"Maintaining Compliance During Final Cover Construction"

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Construction of a final cover system at a landfill with an existing full-scale gas collection and control system (GCCS) presents numerous challenges for the owner/operator and their contractor in terms of physical obstacles such as vertical well casings and above grade piping, as well as the challenge of maintaining compliance with air quality regulations and equipment operating permits.

Anderson Landfill, Inc. (ALI), a Waste Management landfill in Anderson, California is located approximately two hours north of Sacramento. ALI began in 2007 a two-phased closure of an inactive fill area that contains a GCCS once active filling moved into an adjacent landfill cell. The 2007 closure area consisted of approximately 5 acres and the 2008 closure area consisted of approximately 17 acres (Drawing G1). The GCCS currently recovers approximately 500,000 cubic feet of landfill gas per day. The GCCS consists of vertical extraction wells, horizontal gas collectors, and above ground header and lateral piping. The final closure system consists of general cover soil (foundation layer), a geomembrane liner, and a vegetative cover layer.

GCCS permits typically require the entire GCCS to operate continuously with varying degrees of flexibility from air district to air district. ALI is under the jurisdiction of the Shasta County Air Quality Management District and is required to operate a minimum of eighty percent (80%) of the GCCS at all times. This requirement stems from the NSPS Subpart WWW which requires LFG to be extracted from each area, cell, or group of cells where MSW has been in place for 2 years or more if the area is closed or has reached final elevation.

As such, the GCCS covers essentially the entire older landfill footprint to ensure adequate control of landfill gas emissions and migration. The GCCS components such as piping, wells, valves, and gas mover equipment, if located within the waste footprint, present significant obstacles for contractors, particularly when having to place and grade large quantities of cover soils and geotextiles. For the owner/operator, relocating or temporarily removing portions of the GCCS puts the site's air quality compliance status at risk. In addition, complete or partial shutdown of a GCCS for an extended amount of time is typically not allowed by regulatory agencies and operating permits. This makes

constructing a final cover system, while keeping most of the GCCS active to maintain compliance during the construction process, a significant challenge.

This paper discusses the permitting, engineering, construction phasing, coordination, and communication required among ALI and its contractors, engineers, GCCS operator, and regulatory agencies prior to and during final closure construction, to maintain compliance with applicable regulations and GCCS operating permits. The paper will also present the engineering and construction methods utilized to minimize downtime of the GCCS to maintain compliance with site permits.

Project Description

ALI recently installed final cover (cap) in two phases across inactive fill, namely Units 1, 2ba, and South Canyon. The first phase of cap construction was completed over approximately 5 acres in 2007. The second phase of cap construction was completed over approximately 17 acres in 2008 (Drawing G1). Unit 1, Unit 2ba, and South Canyon have been inactive since 2006 and have had intermediate cover installed. Following installation of intermediate cover, ALI installed a geotextile to prevent erosion of the cover soil from stormwater runoff.

In June 2006, to maintain compliance with perimeter migration, avoid groundwater contamination, and to comply with New Source Performance Standards (NSPS) Subpart WWW (40 CFR 60.752), ALI installed a new gas collection and control system (GCCS) in Units 1, 2ba, and South Canyon consisting of twenty-two (22) vertical landfill gas extraction wells and one enclosed landfill gas flare station with a capacity of 1,500 scfm. GCCS piping consists of 18-inch, 8-inch, and 4-inch diameter high-density polyethylene (HDPE) piping (See Figure 2 – GCCS Site Plan). Well casings are 6 inches in diameter and constructed of HDPE. Well heads are 2-inch diameter orifice plate style.

In preparation for closure of the inactive units in 2007, ALI proactively designed a "looped" header for the GCCS, which would allow for access to vacuum at any point around the perimeter of the landfill. This allowed for isolation and removal of certain piping during cap construction while maintaining vacuum to the remaining sections of the loop header such that wells could remain active.

This GCCS has been in operation since January 2007. ALI conducts surface emissions monitoring and perimeter probe monitoring. Since the operation of the system, the ALI has had no issues with surface emissions or landfill gas migration to perimeter monitoring probes.

ALI awarded the closure of these units in two construction phases. The first phase of cap construction took place in the summer of 2007. The second phase of cap construction took place in the summer of 2008.

