PUBLIC HEARING

before

ASSEMBLY WASTE MANAGEMENT, PLANNING AND RECYCLING COMMITTEE

"The management of residual ash from the combustion of solid waste at resource recovery facilities"

March 22, 1990
Room 373
State House Annex
Trenton, New Jersey

MEMBERS OF COMMITTEE PRESENT:

Assemblyman Harry A. McEnroe, Chairman
Assemblyman Thomas J. Duch
Assemblyman Robert D. Franks
Assemblyman Robert C. Shinn

ALSO PRESENT:

Algis P. Matioska
Office of Legislative Services
Aide, Assembly Waste Management, Planning
and Recycling Committee

Leonard J. Colner
Office of Legislative Services
Aide, Assembly Waste Management, Planning
and Recycling Committee

* * * * * *

Hearing Recorded and Transcribed by
Office of Legislative Services
Public Information Office
Hearing Unit
State House Annex
CN 068
Trenton, New Jersey 08625

HARRY A. McENROE
CHAIRMAN
DANIEL P. JACOBSON
VICE-CHAIRMAN
THOMAS J. DUCH
ROBERT D. FRANKS
ROBERT C. SHINN, JR.

New Jersey State Legislature
ASSEMBLY WASTE MANAGEMENT,
PLANNING AND RECYCLING COMMITTEE
STATE HOUSE ANNEX, CN-068
TRENTON, NEW JERSEY 08625-0068
(609) 292-7676

NOTICE OF A PUBLIC HEARING

The Assembly Waste Management, Planning and Recycling Committee will hold a public hearing on:

The Management of Residual Ash from
the Combustion of Solid Waste at Resource Recovery Facilities

The hearing will be held on *Thursday, March 22, 1990 at 10:00 a.m. in Room 373, State House Annex, Trenton, New Jersey.*

The public may address comments and questions to Algis P. Matioska or Leonard J. Colner, Committee Aides, and persons wishing to testify should contact Elva Thomas, secretary at (609) 292-7676.

The Department of Environmental Protection is considering amending existing rules and regulations governing the disposal of residual ash generated from the incineration of solid waste at resource recovery facilities. Current DEP rules and regulations require that any residual ash, as tested and analyzed, which exhibits the characteristic of EP toxicity must be classified and disposed of as a hazardous waste at a federally approved hazardous waste facility.

The Committee is interested in receiving testimony from informed members of the scientific and environmental communities on this very important issue.

Issued 3/12/90

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

APPENDIX:

TABLE OF CONTENTS (continued)

APPENDIX (continued)

TABLE OF CONTENTS (continued)

APPENDIX (continued)

* * * * * *

di: 1-36
dcj: 37-49
hmw: 50-77

ASSEMBLYMAN HARRY A. McENROE (Chairman): Good morning, I'd like to thank everyone for their attendance. We'll have some delay in other members of the Committee joining me at the table for our hearing, but they will be joining us very shortly.

I want to welcome everyone this morning. As all of you know, this is a regularly scheduled Committee meeting of the Waste Management, Planning and Recycling Committee. Today is a special opportunity for us to consider residual ash from resource recovery facilities. It is an important subject; all of us are very much concerned in the public sector with that particular subject and its classification. The Legislature has a particular role, most especially this Committee, in developing legislation that will address the concerns of all of us regarding residual ash. We have a long list of people that wish to testify.

Just quickly I'll just touch on-- All of us know that for twenty years the State of New Jersey has been addressing the needs of appropriate waste management. We are the most densely populated State in the nation. We are mostly urbanized, and if there is a crisis anywhere in America, it begins in New Jersey as it relates to waste management. We, through the centuries, have spoiled our public lands with inappropriate disposal of waste. We're in a time in history where New Jersey now approaches waste management, I think, from a circumstance of carefully developed legislation and policy. We have had, since 1970, four governors, ten sessions of the Legislature, all of them interested in this compelling issue of waste management in an environmentally and economically acceptable manner.

So, again, I welcome all of you. I'll begin by just introducing for the record a memorandum prepared by staff that-- Just as an introduction I'd just like to read into the record part of a memorandum prepared by staff for members of the Committee. I also want to welcome Assemblyman Thomas Duch of Bergen and Passaic County, a member of the Committee who has joined us. We will be joined by other members as the hearing moves along.

"New Jersey's solid waste management strategy requires that every county achieve self-sufficiency with respect to the management of solid waste by 1992 for the use of resource recovery incineration and waste stream reduction, recycling, and land filling. Resource recovery facilities are capital intensive and require a guaranteed flow of combustible solid waste to operate economically and efficiently. A resource recovery facility can convert approximately 75% of the weight and as much as 90% of the waste volume into energy. The remainder is reduced to an ash residue and treated air emissions. Although this incineration ash represents about 25% of the initial solid waste by weight, the material will encompass only about 10% of the volume of the waste processed. Thus, a 3000 ton per day resource recovery facility will generate approximately 750 tons per day of ash residue requiring landfill disposal. The tipping fees of these facilities will range from $65 to $100 per ton, exclusive of ash transportation and disposal costs. Consequently, State policy regarding the classification and attendant costs of disposing the ash generated at resource recovery facilities is an issue of particular importance to the future of solid waste management in this State. Existing rules and regulations adopted by the Department of Environmental Protection in 1981 require that prior to disposal, all incinerator ash from the combustion of solid waste at a resource recovery facility must be classified in accordance with testing procedures set forth therein to determine the hazardous or nonhazardous nature of that residual ash. The rules and regulations include the following requirements..." -- there are many requirements; I think many of the people in this hearing are quite familiar with those.

But I do state for the record that self-sufficiency is a goal of all of us in New Jersey, and a comment I think is appropriate is that if we don't make ourselves self-sufficient in New Jersey, I think other states will impose that self-sufficiency on us. Because there is certain pressure building from our surrounding states regarding disposal of waste. We have some information: Pennsylvania, during this current year, has legislation pending to limit out-of-state waste to 30% at each of the state-- Thirty percent of the waste coming into the state is the limit for out-of-state waste. In West Virginia there is currently legislation being considered to limit out-of-state waste to 5%. In Ohio, there is pending legislation that will impose a higher tipping fee on waste generated in other states and disposed of in Ohio. In Indiana there is a circumstance of legislation being considered for a comparable rate basis, meaning that they will accept waste based on the existing tipping fees in the state of its origin. So, all of these are pressures building in New Jersey requiring us to be attentive and to move directly along in the area of self-sufficiency in the disposal of our waste in New Jersey.

We have a long list of people that have backgrounds and interests in this subject, and I'd like if I may to call the first person. We're going to substitute -- we have an Assembly member, George Spadoro of Middlesex County, who would like to comment on today's hearing, and Mr. Assemblyman, we'll accommodate you very shortly. But I'd like to begin with a gentleman who called quite early, Dr. Richard Magee, Executive Director of the Hazardous Substance Management Center. Mr. Magee, we'd like to welcome you, if you are here?

RICHARD S. MAGEE, Sc. D.: Thank you very much. Mr. Chairman, I'm wondering if it might be appropriate at this time, I don't know where you have Dr. Kosson on the list, but Dr. Kosson is one of the researchers in the Center, and it might be appropriate if it's all right with you that we might put the two together, because part of my testimony represents some of the work that's underway by Dr. Kosson.

ASSEMBLYMAN McENROE: Well, it's very fortuitous that we have Dr. David Kosson, apparently, Assistant Professor at Rutgers, indicated to offer testimony at the completion of your testimony. If you would like him to step forward now, is that what your intention was? Fine.

DR. MAGEE: Yes, it might be. Yes. That would be appropriate. I've also prepared some statements. I am not going to read the statement; it's quite lengthy, but I thought you ought to have it for background material.

First of all Mr. Chairman and members of the subcommittee, my name is Richard Magee. I am a Professor of both Mechanical and Chemical Engineering at New Jersey Institute of Technology. But more importantly, I currently serve as Executive Director of the Hazardous Substance Management and Research Center, which is one of the State funded centers to the New Jersey Commission on Science and Technology, funded through the Legislature. The Center is headquartered at NJIT, but the research is carried out at a number of institutions in New Jersey: members of the consortium involving Rutgers, Princeton, Stevens, and the University of Medicine and Dentistry.

The research agenda of the Center is quite broad. Incineration is only a small portion of what we do. We also do research in biological and chemical treatment, physical treatment -- for example, it might be involved with things like solidification. Also, site assessment, remedial action, as well as health effects, public policy, and education. In addition, we have instituted an aggressive program just recently in waste prevention and waste minimization. I just give you that as a background on the Center's activities.

I personally believe, and I think the Center believes, that incineration is one of the waste management options which will be required not only in New Jersey, but on a national basis, to be able to manage our hazardous waste -- I mean, excuse me -- our municipal waste. Currently, we probably have about 10% in the country, and estimates are that that may grow to maybe double that by the year 2000.

But as you know today, as we're here, as incineration has grown as a waste management option, so has concern over the management of increasing volumes of the ash that is being produced, as you pointed out in your initial comments. The debate is raging in the country as to whether or not the ash from these facilities should, in fact, be treated as a hazardous waste or not. Therefore, I'd like to address my comments in four areas. I'd like to discuss them in the areas of what are the physical and chemical properties of ash, the results of recent studies on leachate from ash landfills, a little bit about the regulatory status of ash, and ultimately, what about the area of ash utilization.

I want to point out to the Committee that basically unprocessed municipal solid waste contains varying percentages of inert materials which ultimately become the ash; typically, as you said, 25%. Since one of those inert materials are metals, the metals tend to become concentrated in the ash. So therefore, whatever metal is originally there in the unprocessed waste ends up in the ash and the concentration level then will increase four- to five-fold, depending upon what the mass reduction of the ash is. There is no data that I'm aware of to indicate that the combustion process makes the ash and the metals in the ash which is a major concern, any more hazardous or any more of a concern than that in the unprocessed raw waste to begin with. So an important point to realize is that metals are a problem in the waste stream, and metals then become a concern or potential concern in the ash after the combustion process has taken place.

Now, much of the ash -- and you've got in there -- is basically an inert material. And that will be important when we get to the issue of discussing how we might utilize that ash. But it is true that there are a lot of trace amounts of certain metals, some of which you may hear about, such as lead and cadmium, possibly things such as arsenic and whatnot. Therefore, I think it is important that we recognize that since the metals are in the ash -- those metals have a potential to contaminate groundwater -- it is important that the ash be managed properly.

Now what happens, then, when we take this ash and we put it into a landfill? Recent studies were done a few years ago for the EPA by NUS Corporation and Versar, but more importantly a recent study that has just been completed for EPA and CORRE -- and CORRE is the Coalition on Resource Recovery and the Environment -- basically tells us the following: It tells us that whereas the tests that we're currently using to determine whether or not an ash is, in fact, hazardous, way overly estimate the amount of metals which actually will come out of the ash when you put the ash in a landfill. What's the reasoning behind that? The basic is that depending upon the chemical composition of the material you use as a leachate as you kind of bubble it through the ash, if that is not similar to what you would get at a landfill, you are going to predict different levels of metal solubilities -- metals coming out. So the bottom line, then, says that certain regulatory tests which were developed for hazardous waste which are now being used for municipal waste are predicting things like lead and cadmium to come out in greater concentrations than the allowable drinking water standards. Therefore, people say "Wait, we've got a concern about the ash." However, when you put the ash in landfills, and you look at what actually happens in the landfills, whether you do it in what's called a monofill -- put it in by itself -- or a codisposal facility, you find out that the actual metals that are in the leachate are well below the metals of regulatory concern. The reason being, again, that the environment in the landfill is different than the environment in the test.

So we have this dilemma. And when everybody says, well, ash is hazardous, and the question would be, yes, if that ash were subjected to an environment such as the test, then one might expect metal contents above the allowable limits. On the other hand, when you put it in a landfill and properly manage the landfill, you don't get those conditions.

So, I think the community has come to the point at this position that, yes, ash is potentially hazardous, however, ash can be managed in an environmentally safe manner. In other words, with proper landfill design and proper leachate collection conditions we can manage the metal content of the ash, which is what is generally the area of regulatory concern. Dr. Kosson will talk about some other concerns, however, regarding salts in the ash, which may come up at that particular point in time.

I've had opportunities through some of my professional affiliations, ASME committees, to do some testifying before Congress. In Congress right now there's a lot of legislation, a lot of bills that are pending, predominantly how to manage the ash. In general, these are all, to the best of my knowledge, going to regulate as a Subtitle D; in other words, as a nonhazardous ash. However, if guidelines for proper landfill management -- that's those things about having, for example, flexible membrane liners for leachate collection -- the leachate collection system and treatment on-site. Therefore, even though the data indicates that the metals are not a regulatory concern in actual landfills, the management techniques the people are using are going to be to properly protect the environment from that leachate and also to take it off and treat it.

The last area, because I want to make my comments brief in case you've got some questions, is the whole area of ash utilization. As I mentioned to you, the majority of the ash is basically an inert material. And therefore it offers potential to be used, for example in aggregate and roadbeds; it offers potential to be used in asphalt; it offers potential to be used in concrete and building blocks. Dr. Kosson, who can talk more about it, since the inception of the Center has been working on an extraction process whereby many of the metals of concern can be removed, consequently making the material useful for other materials.

At the New Jersey Institute of Technology, under the direction of Dr. John Liskowitz, we have a major program for the Environmental Protection Agency right now, whereby we are looking at various ways ash can be utilized -- ash from municipal solid waste incinerators. Now, I believe we may need some more research and testing, even though it is currently being used in Europe as roadbed material; it's being used in certain areas in Japan. This is not a new thing. And I believe it's going to be some help from public acceptance to understand the fact that this material, which they read a lot in the paper as being a hazardous material, okay -- and again it's hazardous because it flunks a test, a test which was never intended to be used on that material -- to be utilized in various products. To me that's the challenge. It's the challenge in New Jersey in particular. We've got limited landfill capacity. Why use that limited landfill capacity to store a material which is basically an inert material -- very small content -- when in fact we can find uses for that material? And I believe that's where the industry is moving; I believe that's where the nation is moving. And at this point I'd like to turn it over to Dr. Kosson to give you an international perspective, because he is on some international committees, as well as his own perspective of this balance between how we manage ash today, and what is it's potential for utilization in the future. Thank you.

ASSEMBLYMAN McENROE: Thank you. Before you do, I want to acknowledge the arrival of Assemblyman Franks, and also Robert Shinn, Assemblyman from Burlington County. Mr. Franks is from Union and Essex Counties.

DR. MAGEE: And before I do, I do want to thank you again for the opportunity. I'd like this Committee to know that we believe in New Jersey. We have a resource. You've established it through the establishment of the Center on Environmental Matters, and other matters beyond this area, and we've got a lot of researchers and a lot of people very active in various fields. And we certainly welcome the opportunity to bring that expertise and our views on these issues before the Legislature.

ASSEMBLYMAN McENROE: We'll have some questions for you, Doctor, and also for Dr. Kosson in a moment. Any questions from members of the Committee for Dr. Magee, or do you want to hold them?

DR. MAGEE: Yeah, why don't we wait-- Because, as I say, a lot of the work is being funded, and we're kind of working together in some of these programs.

ASSEMBLYMAN McENROE: Very good. Dr. Kosson, Assistant Professor, Rutgers University, Department of Chemical and Biochemical Engineering? Welcome, good morning.

DAVID S. KOSSON, Ph. D.: Thank you. Good morning. I'm very honored to be asked to present this information to you. I've always felt that it's important to establish what my background is in these materials, and then make it very brief to hit certain very important points which I feel that you ought to consider in developing your ash management policy and guidelines.

My knowledge of ash issues evolves from research into ash characteristics almost from the inception of the Center up at NJIT, the Hazardous Substances Management Research Center. And the areas of research have included the physical and chemical characteristics of ash, the leaching characteristics, and the bio-availability of lead and cadmium from incinerator fly ash, as well as the recovery of heavy metals from ash and other treatment processes.

Currently, I'm involved in research with ash issues in the following capacities: I'm the Technical Coordinator and a member of the Science Advisory Panel for the US EPA Program for evaluation of different treatment technologies for ash utilization. I'm also a member of the Ash International Expert Working Group, which is an effort to draw together information internationally on ash characterization, evaluation, and management protocols. This work is supported by over 10 countries right now, and is also endorsed by the International Energy Agency. In addition, I served as the Co-chair of the ASME -- American Society of Mechanical Engineers -- committee on ash management. In addition to other aspects and involvements which are summarized in my statement.

In considering the development of legislation and policy regarding ash management, I think there are a few very important concepts which you ought to keep in mind. The first is that incineration of municipal solid waste reduces the volume of waste to be managed, as you stated earlier, through combustion of the organic constituents in the waste. Thus, the inorganic constituents are concentrated. The process results in two fundamental types of ash generated by the process. These are bottom ash, or the material which is retained on the combustion grates or discharged from the combustion grates. And you can think of that as analogous to the cinders remaining from a campfire or your fireplace. The other is the fly ash, the materials which are entrained in the combustion gases and carried over and recovered as a consequence of the air pollution control trains, including acid gas scrubbing and particulate recovery. A way to easily visualize this is as the cinders that escape when you burn newspapers and are carried over.

The composition of these two types of materials are fundamentally different, and that ought to be considered in developing ash management practices. Fly ash represents about 20% of the total ash generated, and contains almost all the cadmium and a substantial fraction of the lead from the original waste. It also varies between 40% and up to 60% or 70% water soluble; that being it contains a high concentration of soluble salts. Keeping this in mind, bottom ash and fly ash can be managed in an environmentally safe fashion. The current criteria for landfill design, including liners and leachate collection and treatment, is protective of the environment and is a sound practice.

