

# LNG: rundown to storage

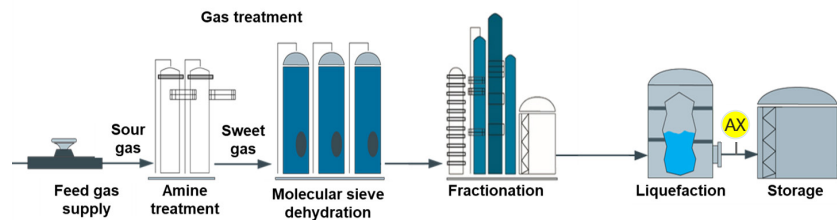


Figure 1: Rundown to storage tank in an LNG baseload liquefaction plant

## Benefits at a glance

- No vaporizer - measures LNG *in situ* in the cryogenic liquid phase
- Simple analyzer installation in a 3-sided shelter or a control room – no requirement for a dedicated analyzer room
- Low installation costs – no need for vacuum-jacketed tubing for sample transport
- Rxn-41 probe (C1D1/Zone 0) can be installed up to 250 m from the analyzer
- No analysis delays due to sample transport or vaporization
- Virtually immune to LNG flow variations
- Lower OPEX – no moving parts, consumables, or insulated sample transfer lines

The measurement of LNG composition is the final quality check in the liquefaction process before transferring the LNG to storage tanks and is used to prevent transferring off-spec product to the tanks. This measurement also provides information for feedback control of the liquefaction process, allowing for process optimization and adjustment of the composition and amounts of lights and heavies in the final product, depending on current market requirements on LNG quality and energy content.

## Measurement of LNG rundown quality

The composition of LNG in a liquefaction plant is a function of the incoming natural gas, the amount of sample pre-treatment, and the operating parameters of the liquefaction process, affecting the composition of LNG being sent to storage tanks via rundown lines. Knowing the composition of the LNG in the rundown lines provides vital information to help ensure these processes are optimized to achieve the desired LNG quality. In addition, weathering of the LNG already stored in the tanks means that the composition, as well as the density, will vary over time. Many liquefaction plants monitor the density of the rundown lines to determine whether to bottom fill or top-fill the tanks to avoid fill-induced stratification, which, if not controlled, can lead to tank rollover. In addition, the measurement of nitrogen in LNG is essential, since the high molecular weight and high volatility of N<sub>2</sub> means that the density

of LNG containing nitrogen will initially decrease with weathering, whereas the density of LNG without nitrogen will initially increase with weathering. This can lead to auto-stratification in LNG tanks<sup>1</sup> and can impact the decision of where to add the rundown LNG<sup>2</sup>.

## Issues with traditional measurements

LNG composition has been traditionally measured using a gas chromatograph (GC). To use the GC, the LNG sample must be brought from its cryogenic liquid state to a room temperature gas. It is essential to eliminate partial and pre-vaporization of the LNG sample, which requires careful installation and proper maintenance of insulation in the sample vaporization and transport paths. Improper or incomplete vaporization is usually the dominant source of uncertainty in the measurement of LNG composition and the energy content transferred. Vaporization systems are often sensitive to LNG flow rates, and this can alter the measured composition and calculated density of the LNG. Raman analyzers are essentially immune to LNG flow variations and have very low maintenance requirements, since there are no moving parts and no insulated transfer lines to maintain, and no consumables, such as calibration and carrier gases. Raman spectroscopy is also unique among optical spectroscopic techniques in that it can measure the nitrogen in LNG.

