April 10, 2019 Meeting

The April 10, 2019 Waterloo Technical Society (WTS) meeting was called to order by Vice President Stevenson at 7:40 pm. Vice President Stevenson welcomed visitors and noted that this was the seventh meeting of the 105th year of the Society.

A total of 34 members and guests attended.

Treasurer's Report. Ken Friend reported a beginning balance of $837.17. No income from memberships with expenses of $60.00 for the March speaker's meal leaving a new balance of $777.47. Treasurer Friend's report stated a total of 8 honorary and 40 paid members yielding a membership roster of 48 members.

Slate of Officers. Officers for the 2019-2020 year (year 106) were presented:

President:	Open
Co-Vice Presidents:	Jerry Mohling and James Stevenson
Treasurer:	Kenneth Friend & Paul Anderson
Dinner Reservations:	Derek Eagles & Steve Lang
Secretary:	James Stevenson
Publicity/Recognition:	Jim Volgarino
Auditing:	Bill Mitchell & Jim Garrett
Nominating Committee:	Ralph Marrero
Web Site:	Tim Schoenfelder

This slate will be sent to all members and friends of WTS to solicit a volunteer for President. A vote on the slate is scheduled for the May 8, 2019 meeting.

Old Business. The topics for this year were reviewed. The dates, speaker and topics for the 105th WTS are:
Speakers for the 2018-2019 Meeting Year (Year 105)

12 Sep 2018—Austin Maginnis—Tiny House Project at UNI

10 Oct 2018 – Steve Lang – Early Electronic Digital Computers

14 Nov 2018 – Jim Volgarino – History of Tunis Speedway

9 Jan 2019 – Chuck Nielson – Airgas Gas Supply

13 Feb 2019 – Chad Emerson – Emerson Crane

13 Mar 2019 – Vasko Popovski – Aspects of Heat Treatment in Firearm Components, AHT (Mike Woods)

10 Apr 2019 – Mark Albright and Tom Pfiffner -- MidAmerica Energy, LNG

8 May 2019 – Doug Schindel – Highway 58 and Viking Road Intersection Reconstruction, AECOM Engineering Services, Waterloo, IA (Architecture, Engineering, Construction and Operations Management)

Discussion on the May 2018 motion to donate $250 to Tiny House Program at UNI concluded with a decision to identify where donations have been made and prioritize alternatives for donations for action at the November 14, 2018 meeting. President ProTem Stevenson and Treasurer Friend are to make a list and members to identify

