Municipal Solid Waste Incineration: Observations on the IEEP Report for the National Society For Clean Air

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Background

In May 2001 the UK National Society for Clean Air published a report entitled "Municipal Solid Waste Incineration: Health Effects, Regulation and Public Communication". The central thesis of this report, written by Andrew Farmer and Peter Hjerp of the Institute for European Environmental Policy (IEEP) has been widely quoted. The authors assert that environmental releases from a modern incinerator are a fraction of those occurring ten years ago. The corollary promoted by the authors, that in consequence relative health impacts consequent from releases from municipal solid waste incinerators are exceedingly low, has also attained a wide currency. This is despite the authors concluding that "…..we cannot discount effects resulting from the small quantities of pollutants emitted by MSW incinerators….". The primary purpose of this report seems to be to allay human health concerns of community residents associated with incinerator operation.

The conclusions (in both cases) are open to considerable question, the subject of this current critique. This argues that the shortcomings and omissions from the IEEP (2001) report render it unusable as a basis for defining a waste management strategy either in whole or in part. In fact, any local authority using the report in this way, on the basis that the IEEP (2001) conclusions are supportable, will find that their position can be immediately undermined by information already published and freely available in the academic literature. It follows that, shouldany future (medium to long term) liabilities be accrued as a result of relying on the IEEP report, it will be impossible to put forward a plausible defense against them. Such liabilities could be substantial.

The significance of any reliance upon the IEEP (2001) conclusions relating to MSW incineration is considerable in the light of the current situation. Local authorities in the UK, faced with a considerable waste management crisis following many years of failing to develop an integrated, sustainable waste management strategy, are looking to MSW incineration as a means of reducing dependence upon landfill. Quite apart from direct environmental considerations arising from the use of incineration technology, there are potential secondary impacts of some considerable importance. The impacts of incineration as a "technology lock in" upon higher elements in a waste management hierarchy are likely to be profound. The burning of compostable waste, of plastics which could be recycled *via* a feedstock route, and of recyclable paper and card is likely seriously to prejudice the recycling of these elements. In addition, the recyclability of other elements of the waste such as steel cans is likely to be compromised. Taken together, the recycling impacts and impacts upon the environment are sound reasons to question thoroughly any waste management strategy based upon incineration as a central technology.

It is of significance that, when confronted by the misgivings and criticisms of a number of parties, the authors of the report have declined to defend their work either verbally or in writing. The reasons given by the NSCA (Brown *pers. comm.)* are trivial. In the main it appears that the authors consider criticisms made to date to constitute a personal attack upon them. For researchers to decline to defend their work in a public debate is highly unusual and inevitably must raise the possibility that they lack the depth of expertise required to enter fully into this debate. An alternative view, of course, is that the authors actually do recognise that their report is in fact deeply flawed and in consequence, indefensible.

The IEEP Report in Context

The IEEP (2001) report is one of at least three recent reports and papers which have set out to examine the impact of MSW incineration upon human health and the environment. It stands alone from the other material published in the literature in largely dismissing potential human health and environmental impacts. It also stands out, however, as a result of its apparently superficial appreciation of the literature base which underpins the overall subject area. The concluding views contrast with many of the conclusions of the wide ranging review conducted recently by the US National Research Council Committee on Health Effects of Incineration (NRC 2000). It contrasts also with the conclusions reached in a review conducted on behalf of Greenpeace International (Allsopp *et al.* 2001) and with the broad conclusions articulated in a review published in the Journal of The Air and Waste Management Association (Hu & Shy , 2001).

The underlying reasons for this divergence of view between the IEEP study and the other studies mentioned probably have their origins in a number of factors. In any such review exercise, the quality and authority of the source materials is of paramount importance. The IEEP report cites 34 sources (some wrongly, many from the "grey" literature) in the bibliography. Hu & Shy (2001) cite 28 sources in their short but highly focussed 10-page review based on a literature search. Allsopp *et al.* 2001 cite over three hundred literature resources while The NRC (2000) bibliography makes over six hundred citations. On this basis alone, it is clear that the IEEP report has not reviewed the subject area holistically, but has drawn on a very limited base of the information resources actually available. Accordingly, oversight of the subject area by IEEP (2001) can be best regarded as extremely superficial.