Description of Landfill Cap System

The capping system installed over Units 1, 2b, and South Canyon consisted of a minimum of 24 inches of foundation layer of clean soil, a low density polyethylene (LLDPE) flexible membrane liner, a non-woven geotextile, and a minimum of 12 inches of top soil (vegetative cover). The final cover has a general top slope of five percent (%) with side slope of approximately 4H:1V to promote stormwater runoff to stormwater runoff controls. Stormwater runoff controls consisted of earthen and rip-rap lined drainage swales and headwalls mated to HDPE piping.

Regulatory Requirements Pertaining to the Operations of the GCCS

In terms of the operations of the GCCS, the ALI is subject to federal regulations as an NSPS site and to local regulations under the Shasta County Air Quality Management District (SCAQMD). The ALI was issued an Authority to Construct (ATC) for the GCCS by the SCAQMD in June 2006 and a Permit to Operate (PTO) on December 12, 2008. Conditions of the PTO pertinent to operation of the GCCS require that:

- The GCCS be operated continuously unless written permission by the SCAQMD Air Pollution Control Officer is granted (ATC Condition 30)

16. If any portion of the Gas Collection and Control System is shut down which results in gas collection from less than 80 percent of the total number of active collection wells for longer than twenty-four (24) hours due to scheduled or unscheduled maintenance activities, equipment breakdown, or any other reason, the owner shall notify the District within twenty-four (24) hours of the detection of such shutdown.

- The SCAQMD be notified within twenty-four (24) hours of the shut down of any portion of the GCCS that results in gas collection from less than 80% of the total number of active collection wells for longer than 24 hours due to scheduled or unscheduled maintenance, equipment breakdown, or any other reason
- The concentration of methane at the surface of the landfill be less than 500 parts per million (ppm) (ATC Condition 34)
- Untreated landfill gas must not be conveyed to the atmosphere (ATC Condition 31)
- The GCCS be operated to maximize the amount of landfill gas extracted as proven by quarterly surface emissions monitoring and monthly well monitoring (ATC Condition 14)

Applicable requirements set forth by the NSPS require that the GCCS:

- Not be shutdown for more than five (5) days at a time (40 CFR 60.755)
- Negative pressure shall be maintained at all wells except when a geomembrane cover is installed (40 CFR 60.753 (3))
- Operate the collection system so that the methane concentration is below 500 ppm at the surface of the landfill (40 CFR 60.753(d))

Applicable requirements required under California Code of Regulations (CCR) Title 27

- Methane shall not exceed 5% in air at the facility boundary or 1.25% in onsite structures (Title 27, Division 2, Chapter 3, Subchapter 4, Article 6)

Applicable requirements required under the County of Shasta Conditional Use Permit include:

- Quarterly perimeter probe monitoring and monthly probe monitoring should methane be detected at probes in excess of 0.1 percent by volume in air. (CUP 024A#66)
- Methane concentrations as the surface of the landfill shall be less than 500 ppm (CUP 024A#31)
- Comply with all requirements of Title 27 (CUP 024A#39)
- Operate the control system to maximize the amount of LFG extracted (CUP 024A#35)

Applicable requirements required under the NESHAP Subpart AAAA

- Document the startup, shutdown, and malfunction (SSM) of emissions control devices in accordance with the ALI SSM Plan

In order to maintain compliance with the above regulations, or to seek a variance from the above regulations, the following administrative steps were taken by ALI with assistance from Cornerstone.

Administrative Measures to Maintain Compliance

In order to comply with the ATC and other regulations regarding the operation of the GCCS during construction of the landfill cap, ALI took administrative measures to maintain compliance or to seek a variance from certain conditions.

Notify the SCAQMD In Advance of Construction and Request a Variance

Since the construction of the landfill cap would require removal of gas collection header pipe to facilitate earthwork and installation of the flexible membrane liner and other materials, several LFG extraction wells would be affected and would need to be disconnected from the GCCS (taken off line). The number of wells off line was going to exceed 20 percent of the total wells of the GCCS. In accordance with Condition 16 of the ATC, ALI is required to notify the SCAQMD in writing that ALI would need to take more than 20 percent of the well field off line at various times throughout the course of landfill cap construction. This notification had to be made during both phases of cap construction; one in 2007 and one in 2008. ALI explained in the notification that wells needed to be taken off line as vacuum laterals were removed for construction of the landfill cap. ALI committed to placing the wells back in service as soon as phases of cap

construction were completed that would allow the reinstallation of the vacuum laterals. The SCAQMD approved of both notifications allowing ALI to take more than 20 percent of the well field off line as necessary to construct the landfill cap.