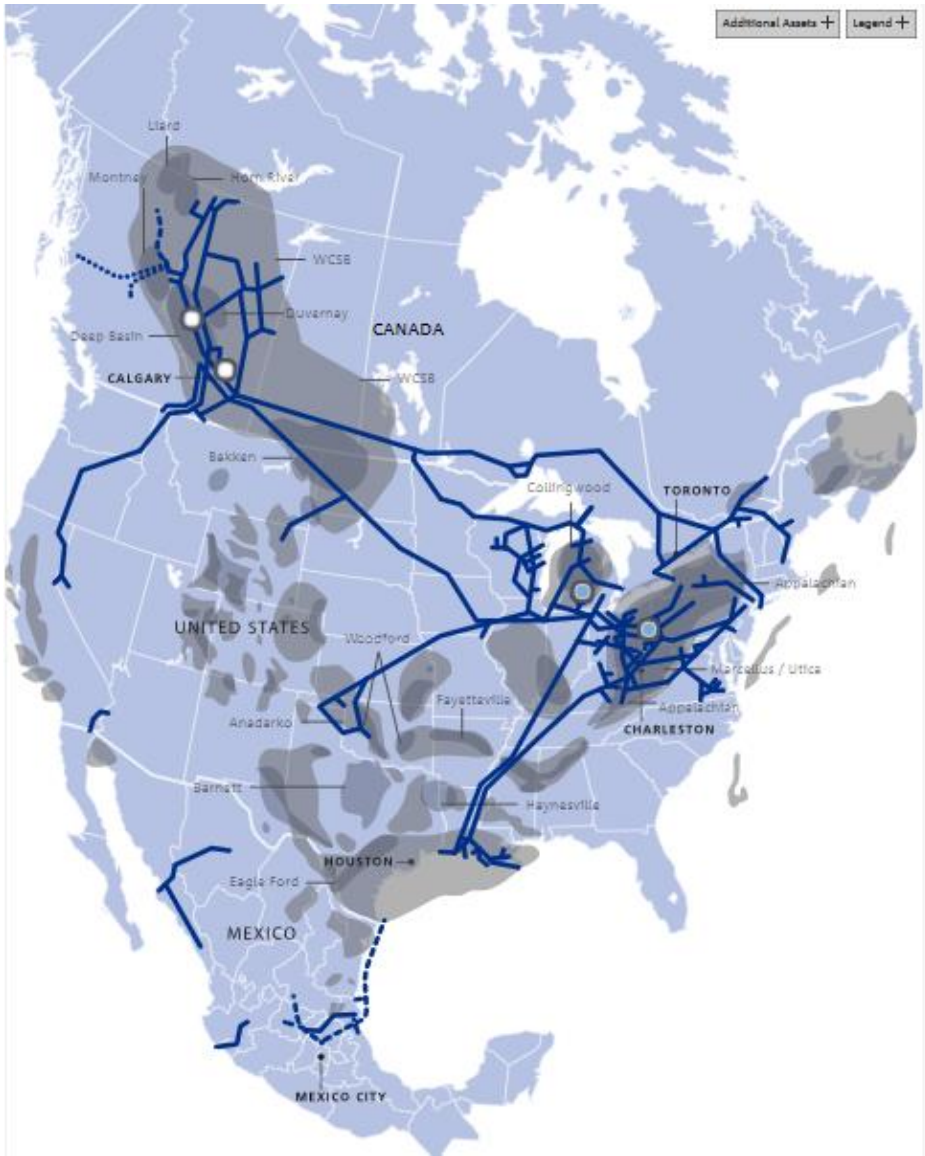
possible recipients. Item tabled until the January 2019 meeting. No discussion on this topic. Tabled until May 8, 2019 meeting.

New Business. No new business discussed.

Guest Speaker. **Mark Albright**, P.E. BSME 1989, Iowa State University, has 29 years' experience in the Electric and Gas Utility industry in the areas of Gas Production, Electric Generation, Electric Distribution, Electric Transmission Operations and Electric Generation Operations and Marketing. In addition, he is a Licensed Professional Engineer in Iowa and is a NERC Certified System Operator at the Reliability Coordinator level. Mark serves as Chairman of the Central Iowa Chapter, ASME.

Tom Pfiffner, Senior Plant Technical Specialist. Has 22 years in the utility industry; 19 at the UNI power plant and the last 3 at Midamerican Energy Co. He has been at the Waterloo LNG plant for the last 18 months. He has 30 years as a licensed journeyman electrician, with extensive experience in industrial controls and automation. Tom is a lifelong Black Hawk county resident, and a member of WTS for about 5 years.

Mark and Tom addressed the topic of **Liquified Natural Gas**. Mark Albright and Tom Pfiffner presented information on Liquefied Natural Gas (LNG). Mark presented information about the LNG industry, the various processes used to liquefy and re-gassify natural gas, store and transport it as a liquid, described facilities involved, and identified the reasons for turning it into a liquid in the first place. Tom shared more detailed information about Midamerican's LNG plant in Waterloo, where he works as the technical specialist. Midamerican also has similar LNG plants in Des Moines and Bettendorf, and Northern Natural Gas has one near Garner Iowa.



What is LNG? Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane, but commonly including varying amounts of other higher alkanes, and sometimes a small percentage of carbon dioxide, nitrogen,

water vapor, hydrogen sulfide, or helium. It is formed when layers of decomposing plant and animal matter are exposed to intense heat and pressure under the surface of the earth over millions of years. The energy that the plants originally obtained from the sun is stored in the form of chemical bonds in the gas. Natural gas is a naturally occurring hydrocarbon used as a source of energy for heating, cooking, and electricity generation. It is also used as a fuel for vehicles and as a chemical feedstock in the manufacture of plastics and other commercially important organic chemicals. Natural gas is called a non-renewable resource.