Of what could be regarded as key recent publications, the IEEP (2001) report understandably does not cite Hu & Shy (2001) since their report preceded the publication of this paper by some two months. Less understandably, IEEP (2001) fail entirely to reference the NRC (2000) report. The NRC report preceded the IEEP report by some months. As probably the most extensive review carried out in this subject area to date, omission of this source reference is entirely mystifying. The NRC (2001) review (in common with other reports produced by this body) has been produced by an authoritative committee and has been subjected to extensive peer review.

Allsopp *et al.* (2001) is cited by IEEP (2001). The citation, however, is misrepresentative of the overall content, and implies that the report was only cursorily considered.. This view is strengthened by the fact that Allsopp *et al.* (2001) refer to the NRC (2000) report and clearly identify it as a work of some importance. This would have been obvious to anyone who had thoroughly read the Greenpeace Report. Indeed anyone truly familiar with this subject domain would have identified the NRC (2000) report as a key contribution to the knowledge base via a thorough search of the literature and included it in their consideration of the subject. The fact that IEEP (2001) appear not to have been aware of this suggests that their approach was less than thorough.

In a general context, therefore, the IEEP report can be considered as the weakest of the recent publications on incineration and environmental issues based upon its failure to consider the most recent other publications in the field. This failure, coupled with questionable data abstracted from other reference sources, particularly on the mass balance of dioxins and other toxic chemicals has led to one extremely important consequence: In considering the potential health consequences of incinerators to be negligible, the IEEP is effectively equating absence of evidence of impact with evidence of absence of such impact. This is naïve at best, while at worst it could be construed as fundamentally dishonest in scientific terms. In fact this thematic pervades the report. Not only does it adopt this view in relation to the health impacts but also in relation to likely releases from incineration plant. In short it chooses effectively to interpret the largely non-existent empirical data set on releases from new plant as positive evidence that these are not a problem. This choice once made clear, in addition to being scientifically poor, effectively undermines the whole of the rest of the report.

The IEEP (2001) report, moreover, is grounded generally in risk assessment, without appearing to appreciate the many drawbacks associated with such methodologies (see: Santillo *et al.*2001). Broadly, risk assessments depend upon identifying releases of significance, assessing exposure of the general population/ecosystem and specific subgroups thereof and then using these data to assess the risk of a negative environmental or health impact. If the data used in any of the steps are inadequate, then inevitably the risk assessment is flawed. This includes the wider consideration of the full universe of chemicals released. Moreover, it is commonly impossible to evaluate the validity of the many assumptions regarding *e.g.* chemicals and pathways of concern, exposure and effect concentrations, which are an inevitable part of the conduct of risk assessments. The uncertainties and degree of ignorance which pervade such judgements are central to any understanding and critical appraisal of the assessment conclusions. While the IEEP report acknowledges the existence of uncertainties, the authors fail to appreciate the significance of these in influencing their conclusions.

IEEP (2001) justify an emphasis on the chlorinated dioxins released by incinerators on the basis that Allsopp *et al.* (2001) among others specify this group of chemicals as comprising the main health risk. While it is true that these compounds are important, a premise confirmed by the NRC (2000) report, this

attribution is a clear misrepresentation of the content of the Greenpeace Report. While the dioxins are undoubtedly the best researched of the chemicals released from incinerators, they are not the only ones of significance. In fact Allsopp *et al.* (2001) consider a wide range of metals and organic chemicals to be of potential significance and discuss them in some detail..

