MODULE 1

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Module 1: Basics of Operating LPG Station

- Specify the attributes and features of natural gas.
- Describe the different LPG fuelling station types and how they are used.
- Identify the key fuelling station components and explain their purposes, maintenance needs, typical failure mechanisms, and recommended corrective action.

ATTRIBUTES AND FEATURES OF NATURAL GAS

Natural gas is a colourless, extremely flammable gaseous hydrocarbon that is mostly composed of methane and ethane. It is also known as methane gas or natural methane gas. It is a kind of petroleum that frequently coexists with crude oil. Natural gas is a fossil fuel that is used to produce power, heat homes, fuel some vehicles, and for cooking. In addition to being required for a vast array of other chemical products, such as fertilisers and dyes, it is significant as a chemical feedstock in the production of plastics.

At the high pressures present in a reservoir, natural gas is frequently discovered dissolved in oil. It can also be found as a gas cap atop the oil. The natural gas pressure that is applied to the underground oil reservoir frequently acts as the force that propels oil to the surface. Known as "associate gas," this type of natural gas frequently consists of light liquids like propane and butane and is frequently seen as the gaseous phase of crude oil. Because of this, related gas is occasionally referred to as "wet gas." There are also reservoirs that contain gas and no oil. It is known as non-associated gas. Dry gas, also known as non-associated gas, is produced by reservoirs that are not associated with any known source of liquid petroleum.

History of use

Early discovery and application

Between 6000 and 2000 BCE, the first natural gas leaks were discovered in Iran. Early writers frequently discussed the Middle East's natural petroleum seeps, particularly those in the Baku region of what is now Azerbaijan. The "everlasting fires" of the fire-worshipping religion of the ancient Persians were fuelled by gas leaks, which were most likely first sparked by lightning. About 900 BCE, natural gas usage was mentioned in China. The first known natural gas well was dug in China in 211 BCE, and it was said to have reached a depth of 150 metres (500 feet). For the specific goal of looking for gas in limestones from the Late Triassic Epoch (about 237 million to 201.3 million years ago) in an anticline (an arch of layered rock) west of current Chongqing, the Chinese dug their wells with bamboo poles and crude percussion pieces. The rock salt that was found embedded in the limestone was dried using gas. Over 1,100 wells had been dug into the anticline by 1900, and eventually, wells were drilled to depths of about 1,000 metres (3,300 ft).

Up until its discovery in England in 1659, natural gas was unknown in Europe, and even then, its use was not particularly widespread. Instead, from 1790 on, gas produced from carbonised coal (also referred to as town gas) became the main fuel for lighting up homes and streets throughout much of Europe.

The use of natural gas from a shallow well at Fredonia, New York, in 1821 was the first commercial use of a petroleum product in North America. Small-bore lead pipes were used to deliver the gas to consumers so they could use it for cooking and illumination.

[Petrochemical. At dusk, a petrochemical factory with distillation towers. Gasoline, Greenhouse Gas, Natural Gas, Oil, Pollution, Refinery, Smoke Stack, Factory, Fossil Fuel, Power Generation, Gas, Natural Gas, Oil, Petroleum]

Upgrades to Gas Pipelines

Natural gas usage remained regional for the duration of the 19th century because there was no practical way to move large amounts of gas over great distances. The industrial revolution, which was built mostly on coal and oil, continued without natural gas. The development of leakproof pipeline coupling in 1890 marked a significant advance in gas transportation technology. However, the materials and building methods were still so laborious that gas could not be used more than 160 km (100 miles) from a supply source. As a result, town gas was produced for consumption in the cities, related gas was primarily flared (burned at the wellhead), and non-associated gas was left in the ground.

