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Stop Flaring and Venting — Utilization of Associated Petroleum Gas with Gas Engines

Thomas Elsenbruch, GE Power & Water Jenbacher gas engines, Marketing
Jenbacher Background

A leading manufacturer of gas-fueled reciprocating engines for power generation.

- Acquired by GE in May ‘03...100% gas-fueled recips
- Manufacturing/HQ in Jenbach, Austria
- Employees: 1,800 total; 1,400 in Austria

- Power range from 0.25MW to 4MW, 4 platforms / 11 products
- Fuel flexibility: Natural gas or a variety of renewable or alternative gases (e.g., landfill gas, biogas, coal mine gas)
- Plant configurations: Generator sets, cogeneration systems, container solutions
How to utilize associated gas?

Many solutions for APG utilization are available

Source: EU-Russia technology center (on Internet)
Important Gas Properties

**Heating Value**
Calorific value and thermal value indicate the energy content of a gas. The former can be differentiated from the later only through the heat of vaporization of the water resulting from combustion, the water is in liquid form after it has already liberated its condensation heat.

**Methane Number**
Determinant parameter for knocking resistance of a gas. It is comparable to the Octane Number of gasoline and indicates the percentage methane volume ratio of a methane-hydrogen mixture which, in a test engine and under controlled conditions, indicates the same knocking resistance as the gas to be tested.

**Laminar Flame Speed**
Laminar flame speed is the speed at which the oxidation takes place.
Lower Heating Value
range of gases used in Jenbacher gas engines

Calorific value (in kWh/Nm³)

Gases from chemical industry
Wood gas
Pyrolysis gas
Coal mine gas
Coke gas
Landfill gas
Biogas
Sewage gas
Natural gas
Flare gas
City gas
Propane
Butane

0  Logarithmic scale  5  10  15  20  30
Combustion Limits/LHV

Combustibility depends on the combination of composition and NOT on the heating value of the gas.
## Characteristics of Flare gas

### Gas composition: main constituents

- Methane $\text{CH}_4$: 40 - 90%
- Ethane $\text{C}_2\text{H}_6$: 2 - 20%
- Propane $\text{C}_3\text{H}_8$: 1 - 15%
- Butane $\text{C}_4\text{H}_{10}$: 1 - 10%
- Carbon dioxide $\text{CO}_2$: 1 – 40%
- Methane numbers: 30 - 65
- Lower Heating Value [kWh/Nm³]: 11 - 20
- In case of high contents of H2S, desulphurization is needed

**Associated gas varies in composition & flow over time**

» **High flexibility in operation and control necessary**
Methane Number is the main limiting factor for the achievable output of Flare gas Applications.
LEANOX® - Lean-burn combustion control

- Sensors in non critical measurement ranges (pressure, temperature, deposits...)
- Reliable and durable compliance with exhaust emission limit at changing operational conditions (fuel gas compositions...)
- Controlled combustion and subsequently controlled stress of various components (valves, cylinder heads, spark plugs...)

GE GE Power & Water / Thomas Eisenbruch / 03.-05.03.2010
Main requirements for applications in the oil and gas industry

Operation with associated petroleum gas (flare gas)
- Fuel flexibility
- Stable island operation
- Operation at low Methane numbers

Operation in hazardous environment
- Gas engines can **not** be operated in ATEX zones 0-2
- Enclosures must be built accordingly
- Ventilation systems to ensure CH4 dilution
- Spark arrestors in exhaust gas systems
Container design concept

- Silencer
- V-type radiator
- Air intake chamber
- Control cabinet
- Sound attenuated air outlet
- Concrete strips as foundation
Features of Jenbacher container-concept

- Pressurized ventilation => good dilution in case of gas leakage (safety concept)
- All components on the container roof => small footprint
- Separated control room
- Optimisation of air flow for best cooling results
- Minimal number of interfaces
- Sound attenuation levels of 65 dB(A) and lower possible
- Best accessibility for maintenance via double doors
- Special versions for full heat recovery (cogeneration) available
Power plant output range

Product line 2010 (50Hz) – Natural gas NOx $\leq 500 \text{ mg/m}^3_N$

- Electrical Efficiency up to 45%
- Thermal Efficiency up to 50%

**Additional benefits with multiple engine approach**

- High fuel efficiency: engines constantly running at nominal load and efficiency
- Availability and reliability: stable electrical output
- Flexibility: scheduled maintenance in sequence
GE–J APG Solutions