The third issue is that EP toxicity and TCLP leaching tests that have received so much attention and publicity lately, are not appropriate tests for determining ash management protocols, and ash management based on these protocols can result in significantly less efficient and less environmentally sound ash management. The reason for this is that EP Toxicity and TCLP assays are flawed by poor repeatability and the ability to artificially manipulate the test results. Test results which are marginally different -- which we've been debating about in the literature, and you can see it in the public forums lately -- as you cross the "pass" threshold to the "failing" threshold of how you behaved on that test. Ashes that pass and fail by marginal amounts are not significantly different. Great variability exists in the sampling of ash and in the subsampling of the material, and therefore the inherent range of results on the same material is so great that the marginal differences between this passing and failing are not really characteristic, and have led to some very poor management practices in order to be pragmatic in operating facilities. These tests are not predictive either of leachate characteristics in the field, as Dr. Magee stated earlier, nor are they predictive of the total potential materials that are available for leaching. While there's a regulatory basis for interpreting these tests -- there are Federal guidelines for pass or fail -- these test results are not scientifically interpretable. I cannot take the results of those tests and tell you with any degree of confidence what these test results mean in terms of ash management or field application. They are not predictive at all, and they're very difficult, if at all possible, to interpret beyond the regulatory protocols.

Better ash characterization procedures exist. However, it is unlikely and not possible to characterize ash in a predictive manner based on a single test. And I think that is one of the failings of the management protocols that we have right now. Implementation of characterization and management protocol specific for municipal waste combustor residues can dramatically improve both the economy and the environmental safety of ash management.

The fourth issue that I would like to bring to bear on this is that ash management policy should encourage safe utilization of bottom ash. This is predominantly an inert material, and current technology will most likely permit safe utilization, that being as incorporation into products such as aggregate in road base, or in concrete block or other types of vitrification products in an environmentally safe manner. Several State and Federal programs are in progress that were initiated to evaluate the different treatment options and their potential long-term environmental integrity. Of particular, is the EPA program right now, which is providing on a laboratory scale, side by side comparison of the different ash treatment technologies, including both their technical and environmental safety in the long run, but also the comparative economies of each of these sorts of ash treatment and utilization technologies. Utilization of bottom ash would require the development of separate management practices for fly ash. I think fly ash utilization is less certain in the near term because of the higher concentrations of heavy metals, and especially because of the higher concentrations of soluble salts. They have, under certain circumstances, led to interferences in some of the utilization applications, so I think technology development in that area will take a longer time.

Overall factors which will limit our utilization of these materials, and I do believe that's the direction that we ought to be headed so that we're not relying on very scarce landfill capacity in the State, the issues which will constrain this progress are unclear regulatory criteria, what are the guidelines for measuring and for determining and utilization of these materials, and also unresolved issues about potential liability in the long term. If those issues are not resolved, even if we have a technically and environmentally safe product being developed, you are not going to be able to bring those products to the marketplace because the people receiving them will not want to carry the risk because of these unresolved issues.

With that, I certainly would welcome any questions.

ASSEMBLYMAN McENROE: Thank you. I appreciate your comments. I do have a few questions prepared, and of course the other members will have ample opportunity for presentation of their views.

You're talking really about the current testing procedures. Now I don't want to-- Of course, I'm not capable of directing your thoughts, but-- Are you rejecting, in a sense, the current testing procedure as kind of an experiment in a laboratory and not having any application in the real world?

DR. MAGEE: Well, let's both take a shot at it. I think the idea that we've said is that: A) the test does not in any way seem to represent what goes on in the field. Okay? So therefore, that, in my mind, gives it a limited value. Second of all, as Dave has pointed out, the test can be manipulated. You can manipulate it by putting additional buffering agents so to speak, and particularly in your fly ash with additional lime, and therefore, whether or not you pass or don't pass the test is somewhat meaningless. I think what we're saying -- at least what I'm saying -- is that I think we ought to ensure ourselves that we manage it in an environmentally safe way, and don't rely on the test. If the test says, you know, it's not hazardous, and the other one says it is because you get a reading of 1.1 on the cadmium versus .9 on the cadmium, it really doesn't mean anything. It doesn't mean anything as far as field application.

Taking that aside, however, we feel that our landfill design criteria that are coming up that says we can manage it in a safe environmental way. And that is the way to go, and not rely on a test, and say, well the test says it passed, so we can go ahead and put it over here, and we don't have to worry about it anymore. I think that's the issue that I'd like to get across.

DR. KOSSON: I think the issues that I'd like to get across are, one, that the test was developed originally for a very different application and for a different management scenario, and therefore is no longer appropriate for the management of practices which we were considering for ash. The second is that, with the results that we are seeing on these tests, we're typically borderline, passing or failing -- a test which is not meaningful for the application to begin with, but we are marginally passing or failing that test. And it is important to recognize that if you have a drum of ash which is the same ash, and you subsampled it many different times, the error associated with the subsampling of the particular quantity of ash, isn't as great as the day-to-day variability in the ash itself. That means that the confidence that you have in the results as you go across these thresholds are not very meaningful at all.

The final issue is that there exists better tests that look at performance with the understanding of what the ash characteristics are that would be a lot more appropriate to ensure that ash is being managed in a much more useful and meaningful fashion.

ASSEMBLYMAN McENROE: And the testing procedures presently are developed by the Federal government?

DR. KOSSON: I don't think these testing procedures have been promulgated domestically yet. I think what that is drawing on is experience occurring and management protocols occurring in other countries.

ASSEMBLYMAN McENROE: Okay. It's often commented that the culprits in the waste stream are often heavy metals, cadmium, lead, and also batteries in particular. Can we lay at the feet of the battery industry a major part of this problem? Is it generated by that? In other words, is there an opportunity here for us to limit the amount of those kinds of substances in the waste stream and thereby improve the quality of residual ash?

DR. KOSSON: I think there are considerations that must come into play before you go ahead with a policy of that sort. One is that, in particular, lead acid batteries have been pointed to as being a source of lead in the ash and being a culprit that we ought to take out. First off, a lot of lead acid batteries, greater than 85% in recent data that I've seen, already are being recycled. And it is unclear whether a greater emphasis on that would result in greater community participation, and therefore, be effective. Secondly, it is unclear what the sources of the material which are environmentally -- or potentially environmentally mobile, that being the leachable lead and cadmium which exists in different speciation, in different chemical combinations in the ash, where did they come from? It is not clear whether they come from batteries or whether they come from batteries or whether they come from other sources in the original waste stream. So there is not data that exists that will correlate saying, removing this battery would result in any improvement in your ash characteristics. Given the difficulty in getting community participation and the high level of participation that may be necessary, I think it would be very difficult -- although it is worth exploring -- it would be very difficult to say a priority that that would be an effective approach to take.

DR. MAGEE: Along with that, certainly, anything we can do to remove heavy metals from the waste stream is in the best interest, I believe, whether -- of any of our options -- we do a landfill option or we use an incineration option. As an incinerator person, we don't want to put metals in the incinerator. That's not why you use incineration.

Particularly, concerns about mercury and cadmium in the smaller batteries-- I believe that anything we can do to keep them out of the waste stream is in the best interest of good waste management practices, no matter what option we use. So, I would encourage the Legislature, in my mind, to seriously consider that.

In addition, there are numerous industries that are looking at ways of reducing and substituting materials. For example, the cadmium and lead: If you take them out of the batteries, a lot of the materials that are used either as pigments, as colorants, or they're used as stabilizers -- okay? -- in plastics, for example, that's one of the areas. Pigments as a color question is, well, if we're concerned on waste management or if we're concerned about heavy metals, maybe we just have to change the colors that we live with. And I believe that makes a lot of sense. I think you're seeing some Federal legislation looking at that issue. The stabilizer issue is a composition. Do we have technical solutions for it? In some instances the answer is, yes, there are some substitutions that you can use for cadmium based stabilizers. On the other hand, for example, a lot of lead ends up in wire and cable, and it's necessary for the insulating properties of the wire and cable. You take it out and you don't have a functional product anymore.

So, I think you're going to see over a period of time industry moving to look for substitutions to get heavy metals out of the waste stream, because we've just seen what heavy metals can do to the environment and other areas as well. So, substitution levels make a lot of sense.

But I think it's always going to be there, and the point that Dave was making, that if we cut the lead and cadmium going into the incinerator in half, it does not necessarily mean that we are going to cut down the leachable lead and cadmium in half. Because this whole question of how it deposits on the particles and what is available from the leaching thing is not a simple one-to-one relationship. Okay? It comes from different form. But prudent waste management, in my mind, is to limit the amount of the heavy metals that are in the waste steam.

ASSEMBLYMAN McENROE: Okay, a related question. Based on your backgrounds and interest in the subject, what kind of danger does leachate-- What danger does it have insofar as its impact on water contamination from a well-designed double lined sanitary landfill?

DR. KOSSON: A well-designed landfill is designed to recover the leachate from that material, and has redundant barriers to prevent the migration of that material into the underlying aquifer or groundwater system. Leachate that has been collected and analyzed from various monofills in recent data that I believe is representative, shows that the heavy metals present are not a significant issue, because they are in extremely low concentrations. The issue with a leachate or what will make it somewhat difficult to manage is because of very high salt concentrations. Those salt concentrations and salinity, typically will be that of seawater or above the concentrations of seawater. So, heavy metals are not predominantly an issue there, but salt concentrations may be an issue.

ASSEMBLYMAN McENROE: Would they have the kind of impact on people's general health that heavy metals would have -- the salt content?

DR. KOSSON: I think the salt content would not-- It depends on the (inaudible) route. You certainly would not to be drinking a lot of salts, nor would you want to drink seawater. But at the same time, with proper landfill design, this material is collected and treated. It is not discharged randomly into the environment. So, I think the prudent path to follow is proper landfill design and proper ash management that would prevent migration of these types of materials.

DR. MAGEE: I think that we have to recognize that the landfill data that we have on, say monofills -- I guess the stuff in Europe is -- what? -- sixteen or eighteen years or something like that that the Netherlands data runs that long?

DR. KOSSON: About ten years or so.

DR. MAGEE: Well, I've seen data run fifteen, sixteen years. I think what we're saying is in at least the data that we have in the initial stages, that the metal contents which we would expect to come out probably early, all right, are well below regulatory concerns as they exist today. The salt content, however, would make it nondrinkable. I guess you could drink the leachate based on the metal content. I'm not sure anybody wants to do it, but because of the salt.

The question is to manage and design these landfills for a long period of time, if those leachable materials as they are leaching out through the landfill cover are being treated. Okay? And that ultimately, sometime way in the future, if for example the landfill should fail -- and I think one prudently would have to recognize that landfills are not going to last forever -- that all the materials of concern, the metals and the salts, would have been leached out and would have been treated by that period of time.

But I still think it goes back to the issue that ultimately we want to utilize. I mean, why take something that is basically inert, and use up landfill space?

ASSEMBLYMAN McENROE: Well, see, one of the problems we have is before we address what to do with waste, we want to categorize it first, and ensure that we are not turning out bricks that will turn red in five years or something, or begin to glow. And our major concern-- I just want to raise one question. Do you think that each of you, based on your credentials and interest and background in research in the scientific community, do you represent a strong majority you believe of the people that have working knowledge of the subject? You seem to be saying to this Committee that the residual ash from a resource recovery facility, if properly managed and controlled and disposed of appropriately in an approved landfill site, is a manageable commodity that has potential for use as a construction material in New Jersey.

DR. MAGEE: I would say that my answer to that question would be yes. There was an international committee that was established and put together last fall with representatives from all around the world -- the Netherlands, from Japan, and Sweden, and whatnot -- to debate these issues. And the consensus of that group was, I think what we've said here, that the test is not representative of what happens; that ash is being managed, in their minds, in an environmentally safe manner around the world, and that it, in fact, can be managed in an environmentally safe manner. And again, I want to point out to you the question is that if the comparison is that I don't think it's going to be any easier -- in fact probably less easy -- to manage the solid waste in the landfill, than it is to manage the ash. All right? And we have to remember what some of our options are going to be in New Jersey for the material that we can no longer recycle, which we obviously have to put-- Ash by itself -- the data I've seen does not indicate that it is some horrendous material that causes any problems that managing the solid waste in its raw form would, for example.

ASSEMBLYMAN McENROE: Yes sir?

DR. KOSSON: I feel that not only is this -- to people who work in this field -- is this more or less a national consensus, but also an international consensus as to where we are headed. And also, being international consensus being formed, that reuse of components of the ash makes a lot of sense and is technically a viable alternative. So, I would encourage you again that those ought to be the paths that we're following, keeping in mind environmental safety throughout those management practices, and the necessity for clear regulatory guidance that is scientifically valid, not based on tests that were developed for other application and just being dragged off to the side to apply to anything that comes along.

ASSEMBLYMAN McENROE: Okay, thank you. Mr. Shinn, a question?

ASSEMBLYMAN SHINN: You hit on one of my favorite topics, which is disposal of ash and the whole issue of TDS -- total dissolved salts -- and that what you're talking about in regard to the salts -- right? -- TDS. I think you'll probably find typical TDS NJPDES permit limit of 1000 parts per million;

at least that's what I think ours is. And if you're involved in municipal landfill leachate, traditionally, without reverse osmosis or some other desalinization process, you're not going to meet 1000 parts per million. It's been my experience that you're going to have a very difficult time meeting that standard. So, I think a new component that we're going to be looking at more commonly in leachate treatment plants associated with municipal solid waste or typical leachate, with that kind of permanent limit is some desalination process, probably reverse osmosis. At least that's what we're looking to. And if you back that up to an ash standard, in my mind it's a problem to put a -- just looking at ash itself and put a standard on it, without knowing what secondary process that ash is going to go through. Because the bottom line is either the air or the discharge process. So, each process is going to have a different standard that that process can accept and meet its discharge permit.

And what I'm talking about is, let's take a leachate treatment process that has reverse osmosis. It can limit the salt process -- or remove the salt, basically, for a secondary disposal, and in a much lower quantity, but probably in a hazardous waste facility, because you're going to concentrate that salt. So you have a standard that that facility has for ash, and in one of the best investigations of ash in my mind is looking at it, to make sure that it's had enough duration in the incinerator, whether it's a medical waste process or it's a typical resource recovery incinerator -- if the duration of that burn has been adequate to properly burn the ash. And then you have a standard if you're suspicious of that ash in any way you have a set of standards that you subject it to, so you know that that ash is within the standards that your facility can digest, again as a process, based on what your facility contains in its treatment process, both in metal removals and in reverse osmosis for salts.

But to me the parameter that is the problem parameter that we're not set to deal with is TDS, and I think we're going to have to step up to the plate on TDS. And I would prefer, from the experience that we've had in disposing ash in a state-of-the-art landfill, that the monofills give me a little more concern than integrating ash in a municipal landfill, because just by the composition, you're diluting it. Then you can look at what your discharge and your permit standards and you can deal with the problems more easily, both in municipal waste and in ash disposal. I'm not saying that monofills should be ruled out. Just from our experience it's been a more manageable process to be able to deal with the ash individually to disperse it in a landfill and then to look for impacts in our treatment plant.

So I think the salt issue is the predominant issue in my mind. Everybody thinks about metals, but the TDS is really a problem, both in leachate from a treatment plant perspective and in the ash issue. So, I think that is something you'll be hearing more about, because that's the problem with managing the discharge is really--

DR. KOSSON: A comment?

ASSEMBLYMAN SHINN: Sure.

DR. KOSSON: On the salt concentrations. In the best combusted ash, the salt will always be there. Even in the raw waste, those salts are there. The high concentrations of salts predominately in fly ash, come as a consequence for a quest for preventing air pollution or air emissions. Acid gas scrubbing converts those gasses to salts. So, the salts are going to be there. And they are not being created, but they will always be there in their consequence of the waste itself. Management of those salts that are present can take one of two fundamental approaches. Either after the material is landfilled or dispersed in some application, then you collect leachate from that landfill and you treat the leachate. You mentioned reverse osmosis. That is one option. But keep in mind that will just give you a further concentrated brine for disposal.

Another option is to immobilize the salts in some sort of stabilized matrix to greatly reduce or prevent the release of these salts into the environment and therefore you would not have to treat it. I think the salts are an appropriate issue, but I think there are a number of options available to deal with the salt issues, and they have to be considered.

ASSEMBLYMAN SHINN: To me it's a two-step process, and we're going to be in both steps. The first step is state-of-the-art landfills, technically equipped from a leachate treatment standpoint to deal with ash. Because we're dealing with medical waste incinerators from hospitals on a daily basis, we're dealing with resource recovery facilities on a daily basis. We are going to incinerate -- or landfill ash. No question about it.

The other issue that you mentioned earlier, vitrification, which I think is a natural. One of the things that stand out in my mind is Atlantic Energy's facility, which is a coal facility that reinjects its fly ash at 2800 to 3000 degrees. It sells every bit of bottom ash it has, and it has no fly ash, because that's reinjected into the furnace. And between sandblasting material for ships, and roof shingle grit, they sell everything they produce through a vitrification process. So--

DR. KOSSON: The vitrification--

ASSEMBLYMAN SHINN: So, vitrification, to me, is where we should be going. But in the interim, you know, we don't want to tie ourselves into knots.

DR. KOSSON: What I think we have to consider in any ash treatment process, and vitrification certainly would fall into that category, or the overall impacts of that process, it must be kept in mind that the vitrification process is energy intensive, and therefore can be very expensive. In addition, by heating these materials to excessive temperatures, you can result in revolatilization of the constituents that concerned you to begin with, thus generating another material for management.