The late 1920s saw the development of long-distance gas transmission due to additional advancements in pipeline technology. In the United States, more than ten significant transmission systems were built between 1927 and 1931. These systems each had pipes that were over 320 kilometres long and had a diameter of about 50 cm (20 inches) (200 miles). After World War II, numerous longer pipelines with progressively larger diameters were built. It became possible to manufacture pipes with a maximum diameter of 150 cm (60 inches). Since the early 1970s, Russia has been the country of origin for the longest gas pipelines. For instance, the 5,470 km (3,400 mi) long Northern Lights pipeline, which connects eastern Europe with the West Siberian gas reserves on the Arctic Circle, was constructed in the 1960s and 1970s. It had to cross the Ural Mountains and about 700 rivers and streams.As a result, the largest gas field in the world, Urengoy, is now shipped to eastern Europe before being used in western Europe. The 50-cm (20-inch) Trans-Mediterranean Pipeline, another shorter but extremely challenging gas pipeline, was built between Algeria and Sicily in the 1970s and 1980s. Along stretches of that route, the sea is more than 600 metres (2,000 ft) deep.

A Premium Fuel is Natural Gas

In many parts of the world up until 1960, associated gas was a troublesome by-product of oil production. Gas was removed from the crude oil stream and burned off as inexpensively as possible after being separated from it (burning it off). Natural gas didn't become a significant global energy source until the late 1960s and early 1970s crude oil crises.

Even in the United States, the natural gas market for residential heating was small until the 1930s, when town gas started to be phased out in favour of natural gas abundant and affordable supply, which had twice the heating value of its synthetic predecessor. Also, carbon dioxide and water are typically produced when natural gas burns fully. Gas combustion produces relatively little soot, carbon monoxide, or nitrogen oxides compared to other fossil fuel combustion. Sulphur dioxide emissions, another significant air pollutant, are also practically non-existent. As a result, natural gas is frequently preferred as a fuel for electric power plants since it is less harmful to the environment than coal. However, methane has nearly 25 times the ability to trap heat as carbon dioxide, making it an extremely powerful greenhouse gas. Despite natural gas' longstanding reputation as a reasonably clean energy source, methane emissions from storage facilities, pipelines, and during transportation still pose a serious threat to the environment and are a major source of worry.

Natural Gas's Composition and Qualities

A Hydrocarbon Substance

Methane and ethane, both of which are gaseous in an atmosphere, make up the majority of the saturated light paraffin that make up natural gas, which is a combination of hydrocarbons. Other hydrocarbons, such as propane, butane, pentane, and hexane, may also be included in the combination. Due to the higher pressures in natural gas reservoirs, even heavier hydrocarbons are typically found in gaseous form. They are typically produced separately as natural gas liquids (NGLs) in field separators or gas processing facilities after liquefying at the surface (at atmospheric pressure). The NGLs can be further divided into fractions after being removed from the gas stream, ranging from the heaviest condensates (hexanes, pentanes, and butanes) to liquefied petroleum gas (LPG), which consists primarily of butane and propane, to ethane. This source of light hydrocarbons is particularly prevalent in the US, where natural gas processing generates a sizable amount of the ethane feedstock used to produce olefins and the LPG used for commercial and residential heating.

Contains Non-Hydrocarbons

In addition to the hydrocarbon gases, other gases including nitrogen, carbon dioxide, hydrogen, and noble gases like helium and argon also frequently coexist with them. Both nitrogen and carbon dioxide are insignificant combustibles that can be found in significant concentrations. Although nitrogen is inert, it can significantly lower the mixture's heating value if it is present, thus it must be eliminated before the gas is viable for the commercial market. To increase heating value, decrease volume, and maintain even combustion qualities, carbon dioxide is eliminated. Large amounts of hydrogen sulphide or other organic sulphur compounds are frequently present in natural gas. Sulphur compounds are removed from the gas during processing since they are hazardous when inhaled, damaging to plants and pipelines, and significant pollutants if burned in goods made from sour gas. To enable the quick discovery of any leaks that may occur during shipment or usage, commercial natural gas is always supplemented with a tiny amount of a foul mercaptan odorant after the sulphur is removed.

Gas recovered from a well contains water vapour, which is partially condensed during transmission to the processing plant because natural gas and formation water occur together in the reservoir.

