Anchorage Landfill Gas to Energy Project

Executive Summary

The Anchorage Landfill Gas to Energy Project (LFGTE) is a partnership between the Municipality of Anchorage and Doyon Utilities (DU) to beneficially use landfill gas (LFG) produced by the Anchorage Regional Landfill (ARL). The project generates 5.6 megawatts of electricity which is provided directly to Joint Base Elmendorf – Richardson (JBER); a military installation adjacent to the landfill.

Under the terms of the Master Implementation Agreement (MIA) between DU and the Municipality, DU constructed a gas processing facility (GPS) at ARL, a Power Plant on JBER and a 1.2 mile transmission pipeline. The MIA has a base term of 20 years with two 10-year renewal options. DU will operate the GPS, pipeline and Power Plant. The Municipality is responsible for operation and development of the LFG collection system. LFG is sold to DU at equivalent local wholesale natural gas prices. DU will recover construction costs and gas purchases through monthly energy tariffs to JBER.

The Power Plant currently has four Jenbacher engines. LFG production has exceeded modeled expectations. A fifth unit is scheduled for installation in 2013 to bring the plant output to 7 MW. The plant is configured for six units at full production.

The LFGTE Project is the largest Green Energy project in the U.S. Air Force's Pacific theater of operations. Section 203 of the Energy Policy Act of 2005 requires federal facilities to increase renewable energy consumption to at least 7.5 percent by 2013. The project provides 52 percent of the installations electrical demand; 7 times the renewable energy required by the Policy.

The project is a win for the Municipality, DU and JBER. JBER is expected to realize a savings of $73.6 million over the total life of the project. The Municipality will realize in excess of $1 million annually in revenues from gas sales. The net present value of revenue anticipated to be realized by the Municipality over the life of the project is $51.9 million.

INTRODUCTION

The Anchorage Landfill Gas-to-Energy (LFGTE) Project is a collaborative effort between the Municipality of Anchorage Solid Waste Services Department and Doyon Utilities (DU). The project uses landfill gas collected from the Anchorage Regional Landfill (ARL) to produce 5.6 megawatts of electricity which is delivered directly to Joint Base Elmendorf-Richardson (JBER) for base load power. The project provides many benefits to the Anchorage community including:

- Low cost, reliable electricity to JBER, far exceeding Department of Defense-mandated green energy usage;
- Offsets consumption of local natural gas resources which are in decline in the Anchorage area;
- Maintains the landfill in compliance with New Source Performance Standards for landfill gas collection and control; and
- Creates a valuable revenue stream to the Municipality to offset future landfill development, operating and closure costs.

Doyon Utilities Landfill Gas Power Plant

Because DU is the power utility for JBER, the base enjoys power based on the direct purchase price of the landfill gas. The power is not delivered to the local grid, allowing DU to pay a premium price to the Municipality for its gas and provide power at a low price to JBER.

History and Background

The Anchorage Regional Landfill is owned and operated by the Municipality of Anchorage, Alaska. The Municipality serves a population of 330,000 residents spread over a geographic area of 1,960 square miles. Nearly half of the state's population lives or works in Anchorage, making it the primary banking and business center for Alaska.

ARL is permitted under Title 18 of the Alaska Administrative Code as a Class I landfill and meets all the design and operational criteria of a RCRA Subtitle D landfill. ARL began operation in 1987. The landfill was constructed on a 300 acre tract obtained from the U.S. Army. The actual operating footprint of the landfill will be constructed as 12 cells covering an area of 165 acres, with the remainder of the area set aside for support and buffer areas. Currently 8 of the 12 cells have been constructed, occupying 117 acres. The landfill has a design capacity of approximately 21 million tons; with approximately 8 million tons currently in place. Under the current operating plan, ARL has adequate capacity to provide municipal solid waste disposal until approximately 2050. Figure 1 shows a general overview of the landfill development Plan.

In 2003, ARL exceeded the threshold limit of 50 megagrams/year (Mg/yr) for emissions of non-methanogenic oganic compounds (NMOC) as prescribed by federal New Source Performance Standards (NSPS) found in 40 CFR 60.33 (c). As a result, the Municipality constructed an active gas collection and control system (GCCS) which was brought on line in 2006. The system was operated for three full years to verify the quantity and variability of the gas as a commercial resource.

In 2010, the Municipality issued a request for proposals to beneficially use the landfill gas. At the request of the Municipal Assembly, the RFP was to be open to any and all developers and technologies. Based on the strength and experience of its project team, the well developed financing strategy and the overall financial benefit of the project to the Municipality over the life of the project, the Doyon Utilities proposal was selected. A detailed contract was negotiated to define the roles, responsibilities and financial terms of the project for all parties.

The final contract was approved by the Munici-

Figure 1. General layout and development plan for Anchorage Regional Landfill

pal Assembly in May 2011. By May 2012, the Power Plant was on line to generate electricity, and the system was fully operating on landfill gas in August 2012.