So, I think what is needed is a good evaluation of all the options that are available, considering not only their technical efficacy and their overall impacts, not just the solid product that comes out, but also the economics of implementation. The Chairman of this Committee stated earlier that the cost for disposal of waste through incineration can vary between $60 and $100 per ton exclusive of ash management. Ash management costs depending on whether we are at the range where ash management costs are in the $30 per ton to treat ash, or up in the $120 per ton to treat ash, can represent a small fraction of that tipping fee -- a marginal increase -- or it can perhaps even double those costs.

So, I think it's very important to consider both the technical and the economic considerations, and not just look at a narrow focus, but consider the overall effects of a process. We are--

ASSEMBLYMAN McENROE: Thank you. That's the central issue before us today: Affordability, the economics and the environmental impact of the ash in this category.

DR. MAGEE: The ASME research committee, which both Dave and I serve on, is in the process of probably running it -- a program that will cost about a million dollars -- to basically take ash from various facilities from around the country and do a major vitrification to get numbers such as economic numbers on it, as well as get the questions such as air emissions and whatnot. So, we have some data to put that ash management option in perspective against other types of ash management options. And that's clear.

DR. KOSSON: I guess I would caution against dictating an ash management protocol or technology without all the information available on the options available.

ASSEMBLYMAN McENROE: Thanks.

ASSEMBLYMAN SHINN: I think just to follow up on that: What's going to happen if we do that, if we set a standard strict on ash, just from some perceived environmental perspective without considering the secondary treatment, all we're going to do is drive up the cost of waste disposal. And we're not going to be dealing with the secondary issue of proper processing, whether it's vitrification, or landfilling and so on.

DR. KOSSON: Exactly.

ASSEMBLYMAN SHINN: And that's what we have got to caution ourselves against, not to be drafted into that position.

ASSEMBLYMAN McENROE: Thank you very much. I want to introduce also Assemblyman Dan Jacobson from Monmouth County, who has joined us at the Committee table.

Any other questions for Mr. Magee, or Mr. Kosson? (no response) Thank you, gentlemen. I appreciate very much your appearance before the Committee. We'll have this transcript prepared, and we appreciate your input into that transcript, and we'll be in touch with you further, because we appreciate very much your expertise and your interest in the subject.

DR. MAGEE: Thank you very much, Assemblyman McEnroe. I think it's important to realize that we can provide technical data. If there are reports that you don't have that we've made reference to, studies that you don't have, if you want at a smaller staff meeting to sit down and get some type of interpretation of that data, both Dave and myself are available to the Legislature to--

ASSEMBLYMAN McENROE: Mr. Matioska, and Mr. Colner are both on our staff, both assigned to this Committee, and they'll be in touch in order that we can avail ourselves of that.

DR. MAGEE: We'd be more than happy to do that, and as I say, we'd be more than happy to do that. As I say, we appreciate being called upon to help out. Thank you.

ASSEMBLYMAN McENROE: Thank you very much.

DR. KOSSON: I'd just like to emphasize Dick's statement that we are very eager and willing to help in any way possible, and we do appreciate the opportunity to appear before you.

ASSEMBLYMAN McENROE: This is a major public policy issue before the Legislature, and we appreciate your input. Thank you.

DR. KOSSON: Thank you.

ASSEMBLYMAN McENROE: We're going to digress from our published witness list, and invite Mr. George Spadoro, Assemblyman from Middlesex County, a very eager environmentalist. And we'd like to have your comments. Mr. Assemblyman?

ASSEMBLYMAN GEORGE A. SPADORO: Thank you, Mr. Chairman.

ASSEMBLYMAN McENROE: Do you know all the members?

ASSEMBLYMAN SPADORO: Yes.

ASSEMBLYMAN McENROE: The floor is yours.

ASSEMBLYMAN SPADORO: Good to see you all today. I first want to compliment you for arranging for this special hearing. This issue is one which, I think you stated a minute ago, is a major issue for public policy. It is. And I think Assemblyman Shinn commented that, in effect, we should move carefully before we set our protocols for testing, etc., and management. I agree with that. I think the converse is that we can't wait much longer. We've got incinerators operating in Warren County, in the southern part of the State, Essex County has an incinerator that's going on-line shortly, and I am concerned that if we are going to act, we've got to act expeditiously. Certainly we have to act in the best interests of our residents, and in the most sensible way. But I am concerned that by attempting to do it in the most careful way, the horse may be out of the barn by the time that we determine what steps need to be taken. And that's why your hearing today is so critical. It focuses our attention on the issue, and I think that the Governor's Office, and the DEP, and the Senate will benefit by what this Committee learns.

About a year and a half ago, I held a press conference to raise the issue of the -- the ash issue, in effect. I had contacted the DEP, and was advised that in 1988 the DEP was projecting that by 1992, if all things went along the normal course, there would be as much as 2 million tons a year of ash generated in New Jersey. They were projecting incineration of about 8 million tons of solid waste. That projection may have slowed down a little bit, because the incinerators are not moving along as fast as originally expected, and with the Governor's special pause committee being enpaneled shortly, we have a little bit more breathing room. But the reality is that we are going to be dealing with enormous quantities of ash in this State, certainly before the end of the century. The issue that we have to decide, really, is what steps do we take to manage the ash in a sensible way?

Mr. Chairman, you mentioned at the outset of this meeting that you sensed that the other states are looking for ways to prevent us from disposing of solid waste, and I think you're right. As a matter of fact, I'm not-- I don't pretend to be an expert on the court cases, but I think that you'll find that it's going to be very easy for our border states to ban New Jersey incinerator ash. The simple way to do it is going to be to exercise their basic police power for health and safety, and pass legislation that basically says that you can't dump incinerator ash in sanitary landfills. Once they say that, you will effectively ban the ash, because there are no special landfills to handle ash in Pennsylvania. So once they've passed that law, they will have a legal way to ban our ash. So this Committee should anticipate and expect that within the next few years we are going to be confronted with a potential crisis in the State if we have not dealt with the ash issue head-on.

And my concern is that we must move quickly to come up with the proper testing. I've got a piece of legislation which would mandate the use of the EP Toxicity Test. The Warren County incinerator, at the present time, by permit conditions uses the EP Toxicity Test. And we heard one of the doctors testify that, well, he thought maybe that test is for a number of -- sounded to be reasonable -- observations. Maybe we shouldn't be using that test. Well, I'm certainly willing, and I think this Committee should be willing to hear that issue. But, we need to have some test, and it seems to me that we should err on the side of conservatism and notwithstanding the idea that we can use the ash to build for bricks for housing, and maybe we'll have schools someday or factories built with ash bricks, and highways-- I've got reservations about that. I think that we've got to be careful. We've got to move very carefully. I think Assemblyman Shinn said, if I understood him correctly, that he doesn't think we should be comingling ash and other solid waste. That is--

ASSEMBLYMAN SHINN: I think we should.

ASSEMBLYMAN SPADORO: You should comingle, or you shouldn't?

ASSEMBLYMAN SHINN: Should.

ASSEMBLYMAN SPADORO: I think you should not. Excuse me?

ASSEMBLYMAN SHINN: In disposal.

ASSEMBLYMAN SPADORO: Okay. I think you should not. It's my feeling that, to the extent to which we're going to be continuing to dump regular garbage -- I know I've heard talk, for example, about using ash as the layers between the garbage. You know, my concern is that the ash is a special problem, and that we should develop regulations and procedures to deal with that special problem. I'm not looking forward to the day when we have garbage trucks-- Have you ever driven behind a garbage truck, and there's a little net over the top, and things are flying out of the truck as it's driving down Route 1, and some little stones break your window occasionally? I don't look forward to the day of riding behind an ash truck that's hauling the fly ash to the landfill like regular garbage to dump it. I think that you've got to set forth special procedures that distinguish between this product and regular solid waste. I think it makes sense. I think it's in the interest of the State to do so. I think that the Committee has to look at the idea of what steps need to be taken to move siting along, because my sense is we're going to need an ash disposal site or sites in this State that are designed especially to deal with ash. I realize that a double liner system with leachate, in theory, will catch all the leachate that's coming out of the ash. My concern, of course, is that most of these facilities are designed to last for 30 years.

So what are we doing? I mean, I remember when atomic power was put into effect -- you know, they had that little commercial where one ounce-- I don't know if you remember, this is going back -- it shows you my age-- They had the hands with an ounce of uranium in it, and one ounce of uranium, and they showed the city being lit in the background? They never talked about the waste, the atomic spent nuclear reactors. So what we have now throughout this country is a bunch of nuclear plants generating electricity, and next to the plant we have gigantic swimming pools with spent nuclear reactors in the swimming pools, and we're still trying to figure out what we're going to do with those spent nuclear reactor rods. We don't know what to do with them.

Well, there can be an analogy drawn with the technology of resource recovery. The advantage is that we're actually addressing the issue now. And we should be saying, what are we going to do with this ash, where are we going to be, not in the next 30 years -- let's think of our grandchildren in the year 2030 when these double liner facilities deteriorate. Where are our grandchildren going to be? Is there going to be a problem with leaching into our groundwater supplies?

You know, we've all read about the Perrier with the benzene in it. Now we heard just today in the new that there's another mineral water company that's got other traces of other chemicals in it. We've got a groundwater problem in this State, and it seems to me that we have the opportunity with ash disposal to deal with it in a way that we can say with pride that we will prevent any heavy metals, any unusual concentrations of salts from the incineration process from ending up in our groundwater. And one idea, for example-- I think someone mentioned solidification. I think in Japan, they are looking at, I think it's glassification. And if the Japanese are doing it, I think we should find out why, and maybe we should think about doing a similar process for the fly ash, so that we're absolutely certain that fly ash is not going to end up leaching into the environment, because it's in a solid form that cannot leach, in effect, or it's not expected to leach.

So, I think that we've got to be conservative in our approach, and we have to be expedient. We cannot wait. This is not an issue that really can last, that can be debated for years. I think that this Committee should plan on dealing with it head-on, certainly in this session -- I would hope this year, because we will have a little bit of breathing room, with the pause committee meeting. I would encourage the Committee to enact legislation which mandates testing of ash and mandates that the ash after it is tested be dealt with in a special way. It may be that we don't need the so-called "hazardous waste emplacement facility," which is a 21st century concept which maybe hasn't even been developed yet, but we certainly need more than your typical double liner landfill with a leachate collection system.

So, it's somewhere between that and maybe a technology that we haven't yet developed. And we need it quickly. Also, this Committee, I suggest, should move aggressively on legislation -- and I know the Chairman is very interested in recycling and in dealing with the issue of the waste stream itself. But I think if you read between the lines, and I think Dr. Magee may have said it, I think we've got to move aggressively to take out of the waste stream those components which are the bad guys. With all due respect to the other doctor who seemed to say that maybe it's the cadmium in the batteries that's not really the thing that's leaching-- I know it sounds like, you know, if I went and got my Ph.D. -- you know, my sense is that if we get all the cadmium out of the waste stream, then we don't have to deal with cadmium leaching into the--

And so, we should begin taking steps to remove heavy metals and plastics from the waste stream. I didn't hear the word dioxin mentioned during the testimony. Again, I'm not a scientist, but I've heard testimony over the years from a number of individuals who purport to have degrees, and who suggested that the incineration process does produce measurable quantities of dioxin, due to the interaction of the organics in plastics and the other mix that's in your garbage -- in your solid waste stream. And, I think we've got to remember that there are other things other than the heavy metals and the salts in there that we just don't want to have in the environment. Right now, for example, there are studies being done on whether or not living near power lines-- I see a growing sense that maybe there's something wrong with living near power lines, and maybe we'll find out in 20 years there is. Here, I'd rather not find out in 20 years that some of the components in that ash are harmful, unless we really do need ash for building blocks, for example.

ASSEMBLYMAN McENROE: I don't think we do.

ASSEMBLYMAN SPADORO: Okay, I would feel comfortable that-- I'd rather have it put into a landfill, provided we have the capacity. I mean, if we have sites to handle this stuff; only because I'm a little skittish at this point, with the asbestos problems we've had, about looking at utilizing this, unless it's very limited utilization.

So, in summary -- I don't want to take much longer -- I suggest the Committee move aggressively to deal with the ash issue, and also as a component of that move aggressively with legislation that will remove from the waste stream those items which will make the business of incineration more difficult. And so there are a number of bills in. I happen to have a bill in that would impose a deposit on batteries, specifically automobile batteries and other types of batteries. Now I'm not arguing for my legislation, specifically, but there are a number of concepts that can be applied to take these items out of the waste stream, and if you do that, and you handle your ash in an intelligent way, maybe we will be able to restore confidence in the process. And that's my final point, that what you'll be doing -- what this Committee's going to be doing and the Legislature is going to be doing -- I hope, is to restore confidence in our public with the incineration process, so that we can go about the business of dealing with the solid waste issue. Mr. Chairman, thank you very much. I have with me, and I'll leave with the Committee, a short essay that I wrote about a year and a half ago on this subject, for your review. Thank you very much.

ASSEMBLYMAN McENROE: Thank you, Mr. Assemblyman. I appreciate your comments, and we appreciate your confidence in this Committee. As you know, any decisions made will be made in a-- The voting will be done in the political realities of this State, but certainly in order to prepare the legislation, we have to reach out into the community that indicates an interest and has the knowledge and can prepare us well for the choices we have to make at this Committee level. So, thank you. A question from Mr. Shinn?

ASSEMBLYMAN SHINN: Just a comment.

ASSEMBLYMAN McENROE: We have 12 more people who have to testify.

ASSEMBLYMAN SHINN: We've got some big issues here that we're really touching on that I think are significant. I was involved with a negotiation with the City of Philadelphia to get the City of Philadelphia out of New Jersey. And I know a little bit about the planning to remove an importer -- which we are now to Pennsylvania -- from the waste stream. And I always operate backwards from trash on the street. The worst case scenario is trash on the street in New Jersey. I mean, that's the biggest environmental impact that we can have. If we put a strict criteria on our ash that our ash cannot be in any way, shape or form, the easiest way to rule us out of Pennsylvania landfills. All they do is test the ash when they hit the border: It doesn't meet our own standards in New Jersey which if we adopt, Pennsylvania will adopt, and that gets our ash out of Pennsylvania. That puts our ash back in New Jersey, which we don't have enough state-of-the-art landfill capacity to deal with in an environmentally sound fashion, that means ash backs up in the incinerator. You shut the incinerator down, and you've got that debt service; the people have to satisfy that debt service, plus do something with our trash.

That, in a nutshell, is one of my concerns. And I think we have to progress from the ash quality in its process individually-- If you go to a New Jersey landfill or a Pennsylvania landfill, how that landfill can accommodate that ash in their process, whether that includes reverse osmosis to handle the salts, or whatever. What the end NJPDES permit standard that you are meeting, and how the quality of that ash affects that permit, is the bottom environmental line. And that's what I don't want us to lose sight of in this process. We can function toward a solution in an environmentally sound way, but in a logical fashion at the same time.

ASSEMBLYMAN McENROE: Okay, thank you very much. Assemblyman, thank you.

ASSEMBLYMAN SPADORO: Thank you.

ASSEMBLYMAN McENROE: We'll call Mr. Richard Denison, of the Environmental Defense Fund. Mr. Denison, are you with us?

RICHARD A. DENISON, Ph. D.: Yes.

ASSEMBLYMAN McENROE: Good morning. Welcome to the Committee: Mr. Duch, Mr. Jacobson, I'm the Chairman, and Mr. Shinn and Mr. Franks. Welcome, I'm happy to see you.

DR. DENISON: Thank you Mr. Chairman. It's a pleasure to be here to present the views of the Environmental Defense Fund on this very important issue. And I, too, would like to applaud the Committee for this very timely hearing on a very important issue.

I have copies of a written statement, which I'll distribute for the record, and will keep my oral statement as brief as possible.

I'm a senior scientist with the Environmental Defense Fund in Washington, D.C., which is a national, nonprofit organization with six offices around the country, and about 150,000 members. My own personal background is as a biochemist. I have a Ph.D. from Yale University, and I've spent, subsequently, several years at the Congressional Office of Technology Assessment studying effects of hazardous waste incineration and waste disposal impacts on the environment. So I think EDF is in a position based both on the background of its staff and its long experience in this area to aid in the process that you're going through in terms of assessing how best to manage this material.

I would like to focus my comments today on four basic issues:

First, I'd like to make a few comments placing resource recovery in a broader context. I think this is an important issue not to lose sight of as we delve into the details of ash management.

Second, I'd like to touch on the legal status and regulatory status of municipal waste incinerator ash under Federal law as it relates to the DEP's recent proposal to regulate ash as a special waste.

Third, I'd like to discuss some technical and regulatory requirements for proper ash management.

And fourth, I'd like to touch on the need to ensure that whenever and incinerator is built, that there be adequate disposal capacity planned for in advance so that we do not end up in situations that have occurred elsewhere in the country where we have an incinerator ready to come on-line, and no place to put the ash that is protective of the environment. And I have some suggestions in my written statement for how that could be accomplished.

Let me first turn then to placing resource recovery into a broader context. I would suggest there that the Legislature and the DEP have taken a number of steps to deal with the growing solid waste problem in New Jersey. We're obviously in a period of intense change in the way in which we are managing these materials. The Environmental Defense Fund is, however, concerned that as more and more landfills are closed, and as a commitment to resource recovery on a very large scale is pursued in New Jersey, that the State's approach to solid waste management may be somewhat out of balance. And that is that it has lost sight, to some degree, of the need to provide a balanced approach that is based, after all, on a municipal waste management hierarchy that begins with source reduction, reuse, and recycling, and then turns to resource recovery facilities and landfilling.