The IEEP (2001) report under Section 5.7.2 also contains a number of clear misconceptions and omissions concerning the dioxins and dioxin-like PCBs and the use of TEFs. The most obvious is that while the IEEP consider that the WHO 1998 TEF scheme includes 34 congeners, (unreferenced) the widely cited source reference for this only lists 29. (van den Berg *et al.*1998, see also: Stringer & Johnston 2001). The IEEP source cannot be checked since it is not given but the number 34 appears to be a mistake which, although apparently trivial, speaks volumes about the authors understanding and expertise in this research domain. It is unclear at the time of writing whether similar errors pervade the rest of the body of the report.

Another example of poor understanding of the TEQ issue is furnished by the IEEP (2001) statement that while PCBs are not included in the EU 2000 Directive on Incineration, their TEFs are generally low. The clear implication is that the authors consider that compounds are not of importance toxicologically in relation to incinerator releases. This ignores that fact that PCBs are a significant contributor to overall dioxin and dioxin-like compounds in the general population due to their potentially and actual high concentrations. Moreover, there are no data on quantities of PCBs emitted from the burning of MSW tendered in support of the IEEP view. Finally, the EC & DETR (1999) report cited has been superseded by three more recent EC reports of which the authors should have been aware (EC 2000 a, b& c). While these generally support the assertion that exposure to dioxins and dioxin like PCBs has fallen in some countries, the quoted average trend is far from universal and disguises considerable variation. Moreover, recent reports suggest that the decline may not be continuing in *e.g* Germany and Spain (see: Buchert *et al.*2001) based on ongoing monitoring work. In relation to references in the IEEP (2001) report more generally, a number are cited incorrectly or are untraceable from the information given. This is another telling illustration of lack of attention to detail on the part of the authors.

The overall effect of the IEEP (2001) report's self proclaimed emphasis upon the chlorinated dioxins is to draw attention away from the less well researched toxic materials released from incinerators and thus to subtly unbalance the whole content of the report. This approach also has consequences for the risk assessment process espoused by the authors. Risk assessments for dioxins are generally conducted on a single chemical basis and this inevitably fails to allow for the fact that these chemicals are emitted as mixtures with other chemicals. This is a potentially fatal confounder of the risk assessment process in theoretical terms. No practical means exists of resolving this confounding factor. The failings are illustrated under section 5.9 of IEEP (2001) where the epidemiological studies deemed most relevant considered only dioxins as potential causal agents. The approach taken by the IEEP authors is therefore akin to erecting a straw man. Emphasis upon dioxins as the most significant chemical release , justified by misquoting Allsopp *et al.* (2001) is followed by a consideration of epidemiological studies which fail to draw correlations between dioxin emissions and reported health impacts around incinerators.

Overall, the approach taken by the IEEP is to present data on emissions from incinerators derived on the basis of emission factors. It is important to recognise that these are theoretical, not empirical data. The data are based upon a key assumption that incineration plants will operate within the regulatory limit values, and that emissions per tonne of waste combusted will be consistent across the whole industrial sector. Firstly, there is no basis for the assertion that even the new generation of plant will operate consistently within these limits. Secondly, it is known that releases can vary widely even between installations operating ostensibly under the same conditions. Moreover, substantial numbers of breaches have been identified with currently operating UK incinerators through inspection of the relevant public registers maintained by the Environment Agency for England and Wales (Greenpeace 2001). In addition, the work of de Fré & Wevers (1998) (name spelt wrongly in the IEEP 2001 report text and reference list, together with that of Costner, P.) suggests that the results of dioxin monitoring on a semi-continuous basis give substantially higher values than monitoring conducted on a point basis. Despite being aware of this work, the authors of the IEEP Report fail to accord it any real significance in their analysis and fail to consider the potential impacts upon the release scenarios that they reproduce from other (largely "grey") literature sources.

Admittedly (IEEP 2001) recognise that the release figures that they present are subject to considerable uncertainty, but maintain that the trend data are actually reliable. It is difficult to see how this can be supported in the absence of any empirical data, but nonetheless these estimates are used, in turn, to support the assertion that incinerators are now relatively minor contributors to national and Europe-wide atmospheric releases. The releases to ashes and waters are not considered in detail. In general, however, the emission factor approach will tend to underestimate releases of most chemicals; Allsopp *et al.* (2001) cite research which demonstrates this.