Climate

No Alaska story would be complete without a brief discussion of our climate. Climate plays a significant role in the design, construction and operation of ARL and the LFGTE project. The Anchorage LFGTE project is the northern-most project of its kind in North America, at latitude 61^{o} North. Because of its proximity to Cook Inlet and the North Pacific Ocean, Anchorage's climate is described as sub-arctic maritime. The mean annual temperature is 36^{o}F with over 190 days per year having temperatures below freezing.

Winter extends between mid-October and late April. Winter temperatures at ARL drop to -10^{o}F for periods which continue for several weeks every winter. The cold climate results in frost to depths in excess of 10 feet in native soils adjacent to the landfill and as much as 5 feet into the waste. A study performed by Lawrence Technological University in 1999 found that refuse placed in ARL in mid-winter may stay frozen for up to two years after placement.

Anchorage receives an average of 15.9 inches of precipitation. Unlike warmer climates, about 40 percent of the precipitation falls as snow. Because the moisture is frozen for most of the winter, the landfill is considered arid at this time. This is offset by high runoff during the spring thaw as well as in August, our wettest month.

Design and Construction

ARL is designed to maximize use of space on the existing site. In addition to general construction of the landfill cells, key components of the LFGTE Project include the Gas Collection and Control System (GCCS), the Gas Processing System (GPS), the Fort Richardson Landfill Gas Power Plant and a one-mile pipeline for transmission of gas between the GPS and Power Plant. The key components are shown on Figure 2.

Cell Construction

Cell construction showing liner, cushioning fabric and gravel leachate conveyance layer

ARL is constructed on a large glacial moraine. Soils are well graded sand an gravel with cobbles and numerous boulders in excess of 36 inches in diameter. Groundwater is encountered at the interface between the glacial soils and bedrock, approximately 140 feet below original ground surface. Prior to construction, the cells are excavated to approximately 80 feet below the perimeter road elevation. At final grades, the top of the landfill will be approximately 170 feet above the perimeter road.

While Alaska has many natural resources, naturally occurring clay deposits of low permeability is not available, and would be prohibitively expensive to import from other places. Under an approved alternate liner petition, all cells are lined with a composite lining system comprised of 80-mil high density polyethylene (HDPE) membrane over a geosynthetic clay liner (GCL). The liner system is overlain by a layer of coarse gravel with HDPE piping to collect and transport leachate to collection ponds in the northeast corner of the property by gravity.

Gas Collection and Control System

The GCCS includes 36 vertically drilled wells, 21 horizontal collector wells and 8 interconnections with the leachate system. Vertical wells were constructed by installing 6-inch HDPE well risers in 36-inch diameter auger-drilled borings. Wells range in depth between 60 feet and 120 feet. Each casing is perforated generally starting at depths of 40 feet below the landfill surface. The perforated casing is backfilled with porous materials such as coarse rock or tire chips.

The initial horizontal collectors were designed to collect gas from the perimeter of the liner system and constructed with perforated 4-inch HDPE pipe bedded coarse gravel. Larger horizontal collectors have also been constructed within the waste. These collectors use an "in-and-out" construction where segments of alternating 6-in and 10-inch HDPE pipe are laid overlapping in a bed of coarse rock (4-inch minus) or tire chips.

The collection headers were designed to provide positive slope in all pipes and low points where the headers were close to cleanout lines in the leachate collection system. Connecting structures were installed to allow the condensate accumulating in the header to discharge to

Figure 2. General Project Layout

the leachate system. At the same time, these structures allow LFG to be drawn from the leachate collection system.

The original collection header pipe lines were buried a minimum of 48 inches below the landfill surface. Between the insulative properties of the backfill materials and the heat from within the refuse, this depth was found to be adequate to minimize freezing of condensate in the lines. The headers are designed in a looped configuration to draw flow from all wells even in the event of a line blockage.

All well head controls, valves, sample ports and other surface equipment are protected by vault structures. Corrugated HDPE culvert pipe is used for these vaults. This material is relatively inexpensive and allows for easy adjustment as settling occurs. The vaults have adequate insulative capacity to trap some heat from within the landfill which protects the equipment from freezing and snow accumulation.

Insulated gas collection header pipe being installed. Inset shows detail of the insulated pipe

Maintenance or repair of pipelines in the winter time can be difficult depending on the depth of burial and frozen materials overlying the pipe. To improve access in winter, our latest modifications to the pipeline system have been constructed of insulated HDPE pipe mounted on the surface of the landfill. A thin soil cover is applied over the pipelines to anchor them in place and reduce thermal expansion of the pipe. The insulated pipe is constructed with a small channel on the exterior of the pipe. Heat trace, a thin wire which, when energized produces heat, is installed along the bottom side of the insulated pipe. In the event that a section of the pipeline becomes blocked by ice, the heat trace can be energized to thaw the pipe. Through the first winter of operation the heat trace was not needed.