None of these techniques alone are sufficient to deal with the large amounts of solid waste generated in New Jersey. None can be ignored. But the State's current trend toward a very heavy reliance on incineration in our view is flawed by a neglect of alternatives that are safer, less costly, and environmentally more benign.

We believe that in order to aggressively pursue a more balanced and proper balance between resource recovery and other waste management options, that the State's solid waste management system needs to reflect directly the hierarchy of waste management methods I mentioned earlier. And that to achieve implementation of that hierarchy, the State should take several actions. I'm not going to go through all of them that I've listed in the testimony; let me just touch on a couple.

First, I think there needs to be a reconsideration in the solid waste management plan to include the ranking of acceptable waste management techniques with goals of at least 50% recycling and 10% waste reduction, at most 25% incineration, with energy recovery and landfilling of the remainder which includes incinerator ash.

Secondly, I think there needs to be a comprehensive review of the present waste management needs in the State and the practices that are occurring, taking into account the import/export issue, that has already been highlighted this morning.

Thirdly, I think while that is going on, there needs to be a suspension in the granting of new resource recovery permits until these issues are resolved and until a reorientation of that waste management plan is accomplished.

With those general comments on context, let me now turn to an issue that I think is key in its deliberation; and that is the regulatory status of incinerator ash. Currently Federal regulation requires that any ash found to fail the EP Toxicity Test must be managed as a hazardous waste. Now EPA, at one time, considered altering its position on this issue, but instead chose to adhere to its original 1985 interpretation. And it has stated that it will continue to adhere to that position until -- and unless Congress changes the underlying law.

Specifically, EPA went on record last year -- a little less than a year ago -- in a congressional hearing stating that if ash exhibits a characteristic of a hazardous waste, it must be managed as such. And I've excerpted the appropriate passage from the testimony of EPA at that hearing in my written statement.

Thus, it is our legal view that DEP's proposal to reclassify all incinerator ash, including ash that fails the EP Toxicity Test, as a special waste, would constitute a State requirement that is less stringent than the Federal one, and that is a situation specifically prohibited under the Federal statutes. Thus, DEP does not have the legal authority on its own, to exempt ash that exhibits a hazardous waste characteristic, from regulation as hazardous waste. Until and unless there is a change, therefore, in the Federal law, ash that fails the EP Test must be managed as a hazardous waste in full compliance with all Federal and State requirements.

Now, as some of you may know, EDF a couple of years ago filed two lawsuits in District Courts to compel owners and operators of two incinerators to manage ash that failed the EP Test as a hazardous waste. Late last year, the District Courts handed down opinions that ruled against EDF on that issue, and maintained the EPA's position, that ash is subject to hazardous waste regulation, is inconsistent with Federal law. We continue to believe that our position is the correct one; that EPA's interpretation is correct, and we have every intent to pursue appeals in both of those cases later this year.

Let me turn now to what I view as important regulatory requirements for proper ash management. And because of the legal issues I just raised, what I am really talking about is ash that does not exhibit hazardous waste characteristics because the requirements are clear at this point for ash that does exhibit those characteristics. If and when a change in Federal law were to take place that would allow ash to be managed as other than a hazardous waste, then my recommendations would apply to all of that ash.

I think it is important to point out that the present system's sole reliance on an EP Toxicity Test for classifying ash is, indeed, problematic from a technical perspective. That's one thing, I think, all parties in this debate agree, though perhaps for some different reasons.

The EP Test, first of all, is a test, contrary to statements that were made earlier, that is intended to apply to any waste, not simply a hazardous waste. Because, in fact, the point of the test is to determine whether a waste is or is not hazardous. Therefore, to exempt a particular category of ash -- of waste, namely ash in this case, from that test is a deviation from the purpose and the original application of that test.

The test is flawed for several reasons, however. First and foremost, it measures only one of the many routes of exposure to ash that are a potential concern; that is leaching. In fact, ash can be a cause of concern to the environment and public health through a wide array of other routes of exposure, and I've attached some details from a paper that I wrote on this topic given at an international conference on municipal waste combustion last year for some details on that.

It also means that the EP Test-- That ash that happens to pass the EP Test cannot be assumed to be environmentally benign. There was some mention earlier about a new EPA study which has looked at actual leachates over the last couple of years coming from ash monofills. And those data do indeed, at those sites, indicate low levels of lead and cadmium in the leachates from those sites.

There are two important caveats to add to those data: First, we are dealing with a very limited set of samples and sites, and a very limited time frame over which we have looked. Most of the sites were sampled only a few times over the last couple of years. And we have to have a much greater degree of confidence in those types of data before we reach a conclusion that ash is going to be safe for the decades of centuries that we're going to have to worry about it in the ground. There are a number of laboratory studies that suggest that leaching of certain heavy metals does not take place immediately, and, in fact, can be delayed significantly in time.

Secondly, while lead and cadmium were very low in those leachates, several other metals showed up in significant amounts, well in excess of drinking water standards. Manganese, for example, was present in all of the leachates from all five sites at levels well above drinking water standards. And the interesting thing about manganese was that it correlated very well with the EP Toxicity Test. In fact, if anything, the EP Test underestimated the amounts of manganese in the actual leachates in these sites.

So, we cannot simply dismiss this test and say it doesn't -- that it always over estimates results. The data are mixed.

Given the risk to the company, the management of any ash, however, it is critical that ash that passes this EP Test, which is what we're stuck with for the time being, nevertheless is subject to stringent regulation that deals with all phases of management; not simply disposal at the landfill, but the storage, the transportation, and the handling of that ash, both at the incinerator site and at the landfill where it is deposited.

In EDF's view, an effective regulatory program for ash must also embody several other principles. First, I think, based on some comments that you've already heard this morning, it is critical to test and consider managing fly and bottom ash as separate wastes. They are very different and I've detailed in my written testimony some of the reasons why managing this material separately may make a great deal of sense.

ASSEMBLYMAN McENROE: May I ask a question, Dr. Denison: Is fly ash considerably more toxic in general terms than the bottom ash?

DR. DENISON: For most of the metals of concern, the concentrations of those metals are considerably higher in the fly ash. And even more importantly, the metals are present in a much more available form. That is, fly ash is small particles which is more leachable. The metals are much more leachable from fly ash. Those particles are also more likely to be dispersed into the environment by either wind- or water-borne routes. So you're dealing with a material that is quite a bit more toxic.

ASSEMBLYMAN McENROE: Would you recommend that, certainly, fly ash be separated from bottom ash prior to disposal? Or how about, would you recommend two separate testing procedures for each?

DR. DENISON: There may well be the opportunity to use the same testing procedure for both, but to require different management techniques for the two. For example, I think we need to be seriously considering treatment of fly ash, in particular, prior to it either being combined with bottom ash or somehow otherwise disposed, since that's where most of the metals are -- the most leachable and dispersable metals. Treating that material, even if you're going to combine it with bottom ash and go to a monofill may make a great deal of sense.

ASSEMBLYMAN McENROE: So, are the statistics that we are receiving based on residual ash, is it primarily a circumstance of the fly ash being the far greater problem insofar as the environment is concerned than the bottom ash?

DR. DENISON: Certainly the data indicates fly ash is a much bigger part of the problem. It's a much smaller part of the volume, which provides some unique opportunities to deal with it.

ASSEMBLYMAN McENROE: So, then if we restricted disposal, and we increased the testing of the fly ash, which is a -- you know, that part of the residual ash, would that correct the -- would that address the concerns of many people concerning the impact of toxicity in all the ash?

DR. DENISON: I don't think that it is possible at this point to say that we should ignore the bottom ash. There clearly are going to be some management methods needed for that. One could set up two tiers of management for fly and bottom ash. I think I would prefer to see a treatment of the fly ash, then combination with bottom ash prior to disposal. If we are talking about utilization instead of disposal, then we may be looking at a more stringent standard for containing fly ash, and then utilization on the bottom ash.

ASSEMBLYMAN McENROE: Now you've indicated concern with resource recovery as a technical procedure for the State. Now, you don't rule that out completely?

DR. DENISON: No, I think--

ASSEMBLYMAN McENROE: And as a part of New Jersey's strategy, you say only for 25% of the waste though?

DR. DENISON: Mr. Chairman, I think resource recovery clearly will have a role to play in New Jersey, as well as nationally. In our view, there is an overambitious commitment to resource recovery at the expense of recycling and waste reduction options that pose significantly better in economics, as well as environmental concerns.

ASSEMBLYMAN McENROE: Thank you. See, we're going to be moving along quickly so if you would-- Thank you.

DR. DENISON: Thank you.

ASSEMBLYMAN McENROE: Proceed.

DR. DENISON: I will finish up here very quickly. Disposal of ash separately from other types of waste in monofills is in our view, a critical element to proper management. The problem with codisposal of these materials together is that the heavy metals in ash are much more susceptible to leaching under acidic conditions that prevail in codisposal or sanitary landfills as opposed to in monofills. And this is clearly demonstrated also in the recent EPA report.

We have documented -- and I have attached to my testimony -- a description of the state-of-the-art ash monofill with respect to its design and operational characteristics. And I will refer you to that for details on EDF's views on proper ash management. It is very similar to recommendations that DEP is currently pursuing for ash monofills.

Finally, I think it is most important that we take aggressive steps to keep toxic metals out of products that are finding their way into municipal waste, and to keep those materials that contain such metals out of the waste stream. That topic came up earlier, and I would wholeheartedly agree, that we need to go after total amounts of lead, cadmium, mercury, and these other materials, and identify the principal sources. If they can be taken out through recycling or source separation, that would be great. The most optimal solution is to try to keep them out of the products in the first place.

Let me just touch very briefly on one final point, and that is need to insure that ash management is an integral part of the planning process for an incinerator. For both economic and environmental reasons, the public has a right to know from the outset that proper ash management will be guaranteed in each and every project that is developed.

Experience with other incinerators around the country -- and I have developed a couple of case studies in my written statement -- indicate that the only feasible way of doing this is to link the permitting of the construction of an incinerator to an assurance, a guaranteed assurance, of ash management capacity once that incinerator comes on-line.

New York has recently adopted such a requirement, as have several other states. And they basically require that a precondition for getting a permit to construct an incinerator is the identification of guarantee of capacity for ash disposal that is in compliance with all State regulations. I would submit that that mechanism can be a very effective way to insure we don't get into trouble down the road.

On behalf of EDF, let me express my appreciation for the opportunity to present my views. I'd be happy to work with the Committee any way I can to be helpful to you in this deliberation. Thank you.

ASSEMBLYMAN McENROE: Thank you, Doctor. We, likewise, are much appreciative to the Environmental Defense Fund for your appearance. Your testimony is compelling. It will become a part of the record and will be undoubtedly of great value to the Committee. All of the points you have made are of interest to this Committee, and generally, are very much on target with our concerns with New Jersey. Recycling is an issue of this Committee. We do plan substantial hearings on that matter very shortly. So your testimony will be part of this Committee's hearing transcript, and I hope you will provide us with information through our staff in the future. Thank you.

DR. DENISON: Thank you, Mr. Chairman.

ASSEMBLYMAN McENROE: I'd like to now ask the fourth individual who has asked to appear here, Vice President, William Glover, American Ref-Fuel Company. Mr. Glover, would you join us at the table, please. Welcome, Mr. Glover.

WILLIAM GLOVER: Thank you, Mr. Chairman.

ASSEMBLYMAN McENROE: Mr. Jacobson on my left, Mr. Duch had to leave the Committee, and Mr. Franks and Mr. Shinn.

MR. GLOVER: Thank you, Mr. Chairman and Assemblyman for the opportunity to testify this morning. We share a number of the concerns that have been mentioned by the speakers so far.

American Ref-Fuel Company of Essex County, And American Ref-Fuel Company of Bergen County, together "Ref-Fuel," are the developers and will be the owners and operators of resource recovery facilities in these respective counties. The Essex County facility will be operating in late 1990 and the Bergen County facility is in advanced development. Ref-Fuel is familiar in detail with the procedures that are currently incorporated in New Jersey Department of Environmental Protection regulations and is presently in the process of planning for operations in compliance with the regulations as currently interpreted. As the provider of disposal service at Essex County and Bergen County, Ref-Fuel has the obligation to provide for the protection of the environment through the compliance with its permits and regulatory procedures.

We believe that the current procedures established by NJDEP with respect to residual ash testing and disposal were intended to provide for adequate environmental protection regarding ash disposal. We further believe, however, that alternatives to these regulatory procedures are available which provide equal protection to the environment at substantially lower cost to the public. These alternatives are suggested by the DEP proposal itself and should be pursued in the public interest.

Analysis of the current regulations reveal three problems. First, the regulatory protocols currently called for are incomplete and will not succeed in practice as envisioned; second, the procedure starts with a basic assumption of toxicity which has been refuted in a number of court cases and important scientific studies which you've heard about this morning; third, there needs to be an understanding that the proposed special waste classification can, in fact, provide for the environmental protection that DEP is seeking.

As to the first issue, specifically, the current procedure requires the retention of ash at the facility until test results are available, which at best, experience creates a costly storage requirement of 12 days. Retention in Essex will involve 300 to 500 trucks of ash awaiting shipment. That's a minimum. The regulations suggest that eventually ash may be shipped without test results, but still require that testing occur on samples composited over periods of one month. This poses the question of how the responsible parties deal with a retroactive test failure and the potential liability for having improperly manifested, transported, and disposed in a landfill of material that has subsequently been determined to be a hazardous material.

It is suggested that, as long as the sampling and testing requirements are continued without amendment of current regulations, the responsible parties would have no recourse but to perpetually continue the practice of ash retention to avoid potentially improper manifesting, shipment, and disposal of material later deemed to be hazardous. In this way, the regulations will not resolve, as intended, a "characterization" of the ash, even if the initial test results are successful.

With regard to the second problem, newly released scientific studies subjected to peer review in New Jersey, have established clear evidence that the leaching characteristics of ash are very low and are not accurately reflected in the current test procedure. I won't cite the tests; they've been cited already this morning. Those results were available in February. Further, the Federal court determinations: Again, those have been cited, and I'll just delete the reference, but I'm referring to the two cases in New York and Illinois.

Based on evidence available today we believe that no other classification system is need. The RCRA exclusion has recently been upheld in the court. All states who have adopted any statute on residual ash -- and this includes New York, Massachusetts, Connecticut, Illinois, Michigan, and Pennsylvania -- have also adopted the RCRA exclusion. New Jersey is the only state, among all the states with a trash disposal crisis, to regulate resource recovery ash based on the unreliable and inappropriate EP Toxicity Test.

As to the third issue of adequate environmental protection under a special waste classification, disposal of ash in a correctly designed Subtitle D landfill provides adequate environmental safeguards through composite liners, leachate testing, and leak detection. If adequate line and leachate capture specifications are provided, the ash can either be monofilled or codisposed, in our opinion.

New Jersey's proposed sanitary landfill construction regulations, as yet unadopted, provide ample protection for the environment. Monofills or additional construction requirements, while desirable, are not needed for safe ash management.

Ash can be used as daily and intermediate cover material in a codisposal landfill since the normal problems associated with MSW; odors, fires, vermin, are not problems with ash. Ash moisture should be sufficient to avoid fugitive dust. Final cover should be placed over the ash.

The same post closure provisions as applied to MSW landfills should be observed, including a program to ensure that the leachate collection system and monitoring wells are properly maintained. However, methane controls are not required for the ash monofill.

Another issue which should be considered is the impact of current DEP policy on the available hazardous waste landfill capacity in the United States. New Jersey has no hazardous waste landfill but current policy could result in the export of a very large stream of incinerator ash which would seriously deplete the available hazardous waste landfill capacity in the region. New Jersey would also be placed in the posture of advocating the export of hazardous waste as a policy. New Jersey can no longer afford to classify ash differently than all of its neighbors and to exclude ash from landfills where it may legally and safely be disposed of in other states, based on an inaccurate test procedure.

In summary, while the current policy is intended to provide for protection of the environment, the policy results in a cumbersome and costly procedure which will not function as DEP originally intended it to function. Alternatives exist which provide equal protection to the environment, and it is imperative that these alternatives be more fully explored. Thank you.

ASSEMBLYMAN McENROE: Mr. Glover, you mentioned costly procedures, and we're here to evaluate both the environmental impact of residual ash and also the economic aspect of it. What are we talking about insofar as the regulation requiring that the testing be performed under current law in New Jersey? Is that a considerable impact on the cost of disposal to the users of your facility?

MR. GLOVER: Yes, it is. As long as it's required that the ash be retained. And the facilities that are operated so far indicate 400 tons a day and 575 tons a day. Those facilities are using somewhere around 150 roll-offs to store the ash until the test results are back from the laboratories. And those facilities have expedited the testing procedure, but there are limits to how-- You still have a retention time involved. And you have some retention time while you're collecting a weekly sample.

For the Essex facility, which is six times as large as Warren and four times as large as the Wilbur facility and the Gloucester facility. We anticipate several hundred roll-offs. These roll-offs cost something like $200 a week to rent. And by the time you add the costs of rehandling, storage, and testing and all that together, it could add $20 a ton to disposal costs.

If any of the ash fails and has to go to our hazardous waste landfill, you're talking about roughly tripling the cost of disposal of that portion of the ash. If it all went to a hazardous waste landfill, it would add $50 a ton to the raw waste disposal cost. If you go with any percentage of that, obviously, to take some fraction of that-- But, these are not small numbers. They're very large numbers. And the concern that American Ref-Fuel has is that as long as the test is imposed, and as long as the prospect of having a test fail, then it is very difficult to ship the ash and put it in a landfill, and a month later find that the composite test would indicate toxicity. And that would add some additional costs for redisposing of that material.