Surface Emissions Compliance

ALI performs Surface Emissions Monitoring (SEM) quarterly in accordance with the ATC Condition 35, CUP Condition 31, and 40 CFR 60.753(d). Following the placement of flexible membrane liner across the landfill, ALI detected methane emissions in excess of 500 ppm where the vertical wells penetrated the membrane liner. Since several wells were offline during construction, methane emissions were rising to the surface and were being concentrated to the penetration of the liner at certain well casings prior to installation of the liner penetration "boots".

Normally, cover repairs and adjustments to the GCCS would be made to remediate surface emissions within 10 days from the initial exceedance. However, since a number of wells had been taken offline and the landfill cap construction was ongoing, ALI would not be able to repair the surface exceedances until the boots were installed and wells were placed back online. Therefore, ALI requested the construction of the landfill cap and replacement gas collection piping be considered an Alternative Remedy for correcting the surface emissions and submitted an Alternative Timeline to get surface emissions back into compliance to the SCAQMD and Region 9 of the Environmental Protection Agency (EPA). Following completion of the landfill cover and starting up wells that had been offline, results of SEM determined that the landfill was back in compliance.

LFG Migration Monitoring During Construction

Results of LFG probe onsite structure monitoring during construction activities indicated that LFG was not migrating beyond the facility boundary or to onsite structures.

Documentation of Shutdowns and Startups

In accordance with the National Emission Standards for Hazardous Air Pollutants (NESHAP), ALI is required to document emissions control device operations. ALI documented the startup and shutdown of any LFG extraction well and the enclosed LFG flare (overall GCCS) during construction activities. These documents were reported in the ALI semi-annual SSM report. In total, 0 hours of downtime were required in 2007 and only 20 hours were required in 2008.

<u>Engineering Measures to Maintain Compliance and Limit Wells Offline</u>

In addition to filing the necessary paperwork for maintaining compliance, Engineering measures were incorporated into the landfill cap construction drawings that limited the number of wells offline at any one time during the course of construction. Cornerstone was contracted to design the GCCS piping deconstruction and reconstruction for the landfill cap construction project. Cornerstone incorporated the following engineering measures into the construction drawings:

GCCS Piping Deconstruction & Reconstruction Phasing

Construction phasing was used to limit the amount of wells off line at any one time. The design drawings provided instructions for the capping contractor to deconstruct and reconstruct the GCCS in phases such as:

- **Phase 1A–** Deconstruction of 18-inch Header and Take Wells Offline – East Side
- **Phase 1B –** Reconstruction of 18-inch Header and Wells Back Online – East Side
- **Phase 2A –** Deconstruction of other wells and piping – West Side
- **Phase 2B–** Reconstruction of other wells and piping – West Side

Phases were chosen based on the contractor's schedule for placement and grading of landfill cap materials at various locations on the landfill. In general, the phased construction was done in an East-to-West fashion. The contractor would be bringing foundation layer material into the work area from the East so the first phase of GCCS piping deconstruction occurred in the eastern portion of the landfill (Drawing G2). In order to return the wells that were taken offline in the first phase of construction as quickly as possible, the drawings required the contractor to complete work in the east followed by placing the eastern header and wells back into service before moving onto Phase 2 of construction. Reconstruction of the GCCS piping in Phase 1 is shown on Drawing G3. Phase 2 of construction focused on the west side of the landfill and deconstruction of piping and taking wells off line in the west is shown in Drawing G4. Following completion of the work items in Phase 2, the wells and piping in Phase 2 were put back on line as shown in Drawing G5.

Identify Production Wells to Maintain GCCS Operations

The ALI GCCS consists of 22 vertical extraction wells with an enclosed LFG flare that is operating at approximately 350 scfm of LFG. The depth and type of waste deposited in Units 1, 2b, and South Canyon result in various wells producing more LFG than others. By reviewing landfill gas well monitoring data, it was determined that a few wells were producing the majority of the landfill gas routed to the flare. In other words, these wells were identified as "good producers" and must be kept online to keep the flare operating and emissions to a minimum. If these wells were taken offline, there would not be enough landfill gas to keep the flare operating. The enclosed LFG flare at the ALI is rated at 1,500 scfm at 50 percent methane with a turn-down ratio of at least 5:1. Therefore, the flare may have difficulty maintaining temperature at a flow rate less than 300 scfm.

