LESSONS LEARNED IN LANDFILL GAS-TO-ENERGY

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More than 300 landfill gas-to-energy (LFGTE) projects are successfully operating in the United States. The large number of successful projects might lead one to conclude that LFGTE project development is without pitfalls. LFGTE projects do sometimes fail. Participants in failed projects are reluctant to publicize their failures; hence, little information on potential project pitfalls is circulated in print or is presented at conferences. A few of the more important and more frequently encountered pitfalls are discussed in the paragraphs which follow.

Landfill Gas Recovery Projections

In the early years of LFGTE, the over projection of recoverable landfill gas was a significant cause of project failure. When landfill gas recovery is over projected, the LFGTE facility does not operate at its full capacity, and project revenues are not adequate to fully cover debt service and operating costs. Despite advances in landfill gas (LFG) recovery modeling, the over projection of recoverable landfill gas is still a factor in project failure. Several factors come into play.

First, while advances in LFG recovery modeling have been made, and most modeling work is undertaken using a well known and widely accepted first-order model, the selection of site-specific coefficients to drive the model still requires considerable expertise. Definitive guidance on coefficient selection is not available in the open literature. Only a few consultants have the depth and breadth of experience which is required to select site-specific LFG modeling coefficients. SCS Engineers (SCS) has an ongoing, in-house program to continually improve its modeling coefficient selection. SCS employs a nationwide database of well over 100 landfills, as a basis for its modeling coefficients.

Second, the developer of an LFGTE project generally calls for LFG recovery projections early in the project development process, when he is most reluctant to put money at risk, and again late in the development process, when he is in a hurry and is waiting on an LFG recovery projection to support the close of financing. The tendency of many LFGTE developers is to try to obtain LFG recovery projections as cheaply and as quickly as possible. The quality of the LFG recovery projection is, like most technical efforts, directly related to the effort expended. The correlation between effort and quality particularly holds if a partial LFG collection system exists at a site at the time the modeling work is undertaken. A verification of the accuracy of the site's flow meter, a review of wellfield operating practices, and a thorough review of historic data should always be undertaken -- rather than conducting a "desktop" analysis.

Third, the fact that LFG is available for recovery does not guarantee that the LFG will be recovered. At active landfills, the buildout of landfill gas collection systems must lag waste placement. In many instances, this lag can be appreciable. Where wellfield coverage does exist, LFG recovery is often temporarily disrupted when portions of the wellfield are taken offline to

facilitate waste disposal. Older wellfields are sometimes not well operated and maintained by the landfill owner or by the owner of the LFGTE facility. Economic constraints, or simply lack of attention and/or experience, can result in failure to replace deteriorating wells, ineffective leachate management and/or condensate management, and other problems which impair LFG recovery. Theoretical LFG recovery must be adjusted for the site-specific practicality of LFG recovery.

Fourth, the quality of LFG which is required by the LFGTE project can affect the recoverability of LFG. A pipeline quality gas project (high-Btu project) will require 55%+ methane content LFG, while a reciprocating engine project may tolerate a methane content as low as 40%. Generally, but not always, the demand for higher methane quality will result in some decrease in LFG capture -- at least in the amount of LFG destined for the LFGTE facility. Some of the LFG from low methane content wells, such as perimeter or sideslope wells, may need to be directed to a flare for destruction or be directed to a more tolerable LFG use.

In summary, LFG recovery projections are a critical element in project sizing and in its economic performance.

Product Sale Agreements

Technical staffers generally begin to think of a project in terms of what technologies are available, and what size of project a landfill can support. The first question should be -- what type of product sales agreement can we obtain and on what terms? There is little value in evaluating electric power generation alternatives when the market which exists offers a low power purchase rate. Vehicle fuel production may look economically attractive when its product is compared to prevailing local prices for gasoline or diesel fuel; however, market prices for fuel fluctuate greatly over time.