In relation, therefore, to the IEEP (2001) report:

- Overall, it displays a poor appreciation of the importance of the concepts of precaution and sustainability in the formulation of environmental policy, as noted earlier in the text.

- It assumes that new incineration plant releases will be very much lower than old plant, but presents no empirical data in support of this assertion.

- It fails to recognise that many chemicals released by incineration operations are poorly characterised with many remaining unidentified. If a substance is not identified, then its toxicological properties cannot be determined.

- It bases exposure assessment upon the emission factor approach which is known to underestimate releases of chemicals of concern.

- It endorses the application of these theoretically derived estimates in a number a risk assessments reported in the "grey literature"

- It displays an extremely superficial knowledge of the relevant scientific literature.

- The report is poorly and inaccurately referenced, drawing in parts on out of date literature.

- There appear to be numerous errors of fact which indicate a lack of understanding by the authors of the subject area.

- The report does not appear to consider scientific uncertainty and ignorance as legitimate and important factors in environmental decision making.

- The concept of sustainability is largely ignored in the report, despite high relevance to ash disposal amongst other issues.

Taken together, these points go a long way to explaining the difference in the broad conclusions reached by the IEEP (2001) report as compared to the other recent reviews which have been published. Overall, on the basis of this limited reporting of the deficiencies of the report, it would be unwise to consider it either accurate or authoritative or as a basis for the formulation of waste management strategy.

The Other Viewpoints Compared.

a) Allsopp *et al.* (2001)

The report produced for Greenpeace (Allsopp *et al.* 2001) was based initially on an extensive search of the academic literature. As far as could be ascertained, at the conclusion of the search phase, all academic papers of direct relevance to the topic had been identified and obtained. Subsequently. two further papers were published addressing aspects of the incineration/health/environment debate. Hu & Shy (2001) produced a focussed review of epidemiological studies, while Staessen *et al.* (2001) reported on a study of

biomarkers in subject population living in the vicinity of a lead smelter and two incinerators. In addition to the overview of the various studies, concerning health impacts upon workers and the general population, information was provided upon the known substances groups of substances of concern. In relation to the health studies, the detailed findings can be found in the Summary Table in the Executive Summary, as well as in the main body of the report.

The broad conclusions which can be reached from the Allsopp *et al.*(2001) report are as follows:

- The number of studies specifically directed at evaluating human health impacts of incinerators are very few in number relative to the large number of installations in operation and planned for future development.

- Epidemiological studies carried out to date have not been able unequivocally to resolve causality, and have suffered from various confounding factors.

- Findings in different studies have been inconsistent

- Nonetheless, where such studies have been carried out, they provide highly suggestive evidence of negative impact upon human health such that extensive follow up studies are warranted.

- Most studies reported impacts resulting from exposures from older generation plant. Few data are available for new generation installations.

- At the same time, few data exist in the literature to support the assertion that new installations operate to higher standards than old.

Accordingly, on the basis of a precautionary approach in the face of the numerous uncertainties and indeterminacies which exist Allsopp *et al.* (2001) recommended a moratorium on the construction of new incineration plant and the formulation of a waste management strategy based upon the axiomatic principles of reduce, re-use and recycle. It was pointed out that such an approach would also accord with principles of sustainability.

b) Hu and Shy (2001)

This review of health impacts of waste incineration was published in July 2001 and as such would not have been captured by any of the other studies on this subject referred to. The review appears, like that of Allsopp *et al.* (2001), to be based upon an extensive interrogation of literature databases, albeit with a specific focus on epidemiological evidence. In this case Medline was used. The information obtained was broadly comparable to that found by Allsopp *et al.* (2001), although two studies not recovered by these authors were reported. One of these (Schecter *et al* 1995) was also not reported in IEEP (2001) despite being one of the very few studies which suggest that worker exposure to chlorinated dioxins in modern incinerator plant may be lower due to improved ash and slag handling procedures. Equally, the Hu and Shy (2001) review did not consider several papers included by Allsopp *et al.* (2001). Such inconsistencies in data retrieval are not unusual, but it must be noted that, in comparison, the IEEP (2001) provides little evidence of a systematic literature search prior to writing of the report.

