

Kekaha Sanitary Landfill

Subsurface Landfill Gas
Temperature Monitoring and
Contingency Plan
Phase 1 Landfill Disposal Area

Kekaha, Kaua'i, Hawai'i

Prepared by:

County of Kaua'i
4444 Rice Street, Suite 295
Lihue, Hawai'i 96766

September 2018

Table of Contents

- 1. Introduction3
- 2. Data Collection & Analysis3
- 3. Contingency.....4
- 4. Settlement Monitoring.....7
- FIGURES8

1. Introduction

The proposed Cell 2 horizontal expansion includes the installation of a modern, lined waste cell above the mauka sideslope of the existing Phase I Kekaha Landfill. To reduce differential settlement of the Cell 2 liner system, the Phase I waste mass, which has undergone more than 20 years of consolidation, must remain intact. The subsurface landfill gas temperature monitoring and contingency plan, as described herein, is among the several proposed systems and management plans developed to ensure the integrity of the Cell 2 liner and Phase I cover system.

While the presence of the Cell 2 liner above the Phase I waste mass in this area will inhibit the intrusion of oxygen, and thus decrease the likelihood of subsurface oxidation events, this plan proposes the implementation of a landfill gas temperature monitoring system (Figure 1) to identify potential future subsurface landfill oxidation events under the Cell 2 liner system in a timely fashion, in order to allow for appropriate response actions. The County proposes to use the existing Landfill Gas collection system to monitor for fire conditions including subsurface temperature, carbon monoxide and subsurface oxidation indicators including oxygen and balance gas levels.

In landfills, minimizing the potential sources of oxygen intrusion into the waste mass prevents landfill fire generation and propagation. The use of an impermeable geosynthetic liner in the construction of Cell 2 and the existing geosynthetic capping material on Phase 1 will be an effective barrier to oxygen intrusion. Furthermore, additional impermeable cap material is planned to be installed on Phase I beyond the cell 2 footprint, to further inhibit oxygen intrusion.

2. Data Collection & Analysis

As part of the air regulation requirements and in compliance with the covered source permit as well as for operational needs, the county monitors and collects monthly data at each Landfill Gas extraction well monthly including methane, oxygen, balance gas, and temperature among others using a Landtec GEM5000 plus meter or equivalent. Additionally, the county monitors monthly for carbon monoxide using the GEM5000 at each extraction well. The carbon monoxide monitoring is routinely used to complement temperature and oxygen monitoring to evaluate potential subsurface oxidation or fire conditions.

In all the gas extraction wells, temperature will be monitored monthly. A temperature of 131 degrees F will be used as the threshold for establishing whether more investigation is warranted. Note that use of this threshold, within the context of this plan, does not purport to establish a correlation between 131 degrees F and oxidation. It is only used as a criterion for conducting additional investigations.

Determination of Carbon Monoxide Concentration

A landfill gas sample will be collected using a Landtec GEM 5000 plus meter or equivalent capable of monitoring carbon monoxide. Prior to monitoring the GEM5000 will be calibrated for CO using CO calibration gas.

Determination of Oxygen Concentration

Similar to the CO concentration determination, the Landtec GEM 5000 plus meter or equivalent

will be used to monitor for LFG composition including concentrations of oxygen, methane, carbon dioxide, and balance gas. The oxygen data will provide information about the potential for an oxidation event to propagate.

3. Contingency Plan

This section outlines the steps to be taken if monitored conditions indicate the presence of a subsurface oxidation event (SOE).

3.1 Plan Basis

Typically, SOEs are relatively small and involve only 100 – 500 square feet of landfill surface area. Often only a single gas extraction well is involved. The most common method of controlling an SOE is to reduce or cutoff the oxygen supply either by shutting off gas extraction wells in the affected area or by increasing cover thickness or a combination of both. Applying water to the cover, which fills the soil pores, can also be effective restricting further air intrusion.

