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# Health Impact of a Proposed Waste-to-Energy Facility in Illinois

W. H. Hallenbeck

The University of Illinois at Chicago, School of Public Health (M/C 922), Division of Environmental and Occupational Health Sciences, 2121 West Taylor Street, Chicago, Illinois 60612-7260, USA

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The Illinois Environmental Protection Agency (IEPA) has given the Robbins Resource Recovery Company (RRRC) a permit to construct a Regional Pollution Control Facility in Robbins, Illinois. Site approval for this waste-to-energy (WTE) combustor has been granted by the Village of Robbins which is located about three miles south of Chicago. The facility is designed to operate continuously for 40-45 years, process 1600 tons of municipal solid waste (MSW) per day, and produce over 50 megawatts of electricity. Refuse derived fuel (RDF) will constitute essentially 100% of the operating fuel. The fuel preparation system is designed to recover 25% (by weight) of the MSW in the form of recyclable materials (ferrous, aluminum cans, glass, and compostables). Also, appliances, electronic equipment, household batteries, and lead-acid vehicle batteries will be removed. The air pollution control system for the two circulating fluidized bed combustors has been characterized by the USEPA and the IEPA as Best Available Control Technology (BACT) based on the following components: selective non-catalytic reduction (SNCR) to control nitrogen oxide emissions and dry flue gas scrubber (spray dryer absorber) and fabric filter baghouse to control emissions of acid gases (mainly hydrogen chloride and sulfur dioxide), particulates, and metals. In addition, activated carbon injection will be used to control mercury emissions (RRRC, 1992).

It is important to evaluate the health impacts of the RRRC WTE facility at an early stage in planning. The remainder of this report deals with a risk assessment of inhalation exposure to predicted air emissions from the RRRC WTE facility.

## MATERIALS AND METHODS

The emissions of 23 chemicals and chemical classes were evaluated for their potential impact on health. Maximum ground level concentrations were computed using a USEPA computer model (Industrial Source Complex, UNAMAP 6 version) (RRRC, 1989). IEPA permit limits shown in Table 1 were used to determine maximum ground level concentrations for particulates, nitrogen oxides, sulfur dioxide, carbon monoxide, hydrogen chloride, dioxins/furans, and mercury. Maximum ground level concentrations for the following pollutants were based on worst case emission factors derived from operating municipal waste combustion facilities utilizing pollution control equipment similar to the RRRC facility: arsenic, beryllium, cadmium, chromium, nickel, lead, antimony, barium, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), chlorinated benzenes, chlorinated phenols, aldehydes, hydrogen fluoride, sulfates, and ammonia (RRRC, 1993).

Maximum annual average ground level concentrations (RRRC, 1993) were used to evaluate long-term exposure and the potential for generating cancer. Inhalation cancer risk factors were obtained from the USEPA (1987, 1990). Maximum annual average ground level air concentrations and cancer risk factors were used to compute maximum theoretical cancer risks due to lifetime (70 years) inhalation exposure (USEPA, 1989; Hallenbeck, 1993).

Maximum short-term ground level concentrations (RRRC, 1993) were used to evaluate the potential for immediate and delayed health effects due to noncarcinogens. These concentrations were compared to the following health-based standards and guides:

- USEPA reference concentrations (USEPA, 1990). Reference concentrations are set at levels which will prevent the occurrence of health effects from either short-term or long-term exposure to pollutants.
- National Ambient Air Quality Standards (AAQSs)
- National Emission Standards for Hazardous Air Pollutants (NESHAPs)
- Threshold Limit Values (TLVs) published by the American Conference of Governmental Industrial Hygienists

## RESULTS AND DISCUSSION

The cancer risks tabulated in Table 2 are very small and indicate that no cancer cases will be generated even if the facility operates for 70 years. The results in Table

2 most likely represent worst case analyses because:

**Table 1.** IEPA Permit Limits for the RRRC WTE Facility and Comparison to USEPA New Source Performance Standards (NSPSs)

| Pollutant | IEPA Permit Limits[a] | USEPA NSPSs[b] |
|---|---|---|
| Particulate matter | 0.01 gr/dscf; 53 tons/year | 0.015 gr/dry standard cubic foot |
| Nitrogen oxide | 130 ppm (24 hour average); 580 tons/year | 180 ppm (24 hour average) |
| Hydrogen chloride | 25 ppm (24 hour average) or 95% removal; 87.9 tons/year | 25 ppm or 95% removal |
| Sulfur dioxide | 30 ppm (24 hour average) or 85% removal; 187.9 tons/year | 30 ppm (24 hour average) or 80% removal |
| Carbon monoxide | 100 ppm (4 hour average); 270 tons/year | 100 ppm (24 hour average) |
| Dioxin/furan | 30 $ng/nm^3$ of tetra through octa | 30 $ng/nm^3$ |
| Total hydrocarbons | 10 ppm (24 hour average); 15.4 tons/year | |
| Mercury | 0.01 pounds/ton of RDF; 2.2 tons/year | |

[a] Construction Permit/PSD Approval, IEPA, June 11, 1990. All emission levels are on a dry, 7% oxygen basis.
[b] USEPA, 1991.

- Maximum annual average ground level concentrations were used. Most people will not be exposed to these concentrations.

- Lifetime exposure of 70 years was used. The facility is expected to operate for a maximum of 45 years.

- Whenever there were multiple risk factors reported for a carcinogen, the highest risk factor was used.

