LANDFILL GAS SYSTEM CONSIDERATIONS AT HIGH-BTU LANDFILLS

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ABSTRACT
There are generally three broad categories of landfill-gas-to-energy (LFGTE) projects: electric power generation, medium-BTU industrial fuel; and high-BTU pipeline gas. During initial feasibility studies, landfill owners and developers should weigh the advantages of each with regard to the technology, local markets, landfill conditions, and site proximity to potential users. There has been an increase over the past ten years in the number of high-BTU projects developed in the U.S. This paper will provide a discussion of the reasons project owners are selecting high-BTU projects.

The author has been involved as both an owner's representative and consultant in a high-BTU project for over seven years. The paper will draw upon this experience to examine some of the challenges and opportunities in operating the project with respect to maintaining both environmental compliance and quality inlet gas. Some of these challenges are applicable to other technologies as well. This paper will discuss the advantages and disadvantages of high-BTU projects, and contractual considerations related to potential wellfield issues and compliance problems.

BACKGROUND
According to the Landfill Methane Outreach Program (LMOP), the EPA's program to promote landfill gas (LFG) as a renewable fuel, there were 37 active high-BTU landfill gas treatment projects in the United States as of July 2011. This represents approximately six percent of the 558 operating LFGTE projects nationwide. This number has increased in recent years due primarily to the availability of new technology that allows smaller projects to be cost-effectively implemented, increasingly stringent air emissions restrictions, and demand for renewable natural gas in certain local markets. Landfill owners and developers have several technologies to choose from, and must consider many issues in the planning and operation of their next project. The advantages and disadvantages of high-BTU should be considered in this process. As the minimum threshold flow rates for high-BTU projects continue to decrease, the U.S. is seeing more of these projects constructed. With the availability of renewable energy credits (RECs), the right location, and high efficiencies, high-BTU landfill gas projects may be attractive for a site, even when natural gas market prices are depressed.

High-BTU projects, perhaps even more so than other technologies, should be addressed with a holistic approach. The possibility that perimeter collectors or separate collection systems may be required to maintain environmental compliance needs to be considered. Pipeline specifications are not consistent throughout the nation, and can change between states, utilities and regional locations, adding the risk of additional costs. Stringent compliance monitoring, consistent with the Federal New Source Performance Standards (NSPS) and state-specific regulations, should be an integral part of any project. Failure to address these considerations can pose operational problems and incur unplanned costs for either or both parties.

POTENTIAL HIGH-BTU ADVANTAGES
High-BTU systems, like the other technologies available, have certain advantages and disadvantages that need to be considered during preliminary feasibility studies. There are three high-BTU processes within this category: membrane filtration, pressure-swing adsorption, and amine scrubbing, which should be considered on their own merits.

The original high-BTU systems were only cost-effective for larger landfills. However, over the past decade, technology has reduced the minimum operating thresholds for profitable high-BTU projects. Today's systems tend to require lower system operating pressures, and are much more modular. This has reduced some of the significant capital costs such that smaller projects can be considered. LMOP now lists six high-BTU projects with flow rates at or below 1,000 standard cubic feet per minute (SCFM).

When considering whether to install a high-BTU system, the margin over electrical power generation options should be evaluated, as well as proximity to potential users of medium-BTU gas, as these factors may favor high-BTU development. Distance to pipelines, the electrical grid, and the local cost of power are primary factors to be considered. Several high-BTU developers point out that low air emissions (as compared to engines) ease the permitting requirements, and now cite short development times as well. Modular construction has become more prevalent, not only decreasing cost, but easing later plant capacity increases. A consistent pipeline demand is an advantage for this technology, particularly compared to medium-BTU projects, which may use the LFG only seasonally or during certain operating hours.

POTENTIAL HIGH-BTU DISADVANTAGES

There are several potential disadvantages that must be weighed before settling on a high-BTU project. The process has always required significant capital outlay, although costs are decreasing as the technologies mature. High-BTU facilities, compared to power generation, tend to be of higher complexity and therefore require a higher level of personnel skillset, increasing construction and operating costs. If the skillset is not found locally or retained on site, this also adds to the cost.