This Plan has been developed based on this control philosophy. For purposes of this plan, the following definitions apply:

“Operator” – means the gas collection and control system operator or other designated site personnel.

“CO concentration” – means the concentration of carbon monoxide (CO) measured by field instruments including Landtec GEM5000.

3.2 Action Level Triggers

When any of the following conditions are observed, it will be presumed that an SOE has begun and the procedures in this section will be implemented:

- “CO concentration” exceeds **1,000 ppmv** in one or more gas extraction well along Cell 2 and Phase I,
- Temperature exceeds **131° F** and “CO concentration” exceeds **400 ppmv** in one or more gas extraction wells, or
- Actual observation of evidence of an SOE (e.g., smoke, smoldering ash, or burnt materials).

3.3 Actions for SOE

If, as the result of monitoring under the previous section or from other indicators (e.g., smoke), the action levels set forth in Section 3.2 are triggered, the following procedures will be implemented to mitigate the SOE:

1. DOH will be notified of the SOE. A notification will be submitted to DOH within **24 hours** of the start of the implementation of the Contingency Plan as described in this section **via email**. A follow-up letter within 7 business days will be prepared and placed in the facilities operating record.
2. The nearest landfill gas extraction well(s) and any adjacent landfill gas extraction well(s) with a “CO concentration” > 400 ppmv will be closed within **24 hours** of detecting a SOE. Specifically, the “Operator” will shut off landfill gas extraction well(s) within 200 feet of the affected area and any adjacent landfill gas extraction well(s) with a “CO concentration” over 400 ppmv. The affected well will not be operated under vacuum until the SOE has been corrected or an engineering evaluation dictates a different course of action. DOH will be notified of alternative actions within 7 days of their implementation.
3. Within **72 hours**, the “Operator” will reduce, by a minimum of 50%, the vacuum applied to adjacent landfill gas extraction wells with a “CO concentration” between 200 ppmv and 400 ppmv and gas temperatures over 131° F. The vacuum on these adjacent wells will not be increased until the SOE has been corrected or an engineering evaluation dictates a different course of action. The “Operator” may reduce the applied vacuum further depending on conditions and the severity of the SOE.
4. Within **96 hours**, the “Operator” will check the flare flame arrestor and condensate knockout pot for ash to establish if the SOE has impacted flare operation and performance. Any ash found during this investigation will be removed and future inspections conducted. This assessment will require shutdown of the flare, but no longer than necessary.
5. The “Operator” will inspect all landfill gas extraction well seals and any nearby landfill cap penetrations for cracks or obvious indications that air can enter the Phase I landfill.
6. The “Operator” will inspect the landfill cover in close proximity to the SOE area to confirm that the cover is not extensively cracked (indicating subsidence), has not been washed away exposing the geomembrane, or the geomembrane has not been visibly damaged (tears or punctures). For purposes of this plan, the impacted area includes all adjacent wells with “CO concentrations” over 400 ppmv and the area between these wells and adjacent wells with “CO concentrations” below 400 ppmv).
7. In addition to inspecting and confirming the integrity of the cap near the SOE, the “Operator” will place additional cover soil if it shows signs of cracking or has been washed away. The additional cover soils will be spread to extend at least 50 feet beyond the identifiable perimeter of the SOE, but not beyond the lateral limits of the landfill. A 6- mil or thicker geomembrane covered with a minimum of 6 inches of earthen material cover will be installed as a temporary barrier to air intrusion in areas where the geomembrane cap has been damaged. After the SOE has been extinguished, the

damaged geomembrane will be repaired to the originally designed Phase I cap specifications.