ASSEMBLYMAN McENROE: What creates the basic problem: Is it storage or is it testing; cost-wise?

MR. GLOVER: It's the time required to test. It's the cost required to store. It's not the cost of the test itself. That's not the largest cost. It's also the cost of disposing of this material as a hazardous waste.

ASSEMBLYMAN McENROE: And all the scientific data that your industry has reviewed all indicate, mostly, that the waste can be managed? You don't reject testing, but you do reject the current procedure, I understand.

MR. GLOVER: I think we seek to generically classify this material as a special waste. And I think that we feel the key is proper landfill design and not a test. As we mentioned before, the test is not a reliable test so you could be shipping this material to a less regulated landfill than we propose for the generic classification.

ASSEMBLYMAN McENROE: I understand your contract for Essex is for -- through the next seven years to transport it to a facility?

MR. GLOVER: The county has a contract for seven years with a landfill in New York State. The current procedures provide an impass in that it can't be manifested to that landfill until after it's been tested, according to the current DEP procedures.

So, there's a prospect that they will not be able to utilize that landfill for a portion of their material, and cannot ship the ash as DEP proposes, and our permit, without a manifest of whether it's toxic or not.

ASSEMBLYMAN McENROE: Are there any questions for Mr. Glover from the Committee? (no response) We appreciate very much your testimony, and I know the importance of the facility in Essex County as a solid waste disposal strategy. We have as a part of our plan for this Committee, we are looking forward to visiting your resource recovery facility so that everyone recognizes all--

MR. GLOVER: We'd very much like to offer to conduct that tour for the Committee. In addition, we have a nearly identical facility with some minor variations, but the same size facility operating in Hempstead, Long Island. There's a chance to see what a very large facility can look like in operation, and how clean that operation is.

ASSEMBLYMAN McENROE: Thank you very much.

We're going to move along quickly. We'll again digress from our published report. We'd like to-- On behalf of the New Jersey Association of Counties, we have an appearance by Carol Murphy, of Morris County -- President of the Association. Ms. Murphy?

FREEHOLDER CAROL MURPHY: Good morning. Thank you.

ASSEMBLYMAN McENROE: Ms. Murphy is a Freeholder. I'm sure everyone's aware of that. Dan Jacobson, and Mr. Shinn, and Mr. Franks.

FREEHOLDER MURPHY: Thank you very much, Mr. Chairman. With me today is Linda Spalinski, who is the Executive Director of the New Jersey Association of Counties. I believe she is very familiar with all of you gentlemen, having been here many times.

My name is Carol Murphy and I am a Morris County Freeholder. I currently serve as President of the New Jersey Association of Counties. On behalf of county governments throughout the State, I want to thank you for this opportunity to comment on the issue of resource recovery ash management.

The New Jersey Association of Counties supports the classification of resource recovery ash as a special waste. The designation as special waste, combined with a requirement to monofill the ash for disposal, offers what we believe is the most sensible and environmentally sound ash management strategy.

Available scientific and engineering studies indicate that resource recovery ash is nonhazardous but that its characteristics require careful handling, careful transport, and closely monitored disposal. The current regulatory protocol which relies on the EP Tox and the TLCP is inadequate. We believe it is, in fact, irrelevant.

Independent research by international experts indicate that the EP Toxicity Test and the TLCP are not predictive of the actual leachate characteristics of resource recovery ash. Analysis of leachate from recently constructed ash monofills reveal that metal content in the actual leachates are far below the concentrations observed from the EP Tox Test.

From a layperson's point of view, a requirement to monofill the ash seems to be supported for two good reasons. First, by monofilling the ash we greatly reduce the possibility of heavy metals leaching into water supplies. Research shows that metals will not leach from the ash from normal rainfall because they cling tightly to the ash and require an acidic wash to be released. By monofilling, we eliminate the presence of organic waste which influences the acidity and may affect leachate. Secondly, ash monofills will allow for a more careful and precise evaluation of actual leachate activity. This will certainly enhance our ability to develop effective treatment, based on sound scientific data.

I would offer a few general suggestions regarding ash management procedures. Operations at any resource recovery facility should minimize human exposure to residual ash by reducing fugitive dust and fully enclosing conveyor, mixing, and storage facilities. Regular monitoring of the residual ash should be accomplished using a simple and inexpensive testing procedure focusing on pH and/or alkalinity. The transport of ash to the disposal site should be in covered, watertight containers.

Clearly, the primary focus of attention in ash management must be placed on the ultimate disposal site. In New Jersey, the design of Class 1 sanitary landfills is dictated by the underlying geologic structure of the proposed site.

In my own home county of Morris it is most likely that we will be required to construct a landfill which has a containment system composed of a double composite liner; leachate collection and leak detection systems; leachate holding facilities; and an extensive groundwater monitoring network. We support these requirements as necessary measures to protect the environment. These requirements are virtually equal to those of a hazardous waste landfill and they far exceed the requirements proposed by Federal legislation, the US EPA or the Environmental Defense Fund for the safe disposal of this waste.

In closing, I would note that much further scientific and engineering research is necessary in the area of ash reuse. We should have a goal of developing a material from ash that can be safely and commercially utilized. Research efforts to examine potential ash use in road base and construction materials should be intensified. Reuse of ash will decrease our reliance on our scarce landfill capacity. This is an environmental goal most worthy of our best efforts.

Again, I do thank you for the opportunity to present the views of county government on this most important issue. If there are questions, I would be happy either to answer any of them with my knowledge if it is enough, and certainly to find the answers for you, if it is not.

ASSEMBLYMAN McENROE: Freeholder, we appreciate your comments and your testimony. Is there any question from any members of the Committee? (no response)

We appreciate your presentation of the Association's views regarding this subject. Thank you.

MS. MURPHY: Thank you very much. You do have copies of the testimony?

ASSEMBLYMAN McENROE: It will become part of our record, and we appreciate that.

We will next ask Assemblyman John Rocco, of Camden County who has asked for the opportunity of addressing the Committee. Mr. Rocco?

ASSEMBLYMAN JOHN A. ROCCO: Thank you, Mr. Chairman.

ASSEMBLYMAN McENROE: The floor is yours, Assemblyman.

ASSEMBLYMAN ROCCO: Thank you, Mr. Chairman. As all of you know on this Committee, I have great reservations about incineration and have legislation that would call for a moratorium.

Governor Florio, as we know, has also made it known that for awhile at least, he's opposed to incineration at this time.

I know today you are talking about the ash, and redefinition of the ash, and I would like to really address that, as well. In Warren County we know what the problem is and we know that a great deal of that ash is sent to New York at a very expensive cost; and rightfully so, because if it is, in fact, hazardous, then it requires special care and special provisions.

For the citizens of our State, and Camden County in particular, it would be disastrous to just maintain this hazardous substance in a regular landfill.

Back when Warren County first went on-line, I had a chance to speak to the DER in Pennsylvania -- to the chemist, who told me immediately that the ash was hazardous. Those forces to be who were in favor of continuing with the incineration process called me just about everything, including giving them false information.

Ultimately we found out that the ash was hazardous and had to be trucked out-of-state. At this time I am having a very difficult time getting information and maybe this Committee if it has the desire can aid, but it is very difficult to get information in regard to testing at Gloucester at this time, which is our second incinerator. I think our residents should know what the results of the testing are in Gloucester, since that is the second experiment, so to speak, on incineration in this State, which will ultimately have 20-some incinerators and which will have tremendous amounts of ash to deal with.

I will continue to attempt to get that information, but maybe the Committee, Mr. Chairman, if you so desire-- I think all of us would really want to know honestly what the results of the testing--

ASSEMBLYMAN McENROE: Mr. Assemblyman, I have the results of the Gloucester County facility--

ASSEMBLYMAN ROCCO: Oh, do you?

ASSEMBLYMAN McENROE: --and I'll be glad to make them available to you.

ASSEMBLYMAN ROCCO: Oh, good. I haven't been able to get it, and I'm glad you have it. If I could have copies of that.

ASSEMBLYMAN McENROE: We'll make it available at the conclusion of the hearing. Which I've only received this morning--

ASSEMBLYMAN ROCCO: I see.

ASSEMBLYMAN McENROE: --since the meeting had commenced.

ASSEMBLYMAN ROCCO: Do we have any indication whether we have any hazardous substances in it?

ASSEMBLYMAN McENROE: If I read the chart correctly, it appears that on a pass/fail chart, they passed each of the six times that the substance has been tested.

ASSEMBLYMAN ROCCO: Okay.

ASSEMBLYMAN McENROE: I also have results of the Warren County facility. I'm holding this until they are here to testify.

ASSEMBLYMAN ROCCO: Okay.

ASSEMBLYMAN McENROE: So Warren County will testify on their experience over the past year.

ASSEMBLYMAN ROCCO: We'll certainly see what the long-range results are, and when they get to burning substances other than maybe a more controlled type situation in the long-run, we'll see.

I hope they're not hazardous, really, for all people concerned. But if they are, certainly it should, indeed, require special care.

One of the areas not tested I believe -- and maybe you can verify it for me -- is mercury. Is that correct? Is mercury on the test list, does anyone know?

UNIDENTIFIED SPEAKER FROM AUDIENCE: Yes, it is.

ASSEMBLYMAN McENROE: I have no knowledge. We can address that question when we--

ASSEMBLYMAN ROCCO: Mercury is on the test list? Because the State of Florida has had great difficulty now with the animal life and the fish, in terms of mercury content. I will, this afternoon, pass an article out to the members of this Committee showing that the five resource recovery plants in Florida have been deemed the culprit so to speak, in terms of the mercury that is in the Florida waters.

In Camden County we're going to have within a ten-mile radius, three incinerators: one in Pennsauken, one in Camden City, and one in Gloucester. What will happen with prevailing winds in Cherry Hill and much of Camden County, we're going to have a tremendous concentration of incineration which will certainly not only have the air pollution problem-- I mention mercury simply because mercury is, from what I can gather, heavier than many metals, doesn't travel as far, drops closer to wherever it's projected into the environment, tends to not dissipate but accumulate, and has been known to cause retardation in children, and brain damage. In fact, in Florida now they're telling pregnant women not to eat the fish; in fact, to only eat fish once per month. I think that's a growing source of information that this Committee ought to look at carefully and possibly get some additional information from the State of Florida.

I say that in terms of not only Camden County, where we do have the three incinerators in this tremendously concentrated area across the river from Philadelphia, but for all the people of the State of New Jersey.

If, in fact, we move ahead with the 20 incinerators planned for the State of New Jersey, I would suspect that the "cancer alley" that we presently have will further enhance the potential for people to get cancer and that, of course, must take priority over dollars, by any stretch of the imagination.

To change the present Federal requirement for the ash and for the DEP through regulatory form -- which it has attempted to do-- To change the definition of the ash is wrong. There is no reason to classify it as special ash. Even Governor Florio in an Eagleton speech, I believe -- and I will give you the source for that -- indicated that that is not the way to go.

Special ash is not the way to go on this, and to redefine that ash against the EPA would be going in the wrong direction.

We have the Clean Air Act on the horizon. We have in Camden County and parts of Gloucester County drinking water that is now polluted that cannot be utilized. We have "cancer alley." Incineration, in the magnitude that this State is moving ahead, is just wrong.

As a Republican I applaud Governor Florio for his moratorium at this time even though we proposed it some time before he did. But I believe that anyone who objectively looks at the information and what it is we're trying to do, which is really to reduce 100% of mass down to 30% or 40% of mass, and all of the inherent problems that come with that in terms of toxicity and damage to the environment and costs to the taxpayers-- It just doesn't make a whole lot of sense. I've never seen anything in my 15 years of political life more obscene than the way this State is moving ahead with incineration.

Thank you.

ASSEMBLYMAN McENROE: Thank you, Assemblyman. I know of your diligence and interest in this subject, and I recognize your interests and leadership regarding your point of view.

I want to just comment on your supposition that we will have 20 resource recovery facilities in various parts of the State. I've been involved in my area of the State's development of resource recovery as an answer to our urban counties' problems, and never for one moment have I ever envisioned 20 facilities being built in 20 different parts of this State. I've always recognized that regionalization was an appropriate way. Insofar as the necessary capital involved, there never was really any genuine concern other than an obligation under law to provide planning procedures in each of the counties.

There was never, I don't believe, any substance to the argument that 22 plants will be located in 22 different parts of the State, the counties, and the Hackensack Meadowlands.

ASSEMBLYMAN ROCCO: Mr. McEnroe, you have certainly been a leader in this State in this arena, and I'm very happy to hear that because the way the DEP was moving forward, and as we all know, sometimes the bureaucrats tend to get much more aggressive on this. They, in the research that we have done in terms of where the sitings were to occur, we came up with over 20 plants.

So regionalization-- I'm sure that incineration plays some part in this whole process. No one objects to that. But to not look at greater recycling and all of the other possibilities that are out there would just be the wrong way to go.

ASSEMBLYMAN McENROE: I think that the political judgments made by the Legislature and the Governor certainly will provide an adequate disposal plan that we can all support.

ASSEMBLYMAN ROCCO: Thank you, Mr. McEnroe

ASSEMBLYMAN McENROE: Thank you. Mr. Shinn?

ASSEMBLYMAN SHINN: I'd just like to comment on John's mercury concern because we had resource recovery -- a small plant at Ft. Dix. It's 80-ton per day, four 20-ton modules.

We had a mercury problem. Mercury was vaporizing in the bag house, collecting, and became part of a waste stream that ultimately went to a sewage treatment plant and was land applied. When we found that the concentrations were above the limits in their permits, the plant was shut down.

They analyzed their waste stream and found out that because of military operations, there was an excessive amount of flashlight batteries that were going to the plant, thus the source of mercury.

They worked out an exchange process on the flashlight batteries so that when you got a new battery you traded in your old one and they went to a proper facility for reclamation or disposal, and ultimately solved that problem.

In special areas there are special conditions that can give you a problem, and mercury is an important issue and one that I know is on the list because we exceeded that parameter and that's how we came about, that whole resolution of the problem and identifying the issue.

Lead is another potential--

ASSEMBLYMAN ROCCO: Right. It's such a damaging-- It really is so damaging to the body.

ASSEMBLYMAN SHINN: Yeah. Exactly.

ASSEMBLYMAN ROCCO: It accumulates.

ASSEMBLYMAN McENROE: Mr. Rocco, I'm going to make available to you a copy of what we just received regarding the testing at both Warren County's facility and at the Gloucester County facility for your review.

ASSEMBLYMAN ROCCO: Right. Thank you, Mr. Chairman.

ASSEMBLYMAN McENROE: Thank you. I'm going to digress again. Since we have commented on the success or failure of the Warren County facility, I'd like to call on Mr. Bart Carhart and John Polhemus, Warren County Pollution Control Financing Authority, if you would, to make your presentation?

Good morning, welcome. You, I am sure, are aware of who the Committee members are. Thank you.

FREEHOLDER JOHN D. POLHEMUS: Good morning, Assemblyman. I'm John Polhemus, Freeholder Director of Warren County and Vice Chairman of the Pollution Control Financing Authority of Warren County, the financing authority that financed the RRF which is operated by Blount Inc. almost two years now, and the owner/operator of a Warren County landfill which will be on-line on about May 15 or June 1.

I'd like to ask our Executive Director, Bart Carhart, to give some comments and some data.

ASSEMBLYMAN McENROE: Mr. Carhart.

BART CARHART: Thank you. It's good to see all of you again. Briefly, I'd like to explore the history of the facility with you. I know you're interested in the economics and how much of the ash has failed the EP Tox Test, and I can give you a brief update on that.

Our facility went into operation in July of 1988. We have the capability of processing about 150 tons a day. It's probably one of the smaller facilities planned for New Jersey.

Since it went into operation in July of 1988, we processed 210,000 tons of solid waste. This waste was generated from within Warren County. We take all of Warren County's processible waste. We've been taking all of Hunterdon's processible waste, and since about mid-1989 we have been receiving approximately 1000 tons a week from Somerset County. So, we feel we are really a regional facility and I think it's an example of how, through increasing recycling, we can utilize the capacity in our incinerator much more effectively by expanding the service area. By increasing recycling we can expand our service area to include more waste into the incinerator, is what I am trying to say.

Of the 210,000 tons of solid waste that we've processed, we've reduced the volume of that waste to approximately 45,000 tons. We got 210,000 tons processed and that resulted in the generation of about 45,000 tons of ash.

Presently we are testing and sampling testing, and disposing of the ash in the following manner:

One, we collect representative samples of the ash. That's done automatically. The ash is combined, the bottom of the fly ash, and at some point beyond where these ash streams are combined, there's an automatic sweep that comes across and takes an ash sample. I don't know the frequency of this, but it is very frequent. This ash that is taken off is composited into a sample which we call representative of a batch of our ash. A batch generally represents the ash that's accumulated in a 7- to 10-day basis.

So this composite sample we mix up, and then we take 10 samples of this ash, and they go to an independently certified lab, certified by the DEP. They perform the EP Tox Test on it. The test, I think, measures for eight metals. When our ash has failed, it has failed primarily for cadmium. On occasion it has failed for lead.

Then, after it has passed the test, we have two options. As John indicated, we have a landfill that is under construction, and we should have a cell available for the ash sometime in June of this year. But since July of '88 until hopefully June of this year, we've had to export our ash for disposal.

