LFG COLLECTION & CONTROL
A LITTLE PLANNING CAN SAVE BIG $

Kyung Kho, P.E., Project Manager – Cornerstone Environmental Group, LLC.
Thomas Bilgri, P.E., Manager – LFG Engineering Services – Cornerstone Environmental Group, LLC.
Angela Leonard, P.E., Director of Engineering & Environmental Management – Republic Services, Inc.

Introduction

Installing a Landfill Gas (LFG) Collection and Control System (GCCS) is required for a substantial number of Landfills throughout the country. The major regulatory driver for this requirement is the New Source Performance Standards (NSPS) for Municipal Solid Waste Landfills. Per 40 CFR 60.752 (b)(2)(ii)(A), Landfills are required to "collect gas from each area, cell, or group of cells in the landfill in which the initial solid waste has been placed for a period of 5 or more years if active; or 2 years or more if closed or at final grade" (2-Year/5-Year Rule). As a result, Landfills, trying to maintain compliance with the NSPS regulations, encounter operational challenges with the installation and operation of GCCS components while continuing waste placement activities.

One of the biggest challenges that Landfills face is the need for GCCS installation in active fill areas subject to the NSPS 2-Year/5-Year Rule. Installation of GCCS components in active fill areas often results in the destruction of collectors in active disposal areas, overfilling and crushing of header pipelines, and repeated expense associated repairs and/or replacement of extraction wells and header pipelines. In order to address these issues, a good understanding of the Landfill filling operations and cell phasing is important. Most Landfills have a multi-year fill sequencing plan already in place. In conjunction with these plans, the development of corresponding GCCS Phasing Plans will allow Landfills to intelligently place collection components so that waste placement will have a minimal impact on GCCS construction and operations, as well as the expense associated with repairs and/or replacement of the systems.

A long-term approach to GCCS installation, through the development of GCCS Phasing Plans, encourages the integration of GCCS development and Landfill waste placement operations. GCCS Phasing Plans provide a basis for accurate budget and revenue forecasts. They also provide a means for minimizing GCCS component replacement costs and construction change orders, and ultimately reduce the operational frustrations by minimizing damage to the GCCS.

GCCS Installation Schedule

Landfills that operate a GCCS do so for one of two reasons; they are either required to do so, or they choose to do so. Landfills that are required to install and operate a GCCS are regulated by NSPS regulations, or other local regulatory obligations. For these facilities, GCCS installations and installation schedules are "compliance-driven". Landfills that choose to install and operate a GCCS, for the most part, do so because of financial reasons; where the Landfill has chosen to

install a LFG beneficial use facility, for sale of processed gas or electricity to an end user. Their GCCS installations and installation schedules are "profit-driven".

GCCS installation "drivers" are not always mutually exclusive of one another. In many instances, a "compliance-driven" facility will choose to install, for example, a LFG to Energy facility utilizing internal combustion engines to generate electricity for sale to the local power utility. For this facility, the GCCS installation and installation schedules are both "compliance-driven" and "profit-driven". Regardless of whether the facility's GCCS installation and installation schedules are "compliance-driven" or "profit-driven", the Landfill faces difficult challenges with its GCCS, while maintaining its waste placement operations.

GCCS Challenges

For the "compliance-driven" Landfill owner, GCCS installations are required per the installation schedule establish in the NSPS regulations. Although the NSPS stipulates an installation schedule for the "compliance-driven" Landfills, more often than not, the schedule is accelerated because of other local requirements, such as odor control and subsurface emissions control. A Landfill may not yet be required to install GCCS components under the NSPS regulations, however, if odor complaints are filed or perimeter LFG probe monitoring indicates subsurface LFG migration, the Landfill will be obligated by local regulations to install GCCS components in advance of the NSPS schedule.

In the instance where the GCCS installation is both "compliance-driven" and "profit-driven", a Landfill will be encouraged to install GCCS components in every area of the Landfill that potentially produces LFG, and in most cases the installation schedule for the Landfill will be ahead of the NSPS required timeline. This is done because more LFG, or fuel, collected from the Landfill will generate more revenue for the facility, increasing the profitability of the facility.

Whatever the circumstance, the costs associated with the installation and continued maintenance of GCCS components can be significant. Although a Landfill may want to collect from every area of that generates LFG, not every area of the Landfill may be at final waste fill grades. The installation of GCCS components in areas that are not at final waste fill elevations almost always results in damage to these GCCS components. This leads to significant maintenance costs up to and including the Landfill cost for re-installing the entire GCCS components. So, the Landfill faces a dilemma in determining the extent of GCCS components it is willing to install, knowing that some of them will need to be repair, replaced or re-installed.

