Energy from Waste Facility in the Region of Durham

Prepared for:
The Medical Officer of Health
Durham Region

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Executive Summary

This work was undertaken at the request of the Medical Officer of Health of Durham Region. Durham Region is currently undergoing a process of choosing a site for an energy-from-waste (EFW) facility within its boundaries. As part of the process of public consultation before the selection of a contractor and a specific technology, a generic risk assessment was carried out for the Region by Jacques Whitford\(^2\). In the course of public consultation, a number of issues arose regarding the integrity of the generic risk assessment which is of a "model" hypothetical facility. The issue of health effects from EFW facilities, formerly called "incinerators", also came under scrutiny from the review of a report of an assessment of health effects of incineration provided to a nearby jurisdiction (Halton Region). The process and conclusions of the health effects assessment including the assessment of the literature on incineration and health became issues of concern.

The Regional Municipality of Durham had undergone a process of selection which indicated that EFW as their preferred residual waste management option – that is after recycling and composting are optimized. The Region is now undertaking consultation in preparation for the selection of a provider and a technology for the chosen method to handle residual waste.

The Health Department will contribute important information to Council about the public health impacts of the introduction of such a facility into the Region. In order to evaluate current information and gather new information, the Medical Officer of Health requested an assessment of the literature of incineration-related health effects and of the reports from a neighboring health department which generated considerable public concern.

Four objectives are the focus of this report as outlined in correspondence with the Durham Region Medical Officer of Health:

A. Provide advice on Section 4a & b (pages 12-15) of the Halton 4A Report (the health assessment, literature search and conclusions arising)
   1. What do environmental epidemiology studies of incinerators generally have to say and the pitfalls inherent in these types of studies?

B. Soundness of the Durham generic risk assessment report
   1. Is there any missing information that needs to be reviewed that may have bearing on either the generic or site specific Human Health Risk Assessment (HHRA) that will be conducted? (Bioaccumulation of dioxins and furans, etc; greenhouse gas emissions, regulatory air quality guidelines / standards, ultra fine particles, etc.)

C. An independent comment on risk assessment in general and to what extent does the draft generic HHRA conform to the basic tenets of risk assessment.

D. What are best practices for establishing an environmental monitoring program?

This report addresses these questions in sequence.

*The Halton Report Step 4A - Chapter 5 Health Concerns Related to EFW Systems* ("Halton 4A") examines the peer reviewed epidemiologic literature and grey literature relating incineration and health effects. The authors considered original research, research reviews and governmental reports. The Halton 4A report identifies chemicals of concern. With respect to health effects in communities around incinerators, the Halton 4A authors conclude that there are potential health concerns with incineration but the literature they cited generally involves old incinerators which have higher emissions than retrofitted or new incinerators. The Halton 4a Report agrees with the conclusions of the DEFRA 2004 (governmental) Report and with the conclusions of other review publications that state that EFW facilities using currently available modern (thermal) methods and pollution control technology are not expected to pose a significant risk to the public. In addition, the Halton 4A Report states that any new facility should be subject to a site specific risk assessment to identify local issues and ensure that it will not pose a risk to the public.

This author (Dr. Smith) reviewed the current epidemiologic literature on incineration and health of communities around them. A number of new research publications were added to the body of literature considered in the Halton 4A Report. Some 17 publications were

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assessed for validity in developing an opinion about incineration and health effects, including several studies that had not been considered in the Halton 4A report.

This author concludes that the current epidemiologic literature on health effects of incinerators on local communities (2000-2007) is inconclusive and does not demonstrate one way or another that modern incinerators have associated health effects on the people living around them.

Some important new information provided greater insight into the assessment of health impacts of the new generation of incinerators. The direct testing for contaminants (biomonitoring) of people living around modern or upgraded incinerators provides a reasonably good baseline estimate of contaminant load. Such testing does not demonstrate an increased load of key contaminants emitted from incinerators. The literature does not provide any insight into the proportion of the contaminant load in people that is attributable to emissions from current modern technology incinerators.

On the whole, the incinerator-generated contaminant load as measured in blood of residents living near-by is similar to the same contaminant load in other populations. Two possible explanations are considered: 1) emissions from incinerators are considered very small for dioxins, furans, and heavy metals; and 2) sources other than incinerators generally provide a higher proportion of the total burden of exposure for these contaminants than incinerators.

The “incinerator literature” alone cannot be used to support or dismiss possible health effects from the measured load of some of the contaminants in people living around incinerators.

There are inherent pitfalls in the epidemiologic method applied to environmental settings especially because it is necessarily observational, that is, exposures are not under the control of the researcher, so that most studies have proxy or indirect measures of exposure. If a single well conducted environmental epidemiology study finds an association, this does not necessarily invoke a causal relationship between an exposure and a health effect.