If it fails the EP Tox Test, we send it up to a hazardous waste landfill near the Buffalo area, at a disposal fee of $285 a ton. When it passed the test, under regulations by the Pennsylvania DER who gets the test results of each batch, they make a decision whether they can accept it in their landfills or not. Assuming they agree that it is acceptable in their landfills, we dispose of it at $68 a ton. When our landfill goes on-line, we'll probably be disposing of our ash at $40 a ton; it will cost us $40 a ton.

All in all, we've generated, as I indicated, about 45,000 tons of ash since July of '88. Thirty-five thousand, seven hundred tons of that ash, which amounts to approximately 79% of our ash which was generated, passed the EP Tox Test and was approved for disposal by Pennsylvania DER in a sanitary landfill in Pennsylvania.

That means that about 9300 tons of ash failed the EP Tox Test. About 21% of that ash failed and that went, again, to a hazardous waste landfill in New York State.

Total ash disposal costs since July of '88 have amounted to $5,078,000. Again, the major portion of that has been-- While the quantities are less because of the higher disposal costs, the majority of that had been for hazardous waste disposal.

We calculate that while we spent over $5,000,000 for disposal, had we had our own landfill on-line during this period, the cost would have been about $1,800,000. So a substantial savings could have resulted from us having our own landfill on-line and being able to dispose of the ash there.

Mr. Glover indicated about the number of containers that they may need at the Essex County facility to store ash. Basically, while we're testing, doing the EP Tox Test on each batch of ash, we take the samples, and they go to the lab. In the meantime we have to store that ash on-site, and it cannot move off until we have the results of that EP Tox Test back. When we first opened up, the turnaround times from doing the samples to getting the results were averaging about three weeks. So, our ash had to sit on-site for three weeks in storage containers as we were generating more ash. There were times, particularly in the early operational period, that we had as many as 170 to 200 containers of ash on-site, waiting to get test results back to move off so that we could dispose of it.

I think Mr. Glover indicated his facility in Essex

County is going to be five or six times the capacity of ours. So, you know, the cost of the storage in a facility such as Essex will be monumental.

ASSEMBLYMAN McENROE: What have you done to improve the success of your tests over the past year? Because from the chart that I have over the past -- let's say, I would think the past year -- the batches have failed on four occasions and have been positively tested, I guess, probably 30 occasions?

MR. CARHART: Thirty, forty, yes. We had a run of 30, almost 30 batches that failed, and then as you indicated we had four-- I'm sorry, a run of 30 batches that passed, then a run of three or four batches that failed, and now we're up to, like 12 or 13 straight batches. Prior to that, and during start-up period, I don't know-- Do you have the chart there with the batches numbered?

ASSEMBLYMAN McENROE: Yes.

MR. CARHART: Batches 1 through approximately 22. If you look at batch 22, that was batches that were generated in October of '88. So the facility was only operating from July through October, and the majority of our failures occurred during that period.

You asked the first speaker, Dr. Magee, about removing metals from the waste stream. We, in Warren County, are advocates of that.

Our main problem was cadmium at the time. Prior to the facility opening up, we did what we call an industrial survey. We surveyed every industry within the county, for example. They gave us an idea of the quantities and the quality of the waste that they were generating. With that data, plus data that was done by EPA on what waste materials contained cadmium, we went out and surveyed these industries and showed industries some of their materials that they were generating that contained cadmium. We made arrangements for that waste stream to be separated from what came into the incinerator. That waste stream was taken directly to a landfill for disposal.

We're talking items like-- A lot of car fasteners, car bumpers, plastic on car parts, contain cadmium. I think Dr. Magee indicated plastics, particularly detergent bottles that are red and orange in color, they contain cadmium as a dye. Some newsprint, some printers' ink contained in newspapers contain cadmium. So we feel very strongly that if we can eliminate that material from the waste stream, as well as, for an example, mercury in batteries and lead and cadmium in batteries, that we would highly recommend that as a State policy.

ASSEMBLYMAN McENROE: So, your local, vigorous concern demonstrates a substantial improvement?

MR. CARHART: Improvement, yeah.

FREEHOLDER POLHEMUS: Particular thrust on battery recycling. We set up a pilot battery recycling-- Plus public awareness tying the batteries -- throwing batteries in the garbage -- to the public image of making their garbage costs go up. That's the way to get people's attention.

ASSEMBLYMAN SHINN: Are you--

FREEHOLDER POLHEMUS: I think that is partially--

ASSEMBLYMAN SHINN: Are you protocoling your Type 27 wastes and all? Are you, your industrial wastes--

MR. CARHART: Protocoling? I don't know exactly what you mean by that.

ASSEMBLYMAN SHINN: Basically, because that has the potential for contaminants are going-- Are you looking at particularly the Type 27.

MR. CARHART: Right. That's what the industrial survey--

ASSEMBLYMAN SHINN: Putting them through some process?

MR. CARHART: Yeah. We've gone out and visited the industries and in most -- in a lot of cases -- we've split the waste streams. We've said, "This part of your waste goes directly to a landfill. We don't want to combust it." And then there are some materials from ID 27 waste that are clearly suitable for combustion.

ASSEMBLYMAN SHINN: You don't do that at the gate? You do that--

MR. CARHART: We do that at the industry, up front.

ASSEMBLYMAN SHINN: Okay.

MR. CARHART: What we did was we contacted the industry, we took along with our visit the hauler that services that industry and we sat down with them, and in many cases the company would have to hire more roll-off containers to separate the material. But by and large, we found that industry was very cooperative when they knew what the problem was.

We too, just -- I'll go very quickly. We, too, have problems with the EP Tox Test and the results that have come from it. We've taken blind samples -- same samples, send it to the same lab, we get different results back. You know, we don't feel it's an accurate measurement of what's trying to be measured.

We too, would favor some type of special designation that the ash could go into our landfill that's a state-of-the-art, double lined, composite landfill. DEP has told us while they do not have policy in writing yet, that they are going to require monofilling of the ash and we, too, share your-- We don't know whether monofilling is a better procedure than codisposal, but DEP has told us that they are going to require monocelling of ash, so we proceeded on that assumption, and we have a dedicated cell. The first cell that will open will receive only ash.

We feel that through the monitoring of our leachate, through the leachate detection system and leachate treatment, that that's maybe the suitable way to monitor leachate and its potential impact.

ASSEMBLYMAN McENROE: Director, as an elected official, what has been the concerns of the citizens in Warren County? Has there been a major concern regarding ash or its disposal or its toxicity?

FREEHOLDER POLHEMUS: No. Most of the concern has been from stack emissions, concern about the possibility of mercury dioxins. But there hasn't been much concern expressed to us about the ash. The landfill is in my home municipality, and really, I was Mayor of the municipality when it was sited there. That's how I got active very fast. But there hasn't been a lot of opposition. There has been more opposition on the energy from refuse part of it.

ASSEMBLYMAN McENROE: Thank you very much. Questions? Mr. Shinn?

ASSEMBLYMAN SHINN: My first question is more political than technical. But, in the thousand tons you are getting from Somerset-- You know, one of the things that everybody talks about but very few people can achieve, is some type of regionalization agreement. Can you tell us how you -- what came about to bring Somerset in for the thousand tons, and how that materialized?

FREEHOLDER POLHEMUS: Well, in the intricacies of our agreement with Blunt, the provider, they had a provision that they could go to third market waste. Well, that has evaporated. So, we had a provision that we needed more waste for the facility and Somerset approached us and we did, I think, in a good regional agreement-- They're returning some things to us: Incineration of septages, pilot program on composting, and they've offered to take over our entire recycling program. So, we're getting something, plus a two-and-a-half million dollar amount of money, so there are-- It was a give and take deal.

I think both counties have benefited. Surprisingly enough -- you asked about public opposition -- there is where the public opposition has been from; the fact that, particularly a bit chauvinistic I think, that people in our county didn't want to burn anybody else's garbage.

But the economics of it provided that we could. We did have enough capacity, and in doing that and filling the minimum daily commitment to Blunt, we were able to have them generate more money; therefore, we are renegotiating our deal with Blunt and bringing more money back to the Authority, plus providing them an additional profit. So, we're splitting that with the provider.

ASSEMBLYMAN McENROE: Thank you. We are very appreciative of your comments and your attendance here today. Thank you.

FREEHOLDER POLHEMUS: Thank you.

MR. CARHART: I'm going to leave, excuse me, Mr. Chairman. This is what we submitted to DEP on their proposed rule making, and it includes a couple of the reports that were cited here today, and an update on our ash.

ASSEMBLYMAN McENROE: Very good. We appreciate that, Mr. Carhart.

MR. CARHART: Thank you.

ASSEMBLYMAN McENROE: Thank you very much. We will turn now to Mr. Matthew Root, representing Ogden Martin Systems.

MATTHEW ROOT: If I may, Mr. Chairman, I am going to allow Mr. David Sussman to speak in my stead for the Institute of Resource Recovery.

ASSEMBLYMAN McENROE: We have Matthew Root and also David Sussman. So, you are both together or are you--

MR. ROOT: I submitted some testimony--

ASSEMBLYMAN McENROE: Thank you. We have that.

MR. ROOT: --some comments.

ASSEMBLYMAN McENROE: Thank you. David Sussman.

DAVID B. SUSSMAN: Basically, what we're doing is, we're moving up one.

Good morning, and thank you for this opportunity to discuss municipal waste combustor ash. My name is David Sussman. I'm Vice President of Environmental Affairs for Ogden Martin Systems, one of Americas's leading waste energy system vendors. Today I'm speaking for the Institute of Resource Recovery, a component of the National Solid Waste Management Association. The member firms of the IRR design, build, and operate facilities that recover energy from the thermal treatment from municipal solid waste.

I'm the former manager of the United States Environmental Protection Agency's Waste Combustion Program, and have been involved with integrated solid waste management for about 20-years now. I'm a garbage man. I grew up in New Jersey next to one of the world's largest open dumps. It's now called Newark Airport. I grew up in Elizabeth. So naturally I gravitated to this business.

I've personally been involved with the sampling and analysis of ash residues from over 20 U.S. facilities since 1975 and have responsibility at Ogden to oversee the management of about 3000 tons of ash each and every day from 13 of our facilities.

I'm not going to read my testimony. That pile there is the supporting documentation, and I don't think you want me to wade through that.

Resource recovery is an important tool available to municipalities for the management of their municipal solid wastes. It can reduce the volume of material which ultimately must be managed; recover energy, which is the most important resource in our trash materials; and most importantly -- which no one has mentioned today -- eliminate the most serious health threat of municipal solid waste, that of its capability of supporting disease vectors. People tend to forget when we get in these politically charged discussions, that we manage municipal solid waste today for basic sanitation reasons.

Thermal treatment of municipal solid waste converts it into a biologically inert ash residue. As Dr. Magee and Dr. Kosson have discussed -- and I agree with them -- it has only recently been understood that the potential toxicity of ash has been grossly overstated by many of the laboratory toxicity predictive tests.

In fact, everybody's been talking about the EP Tox Test here today. The EP Tox Test has officially been replaced by the toxic characteristic leaching procedure. Mr. Reilly, the Administrator of EPA, signed that rule -- promulgated that rule on 6 March. It hasn't hit the "Federal Register" yet, but it basically means the EP Tox Test is gone. It becomes unusable I think, officially, six months from now.

The TCLP isn't much better, but at least it eliminates some of the uncertainties of the previous tests. So the Federal government itself has acknowledged that the EP Tox Test is not a very good test.

When ash is placed in a proper land disposal unit, the rain water which comes in contact with it produces a liquid -- I mention this because it's not truly a leachate, but just, that's what we call it -- which has the physical and chemical characteristics of ocean water. This "leachate" is generated only while the disposal site is active. As soon as you close it, no more water infiltrates into the site, and consequently no more leachate is generated. It's a short-term generation of leachate for as long as that site's active.

Another thing: Actual toxicity tests carried out in California using the California Toxicity Testing Methods. This is, feeding potentially toxic materials to fathead minnows, indicates that ash is not acutely toxic to aquatic organisms. This was just recently done in California, and we have something in our testimony that supports what California has done, at least from the ash from one facility, they said because of its physical and chemical characteristics, it's considered a nonhazardous waste.

Considering how much we know now about the physical and chemical and leaching characteristics of municipal waste ash residues, the only testing worthwhile in the future would be to determine the changes from today's baseline, from product reformulation, from increased recycling activities. These changes can best be noted using an entirely different testing methodology, one that looks at the total metals in the ash.

Additionally, testing is certainly necessary -- or test methods are necessary -- if we are going to use ash to determine that its use is reasonable.

In any case, ash should be properly disposed. It makes no difference what it's called. Whether you call it a hazardous waste, a toxic waste, a benign material, or a solid waste, the testing and the name of it doesn't buy you one bit of environmental protection. You protect the public's health by the way you manage the material, not by what you call it.

The IRR, in initiatives pending before the U.S. Congress which happen to be similar to the one that Governor Florio introduced in the House last year-- As Mr. Glover pointed out, many states believe ash should go into landfill units that have certain minimum technical standards, for example a composite lined monofill, or a double lined cofill.

There has been a sufficient amount of testing in the U.S. and elsewhere, in Japan and Europe, to know that these technical requirements are protective of the public's health.

The testing of ash to determine the ultimate disposal scenario as has been done in New Jersey in the past -- whether it is a hazardous waste or nonhazardous waste -- is just not supported by the existing data, by Federal law, and is technically, just wrong.

The IRR is supplying the Committee with documentation with regard to the characteristics of ash, ash fill leachates, the Federal initiatives, and what's happened in other states.

I thank you for the opportunity to provide you with our perspective. I'd be glad to answer any questions or to clear up any of the statements that other people made.

ASSEMBLYMAN McENROE: Any questions?

ASSEMBLYMAN JACOBSON: Was that "fathead minnow"?

MR. SUSSMAN: Fathead minnow. It's a very strange test. You take a fish tank--

ASSEMBLYMAN McENROE: This is not your regular minnow type. It's the particular fathead.

MR. SUSSMAN: It's particular. I thought they were flathead minnows for years and somebody told me, "No, they're fathead minnows." You put in the tank whatever you're testing, and after 96 hours you count how many minnows die.

When they were subjected to ash at three times the concentration necessary in the test, they all survived. So it's not an acutely toxic material, at least to fathead minnows.

ASSEMBLYMAN McENROE: Well, one question I have, and I guess it's a personal observation: You know-- Your testimony is impressive. You have 20 years experience. Your industry has an enormous investment in resource recovery facilities and yet we're here at this juncture where we are still unable to influence the Federal government to come up with the level of testing that you feel would be appropriate for your industry.

MR. SUSSMAN: Well, I was--

ASSEMBLYMAN McENROE: Why has the industry failed?

MR. SUSSMAN: I was at EPA when the decision, incorrectly, was made, or when section 3001(i) of the hazardous and solid waste amendments of 1984 were codified. They were codified incorrectly. I mean, I was there; I know what happened.

Once EPA determines its position, it never moves. Right or wrong, it sticks with that position. And they have taken the position now that until Congress passes one of the laws that are up there, either the Durenberger Amendment which is attached to the Clean Air Act, or one of the RCRA reauthorization bills, they will not act.

I think that's unconscionable on their part. They see the data; they know exactly what's going on. They're perfectly capable of officially releasing their guidance -- which is dated March of 1988 -- which outlines a complete ash management program which I know the State of New Jersey has, because they printed it. You know, "Do not quote or cite," but they made 240 million copies of it so we all have it. They just won't say it's official.

Why they're doing that? I can't answer that question. But they have vacillated back and forth since 1984 over the regulatory status of this material.

ASSEMBLYMAN McENROE: Thank you very much. We appreciate your testimony and your comments, and we'll distribute these, if we may, to each of the members of the Committee and we'll have it, of course, as part of our official record today.

Next we have Susan Mazzocchi, State Coalition Against Incineration. Susan Mazzocchi, please?

SUSAN MAZZOCCHI: I am Susan Mazzocchi, Coordinator of the State Coalition Against Incineration. The Coalition is made up of 19 environmental and civic groups in 16 counties, who are fighting the siting of incinerators and working to identify and promote more benign alternatives for solid waste disposal.

Hazardous wastes are identified under U.S. law as those materials that pose a substantial present or potential -- and I emphasize the word "potential" -- hazard to human health or the environment when improperly treated, stored, transported, disposed of, or managed.

This statement describes incinerator ash: In 1987, the EPA, referring to a report that it did, said that ashes from incinerated garbage contain significant amounts of lead, cadmium, dioxin, and other toxic substances that can threaten health and the environment. The study confirmed that ash, particularly fly ash, must be treated as hazardous waste, which could make incineration prohibitively expensive. And I believe that that's why we're here today.

Incineration is dangerous and expensive. We know that it spews thousands of tons of mercury, lead, dioxin, and other hazardous substances into our cities, land, and water. As a matter of fact, they are permitted to do this. Incineration also produces ash which cannot be safely landfilled. The EPA has stated that there is no such thing as a landfill which will not leak, no matter how state-of-the-art it is.

It is agreed by everyone that the EP Tox Test is not reliable for determining ash safety or toxicity. This is the test by which we characterize incinerator ash, and this is the test we will use to assess leachate from landfills and ash reutilization projects. Additionally, the addition of lime promotes leaching of toxins from ash. The more lime that is mixed with it, the greater the release of toxins. Furthermore, studies have shown that leaching increases over time.

We have a history in this country, and in this State in particular, of thinking that we can license and permit a certain amount of pollution, a certain amount of environmental and human health risk and that then we can test it, monitor, and control it. But we have been unable to do this. Neither Federal nor State government agencies have the money or the manpower or the will to do this. And that's why our State is unable to comply with the Clean Air Act, why we are losing our drinking water supplies, and why we now need $20 billion, according to our DEP, for cleanup.