At -253° F natural gas boils from liquid to gas. The volume change from gas to liquid is 620:1. This makes LNG a good way to store natural gas. Peak-shaving, storing during periods of low usage such as summer months then removing from storage during peak usage in the winter months, is the primary reason for processing natural gas by MidAmerican. There are no natural gas caverns in Iowa, all comes from pipelines at 400 psi which the Waterloo plant has to step down to 345 psi for processing. In order to transport natural gas to export markets, plants in Maryland and Louisiana liquefy the gas and bleed a small amount to atmosphere to keep the vessel at -250° F. During the 1970s there was a gas curtailment because the U.S. was running out of known gas reserves. With fracking came the ability to release natural gas from shale, making the U.S. an exporter of LNG.

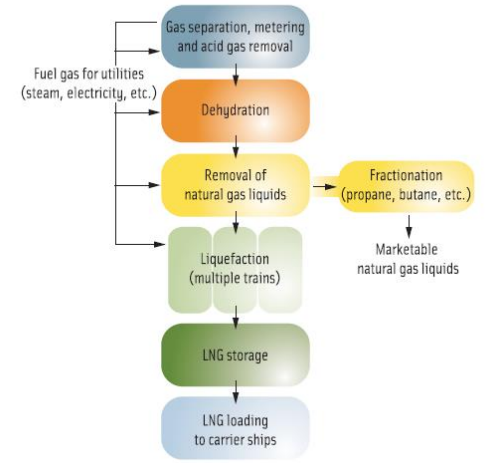
The gas is liquefied for storage and shipping by a four-step process:

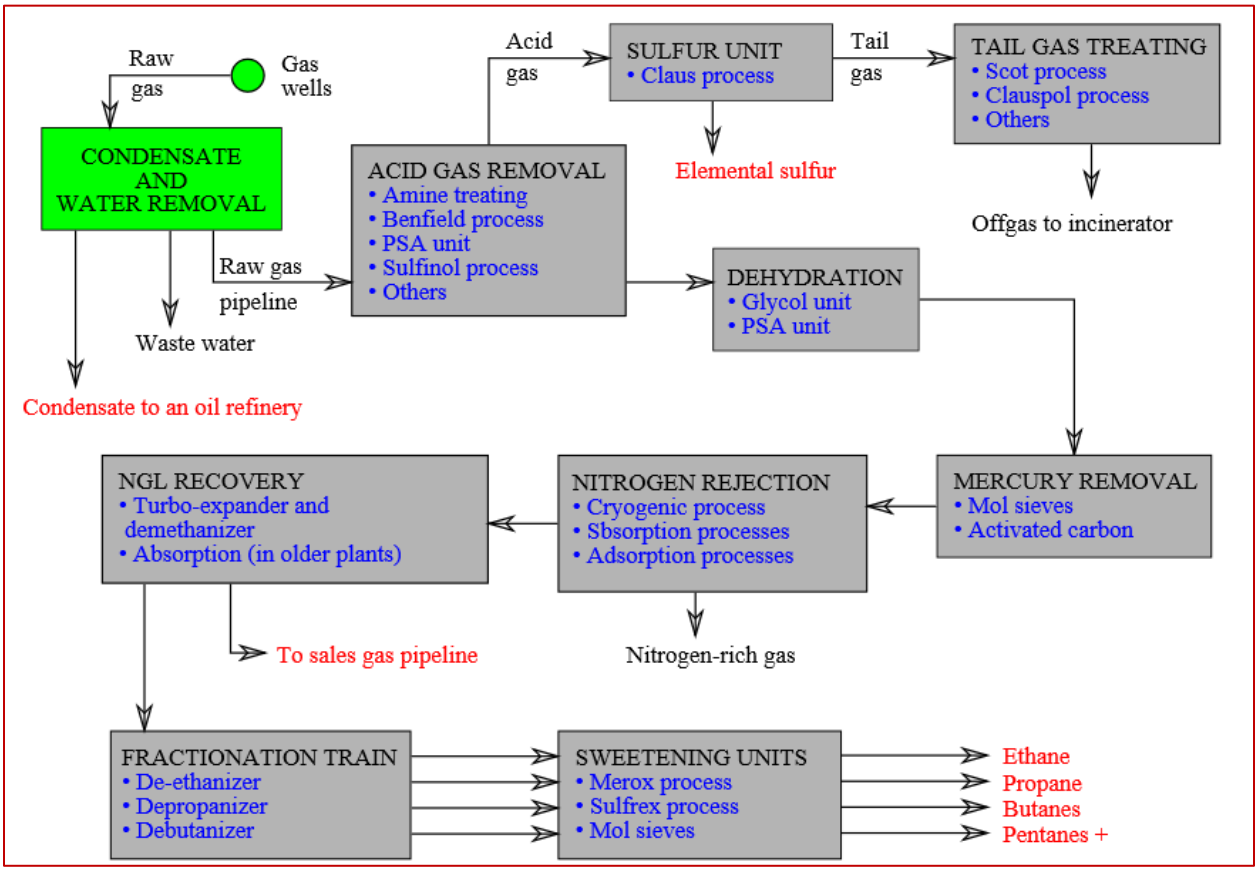
1. Purification,
2. Liquification,
3. Storage, and
4. Vaporization