Physical and Thermal Characteristics

Methane makes up 85 to 90% of commercial natural gas that has been stripped of NGL and sold for heating, with nitrogen and ethane making up the majority of the remaining components. It typically has a calorific value, or heating value, of around 1,050 British thermal units (BTUs) per cubic foot of the gas, or 38 megajoules (MJ; million joules) per cubic metre. Colourless, odourless, and very flammable describe methane. But several of the related gases in natural gas, particularly hydrogen sulphide, have a strong and pervasive odour, and just a few parts per million are needed to give natural gas a noticeable odour.

Transporting and Processing Natural Gas

Measurement Techniques

The volume of gas is measured in cubic metres or cubic feet and is used to determine how much gas is stored in a reservoir, produced in wells, and delivered through pipelines. The estimates are based on the volume that the gas occupies at standard atmospheric pressure (760 mm of mercury, or 14.7 pounds per square inch) and 15 °C (60 °F). The high underground pressures compress the gas in the reservoir, causing it to expand when it reaches the surface and take up more space.

This expansion does not, however, result in a greater production of gas because its volume is computed using standard circumstances for temperature and pressure. The standard units for measuring natural gas reserves are billions and trillions of cubic metres (bcm and tcm) or billions and trillions of cubic feet (bcf and tcf). Thousands and millions of cubic metres (Mcm and MMcm) or thousands and millions of cubic feet are routinely used to measure the daily volumes generated at wells (Mcf and MMcf). The Roman numeral M is generally used in the natural gas sector to represent 1,000 and MM (1,000 x 1,000) to represent one million.

Natural gas is typically bought and sold on the market based on its calorific value, which is roughly 38 MJ per cubic metre or 1,050 BTUs per cubic foot, as mentioned above. MJ/m3 and BTU/ft3 are common abbreviations for these units. In reality, natural gas purchases are typically expressed in much greater units, such as MMBTUs and GJ (gigajoules, or billions of joules) (millions of BTUs).

Conveniently, 1 MMBTU in the British Imperial system is equal to about 1,000 cubic feet of natural gas. The temperature, which equates to 100,000 BTUs or roughly 100 cubic feet of gas, is another often used unit. Natural gas prices are typically stated as per temperature, per MMBTU, or per GJ.

Procedure in The Field

Sometimes the amount of methane in field production gas is so high that it can be delivered straight to customers without further processing. However, the gas is typically only available at extremely low pressures and frequently has unacceptable quantities of contaminants and higher-weight hydrocarbon liquids. Due to these factors, field gas is typically treated through a number of compression stages in order to remove liquids and other impurities and lower the fluid's temperature, all while reducing the amount of energy needed to run compressor stations along the transport route.

Dehydration

Field gas is charged to an intake scrubber in a straightforward compression gas processing plant, where entrained liquids are eliminated. After that, the gas is sequentially cooled and compressed. Water vapour is produced as the pressure and temperature decrease. The gas's water vapour condenses when the pressure rises and the temperature falls. The gas may be at its dew point with respect to water or hydrocarbons if liquid forms in the coolers. This could lead to the formation of ice-like gas hydrates, which can be problematic for plant operation and need to be avoided in order to prevent issues with subsequent transportation. By introducing a glycol solution into the process stream to absorb any dissolved water, hydrate avoidance is achieved. The dehydrated gas keeps moving through the processing stream while the glycol solution, which contains water that has been absorbed, is heated to evaporation and then recycled. Another drying technique includes running the wet gas through a series of towers that are densely packed with solid desiccant. The desiccant absorbs the water that was dissolved in the gas, releasing the dry gas for further processing.

Recovery of Liquid Hydrocarbons

A more complex absorption and fractionation plant may be needed if market economics support the recovery of NGLs from the gas stream. In an absorber column, the compressed raw gas is treated in combination with lean oil, a liquid hydrocarbon that absorbs the heavier components of the gas. The majority of the gas is released from the top of the absorber as residue gas, which typically contains 95% methane and will be treated further to get rid of sulphur and other impurities. The lean oil is recovered after the heavier components have left with the bottom liquid stream, now known as rich oil, for additional processing in a distillation tower to separate ethane for plant fuel or petrochemical feedstock. Additional distillation columns may be present in some gas processing plants to further separate the NGL into propane, butane, and heavier liquids.