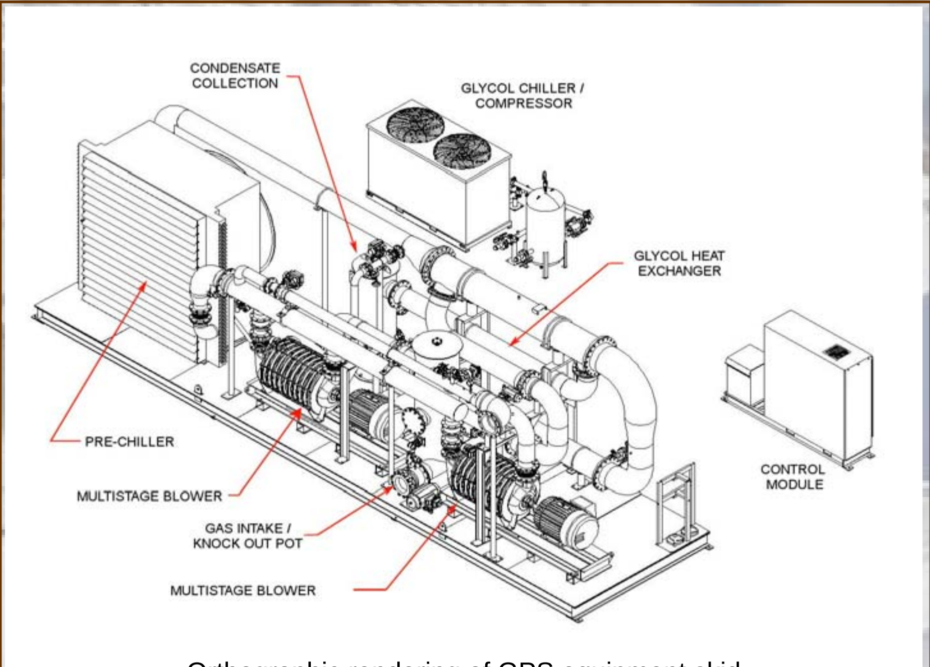
Gas Collection and Processing

The GCCS has two blower buildings; the original gas collection building and the Gas Processing Building (GPS). Blowers, instrumentation, and any component which would collect or convey condensate are housed in one of these two heated structures. The structures were provided to protect equipment from freezing condensate, eliminate snow and ice accumulation, and to provide a safe and comfortable working environment for performing maintenance or repairs to the equipment. Each building is designed with separate "classified" and "non-classified" spaces. Gas handling equipment is located in the "classified" space where all electrical construction is built to NEC Class I Division 2 (explosion proof) standards. Control panels and other electrical equipment are located in the "non-classified" areas.

Gas Processing Facility with original blower building adjacent and enclosed flare in background

The original building houses two multi-stage centrifugal blowers, each with a capacity of 1,200 scfm. The blowers are mounted on a modular skid with associated moisture knockouts, valves and other controls. The blowers discharge charge to a 40-foot enclosed flare manufactured by Parnell Industries. The flare can destroy up to 2,000 scfm with a turn down ratio of 10. The flare typically operates at approximately 1,600 ^{o}F but has been demonstrated to be equally efficient at temperatures as low as 1,350 ^{o}F by source test.

The GPS building constructed as part of the LFGTE project was designed to process the gas for delivery to the generators. Raw gas from ARL is generally very low in sulfides (total reduced sulfides less than 20 ppmv) and siloxanes (less than 10 ppmv) compared to other landfills. The primary design criterion for this facility was to remove moisture and discharge the gas at the pipeline operating pressure. Ground was broken for this structure in May 2012. The facility was fully operational an on line before September 2012.



Orthographic rendering of GPS equipment skid

The operating equipment housed in the GPS includes two multistage HSI centrifugal blowers, each capable of moving up to 2,500 scfm of landfill gas. Gas discharged from the blowers moves through a pre-chiller which uses an ambient air heat exchanger to cool the gas from the blower discharge temperature of 195^{o}F to approximately 90 ^{o}F. The gas then passes through a glycol tube chiller / dehydration unit where the temperature is further reduced to 40 ^{o}F. Moisture which condenses at this temperature is removed with a knockout chamber and is pumped to a condensate storage tank in the original blower building. The gas is then reheated to 82 ^{o}F and pressurized to 9 pounds per square inch (psi).


Installing transmission pipeline with power cable conduit

Within the process system is a bypass which allows the GPS to divert gas collected in excess of the Power Plant demand to the existing enclosed flare. Instrumentation within the building continuously monitors the amount of gas delivered to the power plant, the amount of gas diverted to the flare and the BTU content of the gas.

Transmission Pipeline

Landfill gas is transported 1.2 miles from the GPS building to the Power Plant in a low pressure pipeline which operates at a normal pressure of 9 psi. The pipeline is constructed of 12-inch HDPE pipe. The pipeline is buried at a minimum depth of 6 feet below grade and a typical depth of 10 feet below grade to minimize potential freezing of residual condensate in the pipeline. The pipeline is graded such that any condensate that might accumulate in the pipeline will flow by gravity to one of four collection sumps located at low points along the alignment. The transmission pipeline was constructed in September 2011.