LFGTE projects are generally financed based on product sales agreements incorporating guaranteed minimum purchase quantities and guaranteed minimum prices. Such agreements are difficult to secure for vehicle fuel projects. If the LFGTE developer has a large captive vehicle fleet, or can sign a contract with an agency which has such a fleet, then the necessary guarantees might be able to be secured; however, one might question the wisdom of the fleet owner's entering into such a contract when the price of fuels, including conventional LNG and CNG, threaten to drop below the benchmark price required by the project.

It could be said that there are three important things in successful LFGTE project development -- 1) get a good product sales agreement; 2) get a good product sales agreement; and 3) get a good product sales agreement. The product sales agreement is the second most important thing to address after the LFG recovery projection.

Utility Interconnection

Electric power generation facilities, whether exporting power to the grid or satisfying on-site loads, will find themselves interconnecting with the local electric power company. Projects designed to satisfy on-site loads still interconnect to the utility for the purpose of securing standby and/or supplemental power. While some measure of standardization of interconnection requirements has been accomplished (e.g., California's Rule 21 for investor-owned utilities), interconnections are still approved on a case-by-case basis. It is generally not difficult, nor extremely costly, to satisfy a utility's technical requirements on the power plant side of the utility meter. It is, however, sometimes difficult to determine exactly what will satisfy the reviewer of the interconnection application. SCS has often seen different answers from different regional offices in the same utility, and have had the same office change their requirements from one month to the next.

The interconnection costs on the power plant side of the utility meter are generally not great and are limited to protective relays and disconnect devices. Based on SCS project experience, the utility's upgrades on the utility side of the meter can vary greatly and can range from $50/kW to $250/kW.

The amount of time required to secure an interconnection agreement can vary. It depends on the anticipated impact on the local utility's distribution system. While size of the power plant is an important factor in the level of engineering review that a project will require, the size and characteristics of the utility's distribution system at the point of interconnection is of even greater importance. The quickest SCS has secured an interconnection agreement was three months. The longest period was six months.

Utility interconnections can introduce schedule delays and added project costs. Interconnection applications should be filed early. Fortunately and surprisingly, interconnection applications can generally be filed without a great deal of the detailed design being completed.

Technology Section

Most technical staffers are at least somewhat attracted to new technologies. It is our nature to want to be involved in something innovative and to take advantage of the potential economic and environmental benefits of new and improved technologies. Different LFGTE developers will have different levels of tolerance to technical risk. Most LFGTE developers can tolerate some technical risk, and the corollary economic risk, and will take some risk given the potential rewards associated with a new or improved technology. Risk can be mitigated through conservative modeling of economics, for the early years of operation, and through vendor and contractor guarantees. Somewhat "substandard" performance of a new technology in it initial years of operation is only "substandard" if the project's economic model did not allow for the possibility of impaired performance.

Technology selection is governed by the availability of product sales agreements, project size and the developer's posture with respect to risk. In general, it is not a good idea to be the first person to employ a new or significantly modified technology; however, embracing a new technology shortly after others have installed, operated and debugged one or two facilities can produce great rewards.

General LFGTE Industry Issues

The LFGTE industry's economic success is closely linked to the price of natural gas. Medium-Btu gas and pipeline quality gas (high-Btu gas) directly displace natural gas. The marginal cost of electric power is increasingly established by the price of natural gas since natural gas units are generally the first to be dispatched to match power demands. While vehicle fuel projects ostensibly compete with gasoline and diesel, they actually compete with conventional LNG and CNG. As this article was being written, natural gas prices are on the rise after a long period of depressed prices.

While an LFGTE developer can do nothing to control natural gas prices, the most important lesson to be learned in LFGTE is that LFGTE's long-term viability is directly linked to natural gas prices. In the absence of high natural gas prices, tax credits have helped the LFGTE industry weather a long period of low natural gas prices. With tax credits expiring, the LFGTE industry will be solely dependent on the market price of natural gas.