

**LANDFILL GAS ASSESSMENT AND MANAGEMENT
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LANDFILL GAS PROTECTION POLICY**

Background

Decades ago, most citizens in Los Angeles County used backyard incinerators to get rid of their trash. Open burning was also considered an acceptable practice at a majority of the landfills. With the deterioration of air quality in the Los Angeles Basin during 1950s, the County Board of Supervisors adopted an ordinance prohibiting backyard burners and open burning at all landfills. As a result of this prohibition, the County was faced with a shortage of landfill capacity. During the same period, many depleted gravel pits were left open with no ultimate use as a result of sand quarry operation. In order to utilize these pits and provide for landfill capacity, it was decided that these pits should be used for disposal of municipal solid waste.

The first indication of possible problems surfaced around 1965 when residents adjacent to these pits complained of odor. The problem was brought home when children were injured while playing with matches and the trapped air exploded near one of these pits.

In order to address these problems and to formulate construction criteria for sanitary landfills and improvements which would lead to optimum land development and maximum use, in 1967, the County received a grant from the U.S. Environmental Protection Agency (formerly the Department of Health, Education and Welfare) to conduct a three-year study. Among other things, the information gathered during the three-year period was used to develop criteria for the safe construction of buildings on, in, or adjacent to sanitary landfills.

The study found the presence of methane gas as far away as several hundred feet. As such, it became obvious that there is a need to prevent the migration of landfill gas into structures and that the issue be addressed prior to the issuance of any building permits. Accordingly, the County Building Code was revised in 1975 to prohibit construction of any structure on or within 1,000 feet of a landfill containing decomposable material unless the fill is isolated by an approved natural or man-made protection system or designed according to the recommendations contained in a report prepared by a California Registered Civil Engineer.

This report is to contain a description of the site investigation, as well as recommendations to minimize any possible intrusion of landfill gases and to prevent the accumulation of explosive concentrations of decomposition gases within or under enclosed portions of the building or structure.

The Los Angeles County Department of Public Works is the Building Official for the unincorporated areas of the County and 19 contract cities. Our Department is therefore responsible for ensuring the safety of the buildings and their occupants.

I. LANDFILL GAS PROTECTION SYSTEM

Should a determination be made that gas generation/migration exists at a site and a methane gas protection system becomes necessary, the following is required:

- a. A gas control system,
- b. A gas monitoring system,
- c. A gas monitoring program,
- d. A contingency plan, and
- e. A covenant and agreement.

A GAS CONTROL SYSTEM

In general, there are two types of gas control systems: passive or active.

1. Passive system

A passive system consists of two components. First there is the membrane sheeting which is placed beneath the structure's slab and foundation and is to totally encapsulate the underground portions of the building. The purpose of the membrane is to prevent intrusion of gases into the building. In addition, there is the gravel filled ventilation trench system to collect and remove the landfill gases. This system mainly applies to structures constructed adjacent to or within a 1,000-foot radius from a landfill. **(Plate No. 1)**

2. Active system

The active system is a mechanical system which may consist of a series of extraction wells, injection wells, or cut off trenches that either removes landfill gases or directs gases away from the structures.

- a. **Gas Extraction Well System** · this system is used to remove gases from a landfill. This system consists of a series of extraction wells, each generally of 24 inches in diameter, with a minimum depth equivalent to the lowest elevation of the refuse, a header pipe system and a vacuum pump/blower. Collected gases are either burned at a flare station or used at a resource recovery facility **(Plate Nos. 2 and 3)**
- b. **Air Injection Well System** · this system consists of a series of air injection wells, a header pipe system, and a blower to push gases away from the building. The system is constructed in natural ground to provide a barrier system between the building and the landfill. **(Plate Nos. 4 and 5)**

- c. Cut off trenches - the cut off trenches are trenches dug as deep as the depth of the landfill. These are located in natural ground adjacent to the building. They are filled with gravel and are connected by a series of pipes to a blower or a vacuum pump. The system is maintained under pressure to either remove the collected landfill gases or to push them away from the building. **(Plate No. 5)**

In general, except for single-family residential development, all three types of active systems can be used as control systems for buildings adjacent to a landfill, but only the extraction well system is acceptable for protection of structures built directly on a landfill. (Note Structures built on a landfill must also be provided with a membrane sheeting.)

B GAS MONITORING SYSTEM

Except for single-family residential development, the County requires a monitoring system to be installed to substantiate the adequacy of the gas control system throughout the life of the project.

Depending on the type and location of a structure, a monitoring system may consist of a series of subslab monitoring probes, monitoring wells, automatic methane gas sensing devices or a combination of two or more of these systems.

In general, subslab monitoring probes are used in conjunction with a membrane. These probes are required to be installed both above and beneath the membrane to monitor the intrusion of landfill gases into the building as well as to verify the adequacy of the installed barrier system **(Plate Nos. 1 and 6)**

Monitoring wells are used in conjunction with an active system and are required to be installed inside and outside of the building. A monitoring well may consist of one or several probes installed at various depths. Depending on the location, a monitoring well may be five feet (minimum) or may go as deep as 150 percent of the landfill depth **(Plate Nos. 5, 6, and 7)**

The interior monitoring wells generally are for the detection of methane gas only, whereas the exterior monitoring wells may be used for the detection of methane gas and its rate of generation, temperature, oxygen, pressure, carbon dioxide/monoxide, etc.

