COVER STORY

DEMOUNTABLE FLARE STACK SYSTEMS IN NORTH AMERICA

Nikki Ebert, Zeeco, USA, discusses how demountable flare stack systems work and reveals the advantages that they can offer in refining, petrochemical, and LNG facilities.

Demountable flare stack systems have been a popular flare design solution for many users globally because they offer key advantages in certain circumstances. The first demountable flare stack systems were designed and deployed by Shell in Europe. Shell then applied this same design to its major refinery and chemical plant locations worldwide, including those in the Middle East, Asia, and Australia. Subsequently, they were also used by many other oil and gas and petrochemical companies. Only in the past 10 years have they become more common in North America.

How do they work?

A demountable flare stack system is a flare system that includes a derrick structure supporting typically one or more flare stacks along with utility piping, a stair tower,

access platforms, and a common winch skid. Demountable systems can be designed to support a single flare stack or multiple stacks, with some having as many as 10 stacks. The main components of a demountable flare stack system are shown in Figure 1.

The derrick structure is typically fabricated from structural steel pipe and can be designed as a three-leg or four-leg structure. A derrick structure should include a stair tower and the necessary ladders and platforms to access demounting equipment at elevation. Shielding is provided to protect personnel from radiation, which allows personnel to access the flare system safely, even during a flaring event of any active flare stacks.

The flare stack(s) are fabricated in flanged sections between 12 and 24 m (40 to 80 ft) in length and have utility piping pre-mounted to each section to supply pilot gas/ignition/steam to each flare. The flare stacks are installed on one of the flat faces of the derrick structure to allow access for demounting. Flare stacks can be demounted a section at a time, with the stack and utility piping flange connections being unbolted as each section is lowered. Tilting tables and tilting beds are provided at the base of the derrick structure to lower the demounted sections to grade.

A demountable flare stack system is supplied with a demounting winch skid consisting of a single motor servicing a lifting winch and a canting winch. The winches and motor are designed for the heaviest and worst-case loading to enable a single winch system to service any of the flare stacks on the derrick structure.

What are the benefits?

Demountable flare stack systems have become very popular in various refining, petrochemical, and LNG-related applications due to the versatility they provide. Most demountable systems include multiple flare stacks, and most have an installed spare flare stack. This spare flare remains in an idle, standby mode during regular operation of the flare system. When maintenance on any active flare stack in the system is needed, the spare stack is brought into service. A flare tip or stack that requires any inspection or maintenance work can have its associated process units rerouted to the spare stack, while the primary flare stack and tip is demounted to grade level to allow for refurbishment or replacement. This flexible design enables facilities to perform required maintenance without requiring the shutdown of the plant or of process units.

Even demountable flares that do not include an installed spare still provide added flexibility in the facility because the stack/tip requiring maintenance can be lowered to

Figure 1. Typical demountable flare system.

Figure 2. Case study 1 – demountable flare system during operation.

grade without using a tall – and typically expensive – crane. Demountable flares eliminate this significant cost, as the individual stacks can be lowered to grade level for any maintenance, utilising the built-in demounting system and winch package. This design allows the facility to shut down only those units associated with the flare stack under maintenance, rather than having a plant-wide shutdown. In contrast, traditional elevated flare systems often require the mobilisation of an expensive heavy crane to the site for access to the flare tip or pilots for maintenance.

Another advantage of demountable flare stack systems is the significantly smaller plant plot space they require, in comparison to what an equivalent set of traditional stand-alone flare systems would require.