Fiber optic line and power transmission lines were installed in the same trench as the pipeline. The fiber optic line allows the GPS to be connected with DU’s base-wide utility SCADA system to monitor operation of the facility. The power cables allow the GPS to draw electricity either from the Power Plant or from the local utility grid. The redundancy ensures greater operational reliability under emergency conditions.

Power Plant

The Power Plant is constructed on Fort Richardson, immediately adjacent to the ARL boundary. The Power Plant houses four Jenbacher JGS 420 internal combustion generating units. Each generator is plumbed to operate using either landfill gas or commercially available natural gas to ensure maximum reliability of the plant.. The Jenbacher engines can change between the two fuel sources “on the fly” requiring no shut down or equipment modification to affect the change. The supply manifold is designed such that the two fuel sources can be blended if needed to unsure optimum BTU content of the fuel.

Each unit has an output capacity of 1.4 megawatts (MW) for a total installed capacity of 5.6 MW. Power is output from the generators at a line voltage of 4.16 kilovolts (kV). The power is stepped up to 12 .47 kV before entering the JBER distribution system at the D Street Substation. The switch gear and transformer were constructed as part of the new power plant. All power produced by the project is delivered to JBER.

Power Plant transformer and radiant cooling

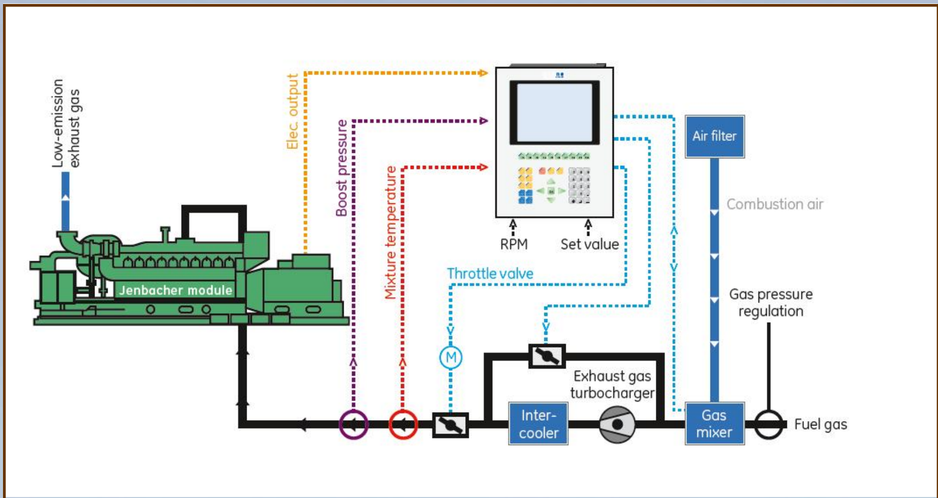
The foundation for this structure was started in August 2011. Snow began falling in early October so much of the concrete work was completed under a polyethylene tent. The winter of 2011-2012 was the snowiest on record with 135 inches of snow recorded at the official recording station and closer to 170 inches of snow at the landfill site. Construction of the building continued throughout the winter and was fully operational on May 15, 2012.

Equipment Systems and Technology

During the design, DU selected Jenbacher JGS 420 engines for the power plant. The engines are 4-stroke 20 cylinder internal combustion engines having a total displacement of 3,728 cubic inches and a power output of 1,966 brake horse power per unit. Each engine drives an electrical generator which has an output capacity of 1,412 KW when operated under 100 percent load on landfill gas at an electrical efficiency of 39.0 percent. Operating on natural gas at 100 percent load, the units are capable of producing 1,236 KW at an electrical efficiency of 39.3 percent.

The Jenbacher engines were selected for their ability to switch "on the fly" from landfill gas to natural gas, as well as blends of the two fuels. The mixing is within the engine with no need for external fuel mixing tanks. The capa-

Jenbacher JGS 420 engines at the new Power Plant bility to operate using either fuel was a key consideration to the designers, as JBER, the ultimate client was looking for a high level of reliability in the power production system.



Schematic of GE Jenbacher LEANOX emission control system

The Jenbacher engines use the LEANOX system which continuously monitors temperature and pressure of the intake and exhaust gas, power output, and other parameters. The system automatically advance or retards the combustion in each cylinder to operate at the leanest fuel to air ratio. The result is increased efficiency in fuel consumption and low exhaust emissions. With this system NOx emissions are less than 50 mg/Nm^3, and carbon monoxide emissions of less than 150 mg/Nm^3.

PROJECT DEVELOPMENT/FINANCIAL MANAGEMENT

Development and operation of the LFGTE project was negotiated between the Municipality and DU in the Master Implementation Agreement (MIA). The MIA defines the roles and responsibilities of each party as well as the duration and financial terms of the agreement. Under the terms of the MIA, DU was responsible for design and construction of the GPS, Power Plant, electrical intertie and gas transmission pipeline.