<u>Purification:</u> The image below is a schematic block flow diagram of a typical natural gas processing plant. It shows the various unit processes used to convert raw natural gas into sales gas pipelined to the end user markets.

The block flow diagram also shows how processing of the raw natural gas yields byproduct sulfur, byproduct ethane, and natural gas liquids (NGL) propane, butanes and natural gasoline (denoted as pentanes).

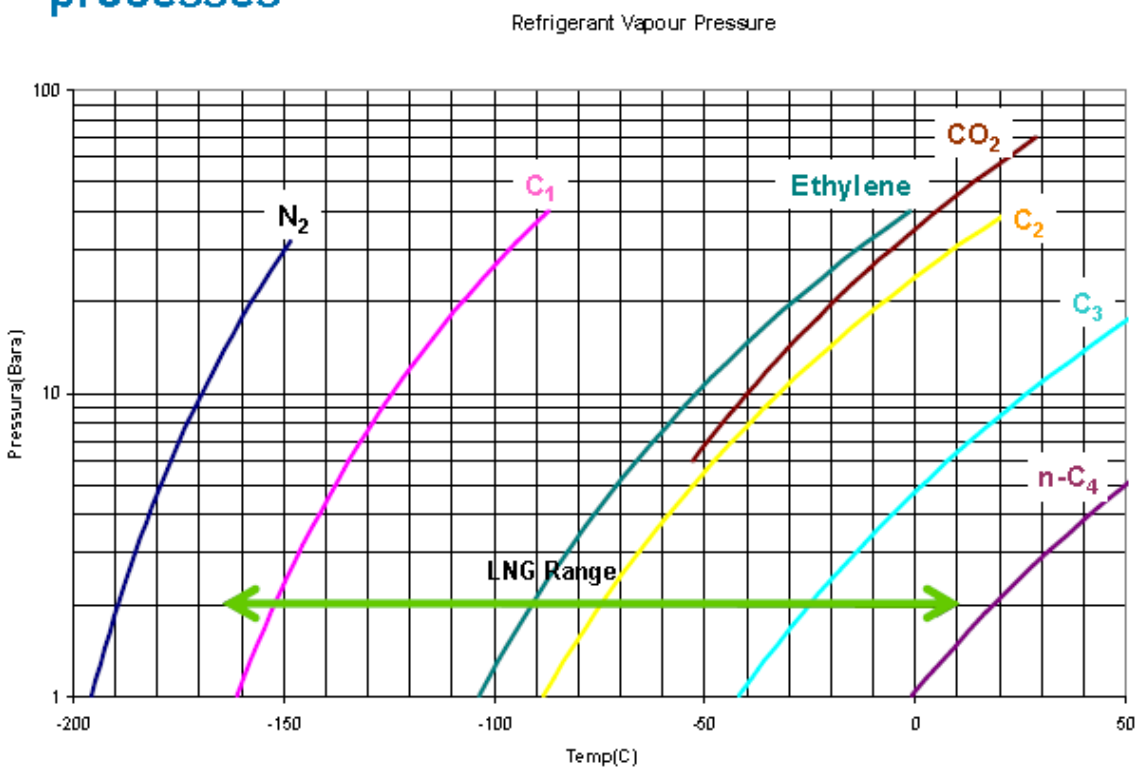
Components of an LNG liquefaction plant.