However, some more up-to-date facilities use refrigeration to lower processing temperatures and boost absorption efficiency. Many older gas-absorption systems were built to run at ambient temperature. Cryogenic expansion is a considerably more effective method, particularly for ethane extraction. In this process, cooled gas is blasted into an expansion chamber by a strong turbine, where it is subjected to additional cooling to a temperature of 84 °C (120 °F) and reduced vapour pressure. Methane is still a gas at this temperature, but heavier hydrocarbons condense and are recovered.

Sweetening

The treatment of sour gas with ethanolamine, a liquid absorbent that functions similarly to the glycol solution in dehydration, sweetens or purifies the gas of its sulphur components. The gas bubbles through the liquid and emerges virtually completely devoid of sulphur. After being treated to remove the absorbed sulphur, the ethanolamine is reused.

Transport

The creation of effective pipeline networks has been crucial to the expansion of the natural gas sector. Modern gas pipelines are built in a variety of sizes depending on their intended function, with feeder lines having a diameter of 15 cm (6 inches) and transmission pipes having a diameter of 60 cm (106 cm) and 122 cm (24, 42, and 48 inches). Russian main lines have the greatest diameters in the world, reaching 140 cm (56 inches). Large transmission pipelines are operated at pressures greater than 1,000 psi, or 8 megapascals (MPa). In areas of the world that utilise the metric system, pipeline pressures are also expressed in bars.

Depending on their intended use, modern gas pipelines are constructed in a variety of sizes, with diameters ranging from 15 cm (6 inches) for feeder lines to 60 cm (106 cm) and 122 cm (24, 42, and 48 inches) for transmission pipelines. Russian main lines are the largest in the world, with diameters up to 140 cm (56 inches). More than 1,000 psi, or 8 megapascals (MPa), of pressure is used to run large transmission pipelines. Pipeline pressures are also expressed in bars in regions of the world that use the metric system.

Automated compressor stations are positioned around every 100 km (60 miles) along the pipelines to increase system pressure and combat friction losses in transit. One bar is equal to 100 KPa, therefore 8 MPa, or 8,000 KPa, is 80 bars.

An effective method of long-distance marine transport has emerged as a result of the existence of natural gas reserves in regions of the world removed from market destinations. Liquefied natural gas (LNG) trades internationally naturally because it makes up only 0.16 percent (1/600) of the total volume of gas. The gas is stripped of carbon dioxide, dried, and then sent through a series of compression-expansion phases where it is cooled to liquefaction temperature (about 160 °C [260 °F]) in today's liquefaction plants using autorefrigerated cascade cycles.

Applications

Natural gas is used primarily as a fuel for the production of electric power. Industrial, household and commercial uses come next, mostly as a source of energy but also, for example, as a raw material for chemical goods. Over time, a number of specialised applications have emerged. Despite emitting the greenhouse gas carbon dioxide, natural gas is frequently chosen as a non-polluting transportation fuel due to its clean-burning properties. Compressed natural gas is being used to power a large number of buses and fleets of commercial vehicles. Natural gas is burned with a small amount of air, creating carbon black, a pigment with colloidal dimensions, which is then deposited on a cool surface. It is a crucial component of colours and inks and is employed in the compounding of rubber.

The production of ammonia involves a catalytic process that relies on hydrogen generated from methane to produce more than half of the world's supply. A variety of compounds, including hydrogen cyanide, nitric acid, urea, and a variety of fertilisers, can be made from ammonia and then utilised directly as a plant food turned into ammonia. A controlled oxidation process can be used to create a variety of additional chemical products from natural gas, such as methanol, propanol, and formaldehyde, which are the building blocks for many other chemical products. Methanol is a gasoline additive or gasoline replacement. Additionally, methanol and isobutylene react chemically with an acidic ion-exchange resin to create methyl tertiary butyl ether (MTBE), an oxygenated fuel additive used to increase the octane number of gasoline.

LPG FILLING STATION TYPES AND THEIR USES

STORAGE TANK

This bulk LPG storage is equipped and specifically made to be attached to the pumping unit type, holding about 11500 or 22000 litres of LPG.