The review by Hu and Shy (2001) overall emphasises the considerable uncertainties and limitations in the epidemiological studies reported to date. Risk assessments and case studies were not included. It noted that there were inconsistencies between the findings of the various studies of community residents with results for reproductive effects conflicting. Three studies reviewed reported significant positive correlations with lung cancer incidence and deaths, or laryngeal cancer mortality. Two studies, however, found no such correlation. Incinerator worker studies, on the other hand, showed consistently perturbed urinary and blood biomarkers. Study of cancer risks also showed inconsistencies similar to the community studies between reports.

The review noted the difficulty of evaluation and comparison of inconsistencies between these studies which can be summarised as follows:

- Different exposure pathways for incinerator workers and exposed community residents.
- The studies investigated different types of incinerator or similar types burning different wastes leading to inconsistent release and, hence, exposure profiles.
- Community resident exposures were largely evaluated using an approach which precluded determination of individual, as opposed to broad community, exposure.
- Occupational exposures were generally assessed by job description rather than empirical chemical determination
- Occupational exposures are likely to vary from plant to plant.
- Different end-points were evaluated in various of the different studies and exposure levels were not well defined.

Far from considering these inconsistencies as a justification for complacency, Hu and Shy (2001) conclude as follows.

"There is an increasing trend toward using incineration to manage waste; therefore, more people will be at risk of exposure to incinerator emissions. It is important to investigate the health effects of waste incinerators currently in operation. More descriptive studies, which use existing disease registration data, can be conducted to compare the incidence of cancers, cardiovascular diseases, reproductive outcomes and hospital visits of respiratory diseases in areas with and without an incinerator and also for communities before and after construction of an incinerator. "

The review goes on to call for more in depth evaluation of many of the pollutants emitted from incinerators such as the dioxins, mercury and cadmium, pointing out that the health effects of such emissions have not been extensively investigated. The report concludes that:

"….more hypothesis-testing epidemiologic studies, such as case control studies and cohort studies, are needed to assess the associations between waste incineration and the risk of cancers, cardiovascular diseases, respiratory health and reproductive outcomes among incinerator workers and community residents."

The above interpretation of the existing research data is more in line with Allsopp *et al.* (2001) than with the thinking of IEEP (2001) insofar as it recognises that uncertainty and ignorance should spark further investigation rather than less. Certainly, the review makes no statements to the effect that incineration operations will not cause impacts upon human health. On the contrary, the lack of information in this subject area is highlighted as a specific concern to be addressed.

c) NRC (2000)

As noted above, this particular report was produced by a specialist committee (including C.M.Shy who produced the review above) under the auspices of the United States National Research Council. Although referred to by Allsopp *et al*. (2001), it was not considered by IEEP (2001). As possibly the most extensive and relevant review of the incineration/human health issue to date, it is scarcely creditable that the authors failed to consider it. Consideration of the conclusions reached by the expert committee concerned would have made it unlikely that the IEEP (2001) report would have drawn the conclusions that it did.

The NRC (2000) report, which can be read without subscription or other charges on the NRC website at URL: http://www.nap.edu/catalog/5803.html, contains a number of important conclusions which run

counter to the broad conclusions reached by the IEEP (2001) and confirm the generally incomplete and superficial nature of this latter report. The NRC considered both old (existing) plant and installations designed to operate under Maximum Achievable Control Technology (MACT) *i.e* new incineration plant. The following text considers the US report in comparison with the IEEP (2001) document, drawing on those conclusions considered to be of greatest significance.