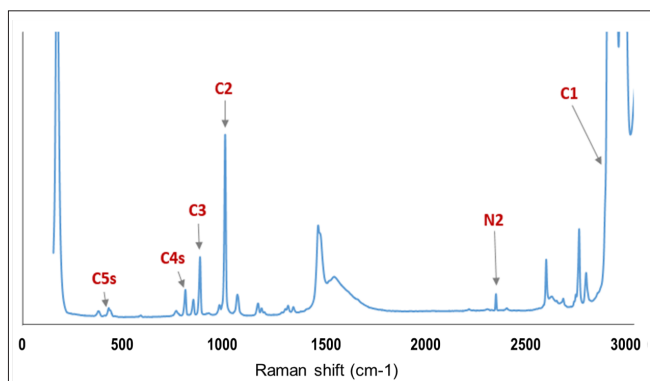


Figure 2: Typical Raman spectrum of LNG in a rundown line

### Solution: Raman Rxn5 process analyzer for LNG rundown to storage tank

The Raman Rxn5 analyzer for LNG with the Rxn-41 fiber optic probe for cryogenic service provides measurement of the composition of LNG in rundown lines, including nitrogen, with up to a 10 times lower uncertainty than traditional GC-vaporizer systems. The C1D2-rated Raman Rxn5 analyzer is easily installed in a near the process measurement in a three-sided shelter or in a control room, with fiberoptic coupling to the Rxn-41 probe. The probe is mounted in the LNG pipe for in situ measurement in the liquid phase, eliminating the need for costly vaporization, sample conditioning, and transport of the vaporized gas to the analyzer for measurement. Minimal maintenance is required, and the Raman Rxn5 does not require carrier or calibration gases.

The Raman Rxn5 analyzer for LNG rundown to storage consists of the following:

- Raman Rxn5 analyzer base unit with internal automated calibration
- Rxn-41 fiber optic probe for cryogenic service
- Fiber optic cable (length from 15 to 250 meters, customized to your plant requirements)
- Dedicated LNG process stream method

\* Precision values from typical LNG transfer. Performance may vary for different cable lengths and analysis time.

### LNG component range and typical performance\*

Component	Concentration (Mol %)		Precision (k=2)
	Min	Max	
Methane (CH <sub>4</sub> )	87.000	98.170	< 0.030
Ethane (C <sub>2</sub> H <sub>6</sub> )	1.300	10.500	< 0.030
Propane (C <sub>3</sub> H <sub>8</sub> )	0.160	3.000	< 0.005
i-Butane (iC <sub>4</sub> H <sub>10</sub> )	0.060	0.400	< 0.002
n-Butane (nC <sub>4</sub> H <sub>10</sub> )	0.078	0.600	< 0.002
i-Pentane (iC <sub>5</sub> H <sub>12</sub> )	0.005	0.120	< 0.002
n-Pentane (nC <sub>5</sub> H <sub>12</sub> )	0.005	0.120	< 0.002
Nitrogen (N <sub>2</sub> )	0.040	1.050	< 0.030

Table 1: Range of validated LNG with typical precision for fiber lengths < 250 m and a measurement time of 300 seconds\*

Component	Range Min – Max	Precision (k=2)
Gross heating value (MJ/m³)	38.4 - 42.2	< 0.020
Gross heating value (MJ/kg)	53.8 - 55.3	< 0.030

Table 2: Range of heating values with typical precision\*

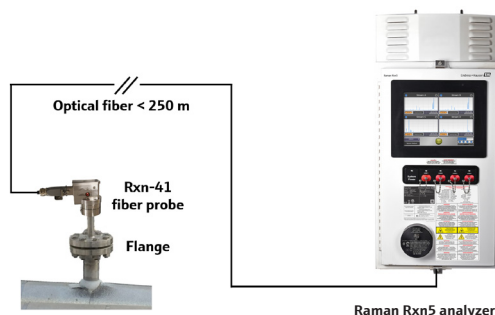


Figure 3: Recommended direct flange mounted installation

### References

1. Handbook of Liquefied Natural Gas, S. Mokhtab, et al., Elsevier, Chapter 2 (January, 2014).
2. Rollover in LNG Storage Tanks, G.I.I.G.N.L., 2nd Edition: 2012-2015; <https://giignl.org/document/rollover-in-lng-storage-tanks/> (accessed Nov 18, 2021)