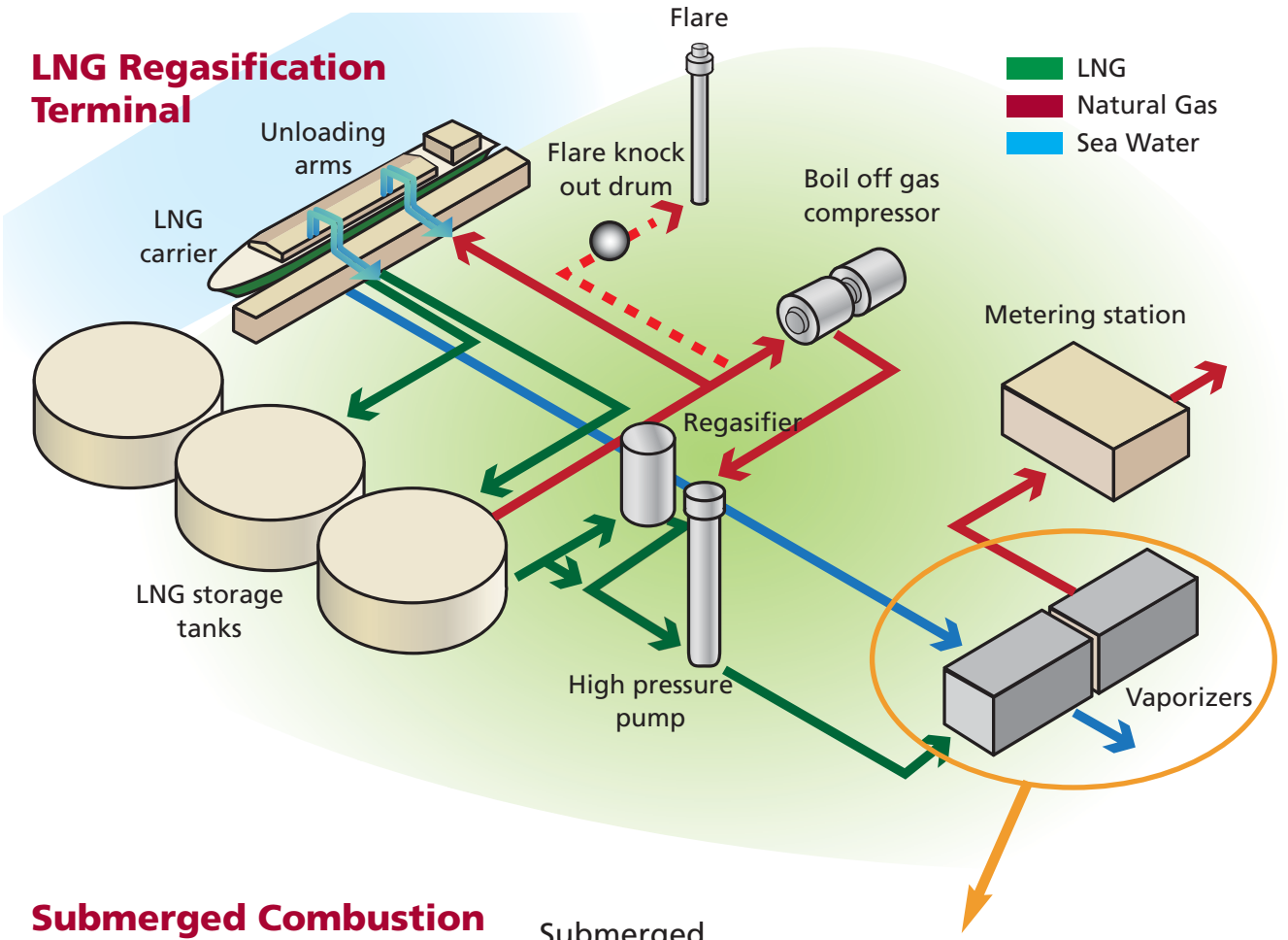
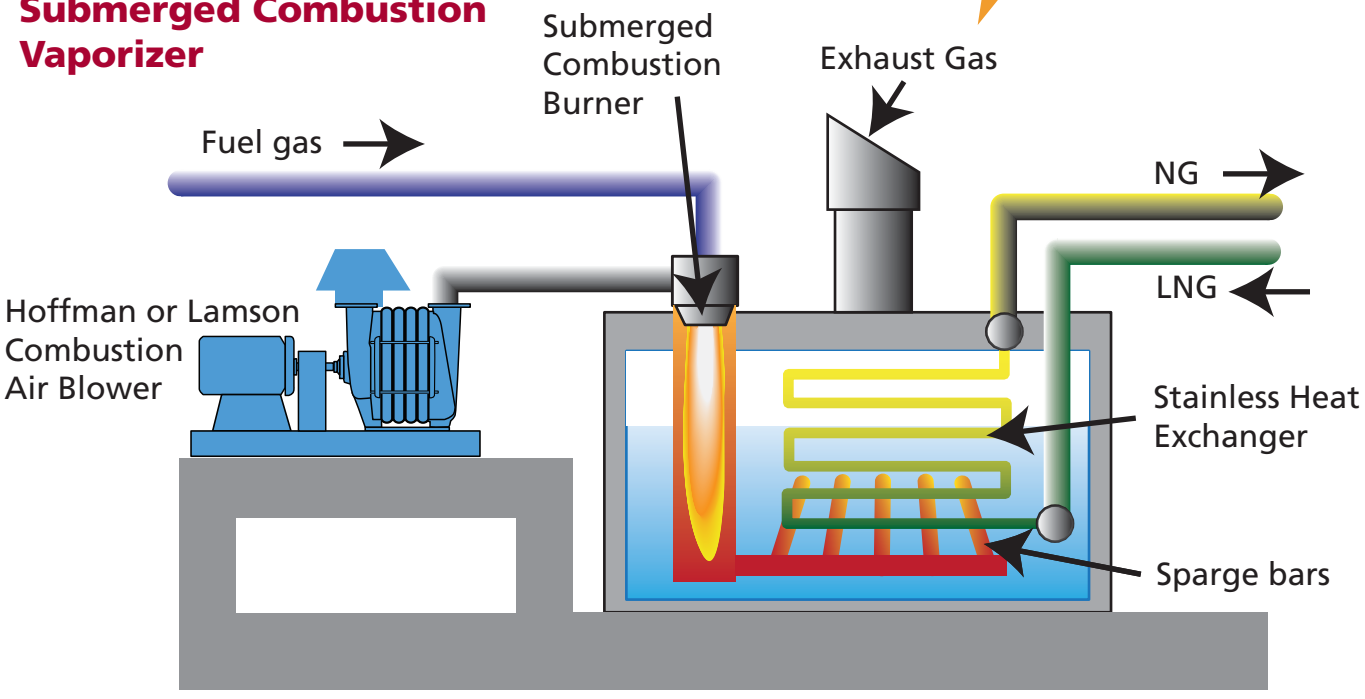
Submerged Combustion Vaporizers (SCV)