Recommendations begin in the Executive Summary of the report where governments and government agencies are enjoined *inter alia* to begin research operations to characterise optimal operating parameters relative to emissions and ash quality. The emissions during start-up, shut-down and upset conditions, when the greatest emissions are expected to occur, are considered particularly important given that NRC (2000) note that emissions are generally measured under steady state conditions. The fact that the NRC (2000) regard this area as requiring research (and hence an area where data are lacking) significantly undermines the credibility of the simplistic IEEP acceptance of incinerator outputs based upon regulatory limits, and hence undermines the whole report.

This is the first of many points made by the NRC (2000) report which throw into question the central assumptions made in the IEEP (2001) document. The NRC further consider that future environmental assessment and management strategies for individual incineration facilities should include a regional-scale framework for assessing chemical dispersion, persistence and potential long-term impacts upon human health. Better material balance information is also required, suggests the NRC. This contrasts with the diametrically opposed IEEP view that only dioxins are of potential importance and that even in these cases the smaller amount will be lost in the greater (Section 5.10). The IEEP presumably considers that material balance data is satisfactorily addressed by the dubious emission factor figures presented in Section 5.

The Executive Summary of the NRC (2000) report also suggests that combined site epidemiologic assessments should be conducted as well as a strengthening of the regulatory regime designed to protect workers, with a particular emphasis on lead, mercury, dioxins and furans. Significantly, the Committee concluded that while compliance with MACT regulations could be expected to improve the exposure profile for local community residents, paradoxically, substantial concerns which exist regarding regional dioxin and furan exposures might not be allayed. This is due to the regulations (*i.e.* new incineration emission standards) not being far reaching enough to address the impact of cumulative emissions on a regional basis. This then further undermines the IEEP (2001) report which considers that, since general population exposure is predominantly through food, inhalation exposures are not likely to contribute much. The simple fact that such chemical releases can enter the food chain and are therefore potentially significant on a regional basis, while recognised in the NRC (2000) and Allsopp *et al.* (2001) report, appears to have eluded the IEEP (2001) authors entirely.

Finally, the NRC (2001) report addresses the need for developing an information base on the socio-economic aspects on the basis of geographical areas likely to be impacted rather than simple jurisdictional boundaries. These considerations are central to a second report produced by the NSCA on the public acceptability of incineration. (NSCA 2001a). The author(s) of this report also appear to be unaware of the NRC (2000) document. Curiously this report bears the same (supposedly unique) ISBN number as the IEEP (2001) report and another report (NSCA 2001b) although both are obviously different documents. This seems to be evidence of further inattention to detail on the part of the publishers.

On the basis of the Executive Summary of the NRC (2000) report, the following points emerge which undermine and wholly discredit the IEEP (2001) report:

- The NRC identifies a need for research of incinerator emissions under off-normal operational circumstances. The IEEP report does not consider this aspect as significant..

- The NRC regards lead, mercury, dioxins and furans as requiring research emphasis

- The NRC recognises the significance of regional impacts of incinerator releases from multiple facilities while the IEEP does not consider this as significant

The IEEP partly developed position that individual incinerators pose little in the way of a health hazard receives scant support in the NRC (2000) document which states (Page 179):

"On the basis of available data a well designed and properly operated incineration facility emits relatively small amounts of these pollutants, contributes little to ambient concentrations and so is not expected to pose a substantial health risk. However such assessments of risks under normal conditions may inadequately characterize the risks or lack of risks because of gaps in and limitations of existing data or techniques used to assess risk, the collective effects of multiple facilities not considered in plant- by -plant risk assessments, potential synergisms in the combined effects of the chemicals to which people are exposed, the possible effect of small increments in exposure on unusually susceptible people, and the potential effects of short-term emission increases due to off-normal operations."

Not one of the qualifiers outlined in the conclusion above is considered in the IEEP (2001) report.

