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EMISSIONS OF TOXIC RELEASE INVENTORY LISTED CHEMICALS FROM MSW LANDFILLS AND FEDERAL RIGHT TO KNOW PROGRAMS

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ABSTRACT

The U.S. Environmental Protection Agency (USEPA) is considering expanding the Toxic Release Inventory (TRI) to include releases from sanitary services including municipal solid waste (MSW) landfills. Information about release of TRI-listed chemicals from MSW landfills under federal community right to know laws is scattered throughout the literature and difficult for the general public to obtain. Reports prepared by the United States Environmental Protection Agency (USEPA) considering TRI expansion to include MSW landfills recognized the quantity and diversity of toxic compounds, some carcinogenic, present in landfill gases and leachate. Both the USEPA and the Occupational Health and Safety Administration (OSHA) have existing and complementary authorities which could get this information into the public domain without imposing a major regulatory burden. This two-part discussion summarizes existing literature on emissions of TRI-listed chemicals from landfills and examines the extent and limits of each agency's program evaluating Environmental Health and Safety impacts of landfill emissions.

BACKGROUND

Chemical releases from MSW landfills in general are well known to USEPA through its own documents and published literature. These data , while readily available to landfill operators and regulators, are not readily available to the general public or landfill workers and the surrounding communities. This data is scattered throughout various sources and, as noted below, is typically presented in units of concentration, not as simple quantities (e.g. pounds per year) .

The USEPA is the federal government's lead for the Emergency Planning and Community Right-to-Know Act's [EPCRA] toxic release inventory [TRI] program. The TRI program is expressly intended to "inform the general public and the communities surrounding covered [industrial] facilities about releases of toxic chemicals" [40 CFR 372.1]. However, current statutory boundaries limit TRI reporting to certain manufacturing industries; Section 313(b)(1)(A) of the EPCRA only requires industries which "manufacture, process or otherwise use" toxic chemicals and are grouped in standard industrial classification (SIC) codes 20 to 39 to inventory and report use and emissions of listed workplace chemicals. The USEPA is currently considering whether to expand the TRI reporting system to SIC Code 49, which includes electric, gas and sanitary services (including landfills, MSW combustors and wastewater treatment facilities).

Similarly, OSHA is the federal lead on health and safety regulation. Although potential health and safety concerns at landfills have been well documented, neither federal OSHA nor independent health or safety studies have addressed the need for greater landfill worker protection and workplace hazard evaluation. USEPA recently noted that"(n)either the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH) or the Mine Safety and Health Administration (MSHA) has a publicly accessible database for tracking facility performance on toxics" (USEPA, 1995b).

Substances such as vinyl chloride, benzene, chloroform, and carbon tetrachloride have been found in many nonhazardous MSW landfills, sometimes at concentrations higher than those found at hazardous waste landfills (CARB, 1990), and in concentrations potentially of concern to landfill workers. New regulatory activity in the area of landfill health and safety is virtually nonexistent (FSC, 1995).

In the 1980's, OSHA and USEPA cooperated on OSHA's Hazardous Waste Operations and Emergency Response (HAZWOPER) standard. The HAZWOPER standard focuses on protecting workers from health hazards at known hazardous waste sites where exposure conditions can be difficult to characterize or where the hazards are unknown. The strong overlap of USEPA and OSHA regulatory authorities addressing toxic emissions and health and safety virtually mandates they work together again if landfill workers and the public are to be better informed of landfill TRI chemical emissions.

PART 1 - THE TRI AND HAZCOM - MADE FOR EACH OTHER

EPCRA's Community Right-to-Know TRI provisions make clear that much of the federal government's right-to-know program was designed to build on the foundation of programs promulgated under authority of OSHA's Hazard Communication (HAZCOM) Standard (Burcatt and Hoffman, 1988) . The lists of TRI and OSHA regulated chemicals are substantially similar. The conceptual linkage between these two programs is clear and strong. Nonetheless, to date, OSHA's involvement in USEPA deliberations over TRI expansion has been minimal.

By virtue of the TRI's current restriction to manufacturing industries (SIC's 20-39), neither landfill workers nor nearby citizens nor emergency responders are presently informed of ongoing and well-documented releases of explosive gases and chemical pollutants from landfills into the air, as well as releases of leachate into groundwater, sewers and storm water. Public access to that information would be greatly enhanced were a national data-gathering program, such as the TRI. expanded to include MSW landfills.

Many former MSW landfills, and landfills which accepted hazardous waste (as distinguished from RCRA-permitted treatment, storage and disposal facilities), are now on the Superfund list. The California Air Resources Board (CARB) tested landfill gas at some 340 landfills (including 41 hazardous waste sites) and concluded that "hazardous and nonhazardous waste sites appeared to be similar in their ability to produce toxic gases" (CARB, 1990). Even so, the rationale used to protect workers at hazardous waste sites has not yet been applied to active MSW landfills, although working conditions and health hazards may well be similar.

