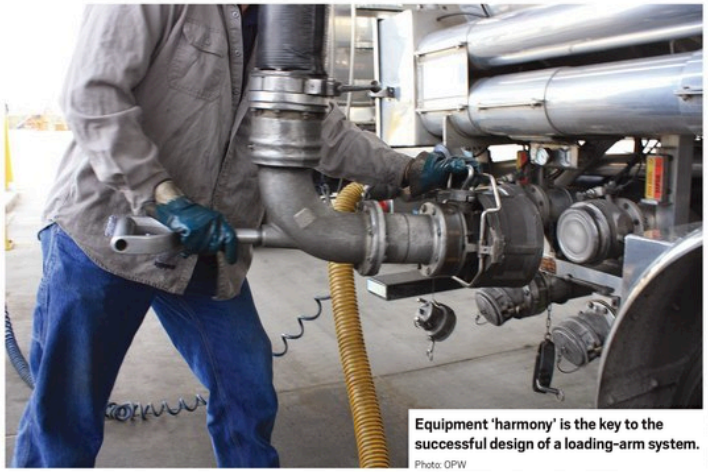
How to optimize a loading system

Considerable time, thought, and effort are required to identify the 'right' solution for each terminal operation

By Dave Morrow



Equipment 'harmony' is the key to the successful design of a loading-arm system.
Photo: OPW

Imagine seeing a notice asking for symphony orchestra musicians to be at a concert hall on a certain day and time, prepared to play Beethoven's Fifth Symphony. Sure, the individual musicians who responded likely would have the talent to play the piece, and maybe even some past experience doing so, but the performance as a whole probably would be disjointed since the players wouldn't be familiar with the conductor or their fellow performers.

That leads us to another thought experiment: Try outfitting a storage terminal in the same manner, just selecting a bunch of loading-arm system equipment that probably should work well together, but with no past experience of doing so. The operation of that equipment probably would be about the same as the sound of that thrown-together orchestra—out of tune and disjointed, with one major caveat: The orchestra can always practice in order to get better, whereas an incompatible loading-arm system has no chance of improving without some major (and costly) design modifications.

In other words, much like the orchestra, "harmony" is key to the successful design of a loading-arm system. However, achieving perfect harmony—where all components work seamlessly in a system that is efficient, easy to operate, and safe for the user—takes a great deal of time, due diligence, and native knowledge. It's not a case of simply choosing a loading-arm system, it's a case of choosing the "right" loading-arm system.

Know the basics

While all facilities that load and unload railcars and tank trucks (storage terminals, chemical plants, refineries, etc.) serve the same basic function—facilitating the arrival, storage, and departure of various liquids via various forms of transportation—each one is unique in its operational design and setup. This means the ones that truly are able to achieve and maintain elevated levels of efficiency, reliability, safety, and ergonomic operation are those with managers who put in the hard hours in order to determine the best loading-arm system to deploy.

Only when site managers fully understands the idiosyncrasies in the product-loading and -unloading operation will they be able to outfit the site with a system that meets all the operation's specific needs. In general, there are three variables that must be considered before selecting a loading-arm system that will be designed for the site. They are:

Site: The location of the loading racks will be the main determining factor for the type of loading arms that will work, along with where all ancillary equipment and structures will be positioned. After determining the number of loading positions, the system designer must choose the best spot for the risers, which are the foundation of the system. If several arms are needed, all risers must be located so they don't interfere with the operation of other arms. The arms must be positioned so they can move up, over, and around any obstructions, from light poles, support columns, and power lines to meters, gangways, and safety cages, as well as fit under a roof if it is a covered application. Loading arms can be heavy, so proper structural support must be built into the system design. Improperly supported arms are difficult to move and potentially dangerous for the operator.