HOFFMAN LAMSON
by Gardner Denver

LNG Regasification Terminal



Submerged Combustion Vaporizer



Process Description

To reduce the volume of natural gas for transporting, the gas is liquefied and loaded into specially designed ships. The liquefied natural gas (LNG) is unloaded at its destination at a regasification terminal, where it is re-vaporized and distributed to the natural gas pipeline.

1 The natural gas is chilled to -260 ˚F (-162 ˚C) at 14.7 psia (1 bar) which reduces the volume by 600 times. The ships are unloaded within 24 hours at the terminal. The LNG is piped by pumps on the ships to the tanks located on land via unloading arms. Any warming that occurs during the unloading causes "boil-off gases" that are immediately reliquified in a recondenser before going to the terminal storage tanks.

2 LNG is stored in tanks. Loading and unloading is carried out through the tops of the tanks.

3 Boil-off vapors, produced in the storage tanks, are sent through a collector to compressors. Depending on circumstances,the vapors can be sent to:
- LNG carrer to compensate the pressure during the unloading of LNG
- Recondenser, where it condenses into subcooled LNG
- Fuel gas system
- Flare

4 LNG is pumped through the collectors, which send it to the recondenser. There, the compressed boil-off gas is condensed with the LNG and is piped to secondary pumps where the pressure is raised to 80 bar G.

5 **Submerged Combustion Vaporizers**

Submerged combustion takes place when the hot gas or fuel oil combustion gases are released under the surface of a liquid. This way, the energy released by the process is transferred by direct contact with the liquid. In the submerged combustion vaporizer, water acts as the heat transfer agent.

Although it is possible for the burner itself to be submerged, most systems are arranged with the burner above the liquid level and an exhaust system that is submerged.

A major application of submerged combustion is the vaporization of liquid cryogens such as nitrogen, oxygen, natural gas (LNG), petroleum gas (LPG), ethylene and ammonia. These fluids are often transported as liquid but are required for use as a gas. Because of safety requirements, indirect heat transfer is often essential.

A submerged combustion vaporizer system includes:
- burner(s)
- a high temperature flue gas distributor or a downcomer
- a bath/exchanger section
- a concrete pit or metal tank
- an exit stack

The hot combustion product, after leaving the high heat release burner, is exhausted through either a downcomer or distributed into the spargers, providing direct contact heating of the water bath. After leaving the bath tank, the flue gas enters a disengagement section to remove, by gravity, the larger water droplets before it exits the stack.

The design of submerged combustion vaporizer is dependent on several operating parameters, such as process fluid, flow rates, temperatures, pressures and viscosity. In the USA, LNG facilities are subject to insurance, federal, state and local regulations, ASME pressure codes and National Fire Protection Association (NFPA) standards. Typical airflow is in the 26,000 scfm range, and pressure is 100-120 "wcg (3.5-4.5 psig).

Other methods of regasifying are Open Rack Vaporization (ORV) and Intermediate Fluid Vaporizers (IFV), which both use seawater for warming, Ambient Air Vaporizer (AAV) and Heating Water Tower Vaporization (HWTV). Only Submerged Combustion Vaporizers (SCV) require air blowers. Most alternate technologies do install some SCV's as back-up to the main technologies. This is especially true of Ambient Air Vaporizers.

6 The natural gas produced in the vaporizers is sent through through a measuring station.

7 The sea water used in the vaporizers is captured by pumps for reuse.

Hoffman & Lamson Advantages

While fans are often used in this application, multistage centrifugal blowers are recognized for their longevity and reliability.

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