By: RAMA CHALLA
Director of AST and Specialty Vessels Business Unit
Matrix PDM Engineering

Introducing cryogenic storage tanks for membrane containment

It was a new application of existing technology — hydraulic fracturing — that resulted in the U.S. becoming the world leader in natural gas production. Together with other global producers including the Middle East, Africa and Australia, this increase in supply — and the resulting decrease in cost — has resulted in the development of very large LNG export terminals and made construction of import terminals in both developed and developing countries more attractive.

Onshore, natural gas is stored in complex cryogenic storage tanks. Tank system standards classify them based on the level of containment provided by the system. Single, double and full containment tank systems have been used in the U.S. for cryogenic and refrigerated storage. A fourth is the membrane containment tank system, which uses an integrated system with an inner membrane, providing liquid and vapor tightness and an outer container for structural integrity.

The system has been used for multiple carrier sizes — the largest being the Q-Max LNG carrier with a capacity of 266,000 m^3. The technology is preferred for floating storage regasification units (FSRU) and floating LNG production units, with one technology provider providing the membrane technology being used on 20 new FSRU and three new FLNG builds alone.

Similarly, more than 100 in-ground and aboveground onshore tanks have been built using membrane technology with capacities ranging from less than 100 m^3 to 250,000 m^3. These are used not only for LNG storage but also other products such as liquid propane gas (LPG), ethylene and argon. The tanks are not restricted to cylindrical shapes and have been utilized with other prismatic configurations.

Cryogenic storage is governed by national regulations such as 49 CFR Part 193, which invoke regulatory standards such as NFPA 59A. The regulatory standards refer to standards such as API 625, which in turn utilize supplementary equipment standards and codes such as API 620 and ACI 376. Broadly, the regulatory and tank system standards set performance requirements, with the equipment standards and codes defining prescriptive requirements.

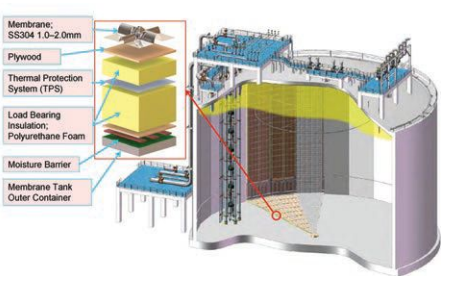
In the U.S., the API Refrigerated Tank Tasks Group (RTTG) has been working for the past two years to incorporate membrane tank systems and components into the API 625 and API 620 standards. Similarly, a working group in American Concrete Institute (ACI) is working on ACI 376.

The technology is proven and safe, based on experience with LNG, LPG and ethylene storage. Conceptually, the membrane tank containment system components are:

- An outer pre-stressed concrete container to resist the LNG hydrostatic and hydrodynamic loads under normal and abnormal conditions.
- A polymeric moisture barrier, applied to the inner surface of the concrete structure, to prevent water and gas migration into the insulation space.
- A corrugated stainless steel membrane to provide liquid and gas tightness under normal operating conditions.
- A liquid tight thermal corner protection system at the bottom annular section to moderate thermal gradients.
- An insulation system with load-bearing reinforced polyurethane foam insulation panels and secured onto the concrete wall with anchoring elements to provide thermal insulation.
- A continuously monitored insulation purge system that maintains the insulation space under a nitrogen purge to be methane gas free and provide effective leak detection.

The technology is mature for application with multiple technology providers providing the technical knowhow and constructors who license the technology to build. Certain vendors perform both functions.

For more information, visit www.matrixpdm.com or call (918) 624-6300.



Membrane tank containment system and components (courtesy GTT).