Making causal links with epidemiology as the tool requires many studies examining a relationship from different perspectives. It is not the number of studies that counts, but rather the methodology and how well they are conducted, what information can be derived from them with relative certainty, and what the weight is of all of the evidence for all studies together. A systematic review of the literature provides a summary of all of the evidence. The net results of a systematic review must then be viewed with yet another lens, - application of criteria that consider consistency of associations that make sense. There are various sets of criteria used for that process, but the most commonly used for inferring causality in occupational and environmental settings are the criteria of
Bradford Hill\textsuperscript{4,5} elaborated in Section 6. In summary, the epidemiologic method is limited in that it can only indicate statistical associations between an exposure and an outcome and not a causal relationship. Causality can be inferred after careful systematic analysis of all studies and applying appropriate criteria.

The generic risk assessment for the Durham EFW facility carried out by Jacques Whitford Ltd., used accepted standard methodologies, standard air dispersion and deposition models of incinerator emissions, and calculations of risk measured against current regulatory emissions standards in Ontario or health benchmarks from the literature. The study infers acceptability of risk if the net results are at or below the benchmark regulatory risk of 1 in a million for cancer, and a hazard quotient under one for non cancer health effects. However, the exposure assumptions made were extreme, and provided a conservative estimate of risks, that is, highly protective of health. As one example, the community exposure to dioxins and furans is assumed to occur for the lifetime of the person living in the area and at the concentrations in the environment at the level theoretically attained after 35 years of facility operations. The report makes assumptions of susceptibility by using the health benchmarks applicable to the most vulnerable in the community in the different scenarios. The generic risk assessment did not make calculations of risk during upset conditions. Modern incinerators are unlikely to experience these so called upset events because the system is shut off if there is a malfunction. Hence, this scenario was not considered relevant. In addition, exposures during upset conditions would tend to be very short term whereas the regulations frame risks on long term exposure to carcinogens and non-carcinogens.

The generic risk assessment of the model community is limited, as are all risk assessments, in that it did not make calculations for complex mixture exposures, unless such mixtures are already regulated as such (i.e., PAHs, dioxins and furans). It did not consider particulate exposure unless the particulate is characterized and regulated (i.e., PM\textsubscript{10} and PM \textsubscript{2.5}). Hence the issue of "nanoparticles" exposure was not and could not be addressed as a regulated toxic exposure; there are no specific risk assessment techniques or sufficient toxicological information available currently to do so. Therefore this is not a failing of the risk assessment methods used or of this report per se.\textsuperscript{6,7} The report does not address upset conditions and any future risk assessment should do so if such scenario applies to the technology and operations used.

\textsuperscript{4} Hill AB. (1965). The environment and disease: association or causation? Proceedings of the Royal Society of Medicine, 58, 295-300.
\textsuperscript{5} The Bradford Hill criteria include strength and direction of an association, dose response, temporal sequence, consistency, theoretical plausibility, biologic coherence, specificity of effect, analogy and experiment.
\textsuperscript{6} Grahame T, Schlesinger RB. Health Effects of Airborne Particulate Matter: Do we know enough to consider regulating specific particle types or sources? Inhalation Toxicology 2007;19(6):457-481.
In summary, the generic risk assessment is properly carried out. The methods used were clearly explained and therefore, the entire exercise can be duplicated by other investigators. As expected, it erred on the side of health protection or “conservatism” despite its failure to assess upset conditions, a scenario which should be applied to any site specific risk assessment of EFW facility chosen for Durham Region in the future, if situations with upset conditions are relevant.

The risk assessment process can calculate health risk during regular and upset conditions, considers pathways of exposure so that interventions can occur, and can put boundaries on actions that lessen exposures to residents around the facility. The methods for conducting a human health risk assessment are reproducible and subject to quantitative checks. With respect to the risk assessment process per se, it is the only procedure that can produce quantitative estimates of predicted health effects.

Epidemiology is a complimentary method to risk assessment in managing environmental risks. Greater precision can be achieved in calculating exposure from environmental contaminants and health effects by using the risk assessment methodology coupled by information from epidemiology, and from direct measurement of exposures (biomonitoring). Biomonitoring is very useful in measuring total exposure (from all sources) and in relating these measures of exposure to health conditions in well executed and controlled epidemiological studies. Epidemiology, risk assessment and biological monitoring methods assist regulatory bodies, support public health activities, and bring a greater understanding of the interaction of humans with their environment. Because each method can have limits and challenges, a combination best serves public health. Health studies in communities have a role, but these studies should be considered carefully before undertaking them.

Environmental quality oversight (surveillance) is the systematic testing and reporting to regulatory bodies and to the community of emissions, upset conditions, environmental concentrations, trends, and regulatory compliance and mitigation. Environmental surveillance can also be complemented by population surveillance which is the systematic collection and evaluation of population health data, including biological measures (biomonitoring). Such surveillance programs have been instituted in Ontario in communities with other types of facilities such as nuclear energy installations or in those facilities whose emissions are of particular community concern (e.g., lead smelters). Community concerns can often be addressed by the industry outside of the regulatory framework. Environmental quality oversight and health surveillance activities constitute engagement of communities with public health agencies (health, environment) and the industry and may be considered part of a responsible program for environmental quality assurance. These surveillance activities can also be coupled with timely responses to community concerns and regular discourse throughout the life of a facility to create a climate of alertness and trust for all parties that can improve facility operations and general well being.