GUIDANCE FACT SHEET: LANDFILL GAS COLLECTION, FLARING, AND ENERGY RECOVERY OPERATIONS AND MAINTENANCE

The collection of landfill gas (LFG) accomplishes many objectives including subsurface methane migration control, odor abatement, greenhouse gas emissions reduction, and energy recovery (if feasible). The success to which these objectives are accomplished largely depends on a suitably designed gas collection and control system and proper operations and maintenance of the same. For purposes of this discussion, a control device can be a flare, engine, boiler or other combustion equipment that destroys methane. Advanced treatment systems that process LFG into pipeline quality gas (for subsequent use as a fuel) are not addressed herein.

General Operational Approach for Collection Systems

In most cases, the goal in collecting LFG is to maximize gas collection while maintaining good gas quality. Good gas quality is generally defined as high methane content (around 50 percent) and low amounts of air (nitrogen less than 20 percent and oxygen less than 5 percent) in the collected gas. Gas quality is important both for energy recovery/combustion and for landfill safety (i.e. to prevent landfill fires). Adequate methane content and low oxygen are necessary for energy conversion devices such as engines or boilers. Nitrogen and oxygen in collected LFG is mostly due to atmospheric air being drawn in to the waste mass due to the vacuum applied by the collection system. This situation can lead to aerobic conditions and fire.

Ideally, LFG would be collected at the same rate as it is being generated. In this instance, 100 percent collection efficiency would be achieved. In practice, actual collection efficiencies are significantly lower (typically ranging from 40 to 80 percent). Assuming that a well-designed collection system is installed, the following operational approach is employed to maximize the collection efficiency:

1. Monitoring of extraction components, including extraction wells, horizontal collectors, and gas system connections to the leachate management system. Each of these components must have monitoring port(s) between the control valve and the point of extraction. Monitoring parameters should include gas quality (methane and oxygen, plus carbon dioxide and nitrogen {usually calculated by instrument as balance gas}, if possible), pressure/vacuum, temperature, and flow rate. At system startup, the monitoring frequency should be daily for 1 or 2 weeks. After steady conditions are achieved, biweekly or monthly monitoring is appropriate. More frequent monitoring may be appropriate for some sensitive situations (for example, ongoing odors, suspicion of landfill fire, system expansion activities).

   Monitoring is best accomplished with an instrument that stores data electronically so that it can be reviewed easily and compared against previous data. Before and after any round
of system adjustments, the gas quality and flow at the blower should be monitored and recorded to determine the impacts of system adjustments.

2. Depending on system performance, liquid level monitoring in select extraction wells may be necessary. Elevated leachate levels in landfills are a common problem that impact gas collection. If the slotted portion of an extraction well is submerged in leachate, no gas collection can occur. Indications that a well is submerged (or “watered in”) include: no measurable flow and a vacuum level that matches the available system vacuum as soon as the valve is slightly opened from the closed position.

3. In conjunction with monitoring activities at the extraction components, valve adjustments should be made as needed. By opening or closing the valve, more or less vacuum is applied to increase or decrease the LFG extraction flow rate. Gas quality target parameters should be established by the system design engineer or responsible site manager based on system objectives.

**Typical Maintenance Activities for Collection Systems**

Routine maintenance of the collection system is important for maximizing LFG collection efficiency. Maintenance needs are normally identified during monitoring activities. Some of the most common maintenance activities include the following:

- Each extraction well normally has a flexible hose connection between the well riser and the lateral pipe connecting it to the header (manifold). As the landfill settles, this flexible hose takes up the slack caused by the different rates of settlement between the header and the well itself. Sometimes, the flexible hose becomes disconnected if stretched too far and needs to be replaced with a longer hose. When disconnection occurs, a sudden in-rush of air enters the header and can cause the flare or energy conversion device to shut down. Moreover, flexible hose material degrades in sunlight. Routine replacement of flexible hose should be accomplished at least every 2 years, unless an ultraviolet resistant hose material is employed, which may provide for an additional 2 or 3 years of life.

- Differential settlement in the landfill also leads to low points developing in the header piping. Such low points cause condensate to accumulate resulting in surging flow conditions or complete blockage of the pipe. For above grade headers, visual inspection can identify the low points and corrective action taken. For below grade headers, vacuum and flow measurements at accessible system components (wellheads, isolation valves and condensate traps) assist in locating the portion of the header experiencing a low
point. Excavation is necessary to correct the situation.

- Each wellhead has monitoring ports for checking gas quality, pressure, flow, and temperature. These ports are normally threaded and installed with Teflon tape to provide a gas tight seal. Exposure to weather causes degradation of the monitoring ports and can cause air leaks during monitoring. These leaks give false readings of gas quality leading to inappropriate valve adjustments. Monitoring ports should be inspected routinely and sudden changes in gas quality at a particular well should lead the operator to check the monitoring port integrity.

- As noted in the monitoring section above, extraction wells sometimes become submerged in leachate. One approach to this condition is to install a submersible pneumatic pump in the well to remove the liquids. This is an intensive effort involving compressed air lines, condensate discharge piping, pumps, and an air compressor. The value of such efforts should be evaluated against the benefits from increase gas flow (via energy recovery and/or carbon emission reductions).

**Control Device Monitoring and Recordkeeping**

As mentioned above, a control device could be a flare, engine, boiler or other combustion device. Monitoring of such devices for carbon emission reduction projects includes gas flow, methane content, and combustion temperature (or other parameter established in the monitoring methodology) to quantify the emission reductions. Normally, this monitoring is accomplished continuously with data stored electronically every 15 minutes at a minimum.

Data should be stored on electronic media or internet based data storage system to facilitate recordkeeping and reporting. Data review should be conducted by an operations supervisor or manager to identify potential problems in the collection system as evidenced by trends in the data. Close communications between the manager and field technicians are critical to achieving the highest LFG collection efficiencies.

**Operator Training**

LFG collection and control system operations require a certain level of expertise. As such, LFG system operators must have adequate training to properly operate and maintain one. The California Integrated Waste Management Board (CIWB) recommends as a Best Management Practice an initial LFG course of four days, including two days of classroom training and two days of field training. This should be supplemented by one day of annual refresher training and specialty training classes offered by equipment vendors for typical LFG equipment, such as flares, blowers, flow meters, gas analyzers, and data recorders.

**Spare Parts**

The following spare parts should be stored on site to address common maintenance activities:

- Wellhead monitoring ports
• Flexible hose and connection clamps
• Wellhead assembly
• Chart paper or digital storage device for a chartless data recorder
• Pilot gas solenoid valve
• Igniter spark plug
• Igniter transformer
• Louver actuator for enclosed flare combustion air louvers
• Flare stack thermocouple elements
• Ultraviolet flame detector
• Vacuum/pressure gauges
• Temperature gauge
• Flame arrester element assembly with gaskets
• Blower grease
• Blower shaft couplings (direct drive) or belts (belt drive)
• Pumps (adjusted for the number of on-site condensate and down well pumps)
• Other pump or air compressor parts if pneumatic system used
• Pipe and fittings matching existing system sizes.

Conclusion
As a general guide, all equipment should be maintained in accordance with the manufacturer’s specifications. Additionally, monitoring equipment should be tested and calibrated according to the manufacturer’s recommendations. This approach should assure that the landfill gas collection equipment will function at the manufacturer’s expected performance and accuracy standards.

Sources of Additional Information