Prior to construction, ALI was extracting approximately 325 to 350 scfm of landfill gas. During construction this flow rate dropped to as low as 275 scfm after select wells were taken off line in Phases 1 and 2. By identifying which wells must be kept online, and the good producers, ALI increased vacuum to select wells and flare operation was able to be maintained. In Phase 1 of the 2008 construction, six (6) vertical wells and four (4) horizontal collectors were taken off line. If each of these wells was producing 10 scfm of LFG, this would represent 100 scfm which would have caused the flare station to shut down. By redirecting vacuum to good producers and keeping certain wells online using

sacrificial piping, the LFG flow and flare operation were able to be maintained. In Phase 2 of the 2008 construction, two (2) vertical wells were taken offline.

Use of Temporary LFG Collection Piping (Jumpers) to Maintain Vacuum and Maximum LFG Recovery

Temporary LFG collection piping ("jumpers") were used to direct more vacuum to good wells to keep LFG recovery to a maximum and maintain flare operations. The blower station at ALI has a variable frequency drive (VFD) which was increased to get more vacuum to active wells. The result was having only twenty (20) hours of total downtime on the GCCS throughout the duration of construction in 2008.

Sacrificing Vacuum Laterals to Keep Wells Online During Construction

Following the identification of wells that must be kept online to maintain flare operations, it was determined that their vacuum laterals must be protected in place and were then buried during the installation of the foundation layer and below the membrane liner. Permanent installation of LFG collection laterals beneath a flexible membrane liner is undesirable should the lateral become watered in and need to be serviced or replaced. Servicing a pipe beneath a liner would require cutting into the liner and replacing it. Therefore, once the membrane liner was installed, the Drawings called for replacing the buried vacuum laterals with laterals above the membrane liner to enable service to the lateral piping in the future if necessary. The contractor cut and capped the system side and well side of buried laterals and connected new laterals to the extraction wells placed on top of the membrane liner. These above-liner laterals, up to 8 inches in diameter, were later buried within the vegetative cover at the request of ALI. The 18-inch header was reinstalled on top of the vegetative cover as it was too large to be buried within the vegetative layer. Burying piping within the vegetative layer eliminates thermal expansion which can damage pipe joints and vegetation and makes it easier to access areas of the landfill cap with a service vehicle.

Communication between the Contractor and the GCCS Operator

ALI's GCCS operator (Cornerstone) maintained frequent communication with the landfill cap contractor during construction phases. This was important in order to schedule GCCS down time and to make sure the GCCS operator was onsite should adjustments to the well field or enclosed flare station be needed. When major GCCS piping construction activities were scheduled, the GCCS operator was on site to make adjustments to the well field or flare station, or to shut down and start up the flare as necessary to accommodate construction activities and to prepare any documentation required (e.g. SSM forms). For example, if the contractor needed to cut into a major landfill gas header or perform a tie-in to the piping network, the GCCS operator would shut the flare down manually during the work and restart the flare immediately following completion of work to limit overall down time. Having the GCCS operator onsite when sections of GCCS piping are either taken off line or put back on line helped to ensure smooth GCCS operations and reduced GCCS down time. In addition, the GCCS operator provided guidance to the construction contractor as to what activities are going to affect the GCCS operations and assisted in recording the shutdown and startup times for each extraction well and the flare station in accordance with the ALI SSM Plan.

Conclusion

The construction of the landfill cap for Units 1, 2ba, and South Canyon, was completed over two construction seasons. In 2007, the flare had no downtime while the landfill cap was being construction. The wells that were taken off line in 2007 and the piping work that was done in 2007 did not impact the overall flare operations. In 2008, the flare was shutdown for only 20 hours during the construction of the landfill cap. During the course of the project, there were no methane migration issues to perimeter probes, and ALI did not receive any violations for LFG control. This can be attributed to proper planning, communication, scheduling, submittal of required notifications, and understanding which regulations and exemptions can be applied under certain circumstances. In addition, while landfill closures are conducted in accordance with final closure plans, typically approved by regional water quality control boards, it is important to pay close attention to air quality regulations during closure as well. ALI's proper notification of the local air district (SCAQMD) in advance of the construction work and keeping SCAQMD up to date on construction progress assisted in the overall success of the project.

DRAWINGS

See Separate Email of Attachments