Ownership and Financing

The project was financed and constructed by DU with the construction costs to be recovered through monthly utility tariffs to JBER. The project costs include:

Project Costs by Key Component

COMPONENT	CAPITAL COST
Gas Processing Building (GPS)	$2,496,000
Transmission Pipeline	$1,472,000
Power Plant (including transformer and switch gear)	$26,620,000
Interconnecting Power Lines	$396,000

The Municipality received a grant from the Alaska Energy Authority for $2 million from the state's Renewable Energy Grant program. Under the terms of the MIA, DU designed and built the GPS and transmission pipeline as a Municipal construction project. The Municipality reimbursed DU up to the value of the proceeds of the grant. The remainder of the project was donated by DU to the Municipality as contribution in aid of construction. The Municipality owns these facilities but DU is responsible for their operation and maintenance for the life of the contract.

The Power Plant and associated transformer and switch gear are owned by DU. These facilities were constructed as part of DU's Utility Privatization contract with Fort Richardson. Because of its timing and nature, DU was able to take advantage of Section 1603 of the Federal Recovery Act of 2009. Under this section DU was reimbursed $7.8 million of the Power Plant costs as payment in lieu of tax credit.

Contract Terms

Under the terms of the MIA, DU purchases the landfill gas from the Municipality for a period of 20 years with two 10-year option periods. The purchase price of the gas is equal to the average price that Chugach Electric Association (CEA), the major power producer in the region, pays to purchase natural gas for operating its power plants, less shipping and storage charges. Since the natural gas purchased by CEA is primarily from producers in the Cook Inlet natural gas fields adjacent to the Municipality, the price is a fair representation of energy costs in the region. Gas is purchased in units of million BTUS (MMBTU) as measured at the gas delivery point in the GPS building.

The landfill received 170 inches of snow during construction of the Power Plant which was completed in 10 months

Each year, DU must purchase a minimum "take-or-pay" quantity equal to 80 percent of the average generation rate as predicted by the gas production model developed by Shaw/ EMCON in 2004. This term was meant to ensure a minimum cash flow to the Municipality. In DU's original proposal, the power plant configuration would use approximately 372,000 MMBTU per year. As an incentive to DU to expand the project beyond the scope of their original proposal, the MIA provides a discounted purchase price equal to 65 percent of the Cook Inlet gas price for all gas sold above the base or "Tier I" quantity of 372,000 MMBTU.

The Municipality retains full responsibility for operation, maintenance and continued development of the GCCS. DU is responsible for operation and maintenance of the GPS, transmission pipeline, Power Plant and electrical transmission system. The Municipality pays DU 2 percent gas purchase price for operating and maintaining the GPS and transmission pipeline.

Project Benefits

The project provides a stable power source which represents approximately one-half of the base power demand for the Fort Richardson side of JBER. Should the local power grid fail, as might be the case in an earthquake or other major natural disaster, the project could provide 100 percent of the emergency backup power to keep Fort Richardson in operation at all times.

The LFGTE project is the largest Green Energy project in the U.S. Air Force's Pacific theater of operations. Section 203 of the Energy Policy Act of 2005 requires federal facilities to increase renewable energy consumption to at least 7.5 percent by 2013. The LFGTE Project provides 26.2 percent of the energy used by JBER. This Policy provides for double credit if the renewable electricity produced on-site at the Federal Facility. With the bonus, the project currently provides 52.4 percent of the installations electrical demand; approximately 7 times the renewable energy required by the Policy.

The project is anticipated to result in a savings to JBER of $32 million on electrical purchase over the initial contract period and $73.6 million over the potential life of the project. The Municipality will realize in excess of $1 million annually in revenues from gas sales. The net present value of revenue anticipated to be realized by the Municipality over the life of the project is $51.9 million.

Because the pipeline crosses property lines and enters federal property it is considered by the USDOT as a regulated pipeline. DU has subcontracted with NORSTAR Pipeline Company, Inc. a registered pipeline operator to perform compliance testing, monitoring and annual reporting.

Multi-stage blowers and moisture knock out in GPS Building

OPERATIONS, PLANNING AND FUTURE EXPANSION

DU is responsible for operation and maintenance (O&M) of the Power Plant, GPS facility and transmission pipeline. The O&M budget for these facilities is $639,000 per year. DU accomplishes O&M activities using subcontractors as well as in-house forces. Western Energy Systems (WES), the vendor for the Jenbacher engines has a contract with DU to perform all major maintenance as well as to train DU employees to maintain the equipment. WES opened an office and parts warehouse in Anchorage to support this project as well as other projects in Alaska. DU staff performs routine maintenance on the GPS facility.