In 1987 the City of Philadelphia put hundreds of thousands of tons of incinerator ash on a ship and sent it around the world trying to get some country to use it as a resource, or at the very least, to landfill it.

It was originally intended for Panama to use in roadbeds. Out of fear that international relations with Panama would be harmed if the ash were to poison Panama's environment, the EPA was asked to study the situation. EPA recommended against Panama's using the ash for roadbeds, saying that it could harm wetland areas and bioaccumulate in animals, birds, and fish through soil migration and runoff.

Following Panama's rejection of the ash were the governments of Guinea, the Bahamas, the Dominican Republic, Honduras, Guinea-Bissau, Haiti, Yugoslavia, Costa Rica, Cape Verde Islands, Chile, and Turkey. All felt the ash was too hazardous, despite the assurances of Bulkhandling, the Norwegian firm trying to broker the situation, that the ash and the materials made from it had been tested and were not toxic.

Philadelphia's incinerators were old and did not burn as efficiently as the ones being built here now. The more efficient the burning process, the more toxic the ash. So what was true of Philadelphia's ash will be more true of ours.

What we are saying is simply this: You cannot make a silk purse out of a sow's ear. If ash is reclassified as a nonhazardous or special waste, it will be shipped around the globe as a resource instead of the waste that it is. It will be used for a whole host of projects in our State and around the country. Projects that must be monitored for their life spans, but won't be. And as they deteriorate from abrasion, erosion, weather, and acid rain, and when they are no longer viable and need to be dug up, razed, and discarded, our children and grandchildren will have to deal with these toxic wastes or be threatened by them.

Additionally, we will be exposing workers in ash reutilization industries to dioxins, furans, heavy metals, and other toxins in the extremely hazardous form of toxic dusts which can be breathed in, ingested, and absorbed through skin.

This would be irresponsible; it would be criminal. It is time for us to stop arrogant, short-sighted behavior and be prudent. Since it is a given that the true environmental and health costs of such action cannot be known, we must protect through prevention.

The Coalition does not understand the purpose of this hearing. Governor Florio has publicly stated that he would not consider any reclassification of incinerator ash. While we are here today, the DEP is proceeding with two heavily funded ash stabilization and reutilization projects: The NYSERDA project for road pavement, which I believe will cost $2.7 million, and another $1.1 million project utilizing $800,00 in recycling funds to build and study a whole host of projects on which bids have already been received.

The NYSERDA project is flawed from the beginning. And it seems to us that the right hand does not know what the left hand is doing down here in Trenton, and that there is a great deal of confusion.

Additionally, it is my understanding that Warren County ash is being sent to Minnesota for road paving. I would suggest if that is the case, we should study their experience before we embark on anything here.

In any case, we do not believe that hearings such as this should be taking place. The only safe way to deal with incinerator ash is not to have it in the first place.

We produce too much waste. We must reduce waste at its source. We must improve recycling. We must develop markets for recyclables. We must develop the utilization of composting.

We need hearings on these things, and we need to divert the $4 million being allocated for ash reutilization studies, to study these things. Only then will we know whether we actually need to promote and bolster the questionable incineration industry. Until then, there is no proof that we need it at all and therefore that we need to deal with the question of its waste product, namely ash.

We have a four-month pause now, and if it is not just for PR or a fulfillment of campaign promises, then this four-month pause should be used to see how we can do without incineration.

We are not happy about the idea of regional incinerators because larger incinerators are more hazardous than small ones. They do not solve any of the problems discussed here today. They need the same amount of garbage to burn; they produce the same amount of ash. It is less economically feasible, and more transportation is necessary.

My conversation with DEP officials over the last few weeks leads me to believe that the DEP really cannot turn its back on this policy that they set into motion. But we are here today to ask you to see if we can't use this four-month reprieve that we have, to see if we can turn away from this policy.

Thank you.

ASSEMBLYMAN McENROE: Thank you. We appreciate your coming before the Committee and providing us with your strongly held opinions on behalf of your organization. I do want to comment, if I may, and then we'll hear from Mr. Shinn.

The Legislature has the responsibility as the forum for refinement of public issues. This is a major issue affecting the State. The Governor's Office is interested, certainly, in the testimony that we developed here today. The Office of Policy and Planning representing the Governor's position is vitally interested in the information that we develop, as is the Department of Environmental Protection.

I should remind you, that under the Constitution of our State we conduct our affairs somewhat independently of any other body of government. The Department is not the place where policy is set. The policy of the State is set within the Governor's Office and the Legislature. So, we share an equal responsibility in the development of policy. This is an important public issue and in our view to provide for our members so they can vote appropriately at the proper time, if that is the direction that we take. This is important testimony. We appreciate your coming.

Mr. Shinn?

ASSEMBLYMAN SHINN: I'd like to respond to the comment relative to lime -- the process and its relationship to heavy metals that magnify the dropping out of heavy metals. That's accurate, but in a leachate treatment process, if you have a landfill that typically the leachate is very low pH and exceeds the standards on various metals. What happens in the leachate treatment process, you add lime to that leachate to raise the pH, to super elevate the pH, which drops out the heavy metals. Then you congeal the lime in the process and pull the lime back off which ends up in the sludge cape, a dewatered sludge cape.

Essentially that process drops the heavy metals out to meet your discharge permit and puts the pH on a level of somewhere around seven or seven-and-a-half, which is also discharge permit condition. So, the lime in dealing with leachate from either an ash fill, which again has a low pH, or a typical municipal waste landfill has a very positive effect on the treatment process by getting the heavy metals out of the discharge and elevating the pH.

I don't understand the lime relative to the increasing of the heavy metals, unless it's a lime application at the landfill itself. So that confused me a little bit, and I thought it ought to be clarified just for the record.

ASSEMBLYMAN McENROE: Thank you for your comment, Mr. Shinn. I'm sure questions that are unanswered here will provide as a part of the testimony, the opportunity for providing those kinds of answers.

We also have Mr. Edward Cornell, Executive Director, Waste Management Association. Is Mr. Cornell here? (no response) Is there anyone representing Mr. Cornell's point of view? (no response)

Next we have Mr. Paul Bontempo? (no response) Again, these are people who had asked to appear. We will open the floor and the opportunity in one moment for anyone else.

Lorraine Gold, a Warren County resident. Lorraine Gold? (no response)

Is there anyone else in attendance who wishes to be heard by the Committee relative to residual ash? (no response) Without any further testimony, we'll--

ASSEMBLYMAN SHINN: Mr. Chairman? Just one comment:

There's been a project that our New Jersey Department of Transportation in cooperation with New York has been working on; the fly ash for the road construction. I thought it would really be appropriate to have a report at some point from DOT on the status of that project.

ASSEMBLYMAN McENROE: I believe we have it.

ASSEMBLYMAN SHINN: Oh, we do. I'm sorry.

ASSEMBLYMAN McENROE: It was a part of today's information for the members of the Committee.

Thank you all. I'm sure the testimony provided today is important to our careful review of the subject. The Legislature will be acting in this area, and we'll provide testimony -- transcripts -- for all interested parties. We'll get those to the public as quickly as possible.

Thank you all.

(HEARING CONCLUDED)

APPENDIX

Statement of
Richard S. Magee, Sc.D., P.E.,
to the
New Jersey State Legislature Assembly
Waste Management, Planning and Recycling Committee

March 21, 1990

Mr. Chairman and Members of the Subcommittee, my name is Richard S. Magee and I am a Professor of Mechanical Engineering and Chemical Engineering at New Jersey Institute of Technology. I thank you for the invitation to appear before your committee today to present testimony regarding the Department of Environmental Protection's Preproposal to amend existing rules and regulations governing the disposal of residual ash generated from the incineration of solid waste at resource recovery facilities.

I presently serve as Executive Director of the Hazardous Substance Management Research Center (HSMRC), a consortium of five academic institutions - New Jersey Institute of Technology, Princeton University, Rutgers University, Stevens Institute of Technology, and the University of Medicine and Dentistry of New Jersey. Headquartered at New Jersey Institute of Technology, the Center is one of the five original Advanced Technology Centers established by the New Jersey Commission on Science and Technology. The Center has also been designated a National Science Foundation Industry/University Cooperative Research Center. Currently, about 60 faculty members from the five institutions are participating in the research program. With me today is Professor David Kosson, from Rutgers, the State University, who has been conducting research on ash since the Center's inception. His work at the Center has gained him a national and international reputation in ash management.

The goal of the research program of the Center is to develop new technology to advance the state-of-the-art in engineering management of hazardous substances. The Center operates through six Divisions, each of which have different objectives. Each Division is headed by a Division Director who is a valuable resource person for information and advice regarding the needs and interest of industry in that particular technical area. The six Divisions focus on incineration, biological and chemical treatment, physical treatment, site assessment and remedial action, health effects assessment, and public policy and education. I also serve as Director of the Incineration Division. In the past year the Center has established a major new effort in waste minimization/waste reduction.

Incineration of municipal solid waste (MSW) has become an important waste disposal alternative because it provides an effective means of reducing the volume of MSW as well as an important source of energy recovery. Currently, 10 percent of MSW is incinerated. Based on the number of municipal waste combustion (MWC) facilities being planned across the country, this percentage is expected to increase to roughly 16-25 percent by the year 2000.

As incineration has grown as a waste management option, so has concern over the management of increasing volumes of ash. Ashes from MWC facilities frequently exhibit a hazardous waste characteristic as determined by the EP Toxicity Test. The debate regarding the regulatory status of ash and the representativeness and validity of the EP test continues. Congress is considering several legislative initiatives that would give EPA clear authority to develop special management standards for ash under Subtitle D of the Resource Conservation and Recovery Act (RCRA).

In my brief remarks to follow, I would like to address the physical and chemical properties of ash, the results of recent studies on leachate from landfills, the regulatory status of ash, and ash utilization.

Physical and Chemical Properties of Ash

Unprocessed municipal solid waste contains varying percentages of inert materials that eventually become the ash or solid residues upon combustion in a resource recovery facility. The volume reduction achieved by combustion increases the concentration of the metals in the ash versus the unburned municipal solid waste. The total amount of metals, however, have not increased. The increase in concentration cannot be any higher than the weight reduction (that is a 4-to-1 weight reduction of waste to ash, or 80 percent, increases concentration by a factor of five).

Regardless of whether it is municipal solid waste that is landfilled, or ash from a resource recovery facility, the total amount of metals going in will remain the same. No data is available to suggest that the combustion process changes the properties of the metals to make them any more dangerous. On the contrary, leachate data from raw solid waste landfills suggests higher metal mobility because of biological activity and the presence of organic acids. From the available data on ash collected by Ogden Martin, the following list shows average metal concentrations in categories of major, minor and trace constituents:

METALLIC ASH CONSTITUENTS

MAJOR	%	MINOR	%	TRACE	%
Aluminum	3	Copper	0.1	Arsenic	0.003
Calcium	8	Lead	0.2	Barium	0.05
Iron	10	Manganese	0.6	Cadmium	0.003
Sodium	6	Molybdenum	0.1	Chromium	0.02
Silica	30	Potassium	0.4	Mercury	0.0006
		Titanium	0.7	Selenium	0.004
		Zinc	0.3	Silver	0.0006

In addition to the metals listed above, ash contains many other elemental compounds that make up the bulk of the material. Oxygen, sulfur, chlorine, which occur as oxides, sulfates, and chlorides account for more than 30 percent of the ash. There are also trace elements that can be detected at the lowest detection levels of modern analytical chemistry. This is also true of organic compounds, other than unburned or fixed carbon.

Hence as seen from the above analysis ash contains many heavy metals which have the potential to contaminate groundwater if released to the environment in large quantities.

Leachate from Landfill Sites

To assist the EPA in data collection in support of regulatory decisions, NUS Corporation and Versar, Incorporated, conducted several studies. These were combined into a summary report [1]. The main objective of these projects was to assist EPA in developing data to evaluate the potential health and environmental effects of leachate from municipal landfills, co-disposal landfills, and monofills.

As part of these projects, NUS conducted a study of the available literature from the United States, Canada, Japan, and Europe to collect baseline data on municipal waste landfills, co-disposal landfills, and monofills. The baseline data included ranges of concentrations of organics and inorganics in fly ash, bottom ash and combined ash.

Field studies were conducted at four municipal waste disposal sites, two co-disposal sites, and four incinerator sites. The monofills evaluated were designed and became operational in the 1970s and early 1980s and are not likely to accurately represent the performance of the current generation of monofills. Monofills currently being put into operation generally include more extensive controls and more precise management than those included in this study. The four MSW and the two co-disposal sites selected for sampling by NUS were sites that do not accept industrial waste and which became operational only after RCRA regulations came into effect. Therefore, they represent "best case scenarios" of the waste industry.

In summary, the data from the EPA-sponsored studies (NUS and Versar) were consistent with the data in the literature. Key findings of the project were as follows:

- pH from monofills, co-disposal facilities, and new MSW landfills did not differ significantly. The pH levels in the four NUS sampled MSW facilities ranged between 6.98 and 7.8; in the two co-disposal sites, the range was between 7.2 and 7.3. The pH of the monofill leachates ranged between 7.44 and 8.58. The neutral to basic pH conditions in the MSW facilities, the co-disposal sites, and monofills indicate an environment in which the solubilities of the RCRA-regulated metals are limited.

- Based on the limited, available data base it appears that co-disposal of ashes and MSW may reduce the leached level of the conventional pollutants, the level of PCDDs and PCDFs and the levels of several metals. However, because these lower concentrations appear to be primarily the result of dilution, the total mass of leached metals is likely to be substantially the same in monofills and co-disposal facilities handling the same quantity of ash.

- Leachates from the four facilities sampled always met the EP Toxicity Maximum Allowable Limit. These four facilities were all constructed after the RCRA regulations were enacted, and these facilities do not accept industrial hazardous wastes.

- The metal content in actual leachates collected from the co-disposal sites was always lower than in test leachates (EP, TCLP, or SW-924). The actual leachates always met the EP Toxicity Maximum Allowable Limit.

- In general, there is no clear difference between the metal content in leachates from the co-disposal sites and from the municipal disposal sites. This indicates that the neutral (pH 6.98 to 7.82) MSW-generated leachates do not promote leaching of metals from the MWC ashes.

- Actual leachates from all sampled monofill facilities met the EP Toxicity Maximum Allowable Limit.

A recently published study by NUS Corporation [2] was prepared for the United States Environmental Protection Agency (EPA) and the Coalition on Resource Recovery and the Environment (CORRE). EPA and CORRE cosponsored the study to enhance the data base on the characteristics of Municipal Waste Combustion (MWC) ashes, laboratory extracts of MWC ashes, and leachates from MWC ash disposal facilities.

Among the findings was the following:

"None of the leachate samples exceeded the EP Toxicity Maximum Allowable Limits established for the eight metals in Section 261.24 of 40 CFR 261. In addition, the data from this study indicate that although the leachates are not used for drinking purposes, they are close to being acceptable for drinking water use, as far as the metals are concerned."

Thus while the potential for metal leaching from ash exists, and the current regulatory tests indicate that maximum allowable metal extraction will occur, leachate data from operating landfills indicates that the actual metal content is below the limits of regulatory concern.

The Regulatory Status of Ash

Because of the changing definition of "hazardous" waste, the regulatory status of municipal solid waste combustion ash has been subject to debate over the past ten years. Prior to the Resource Conservation and Recovery Act of 1976 (RCRA), ash was primarily regulated by individual states or local jurisdictions as municipal solid waste. It was often approved as cover material for municipal solid waste sanitary landfills.

With the implementation of RCRA and the development of the federal hazardous waste management program, waste classification took on a new meaning. Congress and EPA split up the universe of waste into two categories. Those wastes, subject to management under Subtitle C of RCRA (hazardous wastes), and wastes subject to management under Subtitle D (non-hazardous wastes). Household waste and the ash residue from processing household waste were specifically excluded from Subtitle C.

When Congress enacted the Hazardous and Solid Waste Amendments of 1984, the definition of "household waste" was clarified. The law states that, if a facility takes only household and non-hazardous commercial and industrial waste and has a program to prevent Subtitle C hazardous waste from being accepted, it is not deemed to be generating, treating or otherwise managing hazardous waste. In other words, the ash would not be subject to management as a hazardous waste, and testing to determine its regulatory status would not be required.

When EPA placed the law into the Code of Federal Regulations (CFR), they did not interpret it in the same way as Congress intended. EPA stated that, if the ash was tested and exhibited the characteristic of a hazardous waste, it had to be managed as such. This position has caused a great deal of confusion. If it exhibits a characteristic of hazardous waste, is the ash exempt from requirements to be managed as hazardous since it represents the by-product of municipal household waste? Or, is it to be managed as a hazardous waste in all cases? EPA is presently re-evaluating its decision, developing a new series of characterization tests to determine the regulatory status of ash, and developing environmentally-sound design criteria for ash burial. All state and federal regulatory agencies that are addressing this subject believe that efficient ash management is essential regardless of the outcome of various characterization tests.

What is considered "efficient management" varies across the board nationwide. Consequently, regulators are developing proper ash management criteria for compliance. These criteria focus on prevention of groundwater contamination through the use of lined landfills. Both Congress and the EPA are in the process of further clarifying the regulatory status of ash and developing management standards. In numerous proposed bills, Congress has clearly stated that ash should be managed as a Subtitle D (non-hazardous) waste. In addition, all the bills require some type of lining, leachate collection, and groundwater monitoring systems for ash disposal.