Characteristics:

The 1900mm-diameter LPG elliptic cigar tank is intended for the storage of butane, propane, or LPG mixture (tanks of different capacities can be considered),16 bar working pressure, and 24 bar test pressure. The tank has these features:

- **Safety valves - 85% is the maximum fill level**
- **Magnetometer**
- **Manhole and standard plumbing (liquid filling, return, liquid pumping, excess return, purge etc.)**

- Special fixations to attach and connect the SB2A or SB2B pumping unit.
- 1 big filter with a 40 mesh opening.

Installation of the storage skid will require placing it on horizontal concrete foundations.

Programme and Display Pad for Electronics

Each scale is outfitted with an electrical gadget that displays the primary. It is possible to enter the kinds of cylinders that would be used locally. The operator can choose from a variety of filling procedures in this manner based on the cylinder to be filled type. Additionally, this enables the calculator to determine the sort of cylinder that needs to be filled and avoid overfilling and underfilling. The operator has the option to predetermine the price at which the cylinder will be filled. So, a customer can request to fill his cylinder based on how much cash he has.

Enclosed Cylinder Filling Skid Type, Single or Double

This skid is made of an aluminium sheet on hinges with a steel frame that can be padlocked to secure the following apparatus:

- 1 ATEX-certified fluorescent lamp

- 1 or 2 electronic cylinder filling scales with display pads and electronic programmes for filling between 2.5 and 50 kg cylinders
- NEW: 1 electronic filling scale for filling of 2.5 to 50 kg with an electronic programme and display pad.
- 1 Autogas filling pod and 4 cylinders
- Leak detector: 1

Autogas filling

It's a recent development, 50Kg or up to two automobiles. On the control panel, there is a filling mode choice to pick from. Filling a cylinder and an automobile. For automobiles, there are two filling options:

- Manual filling (Filling ceases when the vehicle's tank is full automatically)
- Automatic filling (Operator selects volume and fills automatically

When this volume is reached, filling immediately terminates. The total pricing is shown with these 2 programmes. The autogas filling POD further contains:

- 1x PD metre with air purge
- 1 pressure gauge to show the line pressure on the car.
- 1 break-away coupling, which secures the installation in the event of an sudden movement of the vehicle while being refilled).
- 1 piece flexible hose (DN13 Length 5m)
- One (1) autogas filling nozzle.

KEY FUELLING STATION COMPONENTS

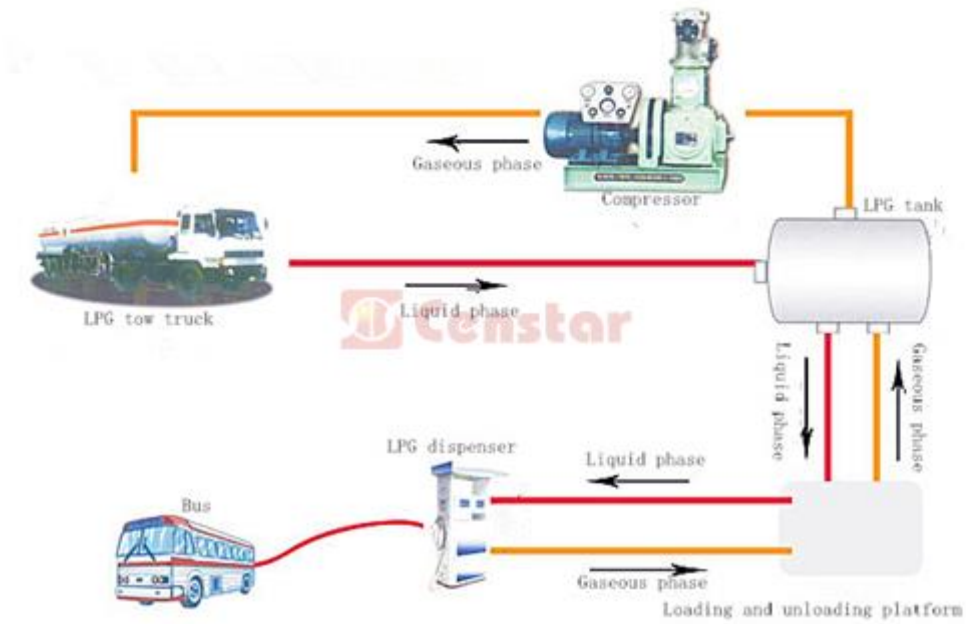
Main layouts for LPG Filling Stations;

