A 10,000 FOOT OVERVIEW OF TANK CONSTRUCTION

Joe Mentzer from the Steel Tank Institute considers the fundamentals

BUILDING A storage tank is a significant investment that will result in a valuable, long-term asset. Properly built and maintained tanks can remain in service for generations, as evidenced by the STI/SPFA Field Erected Storage Tank Century Club.

Storage tank usage can be flexible provided proper planning and decisions are made from the start. Tanks require ongoing inspection and maintenance, but preparation can minimise resources needed to fulfil these long-term obligations. Careful planning will allow the tank system to adapt to future needs.

CONSIDERATIONS FOR LOCATING TANKS

Sometimes the tank location is obvious, and other times not so much. The location must consider access - how will the user get product to and from the tank now and in the future? Location may be limited by access to roads, rail, or pipelines. Weather can also be a consideration - is the site accessible when it needs to be accessible? Often tanks are located where nothing is currently present, but sometimes there is a reason nothing is there; empty land may be empty for a reason.

Geotechnical conditions, both natural and manmade, can affect possible construction. Site soils must be able to support the weight of the tank and its contents. Items that must be considered include:

- Soil quality
- High groundwater tables
- Abandoned foundations or past construction remnants
- The presence of buried utilities
- Past site contamination

'Allow prospective tank builders to visit the site prior to bidding,' recommends Andy Stetzler, sales manager at Caldwell Tanks. 'As a tank builder, we can accommodate most site conditions and safety considerations.'

To prevent surprises, a thorough site evaluation must be completed. Performing a geotechnical investigation will establish site conditions. The results will determine any improvements needed to provide suitable support for the site.

The amount of space required will depend on the tank's type and size, the secondary containment method selected for the tank, and the space needed for supporting infrastructure such as roads, rail connections, load racks, pumps, valves, and other equipment. At a minimum, there should be 300' (9.14 m) of clear area around the tank for access and supporting equipment.

The area should be free of aboveground and buried utilities. Depending on what is stored inside the tank, the type of utility can require certain setbacks be maintained. It is always good to consider space for future expansion as the surrounding infrastructure can often be used to support more than one tank.

Tanks storing regulated materials generally require secondary containment to provide protection in the event of a failure. Options include:

- Construction of earthen or lined dikes around the tanks, such as:
  - Placing impervious material below the tank
  - Installing a double bottom under the tank to provide containment
- Building the storage tank inside of a slightly larger containment tank. This option can be used when tanks are located in urban areas. It requires the least amount of space, but may also be more expensive.

Another consideration is the construction staging area. Field erected tank construction involves handling large pieces of steel using heavy equipment. These materials must be accessible during the building process. The staging location should be near a highway to facilitate deliveries and allow equipment and materials to arrive at the construction

site. Separation between the staging location and the tank construction site can delay the project.

FUNDAMENTALS OF TANK CONSTRUCTION

Field erected storage tanks are primarily built to API standards, specifically API 650. Tanks are generally vertical and cylindrical, but several configurations are available including:

- Open top
- Fixed roof
- External floating roof
- Internal floating roof
- Zero emissions tank

The type of tank is based on the product stored in the tank. Different arrangements are needed to control the emissions of the material stored in the tank. Open top tanks, for example, expose the contents of the tank to the atmosphere and have limited applications to things like water, whereas fixed roof tanks are used for materials that cannot be exposed to the atmosphere and can store liquids with a low vapor pressure, like oils. Fixed roof tanks are generally limited to storing materials with a vapour pressure of 2.5 psi (17.24 kPa).

Brad Veath, vice president of commercial – Americas at CB&I Storage Solutions says: 'Internal floating roofs limit exposure to extreme weather conditions such as rain, snow, and wind. They eliminate the possibility for lightning strikes and limit product contamination.'

Depending on the tank size and location, the roof can be self-supported or utilise a central column for support. The tank must be able to support the weight of the roof, precipitation, loads from snow, and wind velocity.