**Table 2.** Health Impact of the Inhalation of Carcinogens Emitted by the RRRC WTE Facility

| Pollutant | Risk factor[a] $(\mu g/m^3)^{-1}$ | Maximum annual average ground level conc.[b] $(\mu g/m^3)$ | Maximum theoretical cancer risk due to lifetime inhalation exposure |
|---|---|---|---|
| Arsenic | 0.0042 | $2 \times 10^{-6}$ | $10^{-8}$ |
| Beryllium | 0.0024 | $5 \times 10^{-7}$ | $10^{-9}$ |
| Cadmium | 0.0018 | $3.9 \times 10^{-6}$ | $10^{-8}$ |
| Chromium-VI | 0.012 | $1.3 \times 10^{-6}$ [c] | $1.5 \times 10^{-8}$ |
| Nickel | 0.00048 | $2.4 \times 10^{-5}$ | $10^{-8}$ |
| Dioxin/ furan as 2,3,7,8-TCDD | 33 | $10^{-9}$ | $3 \times 10^{-8}$ |
| PAH as BaP | 0.0017 | $6 \times 10^{-7}$ | $10^{-9}$ |
| PCBs | 0.0012 | $6 \times 10^{-8}$ | $10^{-11}$ |
| Chlorinated benzenes | 0.00048 | $1.1 \times 10^{-6}$ | $5 \times 10^{-10}$ |
| Aldehyde as formaldehyde | 0.000013 | $9.8 \times 10^{-4}$ | $10^{-8}$ |

[a] USEPA, 1987, 1990. [b] RRRC, 1993. [c] Assumes chromium-VI is 3% of total chromium (Ogden Martin, 1992).

The results in Table 2 have the following limitations:

- Metal speciation and particle size data for the RRRC facility or a similar facility are not available.

- Metal speciation and particle size data were limited in the epidemiology studies which underlie the risk factors.

The results for noncarcinogens are tabulated in Table 3 and represent worst case analyses because maximum ground

**Table 3**. Health Impact of the Inhalation of Noncarcinogens Emitted by the RRRC WTE Facility

| Pollutant | Maximum ground level conc.[a] ($\mu g/m^3$) | USEPA reference conc.[b] ($\mu g/m^3$) | Ambient air quality stan-dards[a] ($\mu g/m^3$) | Threshold limit values (8 hour) ($\mu g/m^3$) |
|---|---|---|---|---|
| Particu-late matter | 0.5 24 hour | | 150 ($PM_{10}$) (24 hour) | |
| Nitrogen oxides | 0.23 annual | | 100 (annual) | 5600 as $NO_2$ |
| Sulfur oxides | 30.4 1 hour | | 1300 (3 hour) | 5200 as $SO_2$ |
| Carbon monoxide | 26.9 1 hour | | 40,000 (1 hour) | 29,000 |
| Barium | 0.0013 24 hour | 5[d], 0.5[e] | | |
| Ammonia | 0.2 24 hour | 360[d,e] | | 17,000 |
| Lead | 0.0053 24 hour | | 1.5 quarterly | |
| Mercury | 0.021 24 hour | 0.3[d,e] | | |
| Antimony | 0.005 8 hour | | | 500 as Sb |
| Chlorina-ted phenol | 0.00004 8 hour | | | 500 as PCP |
| Hydrogen chloride | 3.6 8 hour | | | 7500 |
| Sulfates as $H_2SO_4$ | 0.7 8 hour | | | 1000 |
| Hydrogen fluoride | 0.1 8 hour | | | 2600 |

[a] RRRC, 1993. [b] USEPA, 1990. [c] ACGIH, 1992-93.
[d] Subchronic. [e] Chronic.

level concentrations were used. Most people will not be exposed to these concentrations. All maximum ground level concentrations are orders of magnitude below relevant standards and guides.

In addition to comparing the maximum short-term ground level concentration of lead to the ambient air quality standard, long-term inhalation exposure of children was evaluated using the predicted maximum annual average ground level concentration of airborne lead (0.00022 $\mu g/m^3$) (RRRC, 1993) and the USEPA Lead Uptake/Biokinetic computer model. At 0.00022 $\mu g/m^3$, this model predicts that there will be no uptake of lead from air for children.

The maximum 24-hour average ground level concentration of mercury of 0.021 $\mu g/m^3$ is 48 times less than the NESHAP of 1 $\mu g/m^3$ for mercury (30-day average). This concentration does not take into account the ongoing reduction of mercury in household batteries, the removal of batteries in fuel preparation, and the reduction in mercury emissions that will result from the activated carbon injection control system. Activated carbon injection is capable of reducing mercury emissions by 83 to 97%. If this pollution control measure is taken into account, the resulting maximum 24-hour average ground level concentration of mercury would be 0.0021 $\mu g/m^3$ instead of 0.021 $\mu g/m^3$. The concentration of 0.0021 $\mu g/m^3$ is 476 times less than the NESHAP of 1 $\mu g/m^3$ for mercury (30-day average). Also, this concentration is 143 times less than the USEPA subchronic and chronic inhalation reference concentration for inorganic mercury (0.3 $\mu g/m^3$, human study, neurotoxicity).

There is no TLV for chlorinated phenol. However, pentachlorophenol (PCP) is likely to be more toxic than chlorophenol. The TLV for PCP is several orders of magnitude greater than the maximum 8-hour ground level concentration of chlorinated phenols shown in Table 3.

Based on standard air emission modeling techniques and risk assessment of the inhalation route, it can be concluded that no immediate or delayed health effects of any type, including cancer, will be generated by the RRRC WTE facility over the expected 45 years of operation.

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