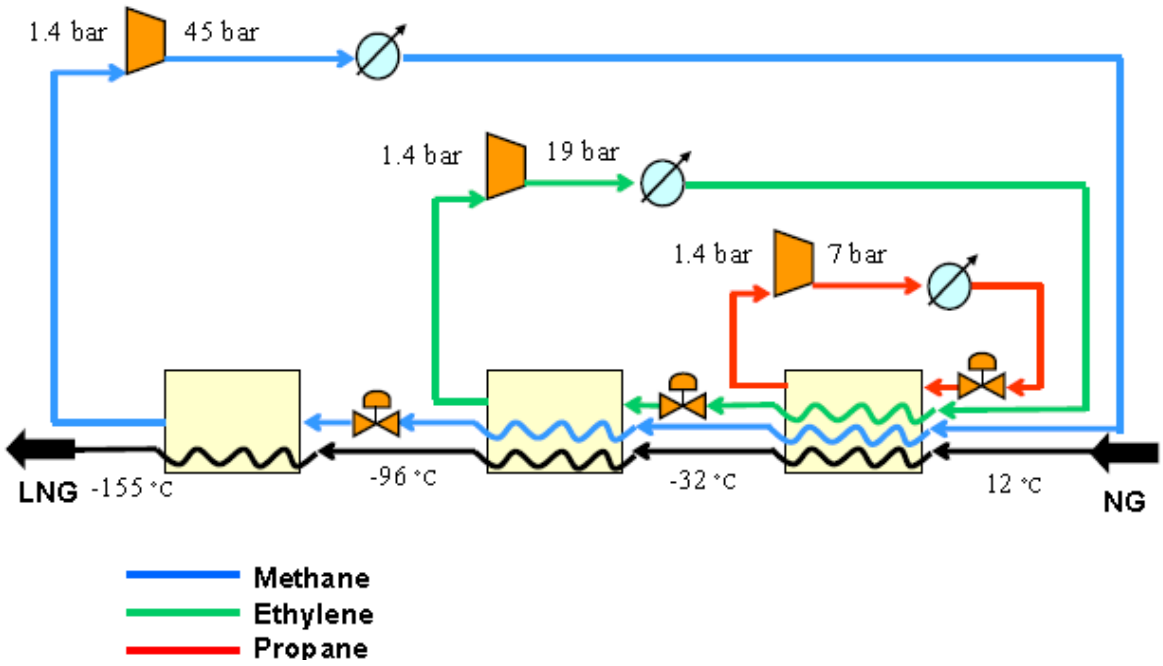


Liquification: Gas must be cooled to get purified LNG. When cooling, carbon dioxide is sent to City of Waterloo as tail gas. Carbon dioxide freezes into a solid above the boiling point of most gases in natural gas. This means that dry ice can clog the delivery lines of the process. The liquification process is done in stages, getting ever cooler as the process continues. The following illustration shows the general liquification process and removal of selected fuel gases as the process proceeds.

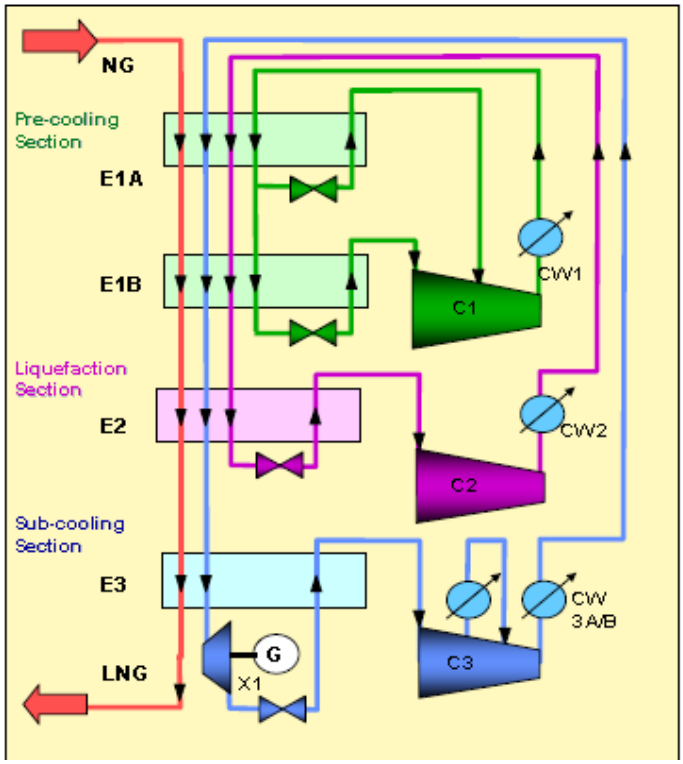
Vapour pressure of pure fluids relevant for LNG processes