For systems that cannot remove all inert contaminants, the landfill gas from wells with low-quality gas may have to be limited in order to meet strict pipeline standards, even if the well would otherwise produce good gas flows. Any concentration of inert gas coming from the wellfield will roughly double in concentration in the sales gas stream if not removed in the treatment process. Collection may be required by NSPS or perimeter gas probe exceedances, potentially requiring a separate system, as discussed later.

Market volatility with depressed natural gas prices has always been a risk and potential disadvantage. As of the writing of this paper, natural gas prices are depressed, but market forces generally force prices to levels which satisfy market supply and demand. Low prices can often be mitigated with Renewable Energy Certificates (RECs) and by increases in the value of landfill gas due to Renewable Portfolio Standards (RPS). The U.S. Department of Energy reports that 24 states have RPSs. Gas can be sold from projects in states without the RPSs to utilities in states with the RPSs, significantly increasing the value of the LFG throughout the country.

Another consideration are the local pipeline standards, which vary regionally and can change with little notice. Although tighter standards can usually be resolved with additional engineered systems, this comes with additional capital and operating costs that may not have been planned for in initial feasibility studies. As with other technologies, the disadvantages need to be weighed against the advantages and against other available technologies during early feasibility studies.

CONTRACTS AND COMPLIANCE

Many contractual issues between the landfill owner and developer should be outlined early in the planning and contract development process. The landfill owner's goals are typically to comply with NSPS; avoid odor and landfill gas migration issues; avoid significant capital and operating cost; to generate revenue and provide a positive public image. Developers must maximize gas collection at an acceptable quality, and construct and operate a treatment facility; and depending on how the contractual relationship is set up, construct and operate a GCCS at a cost that allows a profit from the gas sales. Since the goals are dissimilar, contracts must provide a framework for an NSPS-compliant, yet workable project.

Wellfield ownership, operation and maintenance (O&M), and responsibility for compliance are intertwined, and must be clearly identified in the contract. Conceptually, contracts can be very different, and are unique to each site. Some development contracts assign O&M responsibilities to the developer; others assign these responsibilities to the owner. There have been instances where the landfill owner retains O&M and NSPS compliance responsibility but the developer pays for and helps direct the O&M crews to ensure that the dissimilar interests are met. Regardless of how the contract is structured it is critical that owners realize the ultimate burden of wellfield compliance cannot be contracted away by the landfill owner. This fact was defined in EPA Applicability Determination 0300038. The determination states: "*…the owner of a regulated facility cannot contract away its liability because another entity is contractually obligated to perform activities which are also regulated (see generally, for example, United States of America v. Geppert Bros., Inc. and Amstar Corporation, 638 F. Supp. 996 (D.C. Pa. 1986)).*

If there are compliance problems, the EPA states that both parties may be held accountable. Therefore, if the developer tunes and maintains the wellfield, it's important that the owner remain engaged and perform some level of oversight. Some larger sites schedule routine "compliance calls" on a monthly basis between the owner, GCCS operator, and qualified landfill air compliance consultants to discuss, track and resolve wellfield and control device issues. An active teamwork approach is essential to addressing the compliance issues that often develop.

Many site owners retain wellfield control. In these cases, contracts may require LFG inlet specifications and volumes. This provides the advantage of the party with the greatest compliance responsibility retaining full wellfield control. Typically the owner will maintain the GCCS from the wellfield through the blower system, providing full control over the operation of the wellfield. Once the extracted landfill gas leaves the owner's blower(s), it can enter the developer's system, then the end-user's; or can be discharged to the control system (flare, etc.). This operating methodology requires a greater level of control complexity, but allows the owner to optimize landfill gas extraction and minimize compliance issues.

The converse of this operating scenario is that the owner must typically maintain a specified quality of raw gas into the plant. As discussed earlier, not all inerts are removed by most high-BTU processes, requiring supplemental treatment equipment for gas streams with levels of inerts above delivery specifications.