Tank size is always an important consideration. Increasing size increases cost; however, the tank should be designed to meet current and future needs. It is important to remember that the capacity of liquid a tank can store is less than the physical capacity of the tank shell. Unused space at the top of the tank can allow for expansion and tank equipment accommodations. Similarly, the bottom of the tank may have an amount of product that remains to allow for space for material to settle out.

Another consideration is the material used to build the tank. The construction standard allows for several material options, including carbon steel, stainless steel, or a combination of both. Each material offers different benefits for compatibility with products stored, corrosion resistance, and accommodations for different operating temperatures.

CORROSION PROTECTION

Considerations for corrosion control are an important component of tank construction. Tank coatings are used to prevent and isolate the tank shell from moisture, interrupting the corrosion process. Coatings are available for the exposed tank exterior, the tank bottom, and the tank interior. The proper selection, preparation, and application of a coating will protect the tank asset for years to come.

If the tank bottom is in contact with the ground and is not accessible to apply a coating, a system to offset the electrical component of the corrosion process can be installed. This can be passively done by connecting the tank shell to a sacrificial component that serves to act as an easier path for the electrical current created by corrosion to find its way to the earth. The anode material offers a less restrictive path and will be consumed by the electrochemical process instead of the steel. The anodes are made of a material with a higher propensity to corrode than steel, like zinc or magnesium.

As an alternate, the tank shell can be connected to an electrical current that offsets the actions of corrosion. This method is known as impressed current and has the advantage of offering continuous protection.

Each corrosion protection system is limited as to what it can protect. Corrosion protection systems should be monitored regularly to confirm they are effective, and will require adjustment from time to time. Sacrificial elements of the system may require replacement if they are consumed in the process of protecting the tank.

REQUESTING A PROPOSAL

It is essential to identify qualified contractors when requesting a proposal.

'Not all tank contractors have the same capabilities,' says Fred Ruinen, vice president for Fisher Tank Company. 'The customer must consider what qualifications are important to them and their project.'

A key component to the RFP process is the API Tank Data Sheet. Located in Annex L of the API 650 standard, the data sheet is separated into several categories such as design and testing, tank appurtenances, and roof types. It covers all relevant data from design parameters to nozzles, foundations, cathodic protection, and coatings. Once completed, the data sheet will contain most of the information needed to design, bid and construct a storage tank.

It is vital to read the entire proposal, not just the price. Unknowns will be addressed via statements of assumption in the proposal. Review proposed schedule and provide constructive feedback.

TANK CONSTRUCTION

When planning is completed, the construction process begins. The first step is site preparation.

Any earthwork needed to address geotechnical conditions must be resolved for the tank foundation to be constructed. Provisions for the selected secondary containment system also need to be addressed. This work is completed by skilled contractors that are familiar with the area and its conditions.

Once the site is prepared, construction can commence. The process begins by assembling the floor plates to create the tank bottom. After the floor is in place, the first series of plates that make up the tank shell wall are installed. All welding is performed by certified welders. Welds are inspected at regular intervals using several methods.

Materials are received, staged, and installed at a tremendous pace. Often, portions of the tank shell are left open to allow access to the interior of the tank for access, worker safety, and to limit restrictions associated with confined space requirements.

'Confined spaces pose serious risk, especially in operating facilities,' says Paul Showan, president of TF Warren Group Corporation. 'Worker safety is our top priority. Doorsheets can be used to mitigate risks of confined spaces and provide access to the inside of the tank.'

As work progresses, welders are required to work at heights. This involves the use of work platforms and fall protection equipment. Finally, the tank roof is installed, and the shell is completed. A certified inspector will be tasked to establish construction is complete and test the tank. This is often done through hydrostatic testing to verify structural integrity and foundation settlement.

After final testing is completed, the tank is emptied and cleaned. Any external equipment, such as gauges, sample points, or mixers, can be attached, and the tank will be prepared for service. The certified inspector overseeing construction will then sign off that the tank is ready for service.

Upon the completion of construction, the obligation to maintain the tank begins. But that's another story.

For more information:

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