The focus in recent literature has been towards the examination of air emissions from landfills. To what extent there has been a parallel and systematic evaluation of MSW landfill emissions and related hazards to determine appropriate protection for workers most exposed to these health and safety risks is less than clear.

EPA's Proposal To Expand the TRI

The USEPA is currently examining the impact of SIC limitation by expanding the list of SICs required to report releases which potentially affect public health. This proposal would establish a framework for the first time for systematically reporting TRI-listed toxic chemical emissions to air. land and water from MSW landfills.

The framework for TRI expansion neither increases regulation of any reported chemical nor requires reduction in chemical usage. An expanded TRI would only require industry to "make use of existing, readily available data, including monitoring data collected pursuant to other laws or reasonable estimates, but not (require monitoring of) the actual quantity, concentrations, or frequency of toxic releases beyond what other laws require ." (Arnett, 1992). The TRI makes ongoing toxic chemical use and release data readily available to the public in a computerized database.

Interestingly, both industry and the public have used TRI data for their own purposes; the public to induce industry to reduce emissions and industry to document successes in reducing TRI chemical emissions.

OSHA's HAZCOM Standard Expansion and Expanding The TRI : a Study in Parallel Evolution.

In 1983 the OSHA published the HAZCOM final rule. Like the current TRI, it too applied only to the manufacturing sector. By August 1987, through a series of lawsuits, the United Steelworkers had succeeded in having OSHA expand HAZCOM standard applicability to all employment sectors . "The Third Circuit Court had found no evidence in the record why employees in the manufacturing sector needed information about hazardous materials or toxic substances while employees in other sectors did not." (Arnett, 1992)

A lawsuit challenging OSHA's 1987 expansion of HAZCOM standards beyond manufacturing industries (such as the construction industry) was filed by the Associated Builders and Contractors, along with the National Grain and Feed Association, the Associated General Contractors of Virginia and United Technologies Corporation (Associated Builders and Contractors v. Brock 862# F.2d 63 (3d Cir. 1988)). This suit unsuccessfully sought to prevent extension of the HAZCOM to their industries. Specifically, the Court rejected the petitioners' position that since the construction industry already provided training in handling hazardous materials, there was no significant risk in that industry which required additional hazard information. Instead, the Court held that the very existence of hazardous materials training confirmed that substantial risks existed and that maintaining onsite information about those risks only increased training effectiveness. The Court continued: "as to risks posed by grain dust, the propensity of grain elevators to blow up has been well documented." (Arnett, 1992).

The parallel between OSHA's expansion of the HAZCOM standard and USEPA's current TRI expansion proposal is clear:

- Employees in nonmanufacturing industries which generate or release toxic chemicals are in no less need of health and safety information than

workers in manufacturing;

- The presence of regulated quantities of TRI-listed chemicals in landfill emissions is well known to both USEPA and the landfill industry;
- Health effects of exposure to toxic chemical releases may take 20 to 30 years to appear. However as was the case with grain elevators, safety problems at landfills such as landfill gas explosions, landfill fires, leachate breakouts, etc. are well known;
- Operating activities (excavation, soil movement, pipe installation, etc.) at landfills are very similar to construction; if Courts ruled that construction workers deserved the same access to HAZCOM information as manufacturing workers, should data on TRI-listed chemicals emanating from landfills also be made available to landfill workers and the public?

Reporting TRI Releases. Annual TRI reports require that each affected industrial facility report amounts of each chemical "manufactured, processed or otherwise used" as well as account for all releases into air, water or land. Industrial facilities which manufacture (i.e. produce, prepare or import a listed toxic chemical) or process (incorporate a listed toxic chemical into a product for distribution in commerce) more than 25,000 pounds of a given listed toxic chemical in a calendar year must submit a TRI report. Toxic chemicals "otherwise used" anywhere at an industrial facility (i.e., solvents, lubricants, catalysts, etc) which are neither manufactured or incorporated in the product being distributed in commerce are subject to a 10,000 pounds per calendar year reporting threshold.

USEPA's February 1994 report supporting TRI expansion states that "EPCRA requires reporting of five types of onsite releases and two types of offsite transfers:

- Fugitive (unplanned) air emissions
- Stack (engineered) air emissions
- Surface water discharges
- Underground injections
- Land Disposal (e.g. landfills)
- Transfers to publicly owned treatment works (POTWs)
- Transfers to other treatment or disposal facilities" (USEPA, 1994)

In evaluating the need to include SIC 49 industries (electric, gas and sanitary services) in the expanded TRI "EPA has focused its attention on those industries which ...are related to manufacturing by...treating or disposing of wastes generated by manufacturing processes"(USEPA, 1995a). USEPA's profile of SIC 49 industries, in effect, characterized landfills as having similar potential to release TRI chemicals as chemical manufacturers: "With respect to chemicals produced in a landfill, the possibilities for chemical interactions are endless..." concluding "It is easier to consider where such interactions can lead to chemical releases..." rather than where these chemicals originate (USEPA, 1995a).