Cascade process for natural gas liquefaction



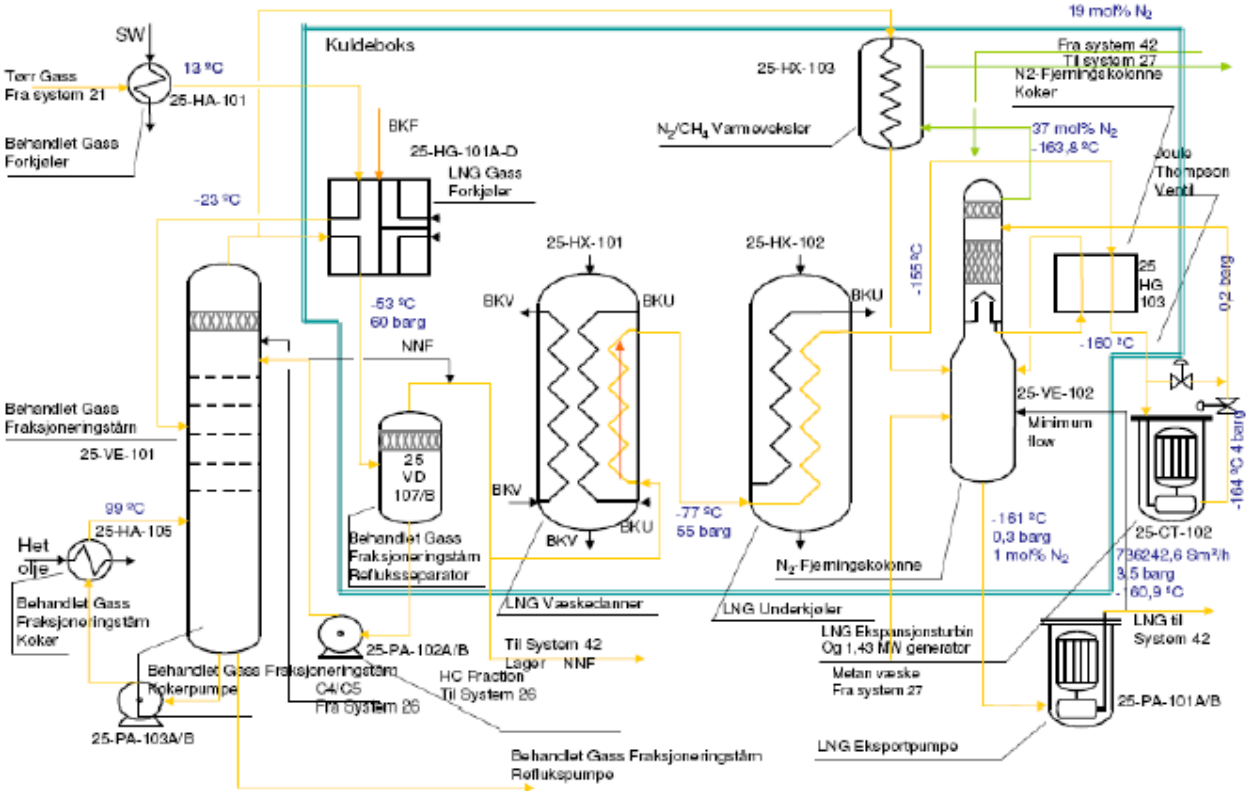
Mixed Fluid Cascade (MFC®) process (Linde-Statoil)