The purpose of a monitoring well system is to ensure the effectiveness of the gas control system as well as its proper operation and maintenance

The automatic methane gas sensing devices are generally installed inside the structure and are used in conjunction with an active system. The system may consist of one detector or several and is generally set to be activated when it detects methane gas in excess of 20 percent Lower Explosive Limit (LEL) in the atmosphere

In general, the type of monitoring system selected will depend on the type of gas control system used. This will, in turn, determine the type of monitoring program that would be best suited to measure the effectiveness of the gas protection system and would also permit an evaluation of the system so as to enable the needed adjustments to be made

C. GAS MONITORING PROGRAM

The gas monitoring program consists of two elements. One is to ensure the effectiveness of the gas control system in preventing methane gas intrusion into the structure. Two, in conjunction with the active system, is to ensure that the system is operating properly and maintained adequately.

1 Methane Gas Monitoring Program

The purpose of the methane gas monitoring program is to test for the presence of methane gas and the effectiveness of the gas protection system. The monitoring schedule required by the County is as follows.

- Test all monitoring probes prior to occupancy (All developments)
- Test monthly for three months after the building occupancy (except for single-family residential developments)
- Test quarterly thereafter (except single-family residential developments)

In addition, the initial test results must be submitted prior to granting occupancy to the building.

The frequency of monitoring for the gas control system and its proper operation depends on the type of active gas control system employed. Parameters to be checked and frequency of monitoring are to be specified in the Operation and Maintenance Plan submitted by the design engineer, and as approved by the County.

D. CONTINGENCY PLAN

In general, the County requires a contingency plan should the landfill gas protection system fail to effectively prevent intrusion of landfill gases into a structure or fail to effectively serve its purpose. The type of contingency plan required depends on the type of gas control system, building type, type of occupancy, and the site location. In general, the contingency plan is initiated when one or more of the following happens.

- Methane gas in excess of a preestablished concentration is detected in a probe above the membrane or in an interior monitoring well.
- Methane gas in excess of 20 percent LEL is detected in the interior room atmosphere

- There is an indication of possible underground landfill fire
- Air and/or landfill gas movement is detected beyond the site property line in conjunction with an air injection system

There are other parameters which may trigger the implementation of a contingency plan. However, this will depend on the type of gas control system used and is beyond the scope of this paper

E. COVENANT AND AGREEMENT

In order to alert future owners of potential landfill gas problems, prior to the approval of the building occupancy, the County requires that the property owner sign a Covenant and Agreement for himself/herself, future successor and heirs, and record the said agreement with the County Recorder Office. Depending on the site location and the type of gas control system used, the Covenant and Agreement will include the following:

- 1 A legal description of the property
- 2 An acknowledgment that the building is constructed on or within 1,000 feet of a landfill containing decomposable materials/wastes.
- 3 A statement that a landfill gas protection system has been installed in accordance with plans and specifications approved by the Building Official of the County of Los Angeles.
- 4 A statement that the said system must be monitored, operated, and maintained in accordance with the approved plans and specifications.
- 5 A statement that gives its irrevocable permission to the County of Los Angeles or its authorized agent to enter the said premises during business hours for the purpose of methane gas monitoring.

II. DESIGN ENGINEER AND HIS/HER RESPONSIBILITIES

A landfill gas protection system must be designed by a California registered civil engineer who is knowledgeable in this field. The system must be constructed and installed under his/her direct supervision.

Prior to the construction and installation of the system, plans and specifications must be approved by the County. However, the County does not inspect the construction and installation of the system, this responsibility is vested in the design engineer. As a result of this policy, the engineer is required to submit a certification to the County prior to approval of the building occupancy stating the following

- A I am a registered civil engineer in the State of California and that I am knowledgeable in the field of landfill gas control protection system.
- B The landfill gas control facilities have been constructed and installed under my direct supervision and in accordance with the approved plans and specifications (a copy of the As-Built plans must be enclosed).
- C The building is free from methane gas and can be safely occupied (a copy of the test results must be enclosed)

III. GENERAL CONSTRUCTION REQUIREMENTS

- A. Design and construction plans must inform the construction workers that they may be subject to exposure to landfill gases. Specific details and precautionary instructions must be provided on the plans to eliminate/reduce the possibility of explosion and to reduce workers= exposure to toxic gases so that their health and safety are protected at all times.
- B Design and construction plans must be sufficiently detailed so that no decision is left to the contractor or his/her workers.
- C. Materials specifications must be clearly called out on the design plans and specifications.