USEPA's Form R instructions defining "manufacturing" state that "toxic chemicals produced and released as a byproduct of waste treatment or disposal are considered byproducts" of manufacturing, and hence TRI reportable were the SIC restriction not in effect (USEPA, 1995b). USEPA's May 1991 NSPS for landfills also noted that unlike a manufacturing entity whose releases stop when manufacturing ends, " a landfill will generate landfill gas long after closure, in some cases as long as 100 years." (USEPA, 1991). Further evidence of EPA's recognition of landfills as organic gas producers is seen in USEPA Publication AP-42: "Emissions of NMOCs (non-methane organic compounds) result from NMOCs originally contained in the landfilled waste and from their creation from biological processes and chemical reactions within the landfill" (USEPA, 1993).

TRI reporting threshold determinations are made on a chemical specific basis, i.e. each regulated industrial facility must quantify its chemical production or use to see if it triggers threshold values for individual listed chemicals. It is therefore reasonable to examine whether known byproducts of landfill disposal of MSW (leachate, gas, etc) contain levels of TRI-listed chemicals in excess of TRI reporting thresholds. As shown below, current literature and a predictive model demonstrate clearly that landfills can and do release quantities of TRI-listed chemicals in excess of TRI thresholds.

Landfill TRI Emissions Data Review. Data reviewed and summarized below indicated that MSW landfills produce and emit well-recognized TRI-listed contaminants (gas and leachate) in quantities exceeding both the TRI annual thresholds for manufactured/processed (25,000 pounds) or otherwise used (10,000 pounds) chemicals.

The presence of chemicals in landfill gas known to have associated "cancer risks and noncancer health effects" was one reason cited by the USEPA in justifying regulation of MSW landfills with New Source Performance Standards (NSPS- 59 FR 24468, May 30 1991) under authority of Section 111 of the Clean Air Act . The landfill NSPS "are issued for categories of sources which cause, or contribute significantly to air pollution which may reasonably be anticipated to endanger public health or welfare." (USEPA, 1991). "In reviewing limited emissions data from landfills, EPA identified both known and suspected carcinogens (such) as benzene, carbon tetrachloride...vinyl chloride...At least 12 pollutants such as benzene, chloroform, and ethylene dichloride contained in MSW landfill emissions have the potential to produce health effects other than cancer." (USEPA, 1991). Nearly all of

these cited pollutants are TRI-listed chemicals.

USEPA's primary reference document for air emission factors (USEPA Document # AP-42) provides emissions factors for dozens of TRI-listed chemicals which are also common landfill air emissions. Similarly, USEPA's NSPS Background Information Document BID (Table 3-6) catalogs existing landfill test data, revealing the presence of TRI-tested chemicals in landfill gas. (USEPA, 1991)

Recent non-government reports using USEPA AP-42 emissions factors (based on actual landfill gas samples nationwide) confirm that existing landfills "manufacture" and emit regulated quantities of TRI chemicals via air emissions alone (see Table 1). Research into air emissions from two 1000-2000 ton per day landfills in Maryland, estimated annual emissions for 1994 from one site (Sandy Hill) to be up to 37,400 pounds of tetrachloroethylene and up to 10,200 pounds of toluene (Gill, 1995), both exceeding TRI reporting thresholds in Table 1. At New York City's Fresh Kills landfill, 1994 annual emissions estimates of toluene (128,000 pounds), xylene (45,000 pounds), dichloroethene (121,400) and benzene (12,600 pounds) far exceeded TRI reporting thresholds (Minnot, 1994). Applying updated USEPA AP-42 factors (USEPA, amended June 1993) to Minnot's Fresh Kills study shows increased annual toluene and benzene emissions (to 193,200 and 33,800 pounds, respectively) and somewhat lower xylene (20,000 pounds).

According to USEPA (56 FR 24473), nonmethane organic compounds (NMOCs) consist primarily of volatile organic compounds (VOCs). Many TRI-listed chemicals, including benzene, xylene and toluene are VOC's. In a lawsuit regarding the Morgantown, Pennsylvania landfill, the Defendant (New Morgan Landfill, Inc.) recognized that the Morgantown landfill (accepting an average of approximately 2250 tons per day of MSW since it opened in January 1994) will emit appreciable quantities of NMOCs (Ogden Projects, Inc. v. New Morgan Landfill, 1995). Specifically the Defendant acknowledged that the landfill will:

1. produce between 580 and 663 TPY of NMOCs (before LFG flare controls),
2. emit as much as 5.8 to 6.7 TPY of NMOCs into the atmosphere from the flare system,
3. have combined flare and uncontrolled NMOC emissions up to 179.6 TPY (per Joint Pretrial Stipulation).

