Often overlooked, tanks are vital to the global economy. This article will explore the MUC Oil & Gas Engineering Consultancy project for the SOCAR AURORA Fujairah Terminal FZE in Fujairah, UAE, to store white and black petroleum products, beginning with an examination of the state of the oil industry today, and how it affects the storage facilities required around the globe.

Energy is the life blood of any modern society. That said, much of what is needed is often not located at the majority of the world’s major centres of conspicuous consumption. Just as there are not petrol stations located in every driveway, the bulk storage and eventual distribution of liquid hydrocarbons and their many byproducts are necessary for the efficient and gradual distribution of these commodities.

In past years, storage tank capacity has gently climbed to meet both increased demand at new industrial and process centres, and also to augment capacities in already established industrial locations. In addition, new storage tanks are being built to replace ageing infrastructure and facilities. But all of that occurred before the current glut of oil, and the resultant pressure on current storage facilities.

Crude oil stocks
In both June 2015, and in December of the same year, stocks of crude oil in the US peaked at more than 490 million barrels, both 80 year highs for stocks of crude oil, and a 34% increase over
June 2014. Likewise, the beginning of 2016 saw stocks of distillates reaching 159.4 million bbls, an increase of 22.5 million bbls over the same time last year. In the same period, reflecting reduced consumer demand, there was a slight decrease in stocks of gasoline, settling at 232 million bbls, a reduction of 5.2 million bbls over the year.

During 2015, the US saw 15 weeks where the supply of oil was over 30 days — the highest number of weeks with the oil supply over 30 days since 1983. In fact, the last time the weekly supply of oil was above 30 days was in January 1984. All of this points to the fact that more oil is being stored. But what of the supply?

In addition to capacities increasing, oil production is also climbing, as Saudi Arabia chooses to up production to maintain market share, refusing to step into its usual role of ballasting global oil prices by cutting production. Also, despite many assertions to the contrary, the industry is not seeing the whole scale shutdown of many fields around the world that were thought to be unprofitable below US$40/bbl — some are cutting costs, and producing more, to maintain revenues. On the other hand, some producers are looking for any payback on their assets and capital spending, for which they would see no payback if they remained idle.

**Demand still grows**

The truth is that the idea of a global glut that would cause the inability to store the oil being produced is likely not going to happen. As 2016 begins, some slowdown in the global economy is apparent. But these economies, and their populations, are still growing. More and more people are demanding a better standard and quality of life. This is part of the reason why oil supply and demand are both estimated to grow from around 96 million bpd up to 97 million bpd by the end of 2016.

The bottom line is that this is the new paradigm of supply and demand. To meet that need, the industry is going to have to increase the quantity of its centres of production, and also increase the capacity, safety and effectiveness of the current and increasingly ageing storage facilities.

**Safety for ageing tanks**

Where safety is concerned, federal and local environmental standards need to be taken into account. These standards are put in place to guard against the accidental and catastrophic release of stored materials and the impact on the environment of any such release.

Storage tanks, and the farms in which they reside, are aspects of storage that most take notice of. Although the tanks themselves demand much focus and attention, their design and construction are nonetheless just a fraction of the work needed to provide safe, efficient and effective storage.

According to the US Environmental Protection Agency (EPA), steel aboveground tanks start deteriorating after just 15 years in the field. As of 2010, an American Petroleum Institute (API) study estimated that more than 90% of aboveground storage tanks were more than 11 years old — so, to put that another way, if nothing had been done to those tanks as of that original report, 90% of the storage tanks in operation may be in a state of decline.

What makes this difficult is that, as stated earlier, the pressures on the storage of hydrocarbons are increasing, which makes it more difficult to furlough, or take out of commission, tanks that may well have been left out of service — not because they were unsafe, but because there were newer tanks, designed to more up to date standards, that could instead be pressed into service.

That said, the vast majority of tanks, if properly maintained and evaluated, can remain in service for decades — ultimately, hydrocarbons are some of the best defenses against many of the waterborne corrosions that ‘spark’ many of the catastrophic failures around tanks. However, if ingress of water into a tank occurs, and is not addressed, it can cause a slow and insipid deterioration that can result in the failure of the tank, and with it, the sudden and catastrophic failures of the foundation it sits upon. Even the most stable tank cannot withstand foundation failure.

In an Elsvier study, researchers found that most of the major accidents over the previous 40 years, at 242 storage tank facilities, centred around petroleum refineries, plants and oilfields (63.2%) and terminal and pumping stations (26.4%). The bottom line is that an estimated 97% or more of terminal and pumping stations service the petrochemical industry, or the delivery of hydrocarbons or their byproducts.
Mastering a complicated dance

With those numbers in mind, it is impressive that, at such a critical point in the transference of such volatile materials – chiefly to and from tankers – terminals and their operations play so minor a role in these accidents. It is here, at many terminals, that a complicated dance and coordination of piping systems take place, delivering commodities to and from a limited number of loading stations, to and from the specific storage tanks that need to be charged, or from which finished products need to be exported.

In looking at the logistics of any terminal, it is obvious that efficiency and logistics would not allow each tank to have its own fill and delivery line to be linked to its own tanker loading station. That would mean that in a 40 tank farm, 80 fill or delivery lines with associated valves and loading infrastructure would be required. Efficiency and common sense demand a better way.

