Systems and Methods for Transporting Natural Gas

Background

[0001] This section is intended to provide relevant background information to facilitate a better understanding of the various aspects of the described embodiments. Accordingly, it should be understood that these statements are to be read in this light and not as admissions of prior art.

[0002] The need for transportation of gas has increased as gas resources have been established around the globe. Traditionally, only a few methods have proved viable in transporting gas from these remote locations to places where the gas can be used directly or processed into commercial products. The typical method is to simply build a pipeline to transport the gas directly to a desired location. However, building a pipeline is, in many cases, not possible due to environmental, geopolitical or economic constraints

[0003] Due to the limitations of pipelines, other transportation methods have emerged, such as transporting natural gas in a liquid state. However, natural gas must be treated and cooled to -160°C (-256°F) to be liquefied. The liquefied natural gas ("LNG") must then be maintained at -160°C (-256°F) during transportation. Specialized materials and equipment must be used due to the temperatures involved with producing and storing LNG, increasing the cost to transport the natural gas. Additionally, LNG must be regasified once it reaches its destination, further increasing the costs involved with transporting LNG.

[0004] Further, existing methods of transporting compressed natural gas ("CNG") may require compression, chilling, and/or heating at each location where the CNG is transferred from one storage containment system to another storage containment system. Therefore, costly equipment is required at each storage location to perform these operations when transporting and storing CNG.

Summary

[0004a] According to a first aspect of the present disclosure, there is provided a system for transporting natural gas, the system including: a loading facility operable to receive, compress, and chill natural gas to a temperature at or below 0°C (32°F) and a pressure at or above 8,274 kPa (1,200 pounds per square inch ("psi")) while maintaining the natural

gas in a gaseous state, the loading facility further operable to transfer the chilled compressed natural gas ("CNG") at a constant flowrate while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi); a first storage system operable to receive chilled CNG from the loading facility at the constant flowrate, store the chilled CNG, and transfer the chilled CNG while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi); a second storage system operable to receive and store the chilled CNG while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi); a CNG carrier operable to receive chilled CNG from the first storage system, transport the chilled CNG, and transfer the chilled CNG to the second storage system while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi); and wherein the system is sized such that the constant flowrate from the loading facility to the first storage system is maintained without interruption.

[0004b] According to a second aspect of the present disclosure, there is provided a system for transporting natural gas, the system including: a floating gas production, storage, and offloading facility ("FGPSO") including: a loading facility operable to receive, compress, and chill natural gas to a temperature at or below 0°C (32°F) and a pressure at or above 8,274 kPa (1,200 psi), the loading facility further operable to transfer the chilled CNG at a constant flowrate while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi); and a first storage system operable to receive chilled CNG from the loading facility at the constant flowrate, store the chilled CNG, and transfer the chilled CNG while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi); a second storage system operable to receive and store the chilled CNG while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi); a CNG carrier operable to receive chilled CNG from the first storage system, transport the chilled CNG, and transfer the chilled CNG to the second storage system while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi); an offloading facility operable to receive, heat, decompress, and offload the chilled CNG into a pipeline, wherein the second storage system is further operable to transfer the chilled CNG to the offloading facility; and wherein the system is sized such that the constant flowrate from the loading facility to the first storage system is maintained without interruption.

[0004c] According to a third aspect of the present disclosure, there is provided a method of transporting natural gas, the method including: chilling and compressing the natural gas received at a loading facility at a constant flowrate to a temperature at or below 0°C (32°F) and a pressure at or above 8,274 kPa (1,200 psi) while maintaining the chilled CNG in a gaseous state; then transporting the chilled CNG to a first storage system at the constant flowrate while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi); then transferring the chilled CNG from the first storage system to a CNG carrier while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi) such that the flowrate from the loading facility to the first storage system is maintained without interruption; and then transferring the chilled CNG from the CNG carrier to a second storage system while maintaining the chilled CNG in a gaseous state at or below 0°C (32°F) and at or above 8,274 kPa (1,200 psi).

Brief Description of the Drawings

[0005] The present disclosure is described with reference to the following figures. The same numbers are used throughout the figures to reference like features and components. The features depicted in the figures are not necessarily shown to scale. Certain features may be shown exaggerated in scale or in somewhat schematic form, and some details of elements may not be shown in the interest of clarity and conciseness.