On page 180 the NRC document states:

"The Committee's evaluation was performed based only on emissions under normal operating conditions. Data are not available for levels during off-normal conditions, or the frequency of such conditions. Such information is needed to address whether emissions resulting from off-normal conditions are a concern with respect to possible health effects."

And also on page 180:

"The committee's evaluation of waste incineration and public health has been substantially impaired by the lack of an adequate compilation of the associated ambient concentrations resulting from incinerator emissions. The evaluation was also impaired by the inadequate understanding of the overall contribution of incinerators to pollutants in the total environment and large variables and uncertainties associated with risk-assessment predictions, which in some cases, limit the ability to define risks posed by incinerators."

This paragraph is in stark contrast to the assured comments of the IEEP (2001) on this area of the subject which promote the view that emission factor estimates are sufficiently accurate and that the trend data which they present has considerable evaluative utility.

The NRC Report also conflicts with the IEEP (2001) conclusion that results from epidemiological studies show little or no evidence for health effects for MSW incinerators operating to new (comparable to MACT) standards. Laying aside the observation that no such studies addressing "new" plant have been carried out and that there are therefore no data to support this view, the NRC (2000) evaluation notes (Page 179):

"Epidemiologic studies assessing whether adverse effects actually occurred at individual incinerators have been few and were mostly unable to detect any effects. That result is not surprising, given the small populations available to study; the presence of effect modifiers and potentially confounding factors (such as other exposures and risks in the same communities); the long periods that might be necessary for health effects to be manifested; and the low concentrations (and small increments in background concentrations) of the pollutants of concern. Although such results could mean that adverse health effects are not present, they could also mean that the effects may not be detectable using feasible methods and available data sources."

In other words, the findings from epidemiological studies should not be construed as evidence of absence of impact which as noted earlier, is precisely what IEEP (2001) have done.

Moreover, although the NRC (2000) accept that MACT requirements will have substantially lower emissions and that potential exposures to community residents will be lower as a result leading to lower risks from local impacts of releases under normal operational circumstances, they point out (Page 181):

"It is unlikely whether implementation of MACT will substantially reduce the risks at the regional level posed by persistent environmental pollutants dioxin, lead and mercury."

Further:

"MACT was not designed to protect workers and MACT regulations are unlikely to reduce worker exposures."

These points are illustrated by the information contained in Table 5-8 on Page 166 of the NRC (2000) report. This indicates that even after MACT compliance, in the view of the evaluating committee, although the impacts of emissions of single facilities upon a local population fall largely to minimal levels from substantial or moderate levels of concern, they do not fall to negligible levels except in the case of acidic gases. By contrast, the concern elicited by multiple facilities on broader populations remains substantial in the case of dioxin emissions while for lead, mercury and other metals, concerns only fall to moderate levels. The multiple installation/ broader population impacts are completely omitted by the IEEP (2001) report.

Taken together, the NRC statements describe rather different impact scenarios and sets of uncertainties to the rather optimistic, simplistic IEEP (2001) report.

Conclusions

The IEEP (2001) report must be considered as deeply flawed. As well as containing some factual errors it is based upon a limited information base and has failed to consider key reference and review works on the subject of incineration and human health. It contains a number of contradictory elements and has signally failed to take into account the potential impact of multiple facilities on regional populations as opposd to local community residents.

The approach adopted by the IEEP (2001) is essentially a risk assessment based approach. Unfortunately, the authors of the report have failed to appreciate the significant limitations to the quality of the data used to estimate exposure, and have failed in turn, to recognise that this inevitably fatally compromises the validity of their risk judgements. Their conclusion that incinerators operating to modern standards exert no health impacts remains unsubstantiated and unproven.

In promoting this report, the National Society For Clean Air is acting in a highly irresponsible manner. This report is superficial and ill-informed to the point that decisions made on the basis of its content will represent high risk decisions which may attract substantial long term liabilities.

Accordingly, the NSCA should issue a statement in the form of *corrigenda* or, as a more responsible course of action, withdraw the report from circulation immediately.

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