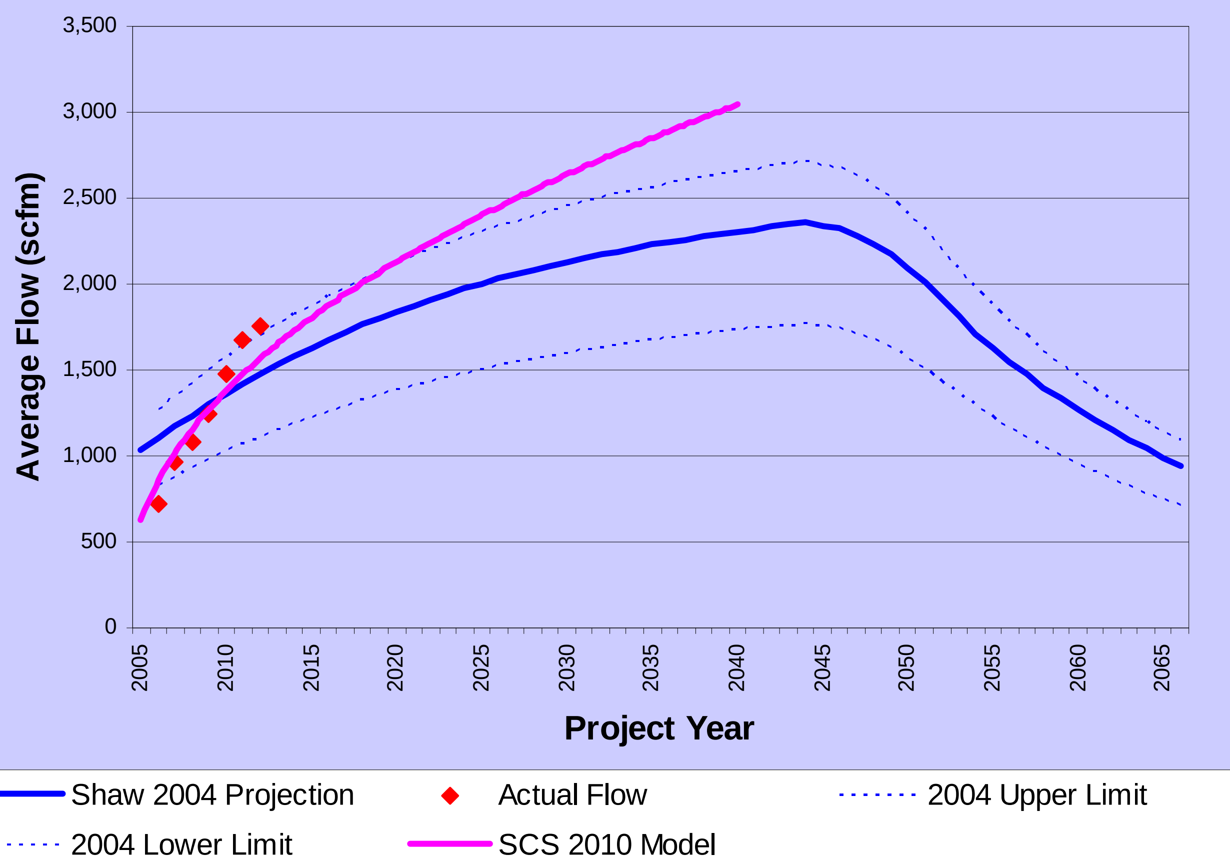
The Municipality performs all O&M functions on the GCCS and original blower and flare facilities. SCS Engineers performs 3rd party testing as well as Title V compliance reporting. The Municipality is responsible for the power cost of the blowers in the GPS building. In total, the Municipal budget for operating the GCCS and related facilities is $280,000.

Landfill Gas Production

Predicting the amount of landfill gas ARL could produce has always been a challenge since there are few landfills of our size operating in similar climate conditions. In 1981, a study performed by the University of Alaska predicted that, due to the low ambient ground temperatures in Alaska, landfill gas would only be a problem in locations where heated structures were built over the landfill. While this has been true of the smaller village landfills found throughout Alaska, larger landfills which have developed in urban areas of the state since the writing of that paper have proven that not to be the case. ARL did not exceed the New Source Performance Standard threshold for NMOC emissions of 50 megagrams per year until 2003. By this time, the landfill had been in operation for over 15 years and had accepted 4.8 million tons of waste; significantly slower than similar landfills in warmer climates.

Shaw EMCON/OWT performed the initial gas generation modeling in 2004, prior to construction of the GCCS, using their proprietary gas generation model. The model required various assumptions as to the internal temperature and moisture content of the refuse. Figure 3 shows the predicted average annual gas generation as well as an envelop of high and low generation estimates. Because of the uncertainty in these assumptions and lack of experience from landfills in a similar climate setting to compare to, the Municipality elected to operate the GCCS for at least three years before considering any beneficial use project to prove up the commercial value of the resource and to confirm whether the model output was reasonable. Actual annual average flow rates from the GCCS are also presented on Figure 3. In the initial years (2006 through 2009) it appeared that the

Figure 3. LFG Production Models



gas production fell in the low to average range of the EMCON generation rate envelop; however the general trend was that the collection rate was increasing much faster than the predicted generation rate for this period. Additionally, we found little difference in the amount of gas recovered seasonally between summer and winter.