- LPG pump or compressor
- Storage tank

Dispenser of LPG Technical Specifications

The creation of such stations must provide these specifications;

- Gas station dimensions
- Local customs, laws, and requirements
- Configuration of the equipment
- Project blueprint



The following components should be present in an entire LPG filling station: the tank area (tank, raffinate, ladder, protective wall, etc.); the compressor room (compressor and related motor); the steam tank loading and unloading station; the variable distribution room; the variable power distribution equipment; and the island (filling machine, etc.); the lightning tower; the fire facilities; and the office and residential buildings.

Procedural flow

Receiving (loading and unloading truck)

The liquefied petroleum gas is discharged into the tank using a compressor and other equipment after being transferred from the gas source plant to the storage facility. Liquefied petroleum gas

is pressured with a hydrocarbon pump as it travels through the pipeline from the gas supply plant to the storage station, where it is filtered and metered before being added to the tank.

Method of Filling

LPG car for gas, tank liquefied petroleum gas delivered to the gas island under pressure from a hydrocarbon pump, and gas filling device.

Recovery and Treatment of Residues

The residual liquid recovery system recovers the residual liquid and fills the residual liquid filling. The vacuum approach is presently utilised more often for residue recovery.

Station Security for LPG

Common Security Risks at LPG Stations

Risks to the security of LPG stations include:

- The fire pool's lighting
- The separation between the living space and the production space does not adhere to the specifications
- There are numerous issues with the tank's construction in the tank area; the sewage discharge outlet is located in the tank area
- Between the tank and the station area fence, there is ample fire suppression;
- There is not enough room between the tanks
- a spare liquefied petroleum gas pump is not installed, there are no residual liquid reclamation and treatment mechanisms, and

- There is no emergency cutting system available
- The fire power supply falls short of the requirements
- The pressure conditions in the bottle workshop are not explosion-proof; owners and operators are aware of fire safety, etc.

Aerated Safety Protocols: Safety Procedures

1) The fraudster must be a certificate holder and has an understanding of LPG and fire.

2) Positioning an aerated car, performing a cheat check to ensure that the engine is off, and disengaging the handbrake.

3) The inflatable officer shall ask the driver to open the vehicle's back cover so that they can examine the container's usage term and label requirements before the changed vehicle is used on the road. Check the surface metre, valves, and pipelines to see if there is a gas leak or other anomalous circumstances using the look, listen, sniff, and other ways. The driver of a non-modified vehicle should be obliged to assist with the aforementioned work.

4) The cheater to certify the solid after inspecting the air gun and the vehicle fuelling connection. The filling pipe must not pass over and wrap around other apparatus.

5) The maximum amount of LPG gas filling must not exceed 85% of the volume of the car tank container or the provisions of the red line. The maximum amount of CNG gas filling must not exceed 20MPa.

6) The inflatable officer should keep an eye on the driver to make sure they don't use the brush to clean the car or the engine's front cover to make repairs.

7) The infiltrator must quickly close the vehicle cylinder valve and press the on-site emergency close button if gas is leaking during the filling operation in order to keep the leakage to a minimum.

8) Remove the air gun and store it properly after the gas has stopped.

9) Filling has to be done in the car; the code can't even be filled in the car. Mobile phones and other portable communication devices are not permitted in the filling area.

10) Filling operations, the filling officer is absolutely banned to the air gun to the customer operation, prohibit one person to operate two gas guns, shall not leave the vehicle is being inflated.

11) Filling station activities should be discontinued in the event of severe lightning, measuring equipment failure, or other conditions that make it impossible to ensure the safety and ongoing operation of the gas station.