[**Note**: at this writing, a second decision, issued January 8, 1996, reversing the Court's earlier decision was issued in the New Morgan case, the response to which is under evaluation]

Regarding landfill leachate, USEPA's own reports document that landfill leachate contains substantial quantities of TRI chemicals: "available data on landfill leachate composition shows that zinc and manganese can both be found above de minimus concentrations in landfill leachate" (USEPA, March 1995). Examining USEPA landfill leachate concentration data (USEPA, 1988) and a predictive leachate generation model for a hypothetical East Coast landfill confirms that leachate contains many chemicals which approach or exceed TRI reporting thresholds (e.g., zinc @ 29,000 pounds, phenol @ 11,000 pounds-see Table 2).

The confirmed existence of TRI chemical releases into these two different environmental media (air and water) highlights that a much fuller understanding of landfill emissions would be gained if a "multimedia" accounting system existed such as the TRI Form R inventory to quantify and track releases and transfers to air, streams, wastewater treatment facilities etc.

Extending The TRI Concept To MSW Landfills The Federal Right-to-Know standards are built on the Jeffersonian ideal that public empowerment stems from public access to relevant information; in this instance, the public has a right to ready access to information regarding risks from chemicals "inside and outside the fence line" (Arnett 1992). The TRI's express purpose is to "inform the general public and the communities surrounding covered [industrial] facilities about releases of toxic chemicals" [40 CFR 372.1].

Within the fence line:

- Employees have a need and a right to know the hazards and identities of the chemicals they are exposed to when working.
- Both employers and employees need this information so it can be used to reduce exposure and establish proper work practices.

Beyond the fence line:

- The public has the right to have ready access to information about the chemical risks that originate from industrial facilities in terms of:
  - chemical accidents
  - hazardous substances stored or held in inventory
  - chemical health effects, and
  - routine releases
- Emergency responders need to know the type of risk they face when answering a call for help from within the fence line. (Arnett, 1992)

The EPCRA gives USEPA two key legal tools to expand TRI to landfills:

Table 1

Comparison of Landfill Air Emissions With TRI Reporting Thresholds*

	SOURCE OF AIR EMISSIONS ESTIMATES (ANNUAL VALUES)*			TRI REPORTING THRESHOLDS***	
TRI- Listed Chemical	Sandy Hill Landfill , Maryland (Gill, 1995) (lbs/year)**	Fresh Kills, New York (Minnot, 1994) (lbs/year)**	Fresh Kills Update with Revised USEPA AP42 Factors (lbs/year)**	Manufactured, Processed (lbs/yr)	Otherwise Used (lbs/yr)
Tetrachloroethylene	37,400	n/a	n/a	25,000	10,000
Toluene	10,200	128,800	139,200	25,000	10,000
Xylene	5,200	45,600	20,000	25,000	10,000
Dichloroethene	n/a	121,400	n/a	25,000	10,000
Benzene	1,800	12,600	33,800	25,000	10,000

* See List of References
** Estimated Release during Calendar Year 1994
*** Values in excess of these thresholds trigger TRI reporting

TABLE 2

PREDICTED LEACHATE QUANTITIES TYPICAL EASTERN LANDFILL[1]			
Constituent	**Quantity[2] (lbs/yr)**	**TRI Reporting Threshold****	
		Manufactured, Processed (lbs/yrs)	**Otherwised Used (lbs/yrs)**
Inorganics	RANGE[1]		
Barium	0.0 - 3,934	25,000	10,000
Zinc**	3.9 - 29,356**	25,000	10,000
Organics			
Acetone	55.1 - 4,327	25,000	10,000
Benzene	0.8 - 2,391	25,000	10,000
MEK**	3.9 - 11,014**	25,000	10,000
Phenol**	3.9 - 11,329**	25,000	10,000
Toluene	0.8 - 1,258	25,000	10,000

** EXCEEDS TRI REPORTING THRESHOLD

[1]Sources: leachate concentration ranges (based on USEPA, 1988), quantitative model (based on Ham, 1990)

[2]Landfill Design Basis: 60 foot deep, 20 year life, 35" annual rainfall, daily dirt cover

- USEPA has discretionary authority to add or delete SICs required to report TRI chemical use, inventory or releases [EPCRA § 313 (b)(2)],

- USEPA is authorized by Section 313 (f) of EPCRA to set alternate reporting limits for specific "categories of facilities."

While it is well known that MSW landfills can generate and release many TRI-listed chemicals (benzene, vinyl chloride, toluene, metals, pesticides, etc.) via air, leachate and stormwater, available data is almost always presented in units of concentration (e.g. parts per million or milligrams per kilogram etc.) rather than quantity (pounds or gallons per year). Neither are these data gathered or reported systematically under any nationwide permit program nor on a facility-specific basis. In contrast, the TRI reporting format requires that data be reported uniformly in pounds per year.

Were landfills required to report actual quantities of toxics released , it would then become more feasible for both the public or regulators to understand the amount of toxics landfills generate or emit, and to monitor changes in those emissions over time. Getting landfills to report toxic releases in understandable and uniform units of measure would go a long way to eliminating this information gap.