As part of the design of the LFGTE project Doyon Utilities commissioned SCS Engineers to perform additional modeling of the gas generation rate using the actual gas flow rates observed through the GCCS as a guide for adjusting model variables. The SCS prediction of estimated recoverable gas is also shown on Figure 2. The projection indicates that by the end of the base contract period, gas recovery will exceed the 2004 estimated average generation rate by approximately 500 scfm. Since 2010, average annual flow rates through the GCCS have exceeded the flow rates predicted by the SCS model.

Potential for Project Expansion

The Power Plant was designed and constructed to house six generating units. All control panels, switch gear, wiring, ventilation and other systems were included in the original construction to allow the generation capacity to be readily expanded. Initially, four generating units were installed based on pre-construction gas collection rates. Each unit consumes between 400 scfm and 425 scfm. Based on the SCS model and subsequent gas collection rates since startup the LFGTE Project, a fifth generating unit was purchased and recently delivered to the site. Installation is pending final approval of the facility's new Title V Major Air Quality Operating Permit, but is expected to be on line in 2013. The SCS model and associated operating data indicate that enough gas may be avail-

Unloading new generator Unit 5

able to support a sixth generating unit around 2023.

Additional, expansion of the LFGTE Project may be possible beyond the current configuration. The current GCCS collects gas from 87 acres of landfill only. The landfill currently has an additional 30 acres under liner and collecting refuse. Under NSPS rules, we will need to be actively collecting gas from these areas by 2015; although it is not expected that these areas will achieve mature gas production until

around 2020. The landfill has an ultimate footprint of 165 acres of which approximately 20 acres have been set aside for inert waste such as C&D materials and asbestos containing materials.

The SCS model was extended only through the LFGTE Contract period which ends 8 years before the landfill's project operational life. At the end of the model period, The SCS model predicts that there may be adequate gas available to support a seventh unit. Typically gas production peaks at about the time the landfill reaches capacity so it is likely that additional gas quantities may be available. A cost benefit analysis will be needed at that time to determine whether the expense to expand the initial configuration is justified.

REGULATORY COMPLIANCE

ARL is RCRA Subtitle D facility designed and constructed to meet all requirements of 40 CFR 257and 258 as well as Alaska Administrative Code 18 AAC 60. The site operates under Alaska Solid Waste Permit No. SW1A001-17. The site is inspected annually by the State of Alaska, Department of Environmental Conservation (ADEC), Solid Waste Management Program. Every year, ARL receives a score of 97 points or better on a 100 point scale from this inspection.

The GCCS operates under Title V Air Operating Permit No. AQ0624TVP02 issued by the ADEC Air Permitting section. As part of this permit, the landfill operator must comply with the New Source Performance Standards (NSPS) contained in 40 CFR 60 Subpart WWW:

- Ensure that landfill gas is actively collected from any waste cell within 5 years of initial waste placement;
- Must test all well heads and collection system controls not less than once per month to ensure the collection system is under negative pressure and not drawing excessive oxygen or balance gasses indicative of over pulling the system;
- Must perform surveys over the landfill to verify that surface emissions from the landfill do not exceed 500 ppm at any point;
- Must perform corrective actions if any deviations from the permit are observed;
- Must operate a flare or other control device that destroys all gasses collected by the system; and

Exhaust stacks were extended 40 feet to meet short-term PM2.5 emissions criteria

- Must certify annually that the landfill is in compliance with all requirements of the regulation.

The Power Plant currently operates under a limited Minor Air Operating Permit No AQ0237MSS06 (Title I) as allowed under

Alaska Administrative Code 18 AAC 50. This permit includes an owner requested limit of 24,000 operating hours per year to avoid classification as a new major stationary source for the purpose of obtaining a Prevention of Significant Deterioration (PSD) Permit and agency preconstruction approval and issuance of a major source construction permit. The process to obtain the Minor Operating permit is much less complex than for a full unrestricted permit. By agreeing to the owner requested limit, DU was able to obtain an operating permit, and construct and commission the Power Plant within 16 months of the contract award approval.

With the Power Plant construction completed and plans in place to add a fifth generating unit, DU has applied for an unrestricted Major Air Operating Permit (Title V) for the Power Plant. The new permit will allow for unlimited operation of 5 operating units. Modeling required for this permit application determined that the exhaust stack heights be raised 40 feet to meet the short term PM2.5 requirements of the new permit. It is anticipated that this permit will be issued by August 2013 to allow installation and commissioning of the 5th unit before the end of the year.

Landfill Operators receive Governor's Safety Award

Safety

The Solid Waste Services Department has a strong safety record. Over the past 6 years ARL has had one lost time accident associated with operation of the landfill. In 2010 ARL received the Governor's Safety Award from the Alaska Department of Labor for completing 2 years of operation without a lost-time accident. That record continued to nearly 4 years (approximately 200,000 manhours). No time lost accidents were incurred during construction of the LFGTE Project.