IV. MEMBRANE INSTALLATION

The proper installation of the membrane is of the utmost importance. A membrane system is effective only if it is installed properly. As a result, it is essential for the construction worker to recognize the importance of the system and the fact that the membrane=s function is not to serve as a moisture barrier system. The following are some tips as to how to ensure its proper installation (**Plate Nos. 1, 8, and 9**):

- A The design and construction plans must specify that all membrane installation shall be performed by a qualified firm with extensive experience in the installation of the membrane specified. (This should be verified by the design engineer.)
- B The design plans and specifications must show all requirements for ground preparation prior to the installation of the membrane. This is to ensure protection of the membrane during the construction phase.
- C. The number of field joints must be kept to a minimum. In order to accomplish this, it is recommended that prefabricated sections be used under the footings (or wherever else that can be utilized). (**Plate No. 8**)

In general, all jointing between membrane layers must overlap a minimum of three inches and must provide a chemical bond. Jointing between membrane and other surfaces of different materials must provide for physical bond, and must have contact surface of six inches minimum.

- D The number of penetrations due to utility piping, etc., must be kept to a minimum and all penetrations must be sealed with a prefabricated boot. When possible, utility piping should be of the same material as the membrane **(Plate No. 9)**
- E The membrane (HDPE or approved equal) must be a minimum of 60 mil in thickness and must be suitable for the purpose and compatible with the environment it is being exposed to. The membrane manufacturer must verify and certify the permeability, tensile strength and compatibility of the material with common constituents of landfill gases.
- F The County requires placement of clean sand both above and beneath the membrane. The sand layer must be a minimum of two inches in thickness. The purpose of the sand layer is 1) to protect the membrane against physical damage during construction, and 2) to provide a media where landfill gas movement can be detected. **(Plate No. 1)**
- G. The plans and specifications must show sufficient detail of how the membrane is to be installed below the foundations and how the membrane is to be protected during construction of foundation frame, placement of reinforcing bars, and the pouring of concrete.
- H Lastly, plans and specifications must provide for the installation of signs inside the building informing the occupants that the building is provided with a subslab methane gas barrier system and that no floor penetration is allowed without written approval of the County Building Official.

V. MONITORING PROBE REQUIREMENTS

A methane gas monitoring system must incorporate the following:

Probes must be placed both above and below membrane (except for structures located directly on the landfill) and must be located in sand layers terminating at a monitoring station. **(Plate No. 1)**

The probe's monitoring end must be 12 inches in length, 2 inch in diameter, perforated and wrapped with burlap, fiber glass or similar material to prevent the holes from clogging **(Plate No. 6)**

The sampling end of each probe at the monitoring station must be provided with a valve and a 1/4-inch rubber hose connection. The valves must be identified as to their locations/depth and must be numbered **(Plate Nos. 1 and 7)**

When applicable, a sign must be posted adjacent to each monitoring station stating AMethane Gas Monitoring Station - Do Not Block@ The words are to be in white letters, a minimum of 3/4 inch high and placed on a red background, a minimum of five feet above the floor

The construction details for probes within a monitoring well are similar to those discussed above

The number and location of monitoring probes/wells depends on the type of gas control system, the size of the building, type of occupancy and foundation. However, in the case of buildings, for each area beneath the slab that has been isolated by a continuous footing, the area must be provided with one probe above and one below the membrane.

VI. VENTILATION TRENCHES FOR A PASSIVE GAS CONTROL SYSTEM

Ventilation trenches must be no further than 50 feet apart or 25 feet from the building foundation and should be provided for each area isolated by a continuous footing. These trenches are to be a minimum of 12 x 12 inches. **(Plate No. 1)**

All ventilation trenches must be provided with a perforated pipe, minimum of 2 inches in diameter with a minimum of 2 percent of the pipe surface area. In addition no perforation is allowed within 12 inches of any foundation

All perforated pipe must be connected to vertical ventilation pipe. Vertical ventilation pipes must be provided for every 400 feet of ventilation trench or at each end of the trench, whichever is least. However, in no case will there be less than two vertical ventilation pipes for each building. **(Plate No. 1)**

All vertical pipes must be protected against physical and chemical damage and must be of metal type when it is used inside a wall. All vertical ventilation pipes must also be terminated at a minimum of two feet above the highest point on the roof within a 10 foot radius of the vent pipe and away from sources of ignition. **(Plate No. 1)**

The top end of the venting pipe must be provided with a tee or other approved device that will prevent rainwater from entering the pipe

VII. ACTIVE SYSTEM: EXTRACTION WELLS, AIR INJECTION WELLS OR CUT OFF TRENCHES

- A. The engineer must submit design calculations, soil analyses and boring logs to the County for review and approval. These calculations must show that the system will provide a continuous curtain to prevent the migration of landfill gases beyond it.
- B. In case of an Air Injection System or positive pressure cut off trench, the engineer must show sufficient data, verified by field testing, that no air is entering into the landfill and that no differential pressure is detected at the site property lines. **(Plate No. 5)**

- C With an Active System, the County will not issue a building occupancy permit until such time as the system is put into operation and is serving its purpose as designed, verified by field testing.
- D With an Extraction Well System, gas condensation may not be returned to the landfill unless approved otherwise by the State Water Resources Control Board.
- E An operation and maintenance manual must be provided to the County for review and approval prior to acceptance of the installed system by the County.

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