Many types of wellfield problems can have a direct impact on compliance, as well as gas sales. Contracts vary widely, but typical considerations that should be addressed are: timeliness of GCCS expansions – and who pays for them; responsibility for impacts to GCCS components by landfill operations; responsibility for LFG that is below high-BTU inlet standards; responsibility for uncollected LFG; and for constructing perimeter control systems that might not be suitable for high-BTU treatment.

There are two contractual questions related to timely GCCS expansions. The first is straight forward: a system must be installed before the NSPS deadline, within two years if closed or at final grade, or within five years if active (40 CFR 60.752(b)(2)). However, a contract should also allow for an interim system in the event the developer or owner wants to or is required to construct in an area being actively filled. The question of financial responsibility could be an issue if an addition is required solely for odor control or remediation, and should also be addressed in the contract.

Responsibility for GCCS problems that impact gas volume, quality, or compliance should also be considered in the contract. Headers can water in due to settlement from heavy vehicle traffic, landfill settlement, or failed or frozen condensate pumps. Landfill operations (mowers, dozers, etc.) can easily damage wells, headers, and wellheads. Wellheads and caps can come loose, causing air leaks; and liquid extraction pumps can fail. All of these issues will affect gas quality, flow volumes, and may require follow-up compliance actions. Use of a wellfield database system, accessible to owner, developer, and consultant (if used) is helpful if not essential in this case, particularly for a larger system. The question of who pays for or loses revenue for these impacts, and for a database service, should be addressed in the contract. A framework for prevention of the impacts should also be agreed upon, such as a minimum slope or casing for road crossings; marking of above-ground GCCS components; infrastructure design for condensate removal via pumps; and design assuring gas flow and condensate flow during cold weather.

LFG development contracts should, for any technology, address the potential need for additional collectors required due to surface emission monitoring (SEM) and perimeter LFG exceedances. Additionally, high-BTU agreements should also address the responsibility for installation of perimeter systems collecting gas unsuitable for high-BTU processing. In the event a perimeter remedial system is required outside of a landfill (more typical at pre-Subtitle D sites), it is likely the LFG would be inappropriate for high-BTU treatment due to high levels of oxygen, nitrogen, and other inert gases. For the same reasons, a perimeter system within a landfill unit, which may be operated aggressively to resolve a gas probe or SEM exceedance, may also not be suitable for some high-BTU systems.

Cornerstone Environmental Group has found that remedial systems for older pre-Subtitle D facilities tend to be more extensive and costly, while those installed for Subtitle D sites are more modest, and can sometimes be incorporated into the high-BTU system. If a separate perimeter system is large enough, it might even be appropriate for another beneficial gas use, such as engine power generation. Regardless, if a perimeter collection system cannot be used in an existing high-BTU system, installation and operation of an additional control device will be costly.

CONCLUSION

As a one of the major and growing parts of the LFGTE pie, high-BTU treatments systems are one of the technologies that developers should consider. Where owners and developers would not have considered smaller high-BTU projects a few years ago, they may want to consider them for projects today. Primary determinants of the type of project to be constructed are locational: proximity to nearby users and the value of the treated product in a potential project area, but numerous advantages and disadvantages for each technology must be weighed. In cases where a landfill is near a natural gas pipeline, wholesale electrical power rates are low, and the local skills are available, owners may decide the risks of cyclical markets and the possibility of remedial systems are acceptable. If a landfill is full Subtitle D and the treated gas can be sold with the pricing advantages of renewable gas, this will increase the likelihood of a project being a profitable one.

For a high-BTU project, like any other, to work successfully and remain in compliance, the contract arrangements need to be fully addressed for many potential issues. Important contractual considerations are ownership of the wellfield; the infrastructure to be provided in the field to prevent downtime and maximize gas production; the assignment of responsibility for timely installation of additional collection devices or even separate systems; and a framework for addressing impacts to GCCS components and compliance issues. Consideration of these issues before a project is implemented will create a predictable atmosphere providing a contract where cost is assigned appropriately and compliance is maintained.