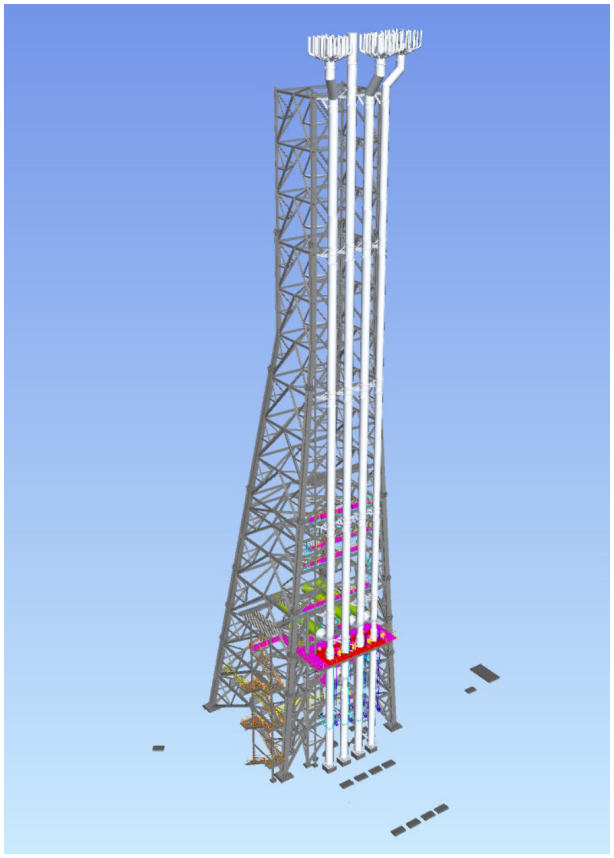

Figure 3. Case study 2 – demountable flare system 3D model.

Case study 1

This case study details a demountable flare stack system for an LNG application in the US that has been in service for approximately five years. In this case, the user elected to segregate the warm and cold flare headers and send them to separate flare stacks on the derrick structure. The warm header utilises carbon steel construction and the cold header utilises stainless steel construction. The overall stack height is nearly 150 m (500 ft) and the derrick structure is a three-leg design. Each flare stack has air assist to enable smokeless performance in continuous, start-up, shut-down, and maintenance operation cases.

The user wanted this system to include a separate spare stack for each process flare, meaning that the structure includes a total of four stacks: two warm and two cold. This allows the user considerable flexibility for maintenance and turnaround requirements, as each header stream can be diverted to its corresponding spare while the plant remains in operation. No shutdown of either flare system is required, and all maintenance can be completed while the plant is online because of the demountable flare system.

To further enhance the ability to maintain either flare system while the plant remains in operation, the user also opted to install fully retractable thermocouples and retractable aircraft warning lights. The thermocouples, which are used for pilot flame detection as required by regulations, can be removed and replaced from grade while the flare is online, meaning that demounting of the flare stack is not required for a simple thermocouple replacement. The aircraft warning lights can also be retracted to grade using a separate lowering system that does not require demounting of the flare stacks.

Figure 4. Case study 3 – demountable flare system during derrick construction.

Case study 2

This case study details a demountable derrick flare stack system for an LNG application in a northern region of North America that was completed in 2023. As in case study 1, the user decided to separate the warm and cold processes into different flare headers and stacks on a demountable derrick structure. The user also added a stack to handle marine flaring cases for their facility. This demountable derrick flare system includes a single installed spare flare stack, suitable for handling flowrates from any of the three active

flare risers installed on the structure. This system is around 120 m (400 ft) tall and utilises a four-leg derrick design. The user for this application has relatively high available pressure for the incoming flare gas and was able to utilise high-pressure flare tip designs to ensure smokeless performance without assist media, such as steam or air.

This demountable system design allows the user to perform maintenance on one flare system at a time by diverting its flow to the common spare riser. While it has less spare flexibility than the unit in case study 1, this design is a lower-cost option because it uses four total flare stacks (three primary plus one spare) instead of six (three primary plus three spares).

This demountable derrick structure is also equipped with retractable thermocouples and retractable aircraft warning lights, allowing for repair and replacement of these components from grade without demounting any flare tips or stacks.

Case study 3

This case study details a demountable derrick flare system for a refinery application in a southern region of North America that was completed in 2023. For this demountable system, the user has separated the flaring streams into three dedicated headers with a riser for the high-pressure flows, a riser for the low-pressure flows, and a riser for the acid flaring flows. This system has a single common spare flare stack suitable for handling flowrates from any of the three active flare risers. This system is nearly 200 m (650 ft) tall and utilises a three-leg derrick design. This demountable derrick is located at a refinery, so medium-pressure steam is available as a smokeless performance assist media for the flare tips. This demountable flare stack system also includes liquid seal drums for each flare stack, which are located at grade outside of the derrick structure itself.

As in case study 2, this design allows the user to maintain one flare system at a time by diverting flows to the common spare flare while the other two flare systems remain in operation, showing that this cost-saving design can be suitable for both LNG and refinery applications.

As with case study 1 and 2, this demountable derrick structure is equipped with retractable thermocouples and aircraft warning lights, allowing for repair and replacement of these components from grade, without demounting flare tips or stacks.

Conclusion

Demountable flare stack systems have become a more popular and widely accepted option for large flare system applications in refineries, petrochemical plants, and LNG facilities. As the case studies that have been shared illustrate, several design options are available, including different derrick configurations and spare stack choices. While these options vary in price, they do offer flexibility in terms of plot space and maintenance, which users should weigh against capital costs and overall operating/ongoing maintenance budgets.