PART 2 - LANDFILLS: NOT AN OSHA PRIORITY

BACKGROUND

OSHA's inspection schedule targets certain industries considered "high hazard" based not only on industry injury and illness records, but also on other available studies or data documenting serious health or safety threats. Industries may also be targeted as a result of a highly publicized incident. "The landfill industry is not included in the (high hazard group) therefore, a landfill is not likely to be inspected by OSHA unless subject to a complaint filed by an employee or by the union representing an employee." (FSC, 1995). Appendix A details key OSHA requirements which may be applicable to the landfill industry.

While many hazardous substances in landfill gas are already regulated under OSHA's General Industry Standards (29 CFR 1910). municipal waste landfills and the landfill industry have not been included in OSHA's high hazard group. Perhaps the absence of compiled and reported landfill toxics data contributes to OSHA's assignment of a lower priority to inspecting MSW landfills.

Total volatile organic compound (VOC) emission amounts from landfills are large and can occur in high concentration. The presence in landfill gas of certain highly toxic VOCs such as acrylonitrile, hydrogen sulfide, vinyl chloride, benzene, and ethylene dichloride can pose both acute and chronic health risks to landfill workers. OSHA regulations (at 29 CFR 1910.1000) list toxic substances, including the above, which are identified by OSHA as industrial toxic substances for which employee exposure regulation is most warranted. There is ample evidence that landfill gas can contain high concentrations of these toxic chemical compounds relative to OSHA health and safety standards.

All landfills must comply with OSHA's exposure limits. For example, when vinyl chloride is present or suspected of being present in the workplace, and conditions exist where an employee may be exposed, the employer is obligated to perform an initial exposure assessment. This initial exposure assessment/monitoring involves the collection of a personal air sample to determine the employee's personal exposure level. The monitoring results are then corrected to correspond to an eight hour (i.e., normal work day) exposure value or time weighted average (TWA). Using the vinyl chloride example, the employee's TWA is compared to the action level and permissible exposure limit (PEL) for vinyl chloride (0.5 ppm and 1.0 ppm averaged over eight hours, respectively) as established by OSHA in 29 Code of Federal Regulations (CFR) 1910.1017. See Appendix B for further PEL, TWA explanation.

Triggering an OSHA action level requires that an employer initiate specific minimal requirements for periodic exposure monitoring and training, medical surveillance as defined in the specific OSHA standard (e.g., Appendix B, Item 6, lists OSHA exposure requirements for specific air contaminants). Exceeding an OSHA PEL triggers extensive requirements for personal protective equipment, housekeeping, engineering controls, and record keeping, etc.

The presence of OSHA-regulated (and TRI-listed) compounds in landfill gas emissions at levels shown in Table 3 indicates a real potential for worker exposure to exceed established occupational exposure limits under certain conditions or while performing certain tasks. (Note: CARB reports present data based on landfill gas and ambient air samples, not employee monitoring data).

Potential for Exposure to Landfill Gases (LFG) of Concern

The California Air Resources Board (CARB Landfill Program, 1990) and USEPA's Office of Air Quality Planning and Standards (USEPA, AP-42, 1993) conducted separate analyses for specific contaminants in landfill gas landfill surfaces, ambient air around landfill boundaries, as well as controlled and uncontrolled air emissions. CARB's report, based on actual field sampling of landfill gas at 340 California landfills, found benzene, methylene chloride and trichloroethylene in more than half of the landfills sampled and vinyl chloride of landfill gas samples in almost half the study sites. This study also reported benzene and vinyl chloride in integrated surface samples

(251 sites) and in the ambient air (288 sites) in and around the site perimeters. Levels measured for some of these landfill gas samples (not personal monitoring samples) approach or exceed OSHA PEL's, with vinyl chloride and benzene being two important examples.

As noted above, CARB's landfill sampling data assumes increased significance since OSHA has expanded health standards for both vinyl chloride and benzene (29 CFR 1910.1017 and 1028, respectively) , which require an initial determination be made for employee exposure to those substances. Specifically, when substances having OSHA-expanded standards are known to be present or are suspected of being present in the workplace, and conditions exist where an employee may be exposed, employers must perform initial assessment monitoring as noted previously.

CARB (1990) reports an average concentration for vinyl chloride of 2.2 parts per million (LFG), a maximum of 72 ppm in the landfill gas, and a maximum concentration of 1.0 ppm at the landfill surface. For benzene, CARB reports and average concentration of 2.5 ppm and a maximum of 480 ppm in landfill gas. The maximum reported surface benzene concentration was 0.12 ppm and 0.5 ppm at site perimeters. Comparing OSHA permissible limits for benzene and vinyl chloride with CARB landfill air sample data and USEPA AP-42 data shows the potential for OSHA action levels for both vinyl chloride and benzene and 8-hour time weighted averages to be exceeded (see Table 3) .

