Appendix D – Landfill Gas Generation at the Cache Creek Landfill



Appendix D1. Cache Creek LFG to LNG Project Definition

Presented by Prometheus Energy

Description of Proposed Project

The Cache Creek Landfill Gas-to-LNG Project is being considered by Belkorp Environmental Services Inc. (Belkorp) and WASTECH Services, Ltd. (WASTECH). Their immediate objective is to determine whether this project is a cost-effective and otherwise beneficial means to utilize landfill gas (LFG) that is presently being flared by its conversion to fuel for heavy duty vehicles such as waste transfer trucks. Belkorp has commissioned a feasibility study to better determine whether the development of a distributed-scale facility to convert collected LFG into high quality LNG by purifying it, liquefying it, and dispensing it on site into heavy duty vehicles is attractive from economic, environmental, and operational points of view. The feasibility study is divided into five tasks, each with a report describing the results of the task. This report is for task 1 that defines all phases of the project to convert the LFG into LNG and its use as fuel for waste transfer trucks.

The Cache Creek landfill ("Landfill") has been in operations since 1989. The Landfill is currently operated by WASTECH, a subsidiary of Belkorp. As of 2007 the Landfill had approximately 7,701,936 tonnes of waste in place. The anaerobic decomposition of this waste produces approximately 650 scfm of LFG which is collected by 29 vertical wells (as of 2003). Today this gas is being combusted in a candle flare located on the landfill. The average composition of the LFG is described in the report on task 2 of this study.

The subject facility will be located near the Cache Creek Landfill in Cache Creek, British Columbia, Canada. Because the landfill may continue to operate for an undefined number of years, the proposed facility will be designed to process at least the maximum LFG flow anticipated at the landfill, i.e., up to ~1200 scfm (~1.728 MMscfd or 2,040 Nm3/hr) with a composition as specified in the task 2 report on the design basis. As described in the task 3 report describing the energy and material balances of the facility, the maximum LFG flow rate could produce up to ~31,658 liters/day (8,364 gpd) of high quality LNG. Based on the analysis of Wastech's fleet fuel usage as reported in task 4 of this study, the amount of LNG produced at the facility to satisfy all fuel needs should be increased to ~12,000 gpd with ~85 % integrated uptime for LNG production.

The present LFG flow rate at the flare is only ~650 scfm (~0.94 MMscfd or 1105 Nm3/hr) so to enable high utilization of the installed purifier/liquefier system capable of converting ~1200 scfm LFG into LNG and supplying sufficient LNG for all fleet needs, the LFG feed stock will be augmented with a controllable quantity of pipeline natural gas (PNG) purchased from the nearby Terasen Energy natural gas pipeline. This choice can immediately provide sufficient LNG for Wastech's entire waste transfer truck fleet and other heavy duty vehicles as they are converted to use LNG. An integrated LNG storage and dispensing station at the facility will allow easy refueling of other commercial vehicles serving the landfill as part of their normal trucking route. The proposed facility includes all equipment from the interface with the existing LFG collection/flare system to the dispensers/truck transfer system for the LNG. The low-risk design will be based on Prometheus Energy's existing LFG-to-LNG plant at Bowerman landfill

in southern California and incorporate 'lessons learned' from its commissioning and operation experience during the past two years. The proposed facility can produce up to ~45,420 litres per day (~12,000 gpd) of LNG with ~85 % uptime for a net average production rate of ~10,200 gpd. The feed stock will be preferentially LFG supplemented with PNG as required for the desired production rate.

Description of the Facility

A simplified block diagram of the Cache Creek LFG-to-LNG facility is shown below.
This facility will include auxiliary infrastructure such as a control room, storage room, administrative building, safety and fire protection systems. If these items already exist as part of Wastech's landfill operations, the new LFG-to-LNG facility will be integrated with existing systems. For example, the proposed LFG-to-LNG facility will interface with the existing LFG collection and flare system; it will also interface with the existing nearby natural gas pipeline. The proposed plant will be located at a site to be determined by WASTECH and Prometheus. One logical location is the current sanitary waste site adjacent to the existing flare station. Approximately 10,000 ft2 will be needed for the plant and another 10,000 ft2 for the total facility including parking, access roads, turn around loops, etc.