One of the most overlooked and impressive features of a tank facility are the bulk storage manifold stations. These manifold stations stand in stark contrast to the relatively simple storage tanks, whose job is to buffer the demands of the plant and the egress of finish commodities to their next stage of use or refinement. Through a relatively complicated switching system, their tens of pumps, hundreds of valves and thousands of feet of pipe save many, many multiples of materials that would be needed to deliver products to and from offloading safely, efficiently and effectively.

Case study

MUC Oil & Gas Engineering Consultancy is a multi-discipline engineering consultancy firm providing consultancy services in engineering, project management, specialised engineering studies and analyses, and safety and environmental engineering for the oil and gas and allied industries. MUC has 60 employees, with headquarters in Sharjah, UAE, plus three branch offices in Abu Dhabi, Dubai, and Fujairah.

Fast schedule for petroleum storage terminal project

To help meet growing demand in the developing trading hub of Fujairah, UAE, a storage facility project is underway. The SOCAR AURORA Fujairah Terminal FZE project is a joint venture of the State Oil Company of Azerbaijan (SOCAR), Aurora Progress SA, the Swiss-based commodity trading house, and the Government of Fujairah.

The terminal is designed to store 640,000 m³ of a range of white and black petroleum products. The state of the art facility includes storage tanks, a ship loading and discharge facility, a truck loading facility, and a blending facility. MUC was chosen to provide the following services for the project:
- Front end engineering and design (FEED).
- Environmental impact assessment.
- Tender administration and management – project management consultancy.

The company needed to perform the engineering design of the petroleum product storage terminals with world class quality within a limited budget and time. MUC needed to deliver a sustainable quality and safe storage terminal FEED within just one month at a reasonable cost.

Cutting delivery time

There were a number of major factors that influenced MUC in selecting its software solutions to perform the project. The company was already using AutoCAD, so it wanted to minimise the training time required for its AutoCAD-based designers. MUC wanted a cost effective solution with minimal hardware required for deployment. Finally, the solution needed to be interoperable with the company’s other applications.

MUC chose a variety of solutions to perform the project. Mechanical and piping engineers and designers used Intergraph CADWorx Plant Professional for the terminal equipment and piping design. Intergraph CAESAR II was deployed by MUC’s piping stress engineers for piping stress analysis.

Process engineers and designers used CADWorx P&ID Professional to create the piping and instrumentation diagrams and process flow diagrams for the terminal. MUC also used Advanced Flow Technology (AFT) Fathom for its hydraulics studies along with Paulin Research Group (PRG) FE/Pipe for piping finite element analysis.

The competitive edge

MUC experienced integration between the software products. The CADWorx Plant Design Suite operated on AutoCAD with seamless integration. CAESAR II also worked smoothly with PRG FE/Pipe.
The applications were easy to implement with the technical knowledge of its in-house IT engineers. The company was ready for production immediately after just two weeks of training.

**Making the difference**

Any oil and gas project scope of work (SOW) requires both knowledgeable staff and the best software tools available to optimise efficiency in project execution. Having the right software solution can make all the difference between success and failure.

In the case of the SOCAR AURORA Fujairah Terminal FZE project, MUC needed a software solution that would satisfy its FEED requirements while allowing it to expedite its workflow activity rapidly and cost effectively to meet the schedule of a fast track project.

**Efficient design**

Intergraph’s CADWorx Plant Design Suite provided drawing and database connectivity and 3D modelling utilities. The series of design tools includes intelligent process and instrument diagrams, structural steel, an equipment modeller, an auto-routing utility for rapid piping design and layout, design review for visualisation and construction coordination, automatic isometric drawing production, plus automated bills of material reports to support procurement needs.

The bi-directional links between CADWorx and analysis programs for pipes and vessels enabled MUC designers and engineers to easily share information while keeping the drawings, models and related information continuously synchronised as changes were made throughout the project design workflow. Meanwhile, the fast processing and highly refined user interface features in CADWorx empowered users to work efficiently together, even on large models.

**Project specifications**

Key to the success of any project is the ability to manage project specifications. The flexibility of the CADWorx Specification Editor enabled CAD managers to effectively develop and manage projects piping specifications and satisfy a variety of project requirements. Inevitably, project specifications may evolve and change over time and/or from project to project. The ease by which CADWorx specifications can be changed is remarkable. Similarly, these changes can then be easily updated and shared with designers in real time. Exporting and importing piping specifications in Microsoft Excel format completes the process and enables documentation of project piping specifications.

**Piping isometric and general arrangement drawings**

Producing project deliverables is just as important as design. Quality piping isometric drawing production is accomplished with Intergraph Isogen. Isogen not only automates the generation of piping isometric drawings but also enables pre-fabrication benefits with the confidence that piping spools will fit the first time and minimise field fitment during construction.

Adding value to the CADWorx Plant Design Suite is OrthoGen, which automates the production of general arrangement (GA) drawings. Like Isogen, OrthoGen can reduce the time and cost of producing project deliverables, all of which pays big dividends to the design firm, project execution, and, ultimately, the client.

**Conclusion**

No matter the price of oil, storage facilities will always be required to support the global economy. MUC has benefitted from a variety of modern technology tools to quickly and successfully complete the vital SOCAR AURORA Fujairah Terminal FZE project.

**References**

5. 2005 Elsevier Ltd.