The potential also exists for OSHA's short term exposure limits (STEL) and ceiling exposure limits (see Table 3 and Appendix B for details) to be exceeded during certain high risk operations where workers may be exposed to peak landfill gas concentrations. Specifically, installation, maintenance or repair of gas collection systems, cap and new cell liner installation, leachate pre-treatment plant operations, and installation of monitoring wells may expose workers to these peak gas concentrations. At a minimum, an initial assessment is needed of these workers to determine appropriate protective measures (FSC, 1995).

Reinforcing the importance of CARB's findings, USEPA Region IX has requiried sampling for vinyl chloride, benzene, toluene and eighteen additional volatile organic compounds in at least one case, (the BKK landfill) in California, to determine the risk which these chemical releases may pose to the community. The BKK landfill began operating as a municipal solid waste landfill in 1963, and served as Los Angeles' primary commercial hazardous waste site from 1972 to 1984; the hazardous waste fill closed in 1989. BKK has been operating a municipal solid waste landfill next to the closed portion since 1987 (USEPA, December 1994). This site's history is not uncommon in the landfill industry, with many landfills having codisposed municipal, commercial, and industrial wastes, particularly prior to the stricter land disposal regulations of the late 1970's and 1980's.

Beyond VOCs, other toxic components occur in landfill gas. USEPA's AP-42 reported a median landfill hydrogen sulfide gas concentration of 36.5 ppm in uncontrolled gas emissions. OSHA's acceptable ceiling concentration for hydrogen sulfide (H_2S) is 20 ppm. Hand held H_2S monitors are typically set to alarm over 20 ppm, at which point OSHA confined space entry requirements (designed to protect workers against toxic atmospheres, asphyxiation, or engulfment), become a necessity.

> "Based on the CARB and EPA AP-42 data reviewed thus far, significant potential health risks exist for landfill workers to be overexposed to toxic and/or carcinogenic airborne substances. These substances could very well be at levels exceeding OSHA or ACGIH (American Council of Government and Industrial Hygienists) exposure limits. Emergency responses to vapor or gas releases, fires, or in response to health-related complaints from a MSW worker or the surrounding public, may also constitute high risk operations. Particularly in emergency response situations, known landfill toxic constituents may exceed concentrations which are Immediately Dangerous to Life or Health (IDLH). See Appendix B for IDLH details. Emergency response actions such as firefighters responding to a landfill gas fire, exposes firefighters to unknown constituents and would therefore pose additional risks; hence, initial assessments are needed to plan for these responses.
>
> Furthermore, uncontrolled releases occurring during a landfill emergency (fire, explosion, or sudden release of gas or vapor) are considered to be potentially immediately dangerous to the life and health (IDLH) of those responding. Appropriate protection would require the use of artificial life support systems while responding to those emergencies." (FSC, 1995).

These studies by CARB and USEPA over the past decade document that several toxic and/or carcinogenic substances occur in landfill gases at levels potentially hazardous to MSW workers. These reports support a conclusion that preliminary worker exposure assessments for those substances are needed, as required by several OSHA health regulations.

Toward More Thorough and Consistent Environmental, Health and Safety Practice at Landfills.

USEPA has the authority to act to assure that chemical emissions data from new and existing MSW landfills are made available to both workers and the general public by:

1. Adding MSW landfills to the list of SIC's or facilities required to compile and report toxic chemical releases under the TRI program;

2. Getting OSHA to be a full partner in TRI

Table 3. Comparison of Landfill Gas (LFG) Sample Data with OSHA Permissible Exposure Limits **

	OSHA PERMISSIBLE EXPOSURE LIMITS				
Compound**	**Action Level (ppm)**	**TWA (ppm)**	**STEL (ppm)**	**Ceiling (ppm)**	**CARB Landfill Gas Sample Concentration (ppm)****
Vinyl Chloride (29 CFR 1910.1017) [1]	0.5	1	--	5	72 (Maximum 2.2 (Average)
Benzene (29 CFR 1910.1028)[1]	0.5	1	5	--	480 (Maximum) 2.5 (Average)
Benzene (from Table Z-2 of 29 CFR 1910.1000, alternate limit for operations excluded in above Benzene Standard at 29 CFR 1910.1028) [1]	--	10	--	25 (50 ppm for 10 min. = Acceptable max. Peak during 8-hr. shift)	
Ethylene Dichloride (29 CFR 1910.1000, Table Z-2) [1]	--	50	--	100 (200 ppm for 5 min. = Acceptable maximum peak in three hours)	98 (Maximum) 0.6 (Average)
Acrylonitrile (29 CFR 1910.1045) [2]	1	2	--	10	7.56 (Median)
Hydrogen Sulfide (29 CFR 1910.1000, Table Z-2) [2]	-- --	-- --	--	20 (50 ppm for 10 min. = Acceptable maximum peak during 8-hr. shift, if no other exposure occurs)	36.51 (Median)

Sources:

1. California Air Resources Board (CARB), Stationary Source Division, California Air Pollution Control Officers, Association Technical Review Group, Landfill Gas Subcommittee; *The Landfill Testing Program: Data Analysis and Evaluation Guidelines*, 1990.

