CLAIMS

1. A process for removing contaminants from a gaseous feed stream, the process comprising:

a) performing one or more adsorption steps; wherein each of the one or more adsorption steps comprises passing a gaseous feed stream at a feed pressure and a feed temperature through an adsorbent bed unit to separate one or more contaminants from the gaseous feed stream to form a product stream;

b) performing one or more depressurization steps, wherein the pressure of the adsorbent bed unit is reduced by a predetermined amount with each successive depressurization step;

c) performing one or more purge steps, wherein each of the one or more purge steps comprise passing a purge stream into the adsorbent bed unit, wherein the purge stream flows countercurrent to the direction of the feed stream, the purge stream is provided at a temperature at least 50°F. above the feed temperature and less than 450°F and the purge stream flow rate is equal to or less than 20 molar % of the feed stream flow rate;

d) performing one or more re-pressurization steps, wherein the pressure within the adsorbent bed unit is increased with each re-pressurization step by a predetermined amount with each successive re-pressurization step; and

e) repeating the steps a) to d) for at least one additional cycle, wherein the cycle duration is for a period greater than 1 second and less than 600 seconds.

2. The process of claim 1, wherein the purge stream is provided in a range between 200°F and 450°F.

3. The process of claim 1, wherein the purge stream is provided in a range between 250°F and 380°F.

4. The process of claim 1, wherein the gaseous feed stream is a hydrocarbon containing stream having greater than one volume percent hydrocarbons based on the total volume of the gaseous feed stream.

5. The process of claim 1, wherein the gaseous feed stream comprises hydrocarbons and H_2O, wherein the H_2O is in the range of 0.2 parts per million volume to saturation levels in the gaseous feed stream.

6. The process of claim 1, wherein the gaseous feed stream comprises hydrocarbons and H_2O, wherein the H_2O is in the range of 100 parts per million volume to 1500 parts per million volume.

7. The process of claim 1, further comprising passing an input stream through a contamination removal unit to form the gaseous feed stream, wherein the contamination removal unit is configured to lower the carbon dioxide (CO_2) level to less than 100 parts per million and the hydrogen sulfide (H_2S) level to less than 4 parts per million.

8. The process of claim 1, further comprising heating the gaseous feed stream to be above the dew point of water.

9. The process of claim 8, wherein heating the gas feed stream to be above the dew point of water further comprises: passing the gaseous feed stream through a first heat exchanger to lower the

temperature of the gaseous feed stream; conducting away a portion of the H_2O from the gaseous feed stream; and passing the gaseous feed stream to a second heat exchanger to increase the temperature of the gaseous feed stream.

10. The process of claim 1, further comprising: passing the product stream from the adsorbent bed unit to a liquefied natural gas process unit; and separating a flash fuel stream of high purity methane from the LNG process unit to be utilized as at least a portion of the purge stream.

11. The process of claim 1, wherein the feed pressure is in the range between 400 pounds per square inch absolute (psia) and 1,400 psia.

12. The process of claim 1, wherein the cycle duration is greater than 2 seconds and less than 300 seconds.

13. The process of claim 1, wherein at the end of the duration of the purge step, the concentration of water adsorbed on the adsorbent bed is at least 40% of the concentration of water adsorbed on the adsorbent bed at the end of the duration of adsorption step.

14. The process of claim 1, wherein the adsorbent bed unit comprises an adsorbent bed, wherein the H_2O loading for a product region near a product end of the adsorbent bed is less than 0.5 mole per kilogram.

15. The process of claim 14, wherein the product region is a specific portion of the adsorbent bed from the product end of the adsorbent bed to 25% of the bed length.

16. The process of claim 1, wherein the purge stream includes equal to or less than 10 molar % of methane present in the feed stream.

17. A system for removing contaminants from a gaseous feed stream, the system comprising: an adsorbent bed unit configured to separate contaminants from a gaseous feed stream and to output a product stream, wherein the gaseous feed stream is provided at a feed temperature; a liquefied natural gas process unit configured to receive the product stream and separate the product stream into a final product stream and a flash fuel stream of high purity methane; and one or more purge units configured to provide a purge stream to the adsorbent bed unit, wherein the purge stream is provided from one of a portion of the product stream, the flash fuel stream of high purity methane, and any combination thereof; and wherein the purge stream is provided at a temperature at least 50°F above the feed temperature and less than 450°F and the purge stream contains equal to or less than 20 molar % of hydrocarbons in the gaseous feed stream; further comprising: a first heat exchanger configured to receive the gaseous feed stream; to lower the temperature of the gaseous feed stream; and to conduct away a portion of H_2O from the gaseous feed stream; and a second heat exchanger to increase the temperature of the gaseous feed stream from the first heat exchanger.

18. The system claim 17, further comprising a contamination removal unit configured to receive an input stream and form the gaseous feed stream, wherein the contamination removal unit is configured to lower the carbon dioxide (CO_2) level to less than 100 parts per million and the hydrogen sulfide (H_2S) level to less than 4 parts per million.

19. The system of claim 17, further comprising a purge heat exchanger configured to receive the purge output stream from the adsorbent bed unit during a purge step; to lower the temperature of the purge output stream; and to conduct away a portion of the H_2O from the purge output stream.

20. The system of claim 17, wherein the water content of the product stream is less than 1 parts per

million volume.

21. The system of claim 17, wherein the one or more purge units comprise one or more compressors configured to compress the flash fuel stream of high purity methane.