8. The “Operator” will monitor for subsidence. If subsidence other than normal landfill settlement is detected, the “Operator” may apply additional cover to the affected area to provide a safe work zone.
9. To ensure safety, all site personnel and the public, except those authorized to be in the SOE area, should be restricted a minimum of 150 feet from the affected area and, if subsidence is detected, all personnel are to be barred access until an engineering review can establish suitable protocols for safe management of the SOE.
10. The “Operator” will measure gas composition including CO, O₂, and balance gases in gas extraction well(s) in the affected area after first purging the well(s). Temperature measurements will also be taken. These measurements will be reviewed regularly by designated personnel to assess the progress of mitigation efforts.
11. All actions will be summarized in a memo at least monthly and placed in the facility operating records.
12. After implementing the above actions, the “Operator” will monitor the affected probes in the area of the SOE weekly. If the “CO concentrations” trend downward for a minimum consecutive 3-week period² and landfill gas temperatures decrease or remain constant, Kekaha Landfill will assume that the SOE has been controlled.
13. DOH will be notified within 30 days of successfully extinguishing the SOE in writing advising that the gas extraction well(s) have been returned to normal operation.

Other Potential Options – SOEs are not the same in every instance. If continued monitoring does not show decreases in CO levels or if temperatures continue to increase, Kekaha Landfill will not consider the SOE to have been controlled. At that point, Kekaha Landfill will prepare a detailed plan for submittal to the DOH for review and approval. The plan will include different alternatives for controlling the SOE, including the feasibility of and procedures for injecting biodegradable foam and/or CO₂ or others as listed below. Upon approval, Kekaha Landfill will implement the approved plan. In exigent or emergency circumstances, Kekaha Landfill reserves the right to take any actions necessary for safe operation of the Landfill in advance of consultation with DOH and that may differ from the tasks outlined in this section.

- **Vent Gas Wellheads.** This option assumes that gas temperatures will naturally decline by conduction to levels consistent with other portions of the landfill. This approach will take a long time and may allow for a subsequent event if cover materials allow air to enter the facility.

² Note: as an SOE is brought under control, carbon monoxide levels may spike as the SOE’s oxygen supply decreases. This is the result of an uptick of incomplete combustion. Consequently, this spike in CO is an indication that the SOE is being controlled provided that it is not accompanied by a similar temperature spike. This scenario would not require additional action, but would prolong weekly monitoring to confirm that the SOE is extinguished.

- Vent probes to allow temperature to dissipate (static pressure created within the waste would prevent air from entering the landfill while allowing heat to escape to the atmosphere).
- Continue to take follow-up gas quality and temperature measurements to ascertain whether venting measures are adequate for temperature dissipation.
- Maintain adequate cover. Fill and compact any low areas that may have been a result of settlement due to the oxidation below.

If Kekaha Landfill personnel determine or develop a better option(s), plan, or program, DOH will be notified.

3.4 Waste Acceptance

While addressing potential subsurface oxidation conditions, unless Kekaha Landfill personnel determine otherwise, waste will continue to be accepted and placed at the landfill. Landfilling placement procedures and conditions will continue to be monitored and adjusted as necessary per the direction of site personnel and DOH.

4. Settlement Monitoring

4.1 Action Plan

In order to monitor settlement along the interface of the lateral expansion and the existing closed Phase I landfill, 3 benchmarks would be installed. The Bench marks would be approximately 6 inches in diameter and approximately 14 inches tall. The bottom 8 inch would be below the surface and while installing them precaution would have to be taken to no damage any existing cover liner in phase I. One bollard would be built next to each bench mark to provide visibility and protection.

The three bench marks will be placed at the two ends of the interface of the Cell 2 expansion and one bench mark in the middle. See the attached figure for the approximate placement of the bench mark and bollard. The bench marks will be built and surveyed before the expansion is completed.

The designer has estimated the hypothetical worst case settlement to be about 2.0 feet at the middle of the slope and the liner experienced little to no strain (approximately 10% of the allowable). To be conservative, if the measured cumulative settlement at the top of the slope exceeds 2.0 feet, and assessment of the slope liner will be performed. The assessment would initially be an engineering evaluation of the data to determine if the settlement is uniform or if areas are experiencing excessive differential settlement. Based on the investigation additional measure such as additional monitoring, excavation of areas to evaluate the liner, or other testing could be performed.

FIGURES