GCCS Installation Dilemma

Landfills that do not encounter any complications with an accelerated installation schedule typically install GCCS components in areas that are at final waste fill grades. By installing GCCS components in areas that are at final fill grades, these facilities can be assured that the

structural integrity of their GCCS will not be extensively compromised, and their costs for re-installing GCCS components are minimized.

Landfills that have an accelerated GCCS installation schedule or where waste phase development does not require reaching final grades before moving to the next cell, whether they are "compliance-driven" or "profit-driven", typically install GCCS components in areas that are not at final fill grades and where waste placement activities are on-going. These interim GCCS extraction components generally consist of vertical extraction wells and horizontal collection trenches. Figure 1 shows a typical vertical extraction well with a remote wellhead (i.e., lateral slopes back to the vertical extraction well). Figure 2 shows a typical horizontal collection trench.

Figure 1 – Typical Interim Vertical Extraction Well

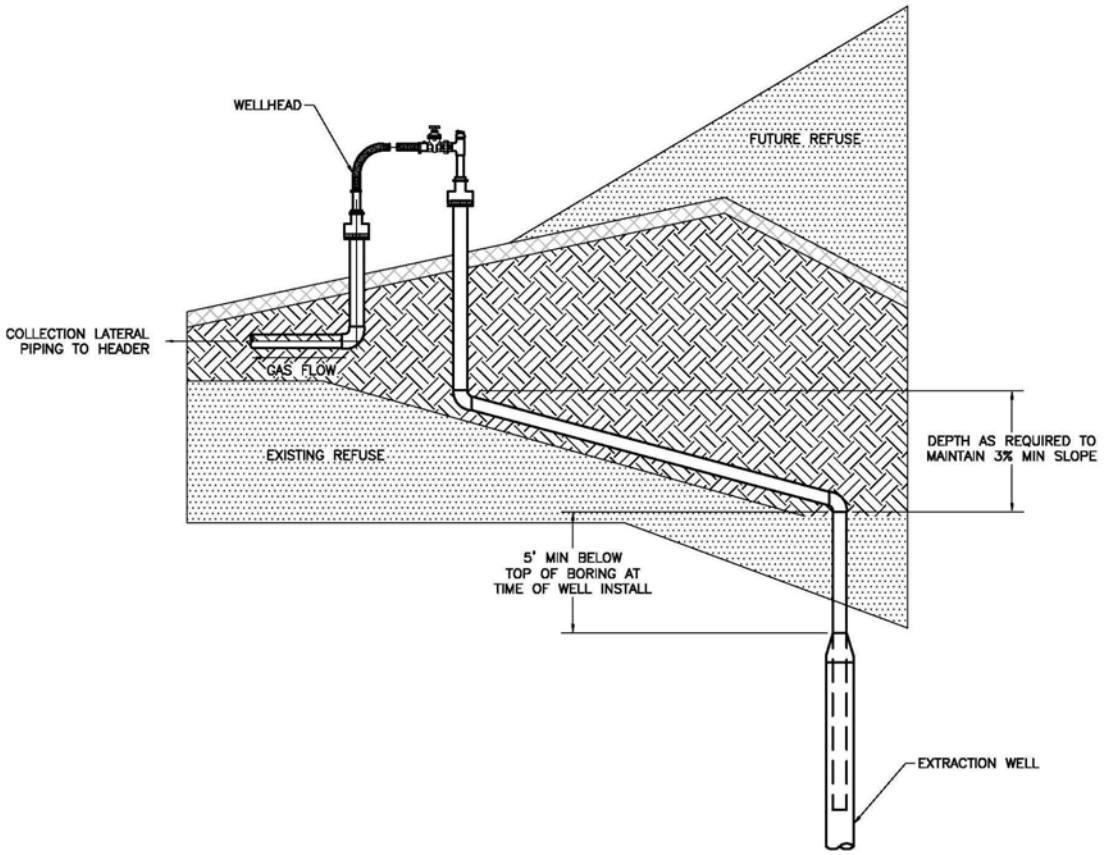
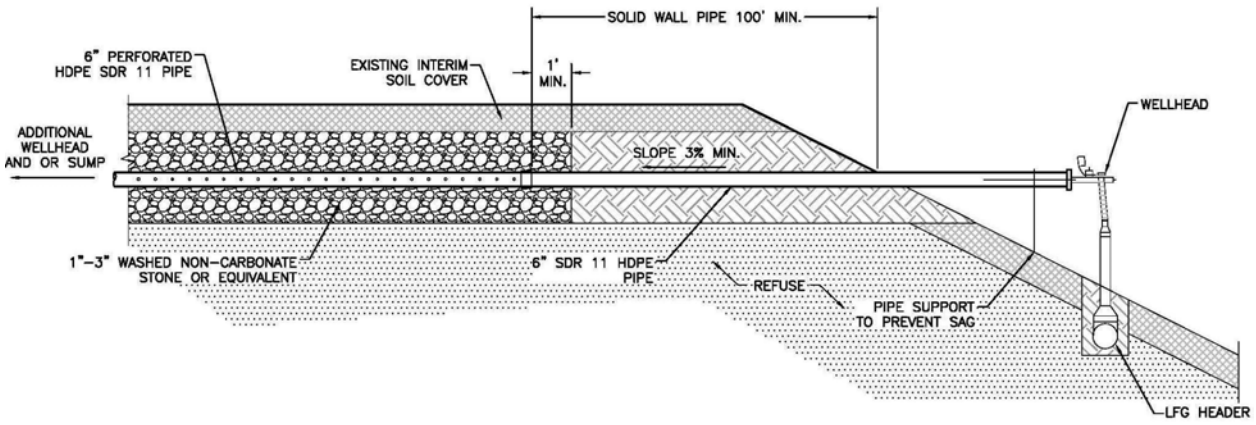