2. USEPA, Office of Air Quality Planning and Standards, Office of Air and Radiation, Research Triangle Park, NC 27711, *Emission Factor Documentation for AP-42, Section 2.7, Municipal Solid Waste Landfill,* June, 1993. Table 2.7.1. Note: limited data available for acrylonitrile, above average data for hydrogen sulfide.

****NOTES:**

a. All Table 3 chemicals (except ethylene dichloride) are both on USEPA's list of TRI reportable chemicals and addressed by OSHA standards.

b. While all compounds listed have potential to exceed at least one OSHA PEL, these data are LFG gas samples, not actual employee personal monitoring data.

c. Appendix B details OSHA PEL's (Action Level, TWA, STEL, Ceiling.)

expansion efforts to ensure health and safety issues are considered when selecting industries required to report TRI releases;

3. Instructing USEPA Regional Offices that:

   a) landfills emit regulated quantities of TRI chemicals and that appropriate health and safety precautions should be followed when inspecting these sites,

   b) states need to inform their employees of landfill hazards and of the need for appropriate safety protection requirements.

4. Invoking its authority under by Section 313 (f) of EPCRA to set lower alternate reporting limits based on categories of facilities if necessary to ensure that landfills systematically quantify and report ongoing releases into all environmental media.

5. Conducting workplace hazard evaluations to identify high risk operations, such as installing or working on a gas collector, intrusive work (drilling or digging), cleaning leachate collector systems, or working in a confined space where gases could accumulate (trenches, manholes, or pits).

Conclusions. There are real benefits to the general public and landfill workers alike were information about landfill TRI chemical emissions consolidated into a single, publicly available data base such as the TRI. These data would make citizens, regulators and the landfill industry itself more keenly aware of the nature and quantity of landfill releases. This information will also allow emergency responders to prepare to meet the hazards they face when responding to landfill fires and release cleanups.

Workers must be protected when working in operations where potential exists for OSHA exposure limits to be exceeded. Only by collecting information and identifying the potentail for exposure to these hazards can critical workplace conditions be evaluated to better control worker risks. Absent information about these hazards, it would appear reasonable that employees be protected based upon anticipated hazards for each work task and upon reasonable worst case scenarios. Specifically, the same considerations now given towards hazard evaluation and protection of hazardous waste site workers should be granted MSW landfill workers.

Understanding a problem is the first step towards resolving the issue. Developing a uniform and accurate TRI database for landfills is a key to this understanding.

References

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APPENDIX A: KEY APPLICABLE OSHA REGULATIONS

The following regulations are identified to be the key OSHA regulations that may be applicable to the landfill industry:

1. Hazard Communication Standard (29 CFR 1910.1200)

Hazard communication standard (HCS) requires that the employer establish a hazard communication program to ensure that hazards associated with chemical usage are communicated to employees. There are training, labeling, and material safety data sheet requirements for known chemicals.

The hazard communication program should include:

- List of known hazardous chemicals on-site;
- Method for informing employees of chemical hazards associated with non-routine tasks; and
- Methods for informing both employees and subcontractors about chemical hazards.

Training should include:

- How to detect the presence or release of a hazardous chemical in the work area;
- Physical and chemical hazards in the work area;
- Means for protecting employees from hazards;
- Details of the hazard communication program.

2. Log and Summary of Occupational Injuries and Illnesses (29 CFR 1910.24)

The regulation requires that each employer maintain a log of all recordable occupational injuries and illnesses and that the information be recorded in the log within six working days of receipt of the information.

3. OSHA's Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120)

OSHA's hazardous waste operations and emergency response standard covers employers and employees who are engaged in hazardous substance response and cleanup operations; operations involving hazardous waste storage, disposal, and treatment; operations at sites designated for cleanup; and emergency operations for release of hazardous substances. The standard defines and requires compliance in specific areas such as:

- Site characterization and analysis
- Site control
- Training
- Medical surveillance
- Engineering controls, work practices, and personal protective equipment
- Monitoring
- Informational programs
- Material handling
- Decontamination
- Emergency response
- Illumination
- Sanitation

All employees who have a potential for being exposed to hazardous substances must be trained by the employer in the following areas:

- Names of personnel responsible for site safety and health
- Safety, health, and other hazards present on the site
- Proper use of personal protective equipment
- Safe work practices
- Safe use of engineering controls and equipment
- Signs and symptoms of overexposure to hazardous substances that might be present on the site

A minimum of 40 hours of training for employees off the site and three days of field experience on the site under a trained person is required. Employees who are responsible for responding to emergency situations must be trained how to respond to expected emergencies, and supervisors and managers who direct hazardous waste operations also must be properly trained.