Product: The facility's commodity "menu" can feature a range of diverse products, from wastewater, anhydrous ammonia and biodiesel to sulfuric acid, all with different handling characteristics. Liquids with water-like viscosities must be handled differently than those with the consistency of molasses, while hazardous or corrosive liquids must be transferred through equipment that is compatible with their volatility. Some liquids will thicken, crystallize, or even freeze as ambient temperatures change, which may create a need for a heat-tracing system or steam jackets. Finally, with throughput rates critical to the terminal operation, the loading-arm system must reliably produce desired flow rates, which goes hand-in-hand with determining the size of the piping that is needed.

Transport: The design and setup of the facility will pre-determine the method of loading and unloading used, either bottom or top. Bottom loading is the preferred method for petroleum products because trucks are standardized, while top loading is more common in chemical-handling applications. In either case, it is good practice to walk through the entire loading/unloading process to determine what an ideal process looks like. Bottom-loading connections are easier to perform, and if the transport has several compartments, overall loading/unloading time is reduced. Bottom-loading bays also require less equipment and poured concrete, which makes them more economical. In the instances where top loading is used, the loading system must have enough horizontal range for the arms to reach the farthest compartment without repositioning the vehicle; the system must make mis-spotting a rare occurrence as any need to relocate the railcar or transport truck means lost time. The facility operator also must consider how the product will be top-loaded, either splash-filled through an open manway or through a hard connection. If hard connections will be used, the operator has many options: hard or soft connection, quick- or dry-disconnect technology, and whether any valving will be needed. Finally, a level-detection system is normally recommended as a secondary shutoff that reliably indicates when the loading process is completed. Overfills lead to spills and unsafe working conditions, with the potential to harm the environment and surrounding communities if the substance is hazardous or dangerous.

Final general considerations include whether or not special non-destructive testing of the equipment is required; are any special welding procedures needed; is insulation designed to protect the operator from handling hot piping required; will any additional weight be added to the loading arms after installation; and if there is a need for connections to aid in venting or blowing product from the arm after the loading/unloading process.

From the field

Now that we know what to look for when designing a loading-arm system, let's take a look at a recent application that took these variables into account, resulting in a new, more efficient loading/unloading process at a petroleum-product storage terminal.

The high-volume bottom-loading terminal in Kentucky was built in the 1970s, but had undergone a number of "on-the-fly" upgrades, expansions, and reconfigurations to its truck-loading lanes. These modifications had ultimately resulted in an unorganized loading-system layout. Specifically, the system had grown to consist of a hodge-podge of components that was cumbersome to operate due to poorly spaced and incompatible arms. This led to loading inefficiencies while putting increased strain on the drivers via the non-ergonomic system design.

In the search for a solution, the terminal operator and his loading-arm system provider determined that the biggest issue was the fact the loading arms did not effectively cross over one another. This meant that it had become difficult for the drivers to access the required arm without needing to move other arms out of the way first or to load more than one compartment at a time.

So, a new layout design that incorporated the ideal spacing and staggering of the arm mounts was created featuring short-range hose loaders that allow simultaneous connecting to and filling of up to three product lines. They are generally stored horizontally with only slight upward or downward movement required to align the coupler with the truck adaptor. Additionally, dry-break API couplers with the ability to ensure reliable and easy connection to a tank truck or railcar were added.

Additionally, new mounting risers for the truck lanes were spec'd and designed that enabled the loading arms to be mounted in the optimal configuration.

Today, the redesigned loading system has arms that are able to cross over and clear one another, which allows easy access to the desired arm and the ability to quickly and efficiently load multiple compartments at the same time. The arms also are more ergonomic in that they store and balance at roughly the same height as the truck adaptors. This means that little effort or strain is required from the drivers in order to connect and disconnect the arms to the truck adaptors and return the arms to their storage position at the completion of the loading process. Finally, with all of the new system's components sourced from the same supplier, it is easier to order, stock, and track spare and replacement parts. And all of this took only six weeks from purchase order to installation.

Conclusion

If a storage terminal's loading-arm system is to make "sweet music," it must be designed for the needs of the site layout, as well as those of each component. It's easier to find that harmonious balance if all system equipment is sourced from the same supplier—one with extensive experience designing and engineering systems that meet unique installation needs. BT

David Morrow is the director of sales for OPW Engineered Systems.