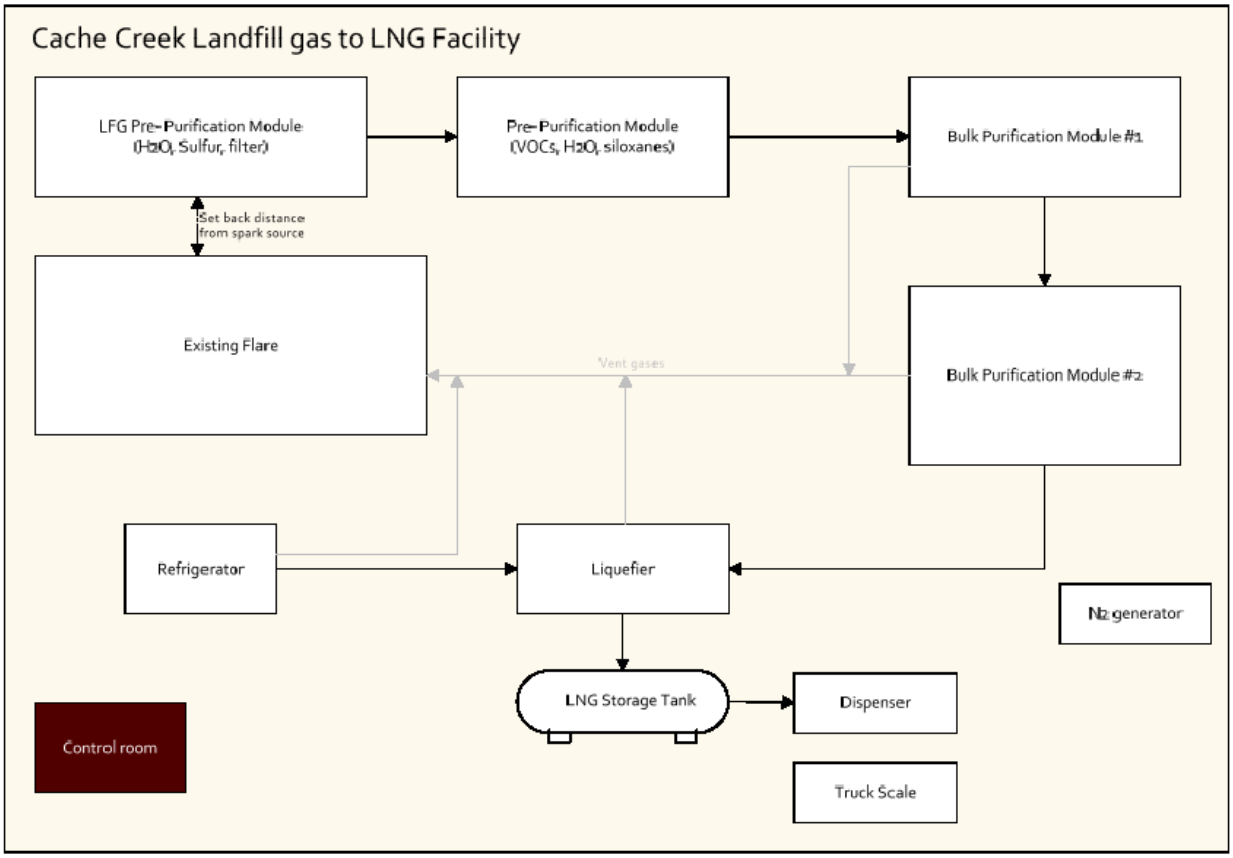
The LFG-to-LNG process proposed for this facility converts the CH4 contained in the LFG to high quality LNG at ~20 psig. No new toxic or hazardous air pollutants are produced by the proposed facility. Essentially all of the CO2, H2O, NMOCs, and most of the N2 are rejected during the production of LNG. The trace concentrations of NMOCs in the LFG are chemically absorbed, removed as condensates or physically adsorbed in the Pre-Purifier Module. There are no new regulated emissions from the LFG-to-LNG process.

