Ultra-Low NOx Flares

BY MIKE WELLS

Several years ago, Perennial Energy was receiving requests from several air quality management agencies and major engineering firms, asking for some insight and assistance as to how to best improve or drive down their state and county emission levels of nitrogen oxides (NOx). NOx gases react to form smog and acid rain. They are a big factor in the formation of fine particles (PM) and ground-level ozone. All of these are associated with adverse health effects and dangerous to those with allergies and respiratory system issues. Nitrogen oxides, nitric acid, and ozone can all readily enter the lungs, where they create serious damage to delicate lung tissue. Even short-term exposure can irritate the lungs of healthy people. For those with medical conditions like asthma, just a short tie spent breathing these pollutants has been shown to increase the risks of an emergency room visit or hospital stay.

One of the most recent air quality district rulings and a driving force behind this new initiative was Southern California's Air Quality Management District (SCAQMD). At the time this agency was working on new legislation known today as South Coast Air Quality Management District's Rule 1118.1 for the "Control of Emissions from Non-Refinery Flares." Rule 1118.1 is intended to reduce emissions from non-refinery flares located at landfills, wastewater treatment plants, oil and gas production facilities, and facilities that handle organic liquids. The rule establishes requirements to reduce NOx and VOC emissions from non-refinery flares and to encourage alternatives to flaring, such as energy generation, transportation fuels, or pipeline injection. This ruling tightened the emission level to 0.025 pounds per MMBtu NOx, 0.06 pounds per MMBtu CO, and a limit of 0.038 pounds per MMBtu for Volatile Organic Compounds (VOCs). Since the SCAQMD rule, several other air districts have initiated, or are in the process of establishing, a similar rule for non-refinery flares for their districts.

Perennial's practice (motto) since its inception in 1980 has been "Value, Quality, Delivered." Perennial strives to provide the client with a biogas product that has "value," is a "quality" product, and is "delivered" on time. Listening to the site engineers and managers, several topics often came up in UL NOx discussions.

Perennial flares are designed to fit into a small footprint.

Photo: Perennial Energy

One major issue many sites encountered was a lack of available site space for new equipment. Due to the addition of equipment over the years, space was often at a premium. As landfills and wastewater treatment plants were being directed towards installing Ultra-Low NOx flares, there were few equipment options in finding a flare with a small footprint to fit the available space at the site. Reluctantly, sites were having to look at moving and relocating equipment, which can be an expensive proposition. To meet this first requirement, Perennial Energy designed a

flare with the air-to-gas mixing chamber built inside the flare to cut down on space requirements. One concern and complaint often mentioned was that the existing designs had large gas-to-air mixing chambers set off from the flare. By moving the air mixing chamber to the inside of the flare tube, this eliminated the large, potentially dangerous gas-to-air mixture chamber often seen upstream of UL NOx flare designs. By establishing a robust fuel ratio mixing chamber inside the flare tube and directly below the surface burner, much smaller volumes of gas and air were pre-mixed and offered a safer work area for the operators. The PEI compact design lowered the footprint by as much as 25-40% over previous designs. Now the site had a much safer design option along with one that required less real estate.

Another concern often encountered in the site conversions dealt with the dusty conditions in the arid parts of the Southwest US. Many blowers and fans used in the gas-to-air mixing systems were notorious for clogging up the inlet filter. Replacing filters can take hours to change out, along with equipment shut-off downtime. If the filter is not properly sized, dust and debris will flow through the fan, allowing the contaminants to enter the flare and plug up the fine mesh on the surface burners. Once the surface burners are plugged, the flare's performance does not meet the required emission rates as established by the air quality districts. To fight the dirt issues, Perennial designed the fan with a much larger inlet filter size, and to help prevent the particulate from passing through the filter and plugging up the burner mesh, a two-stage filtration filter was incorporated. To make it easier on the site, PEI utilized a standard off-the-shelf filter size for the inlet filters first stage and second stage. Experience has shown that if you can make it easy for the operator and owner, the site is more likely going to ensure a properly maintained system.

The third issue of concern was dealing with burner cleaning. Feeling certain that much of the burner plugging issue was solved with better filtration, it was realized that particulate and dirt could still be introduced by the dirty gas coming off the landfill or wastewater site. Existing burners required going inside the flare, unbolting the flare burners, and removing them with a forklift. Sites voiced concerns that they were spending a full shift with several technicians unbolting the burners, pulling them out of the flare, and installing previously cleaned ones. To keep the downtime to a minimum, sites purchased a second set of burners (an additional expense) so that once they had the plugged burners removed, they had a standby set ready to install. Still, in some instances, the change-out time required an eight-hour shift with a staff of three people. In effect, the flare was down for one shift. Once the used set of burners were out, they would be power-washed later so they were ready to be re-installed as soon as they were needed a few months later. Perennial Energy's burner design allows for the stainless steel burner to be cleaned in-place. Additionally, there is much shorter downtime, as well as lower manpower requirements and parts costs. Perennial's design offers two options for cleaning. The gas-air mixing chamber has an access opening on the bottom. The site can remove this plate on the bottom and reach up into the inside of the burner chamber to vacuum the inside surface burner, removing the clog or plugged stainless steel surface burners mesh from the inside. Another option is to remove the outside access door on the outer shell of the flare and, through this opening, flush out the dirt with a standard water hose, allowing the water and particulate to flow out of the same bottom access opening used to vacuum the burner.

Perennial's burner design allows for the burner to be cleaned in place.

Jumping forward to 2021, Perennial Energy has, as of this date, installed one UL NOx flare in the East Coast region, two UL NOx flares into West Coast landfills, and one UL NOx flare in a wastewater municipal site. Another Ultra-Low NOx flare is in production and two more of our safer, compact designs are waiting to be erected in California.

- Location 1: Riverside, CA Wastewater Treatment facility
  UL NOx Flare Size: 6 MMBtu per hour
- Location 2: Kearny, NJ Landfill
  UL NOx Flare Size: 39 MMBtu per hour
- Location 3: Irvine, CA
  UL NOx Flare Size: 120 MMBtu per hour
- Location 4: Riverside County, CA
  UL NOx Flare Size: 150 MMBtu per hour
- Location 5: San Joaquin County, CA
  UL NOx Flare Size: 60 MMBtu per hour
- Location 6: Santa Paula, CA
  UL NOx Flare Size: 120 MMBtu per hour

Mike Wells is a Business Development Manager at Perennial Energy.