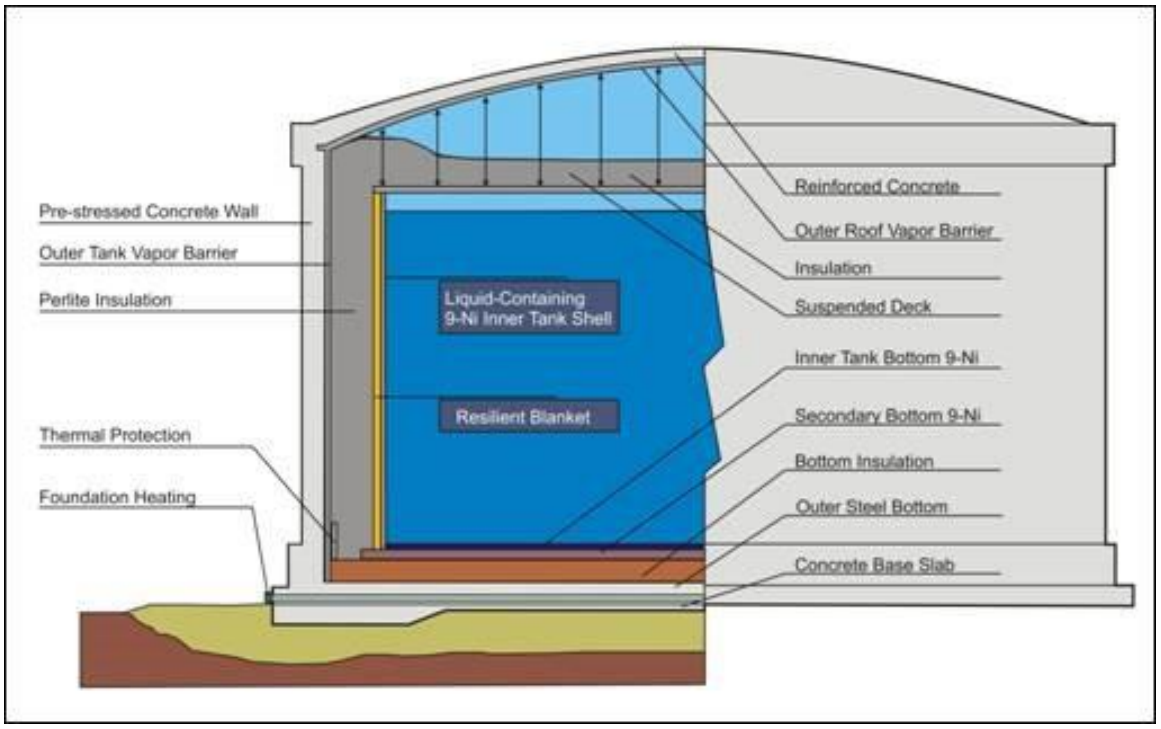
- *Three mixed refrigerant circuits*
  - *Precooling (Mainly: C_2, C_3)*
  - *Liquefaction (Mainly: C_1, C_2, C_3)*
  - *Subcooling (Mainly: N_2, C_1, C_2)*
- *Cascade connection of the circuits*
- *Precooling in two (sometimes three) stages*
- *No fractionation of the mixed refrigerant flows*
- *Expander on subcooling cycle*

A mixed refrigeration loop uses six liquids to pass through expansion valves to absorb the heat in the Methane gas that is desired. The first is Nitrogen, then Methane itself, next Ethylene, then Propane, followed by Butane and finally Pentane refrigerant to end with -260° F LNG.

Natural gas circuiting



Storage: Storage tanks are large thermoses. The outer tank is separated by an insulating perlite layer. The inner tank stores the liquefied natural gas which is under a low, 1.0-1.5 psi pressure due to a small amount of vaporization. To keep the ground from freezing and heaving, the base of the tank is heated to maintain the ground above freezing while the LNG is at -260° F.



Vaporization: LNG is converted to vapor again during the times of peak demand, usually in winter from November to April in the northern hemisphere. Some LNG is exported in tankers to Europe and other places. A small amount of the LNG bleeds off in order to keep the whole at -260° F.



Courtesy of Kawasaki Heavy Industries

Meeting adjourned at 9:20 pm.

Next Meeting. The next meeting will be May 8, 2019. Doug Schindel, AECOM, will speak about IA58 and IA27 intersection with Viking Road Reconstruction.

Respectfully submitted,

James R. Stevenson, Vice President and Secretary