4. Permit-Required Confined Spaces (29 CFR 1910.146)

The OSHA confined space standard includes identification and control of hazards; entry procedures; appropriate training and equipment for authorized entrants, entry supervisors and attendants; documented compliance through written permits; and attendants to control or monitor entry procedures. The standard also mandates advance planning and appropriate precautions for rescuing entrants and coordination with contractors involved in confined space entry.

Training requirements: The standard mandates initial and refresher training to provide employees understanding, skills and knowledge to do job safely.

5. Occupational noise exposure (29 CFR 1910.95)

Under the Occupational Safety and Health Act, every employer is legally responsible for providing a workplace free of excessive noise. Area and personal noise surveys should be conducted to categorize noise levels. The OSHA Permissible Exposure Limit for an eight-hour workday, forty-hour work week, is 90 dBA, as recorded on a sound level meter on the A weighted scale. An employer shall implement a hearing conservation program if 8-hour time weighted average noise exposures equal or exceed 85 decibels on the A scale. Continuous intermittent and impulsive sound levels of 80 dBA or greater shall be integrated into the time weighted average.

Training requirements:

The employer must provide a training program for all employees exposed to the action level. Emphasis of the training should be placed on:

- The intent of the hearing conservation program
- The effect of noise on hearing
- How hearing loss can be prevented

6. Air Contaminants (29 CFR 1910.1000)

OSHA regulates that an employee's exposure to toxic and hazardous substances for substances that are listed in Tables Z-1-A, Z-2 or Z-3 of 29 CFR 1910.1000 be limited in accordance with the requirements of the section. There are also other applicable OSHA standards that refer to particular exposure monitoring procedures, PPE requirements, medical surveillance, training, and record keeping requirements for specific chemical contaminants. Those compounds that may relate to landfill operations are:

- Acrylonitrile (29 CFR 1910.1045) Action level: 1 ppm for an eight hour time-weighted average.
- Benzene (29 CFR 1910.1028) Action level: 0.5 ppm for an eight hour time-weighted average.
- Vinyl chloride (1910.1017) Action level: 0.5 ppm for an eight hour time-weighted average.
- Asbestos (29 CFR 1910.1001)
- Lead (29 CFR 1910.1025)

7. OSHA Requirements for Personal Protective Equipment (PPE):

- General requirements (29 CFR 1910.132)
- Eye and face protection (29 CFR 1910.133)
- Occupational head protection (29 CFR 1910.135)
- Occupational foot protection (29 CFR 1910.136)
- Hearing protection (29 CFR 1910.95)

8. Respiratory Protection (29 CFR 1910.134)

Prior to wearing a respirator, an employee should be certified as medically able to wear one. Each employer should have a written respiratory protection plan for selection and use of respirators. All employees must be trained regarding the appropriate us of a respirator .

9. Bloodborne Pathogens (29 CFR 1910.1030)

The standard applies to all occupational exposure to blood or other potentially infectious materials. The employers are required to develop a written Exposure Control Plan to eliminate or minimize employee exposure to bloodborne pathogens. The plan should include methods of compliance (general; engineering and work practice controls, PPE, housekeeping), communication of hazards to employees (labels and signs, information and training) and record keeping.

10. OSHA Construction Standards

Specific Excavation Requirements (29 CFR 1926.651)
Specific Trenching Requirements (29 CFR 1926.652)
Requirements for Heavy Equipment

APPENDIX B. GLOSSARY AND ABBREVIATIONS

ACGIH American Conference of Governmental Industrial Hygienists. ACGIH is a professional organization devoted to the administrative and technical aspects of occupational and environmental health.

CARB California Air Resources Board

C(Ceiling) Ceiling level is the OSHA ceiling concentrations that must not be exceeded during any part of the workday; if instantaneous monitoring is not feasible, the ceiling must be assessed as a 15-minute TWA exposure.

Hazardous Substances Any substance designated or listed under (A) through (D) of this definition, exposure to which results or may result in adverse effects on the health or safety of employees:

(A) Any substance defined under section (14) of CERCLA;

(B) Any biologic agent and other disease causing agent which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any person, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations in such persons or their offspring.

© Any substance listed by the U. S. Department of Transportation as hazardous materials under 49CFR 172.101; and

(D) Hazardous waste as herein defined. (Hazardous waste means: a waste or combination of wastes as defined in 40 CFR 261.3 or those substances defined as hazardous wastes in 49CFR 171.8.)

HAZWOPER Hazardous waste operations and emergency response (29 CFR 1910.120).

IDLH Immediately dangerous to life or health. IDLH concentrations represent the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.

PEL OSHA permissible exposure limits. PELs are time-weighted average concentrations that must not be exceeded during any 8-hour work shift of a 40-hour workweek.

STEL Short term exposure limits. STELs are concentrations that must not be exceeded for a 15-minute period.

TWA Time weighted average.