enlarged
EXISTING STORAGE CAPACITY WAS INCREASED
RECO, Roatan, Honduras

- 4 x 20V34SG units, EPC by Wartsila
- Due to begin commercial operation shortly
- Fuel delivered to plant site by Energy Transfer via barge or small gas carrier ship
- 12 x 340 m³ bullet tanks = 4080 m³, 2-3 weeks use
- Future LNG Capable
Let’s benchmark a receiving terminal for a 50 MW plant with recips using LNG

• Daily fuel use ~430 m³

• How much fuel to store? Depends on logistics…maybe 6500 m³

• How much land is needed for fuel receiving terminal…maybe 4-5 hectares depending on storage on site

• How long to build fuel receiving terminal? With bullet tanks, 6-8 months

• The big questions – do you need a jetty and a long pipeline? $$$$
Different types of conversions available

- Pure gas fired plant? Or dual fuel plant (LFO as backup)? Many factors to look at! You may have seen previous Wartsila presentations on this.

- Clearly there are many things to consider. But you wouldn’t be watching this unless you are looking at all of these options.

- Trying not to sound too much like a Wartsila advertisement, I will say that we can assist with pricing and constructing all aspects of small scale gas infrastructure!
So….In summary

I think we have finally passed the tipping point. Our friends at AES can load a small LNG carrier just down the road from here, and other suppliers are coming. LNG trucking is actively going on to supply small power projects in the Dominican Republic. More small LNG carrier ships are being built. Plenty of LPG carriers available. Multigas carriers are starting service, carrying LEG and LPG.
So....In summary

Small scale gas receiving and storage terminals can be built, and power plants can be built or converted with fuel flexibility.

The pieces are falling in to place as we speak.
So….In summary, it boils down to this:

Finally we are in the position that if the economics of a particular fuel supply are attractive, then there is nothing standing in your way to do small scale gas fuels!
THANKS

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