Figure 2 – Typical Interim Horizontal Collection Trench



With the installation of these interim GCCS extraction components and associated header pipelines in active waste placement areas, the Landfill will eventually encounter issues with its GCCS operations caused by damage from waste filling equipment operating in the areas where the GCCS components were installed. Regardless of any and all precautions the Landfill may take to preserve the integrity of the GCCS components, the nature of waste filling operations will almost always results in compromising the integrity of the GCCS components. Eventually, header pipelines will be overfilled and may be crushed, horizontal collection trenches may be flooded, and vertical extraction well casings may be pinched, or sheared. As a result, the Landfill will have to undertake the task of repeatedly replacing both GCCS extraction components and associated header pipelines.

GCCS Phasing Plans

The dilemma of trying to maximize LFG extraction by installing interim GCCS components, knowing that these components will eventually fail and have to be replaced, will almost always exist on a facility with a "profit-driven" GCCS installation schedule. One possible solution for this dilemma is the development of multi-year GCCS Phasing Plans.

Landfills generally take the time to plan in advance for waste placement activities, and usually have a set of Landfill Development Phasing Plans to facilitate budgeting for, at a minimum, the following year. For the Landfill with a "profit-driven" GCCS installation schedule, the development of GCCS Phasing Plans, in conjunction with the Landfill Development Phasing Plans, will facilitate budgeting for the GCCS installation.

The GCCS Phasing Plans will not eliminate the need for installing interim GCCS components, nor will it eliminate the need for the replacement of these interim GCCS components when they fail. The GCCS Phasing Plans, if developed thoughtfully, will, however, substantially minimize the costs associated with installing and maintaining an interim GCCS.

Interim GCCS Design Philosophy

When preparing the GCCS Phasing Plans, the Landfill will need to examine the areas of the Landfill where the GCCS will potentially be installed. Furthermore, it will need to examine the impact that the GCCS will have on waste placement activities, and conversely, the impact that waste placement activities will have on the GCCS.

Generally, the areas of the Landfill that will have a need for interim GCCS installation are on a plateau, where active waste placement activities are being conducted, and on an intermediate slope, which may not have any activity for a period of time. With this in mind, the Landfill will need to decide on the type of LFG collector to install in these areas.

Knowing that an area of the Landfill will not be conducting waste placement activities for a period of time, whether on a plateau or on an interim slope, the Landfill may choose to install standard vertical extraction wells, as it would in an area that has reached final waste grade elevations. Since heavy compaction equipment will not be operating near these vertical extraction wells, the Landfill can be assured that they will not be compromised due to waste placement activities. For additional installation cost savings, vertical extraction wells in these areas may be installed at shallower depths than they would be if they were installed in areas where final waste placement grades are achieved. The Landfill's GCCS Plan may stipulate that vertical extraction wells are to be installed through the waste depth, with a 20-foot separation from the bottom of the well to the leachate collection system. However, the Landfill may choose to install vertical extraction wells in these intermediate areas with a maximum well depth of 60 feet, for example, with the expectation that these vertical extraction wells will need to be replaced once final waste placement activities have been completed for the area.