The LFG-to-LNG system will consist of several integrated isocontainerized modules each with standard outside dimensions 2.44 meters wide by 3.05 meters high by 6.10 or 12.2 meters long (8' by 10' by 20'or 40'). Each module includes a specific unit operations module and supporting features. A grid power connection panel, two LNG storage tanks, a LNG and LCNG dispenser station and a truck transfer system will also be components of the facility.

The major components of a facility that converts LFG with supplementary PNG into high quality LNG are:

- The LFG collection and LFG flare system;
- The LFG feed stock supply system;
- The PNG feed stock supply system;
- The Purifier/Liquefier system;
- The utilities system;
- The LNG storage system;
- The LNG tractor dispensing and tanker transfer system;
- Instrumentation and controls system;
- Electrical power system;
- Control room;
- Tools & spare parts room
- Access roads; and
- Security fence.

FIGURE D1-1
Block diagram of proposed Cache Creek LFG-to-LNG Facility



Appendix D2. Landfill Gas Electricity Generation Project Feasibility Study (REF. NO. VA103-182/1-1)

Prepared by Knight Piesold Consulting for Wastech Services Ltd.
Cache Creek Landfill

Cache Creek Landfill generates significant quantities of biogas. A major component of biogas is methane. Methane is a useful fuel that can be collected and used for either heating or energy generation. At present Wastech Services Ltd collects the gas and burns it at a flare. Wastech Services Ltd wishes to consider using the biogas gas to fuel engine driven generator sets. Power from the generators would be fed to BC Hydro's distribution grid for re-sale to other electricity consumers.

When biogas is used for energy generation the most common technology employed is combustion through internal combustion engines. The engines may take the form of either reciprocating engines or gas turbines. For the purposes of this report it is assumed that reciprocating engines will be used to generate electricity from the biogas. The engines will be provided as packaged units from manufacturers with a proven track record of producing biogas re-use equipment.

Predicted gas capture curves have been created as a basis for assessing the energy resource. The Worse Case curve shows a 2025 peak at approximately 990 m^3/hr (580 cfm). The curve then falls to approximately 858 m^3/hr (500 cfm) by 2040. Based on the maximum gas production of 990 m^3/hr and a calorific value of 18,000 kJ/m^3 the theoretical electrical generation capacity is approximately 1980kW.

There are a number of sites which are suitable for construction of the power generating facility. For the purposes of this report Site Option D has been selected as the preferred site. Site Option D is immediately to the South of the existing flare.

A conceptual layout has been developed for the generating facility. The facility will consist of a number of components these will include:

- A biogas transfer system;
- A biogas conditioning system;
- A biogas compression and chiller sled;
- A generator package;
- Electrical switchgear and a transformer;
- Electrical transmission line;
- A building complete with mechanical and electrical installation.

It is intended that the Cache Creek Landfill Gas Project will be connected to BC Hydro's grid for the export of electrical power. It is expected that Wastech Services Ltd will make application to BC Hydro to take part in the Standing Offer Program. Correspondingly, the expected base selling price will be $78/MWh.

Based on the size of this project the interconnection to the grid will be at distribution voltage. Specifically, the project will be connected to BC Hydro's 25kV distribution line. To connect to BC Hydro's distribution network it is necessary to prepare and a copy of which is provided in the report.

The Cache Creek Landfill generates significant quantities of biogas. The quality and quantity of biogas is sufficient to support a landfill gas re-use project. Based on the project described in this document an IRR of approximately 16.4% can be achieved. This is from an initial investment of $3,822,000. On the basis of a favourable rate of return it is recommended that Wastech Services Ltd proceeds with the Cache Creek Landfill Gas Project.

FIGURE D2-1
LFG Gas Engine