Public Acceptance, Appearance and Aesthetics

ARL is surrounded by military training lands with the Glenn Highway main commuter route into Anchorage from suburban areas on one side. As such, the site has no immediate neighbors. The Glenn Highway has an average daily traffic count of 26,000 vehicles. The highest praise our staff enjoys is the number of visitors who comment that they "drive past the site every day but didn't know it was there!"

The site has a detailed dust control program to meet the requirements of the site's Air Operating Permit. The landfill operators must log and track loads of water applied to roads on the site on a daily basis. To improve compliance, the Municipality constructed an onsite truck fill stand when public water supply was extended to the landfill site. Dust control is generally not needed in winter months when snow and frozen road conditions limit dust production.

Litter control is challenging in winter when blown litter can be immediately buried in snow for months at a time. The landfill employs two crews full time from early May when the snow melts until late September to collect wind blown litter. ARL use "The Bull" portable wind screens to control wind blown litter at the working face.

ARL is host to numerous public tours. Every spring, the landfill hosts tours for Anchorage School District junior high classes as part of their science curriculum. The site has hosted numerous tours and educational seminars for the SWANA Alaska Chapter showcasing new projects and operations. The Municipality participates in the International Sister Cities Program. Over the past five years ARL has hosted guests from Tromsø, Norway; Kamchatka, Russia; Magadan, Russia; and Kyoto, Japan.


LFGTE Project Ribbon Cutting ceremony

The LFGTE Project has been in operation for less than 6 months. The project has already hosted tours for the Alaska Energy Authority, the Renewable Alaska Energy Conference, the SWANA Alaska Chapter, as well as numerous military tours.

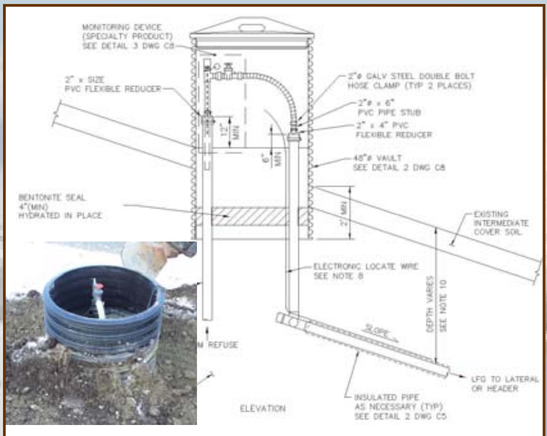
INNOVATION AND CREATIVITY

The project incorporates many innovations and creative solutions to respond tot the challenges afforded by our climate and location, including:

- **Jenbacher Engines.** The Jenbacher engines selected for the Power Plant are state-of-the-art with features such as the LEANOX system, which automatically checks and rebalances the timing of each engine cylinder to burn as lean as possible, minimizing emissions. The engines are plumbed to operate on either landfill gas or commercial natural gas, ensuring an almost uninterruptible fuel supply for the generating plant. The DIA.NE controllers sense the BTU content of the fuel and adjust the operation of the engines automatically.

Pipe Bedding. The Municipality of Anchorage applies over 12,000 tons of street sand every winter to ensure road traction. The "sand" applied is ¼-inch to ½-inch coarse sand. All this material must be collected each spring. The collected sand contains significant quantities of organic material, miscellaneous debris and elevated concentrations of oil and grease. This material was used extensively as a bedding material between the GCCS pipelines and refuse in all installations.

Porous Media. Shredded tire chips have been used as a porous media around horizontal collector lines and as backfill material around perforated segments of vertical well risers. The material provides a flexible, porous media around the pipes to improve gas collection efficiency.



Typical well head installation with protective vault

- **Insulated LFG Collection Headers.** Surface mounted pipelines are common in many landfills, for conveying landfill gas. To make this configuration work in our climate we installed pre-insulated HDPE pipe with electric heat trace to ensure the pipeline would not become blocked with frozen condensate. We believe this is the only application of its kind. The installation will reduce future maintenance and repair costs.

ACKNOWLEDGEMENTS

The Municipality of Anchorage Solid Waste Services Department would like to acknowledge our partner in the LFGTE Project, Doyon Utilities as well as the command at Joint Base Elmendorf - Richardson, the U.S. Army - Alaska, and the Alaska Energy Authority for support of this project. We would also like to acknowledge project designers Electric Power Systems, and SCS Engineers, EPC and their many subcontractors who brought the project together in less than 15 months and the Western Energy Systems, suppliers of the Jenbacher Engines.

2013 LANDFILL GAS UTILIZATION EXCELLENCE AWARD

RELEASE FORM

Release Statement: *I certify that the information provided in this 2013 Excellence Award application is accurate and correct to the best of my knowledge. I understand that nominations become the property of SWANA. SWANA reserves the right to publish any or all of my application. My signature gives SWANA the right to reprint or make available for purchase any portion of this application.*

Printed Name of Representative: Paul F. Alcantar

Organization Name: Municipality of Anchorage

Signature: Paul F. Alcantar

Date: May 10, 2013