For areas of the Landfill that are actively conducting waste placement activities, the Landfill may choose to install interim vertical extraction wells (Figure 1) or interim horizontal collection trenches (Figure 2). By placing these GCCS extraction components, the Landfill can be assured that the GCCS will not impact waste placement activities since all components will be trenched and buried in the active fill area. The Landfill can also be assured that waste placement activities will not severely impact the GCCS since there is no potential for direct equipment contact with collection components during filling operations.

In addition to the types of LFG extraction components to be installed, the Landfill must also examine the appropriately located and sized header pipelines to be installed in conjunction with the extraction components. For GCCS components installed in areas of active waste placement, it is expected that these components will eventually be compromised and replaced. Knowing this, the Landfill can install minimally sized header pipelines to connect to extraction components located in these areas.

In the case where GCCS components are installed on an interim slope that will not receive waste placement for a period of time, the Landfill may choose to install an interim header pipeline on

grade, or at a shallow burial depth. Because the Landfill will plan on replacing the interim header pipeline, it can be sized to accommodate only the expected LFG flow rates from the connected extraction components, instead of the expected peak LFG extraction rates. Eventually, the Landfill will fill up against the interim slope. Knowing the extent and timing of the overlay (using the Landfill Development Phasing Plans), the Landfill will be able to install flanged connections in the header pipeline at strategic locations in order to easily disconnect portions of the interim header pipeline as waste placement elevations reach the header pipeline location, and re-use those portions in other areas.

GCCS Equipment Phasing

GCCS Phasing Plans must also effectively incorporate the phasing of the LFG control equipment for the Landfill. In many cases, the existing LFG control components that are installed and operating at a facility are not sized for the total anticipated LFG flow rate for the facility.

Depending on the waste intake rates, a facility may not need to have LFG control equipment to accommodate the total anticipated LFG flow rates. For example, a Landfill is projecting a peak LFG flow rate of 6,000 scfm in 25 years, but is only collecting 500 scfm with its current GCCS. Installing LFG control equipment to handle the entire 6,000 scfm flow rate to start will most likely not work for the Landfill, as turndown ratios of the LFG blower(s) and flare(s) may pose operational difficulties. In this case, a modular approach to long-term development of the LFG control equipment may be a better option. The Landfill could install LFG control equipment to accommodate a LFG flow rate of 3,000 scfm, with capabilities to expand to control facility to handle the final 6,000 scfm flow rate.

The modular approach to LFG control equipment installation can also be appealing for the Landfill, as the capital cost savings for the equipment will be significant, especially in this example, as the Landfill will be operating for an extended period. The need for additional LFG control equipment will not be immediate, and therefore, the Landfill can budget for the additional equipment as LFG flow rates approach the capacity of the existing LFG control equipment.

Incorporating the LFG control equipment phasing with the GCCS Phasing Plans also has budgeting benefits for the Landfill. Continuing with this example, the Landfill (with LFG control equipment capacity of 3,000 scfm) at some point in the future starts collecting 2,500 scfm with the installation of new GCCS extraction components in the current year (Year 1). The Landfill may not be expecting a significant expansion of the GCCS in the next year (Year 2), but does anticipate a major GCCS installation in the following year (Year 3). The capacity of the LFG control equipment has not been exceeded in Year 1, but will be exceeded in Year 3. For budgeting purposes, the Landfill can install additional LFG control equipment in Year 2, when GCCS extraction component installation will be minimal. By doing so, the Landfill will have

leveled the capital costs and will have installed the necessary control equipment to accommodate the anticipated LFG flow rates for Year 3, when the GCCS is expanded significantly.

GCCS Phasing Plan Updates

As with any plan, the effectiveness of the GCCS Phasing Plans will only be as good as its implementation. Furthermore, the Landfill will gain no benefit from outdated plans. Waste filling operations are not always set in stone – there will always be changes to the Landfill Development Phasing Plans as the Landfill encounters changes in waste filling patterns, changes in waste intake, and other circumstances that may alter its development. When these changes occur, and an alternate Plan is developed for the Landfill Development, it is necessary to make corresponding updates to the GCCS Phasing Plans in order to gain its benefits.

Summary

With more and more Landfills deciding to pursue beneficial-use LFG projects, GCCS installation schedules are often being accelerated in advance of NSPS installation schedules. The desire to collect as much LFG as it can and install as much GCCS extraction components as it can, has led to the Landfill being faced with difficult challenges in maintaining a properly operating GCCS. The dilemma of installing costly GCCS components with the expectation that the Landfill will have to repeatedly replace these components may be difficult to resolve. However, with some planning, and with the development of GCCS Phasing Plans, the Landfill will have a well thought out approach to its GCCS development.