- Safe removal of condensate is very important
- Additional removal of higher HCs beneficial
- Load management necessary for island mode improvement
Typical standard condensate removal
## Reference List Associated Petroleum Gas

<table>
<thead>
<tr>
<th>Customer</th>
<th>Project</th>
<th>Deliv. Date</th>
<th>Country</th>
<th>Town</th>
<th>Type</th>
<th>Pel [kW]</th>
<th>Ptherm [kW]</th>
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<td>Petrobras</td>
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<td>RioVentura</td>
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<td><strong>321 Engines</strong></td>
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Jenbacher engines sold in APG-applications

This bar chart shows the number of units sold annually from 2001 to 2009. The x-axis represents the years, and the y-axis represents the number of units sold per year. The chart indicates a significant increase in sales from 2005 onwards, with a peak in 2008.
1. Jenbacher Flare gas installation in Brasil

Rio Ventura/Brasil
1 x JGS 612 GS-S.LC

Electrical Output: 1,164 kW

- Ventilation/air conditioning system for the Interface and Control Panel
- special alternator design for air temperatures > 40°C (heating device to avoid condensation problems)
- Ignition Coil ventilation system
- special turbocharger tuning

Commissioning 1996
1. Jenbacher flare gas installation Russia

Climate: arctic winter down to -50°C, heavy snowstorms

Severnaya Neft, Usinsk, Russia

Provides heat & power using associated gas from the oil production site near the Arctic Circle ... avoids the need for 8M liters of diesel annually

5 x JMC 320 GS-S.L
Electrical Output: 3.8 MW\textsubscript{el}
Thermal Output: 2.1 MW\textsubscript{th}

Gas composition:
\begin{align*}
\text{CH}_4 & \ldots 81.8 \% \\
\text{C}_2\text{H}_6 & \ldots 6.8 \% \\
\text{C}_3\text{H}_8 & \ldots 7.5\% \\
\text{C}_4\text{H}_{10} & \ldots 1.0\% \\
\text{N}_2 & \ldots 1.9\% \\
\text{CO}_2 & \ldots 1.0\% \\
\end{align*}

LHV = 11.7 kWh/Nm\textsuperscript{3}
MN = 63.9
Flare gas installation Russia
Sibneft-Noyabrskneftegas

Sibneft
10 x JGC 320 GS-S.L
Electrical Output: 10,400 kW
Commissioning: September 2003
Flare gas installation Argentina

J.F. Secco
15 x JGS 420 GS-S.L
Electr. Output: 21,225kW

Gas composition:
- \( \text{CH}_4 \) ... 48.5 %
- \( \text{C}_2\text{H}_6 \) ... 2.4 %
- \( \text{C}_3\text{H}_8 \) ... 1.0%
- \( \text{C}_4\text{H}_{10} \) ... 1.1%
- \( \text{N}_2 \) ... 1.5%
- \( \text{CO}_2 \) ... 46.0%

Commissioned: 2004

This installation runs together with more than 20 engines on other site in island mode, providing the power for oil production equipment.
Flare gas installation Colombia, Oxy - Caricare

Climate: tropical 35°C with 90% rel. humidity

**OXY - Caricare**

9 x JGC 320 GS-N/S.L

Electrical Output: 9,567 kW

Gas composition:
- $\text{CH}_4$ ... 41.5%
- $\text{C}_2\text{H}_6$ ... 7.0%
- $\text{C}_3\text{H}_8$ ... 9.0%
- $\text{C}_4\text{H}_{10}$ ... 6.0%
- $\text{N}_2$ ... 6.5%
- $\text{CO}_2$ ... 27.5%

Commissioning: 2007
Flare gas installation off shore, Black Sea, Petrom

Romania, Black Sea
2 x JGC 620 GS-S.L
Electrical Output: 2 x 2,204 kW
Commissioning: June 2007
Pipeline heating by Skin heat effect

CAIRN Energy/IND
35xJGS 420 GS-N.L
Electrical Output: 39,095 kW
Commissioning:
Sept starting 2009
Pipeline heating CAIRN Energy/IND

CAIRN Energy/IND
35xJGS 420 GS-N.L
Electrical Output: 39,095 kW
Commissioning:
Sept starting 2009
Mini LNG-Plant with Hamworthy/NOR

- Gas engine
- Cooling cycle compressor
- Instrument air & Nitrogen
- CO2 removal
- H2O removal
- Storage tank
- LPG separator & Gas condensation (LNG)
- Return gas compressor
Questions