EPA has released draft guidance on the handling, transport, storage, and disposal of ash. This guidance includes recommendations that ash containers and transport vehicles be leakproof and provided with tight coverings; that groundwater monitoring be performed at all ash disposal facilities. These liners and disposal recommendations are as follows:

- For fly ash disposed of separately, disposal should be at a monofill with a double liner system.
- For combined ash or bottom ash, disposed of in a monofill, either a composite liner or a clay liner with special environmental or operating features should be used.
- For combined ash or bottom ash co-disposed with garbage, a double liner or a composite liner, with pre-disposal ash treatment or source separation to reduce metals content prior to combustion is the preferred method.

Ash Utilization

As discussed previously, ash contains many valuable metals and the non-metallic fraction has properties very similar to sand and gravel. These characteristics lend themselves to potential economic benefits. Ferrous and non-ferrous metal recovery using magnets, screens and other mechanical processes is used at many municipal solid waste combustion facilities worldwide. The techniques for recovery of the larger metallic components (e.g., greater than one inch) are well developed. Metals are not recovered on an industry-wide scale in the United States because of depressed scrap metal markets (i.e., installation and operation of metal recovery equipment is dependent on local scrap metal markets).

There are many metals in the ash that could only be recovered through complex processes. Metals such as cadmium, lead, zinc, copper, silver and gold are recoverable by using chemical techniques similar to those used in the minerals industry. One such process for the removal and recovery of lead and cadmium, the two metals of greatest concern from leaching tests, has been the subject of extensive research by Dr. Kosson.

The major component in the ash is the inert, non-metallic fraction. Because the properties are similar to traditional aggregates, ash is commonly used as a substitute for conventional aggregate in Europe. In the mid-1970s, the Department of Transportation (DOT) researched the potential for use in the construction and maintenance of highways. In Europe, bottom ash is often used in asphaltic paving material and combined bottom and fly ash in concrete. Screened bottom ash is also used as road bed and common fill material. Perhaps, the best use of ash is as aggregate in Portland cement concrete. Municipal solid waste combustion ash has excellent properties for use in concrete itself; it is pozzolanic, which is to say it forms a weak cement-like matrix. This inherent property could be of interest to concrete block manufacturers. Leachability of metals from the blocks will be an important issue that will require resolution before they are widely manufactured.

Currently, HSMRC, under the direction of Dr. John Liskowitz, Executive Director of NJIT's Institute for Hazardous and Toxic Waste Management, is directing a major research project for the U.S. Environmental Protection Agency on municipal incinerator ash utilization. Dr. Kosson is the research coordinator for the study. There are many potentials for the use of incinerator ash. While the technical problems associated with the various utilization scenarios can be resolved, the institutional problems are more difficult to address (i.e., markets for the metals and public acceptance of the ash as aggregate). Lessons can be learned from Europe and Japan and other waste product utilization programs. In Japan, ash residue is used to make artificial reefs and man-made islands. Thus far, metals have not entered the food chain and subsequently pose no significant risk to aquatic life or human beings. While the United States may not necessarily need ash islands or reefs, there are many other potential uses that would fulfill material needs in the construction, manufacturing or chemical industries.

Summary

Ash is the remaining incombustible residue representing approximately ten (10) percent by volume and twenty-five (25) percent by weight of the municipal solid waste stream. It is a biologically inert, dense material that can be managed in a more environmentally sound manner than raw solid waste. Present testing methods do not adequately simulate what occurs when ash is placed into a controlled landfill unit. As indicated by leachate data from actual ash fills, potential ground or surface water contamination from well-managed ash disposal units does not appear to be a problem. Nevertheless, proper landfill design should be utilized to ensure that ash is managed in an environmentally sound manner.

The ultimate goal, however, is to find uses for the ash so that we do not fill-up our limited, and valuable landfill capacity. However, before uses of incinerator ash can reach their fullest potential additional research and testing is required, and public awareness and a better understanding of resource recovery ash characteristics is necessary. This latter can only be achieved through governmental leadership at state and local levels, where community education is most effective.

References

1. Characterization of Municipal Waste Combustor Ashes and Leachates from Municipal Solid Waste Landfills, Monofills, and Co-disposal Sites, NUS Corporation, NTIS PB88-127-949, Oct. 1987.

2. Characterization of Municipal Waste Combustion Ash, Ash Extracts, and Leachates, NUS Project No. 9583, Feb. 1990.

Statement for the

Assembly Waste Management, Planning and Recycling Committee
New Jersey State Legislature Assembly

on

The Management of Residual Ash from the Combustion of Solid Waste at Resource Recovery Facilities

by

David S. Kosson, Ph.D., Assistant Professor
Department of Chemical and Biochemical Engineering
Rutgers, The State University of New Jersey
P.O. Box 909
Piscataway, New Jersey 08855-0909

(201)932-4346

March 22, 1990

Mr. Chairperson and Members of the Committee:

My name is David Kosson and I am an assistant professor in the Department of Chemical and Biochemical Engineering at Rutgers University. I am honored to have been asked to present to you information regarding the safe management of municipal solid waste combustor residues.

My knowledge of ash issues evolves from research into ash characteristics and management initiated approximately seven years ago. Substantial portions of that effort have been sponsored by the N.J. Hazardous Substances Management Research Center (HSMRC). These research areas include: (i) physical and chemical properties, (ii) leaching characteristics, (iii) recovery of heavy metals from ash, and, (iv) bioavailability of lead and cadmium from fly ash. In addition to my work with the HSMRC, I am currently involved in ash research in the following capacities:

- Technical Coordinator and Science Advisory Panel member for the U.S.E.P.A. Program for Treatment and Utilization of Municipal Waste Combustor Residuals. This program is to provide side-by-side comparison and evaluation of several treatment techniques (solidification, stabilization and vitrification) for utilization and/or disposal of incineration residuals. Guidelines for ash utilization also are being developed.
- Member of the Ash International Expert Working Group. This is a working group of representatives from the United States, Canada and several European countries developing guidelines for ash sampling, characterization and management based on coordination of data and research internationally. This effort is supported by more than eight countries and endorsed by the International Energy Agency.
- Member of the NJDEP Ash Research Technical Advisory Committee.
- Member of the N.J. Alliance for a Clean Tomorrow Science Advisory Board.
- Member of ASME Research Committee on Industrial and Municipal Waste, and co-chairperson of the subcommittee on incineration ash.
- Principal Investigator for a sponsored research project by NJDEP on recovery of heavy metals from incinerator ash.

The opinions I am presenting today are my own and do not necessarily represent the organizations listed above.

In considering the development of legislation and policy regarding ash management, I would like to convey several important concepts:

1. Incineration of municipal solid waste reduces the volume of waste to be managed by 80 to 90 percent through the combustion of organic constituents in the waste. This process results in the concentration of inorganic species originally present in the waste. The solid residuals from combustion can be classified into two primary categories, i.e., bottom ash and fly ash. Bottom ash is the material discharged from the combustion grates. Fly ash generally refers to the materials entrained in the combustion gases and residuals collected as a consequence of air pollution control including acid gas scrubbing and particulate removal. Bottom ash and fly ash physical, chemical and leaching characteristics are significantly different. The principal constituents of ash of environmental concern are heavy metals (lead, cadmium, mercury, etc.) and soluble salts. Fly ash represents approximately 20 percent of the total ash generated, contains almost all of the cadmium and a substantial fraction of the lead from the original waste, and varies between 40 and 70 percent water soluble.

2. Bottom ash and fly ash can be managed in an environmentally safe manner. Typical current ash management practice in the U.S. is to dispose of bottom ash and fly ash as combined ash in lined monofills with leachate collection and treatment. Current recommended monofill design is protective of the environment.

3. EP Toxicity and TCLP leaching tests are not appropriate for determining ash management protocols and ash management based on these protocols can result in less efficient ash management practices. EP Toxicity and TCLP assays are flawed by poor repeatability and the ability to artificially manipulate the test results. Test results which are marginally different but cross the "pass/fail" threshold do not mean that the materials being tested are significantly different. Significant variability exists in ash sampling and sub-sampling practices. In addition, while there exists a regulatory basis for interpretation of these results, these test results are not scientifically meaningful. These tests are not predictive either of leachate characteristics or of leaching potential. Better ash characterization procedures with scientific merit exist; however, no single test is sufficient for determining ash characteristics. Implementation of characterization and management protocols specific for municipal waste combustor residues can dramatically improve the economy and environmental safety of ash management.

4. Ash management policy should encourage safe utilization of bottom ash. Current technology will most likely permit the safe utilization of bottom ash as aggregate and in other applications. Several state and federal programs in progress were initiated to evaluate current ash treatment and utilization techniques and develop utilization guidelines. Utilization of bottom ash is most desirable because it is predominantly an inert material and utilization would decrease reliance on scarce landfill capacity. Utilization of bottom ash would require development of separate management practices for fly ash. Fly ash utilization is less certain because of high concentrations of soluble salts and heavy metals. Factors which will constrain utilization of ash are unclear regulatory criteria and unresolved potential liability issues.

Thank you for your attention. I will be happy to answer questions.

ENVIRONMENTAL DEFENSE FUND

1616 P Street, NW
Washington, DC 20036
(202) 387-3500

COMMENTS

OF

THE ENVIRONMENTAL DEFENSE FUND

BEFORE THE NEW JERSEY ASSEMBLY

WASTE MANAGEMENT, PLANNING, AND RECYCLING COMMITTEE

ON

THE DEPARTMENT OF ENVIRONMENTAL PROTECTION'S

PREPROPOSAL TO AMEND

THE EXISTING RULES AND REGULATIONS GOVERNING MSW INCINERATOR ASH

Trenton, New Jersey
March 22, 1990

Presented By:

Richard A. Denison, Ph.D.
Senior Scientist

National Headquarters
257 Park Avenue South
New York, NY 10010
(212) 505-2100

1405 Arapahoe Avenue
Boulder, CO 80302
(303) 440-4901

5655 College Avenue
Oakland, CA 94618
(415) 658-8008

1108 East Main Street
Richmond, VA 23219
(804) 780-1297

128 East Hargett Street
Raleigh, NC 27601
(919) 821-7793

12x

I am Dr. Richard A. Denison, a Senior Scientist with the Environmental Defense Fund (EDF) in Washington, DC. EDF is a national, not-for-profit environmental organization with over 150,000 members and offices in New York City, Washington, DC, Oakland, CA, Boulder, CO, Richmond, VA, and Raleigh, NC. Over the last several years, EDF has been actively working with the U.S. Congress, the Environmental Protection Agency, and numerous states in helping to craft regulatory and legislative approaches to properly manage the environmental risks posed by municipal solid waste management, and in particular those posed by ash arising from incineration of municipal solid waste (MSW).

My comments today will address four issues:

* first, the need for a significant revision to the state's current approach to solid waste management, specifically a scaling back of the state's over ambitious commitment to resource recovery, which will directly affect the ability to effectively and safely manage the large amounts of ash such facilities generate;

* second, the legal status of MSW incinerator ash under federal law, as it relates to the Department of Environmental Protection's (DEP's) recent proposal to regulate such ash as a "special" waste;

* third, technical and regulatory requirements for proper management of ash that does not exhibit a hazardous waste characteristic; and

* fourth, the need to assure that, whenever an incinerator is built, ash disposal capacity that complies with all applicable requirements is available prior to the commencement of incinerator operation.

ISSUE 1: PLACING RESOURCE RECOVERY IN ITS PROPER CONTEXT

Waste management in New Jersey is in a period of major change. Over the last decade, the solid waste crisis which has been felt throughout the Northeast, has been particularly acute in New Jersey. In response, the Legislature and the Department of Environmental Protection (DEP) have taken steps to confront the problem. These include the Mandatory Recycling Act, the Landfill Closure Act, and the pursuit of resource recovery as a large-scale waste disposal method. DEP has been actively pursuing new avenues of waste management, particularly resource recovery, in order to achieve its goal of state self-sufficiency by 1992.*

As more and more existing landfills are closed, and space for new landfills becomes even scarcer, it is clear that solid waste management practices must undergo significant changes. However, it is critical that the path New Jersey chooses is one which minimizes the health and environmental dangers of many waste disposal methods, and maximizes the economic efficiency of solid waste disposal.

The state's approach to solid waste management must be a balanced one, with appropriate reliance on (in order of preference) source reduction, reuse, recycling, and finally, incineration in resource recovery facilities and landfilling. None of these techniques alone is adequate to deal with the 30,000 tons of solid waste New Jersey produces every day; but neither can any be ignored. The state's current trend toward heavy reliance on incineration is flawed by a dangerous neglect of alternatives that are safer, less costly, and environmentally more benign.

More specifically, the present trend toward constructing facilities to burn virtually all solid waste not covered by the State's mandatory 25% recycling law may bind New Jersey to years of costly and dangerous waste disposal. It will lead to an oversupply of incinerators, and will continue for decades to demand an inappropriately large share of the state's solid waste in order to keep them from operating at a loss. This will threaten even the mandatory 25% recycling goal, and will certainly discourage or preclude any expansion of recycling or waste reduction measures. In addition, this reliance on resource recovery will pose a greater threat to the environment, tax the state's financial resources, and require greater landfill use than a plan which includes strengthened waste reduction and recycling.

In short, EDF believes that the state must seek a more proper balance between resource recovery and other waste reduction and management techniques. The state's solid waste management system should be based on a hierarchy of permissible means of waste management, which are, in decreasing order of

---

*/ See "Status of Solid Waste Management and Resource Recovery (March 1988 Update)", Gary Sondermeyer, Assistant Director, Planning & Finance, New Jersey DEP, Division of Solid Waste Management.

preference: reduction, reuse, recycling, and finally, incineration with energy recovery and landfilling.

To achieve these goals, the state should take the following actions:

* Modify the state solid waste management plan to include a ranking, in order of preference, of acceptable waste management techniques, with goals of at least 50% recycling and 10% waste reduction, at most 25% incineration with energy recovery, and landfilling of the remainder (including non-hazardous ash) only in permitted, properly designed and operated, secure landfills;

* Conduct a comprehensive review of present waste disposal needs and practices as part of a restructuring of recycling and resource recovery policies to conform to the above guidelines;

* Immediately implement and adequately fund programs to maximize waste reduction, reuse, and recycling;

* Suspend the granting of any new resource recovery permits;

* Require all permitted facilities to comply with strict air emission and ash disposal regulations, and revoke the permits of any facilities which are not in compliance; and

* Downscale the capacity of all facilities which have not commenced construction, to represent no more than 25% of the waste generation of the area they will serve.

ISSUE 2: REGULATORY STATUS OF INCINERATOR ASH

Currently, federal regulation requires that ash found to fail the EP toxicity test must be managed as a hazardous waste. While EPA at one time considered altering its position on this issue, it has instead chosen to adhere to its 1985 ruling (50 Fed. Reg. 28725, July 15, 1985), and has stated that it continue to do so until and unless Congress changes the underlying law.

Specifically, EPA went on record in May of 1989 articulating its position that generators of ash produced by incineration facilities burning municipal solid wastes that contain any commercial, institutional, or industrial non-hazardous wastes are required to determine whether the ash is hazardous, using the EP Toxicity Test, and if it is, to manage the ash in full accordance with Subtitle C of the Resource Conservation and Recovery Act (RCRA) and its associated regulations. EPA's position was articulated by Ms. Sylvia Lowrance, Director of the Office of Solid Waste, in testimony before the Subcommittee on Transportation and Hazardous Materials, Energy and Commerce Committee, U.S. House of Representatives, on July 13, 1989 (p. 33):

> "The issue and the controversy has centered around our interpretation of section 3001(i) of the law [RCRA]. In our codification of it we stated that, in our view, the provision excludes energy recovery facilities burning household waste along with nonhazardous waste from commercial and industrial sources from regulation under subtitle C. With regard to the ash, however, produced from such facilities, we said in a 1985 notice that the ash generated by these facilities which exhibits a characteristic of hazardous waste must be managed as a hazardous waste. We continue to follow that 1985 policy, and that is our current interpretation."

Thus, DEP's proposal to reclassify all incinerator ash, including that which fails the EP Toxicity Test required under federal regulations, would constitute a state requirement that is <u>less</u> stringent than the federal one -- a situation that is specifically prohibited by RCRA (Section 3009). Thus, DEP does not have the legal authority, on its own, to exempt ash that exhibits a hazardous waste characteristic from regulation as a hazardous waste. Until and unless there is a change in federal law, ash that fails the EP Toxicity Test must be managed as a hazardous waste, in full compliance with all applicable federal and state requirements.

As some of you may know, in January 1988, EDF filed lawsuits in District Courts to compel the owners of two incinerators to manage ash that failed the EP Toxicity Test as a hazardous waste. Late last year, the District Court judges presiding over these two cases ruled against EDF and maintained that EPA's position that ash is subject to hazardous waste regulation is inconsistent with federal law. EDF continues to believe that our and EPA's interpretation of the law is the correct one, and we intend to pursue appeals in both of these cases later this year.

ISSUE 3: REGULATORY REQUIREMENTS FOR PROPER ASH MANAGEMENT

While the legal status of ash remains a confusing state of affairs, technical requirements for proper ash management are more straightforward. As I have already stated, for ash that exhibits a hazardous waste characteristic, the requirements are clearly spelled out in both federal and state regulations.

But what should be done with ash that does not exhibit such a characteristic? EDF considers the present system's sole reliance on the EP Toxicity Test for assessing ash toxicity to be wholly inadequate, since it measures only one of the many routes of potential exposure -- leaching -- and even for this limited use, fails to account for the range of leaching conditions that are likely to be encountered once ash is disposed of. Attachment A describes in more detail the deficiencies of the EP Toxicity Test as a sole indicator of ash toxicity.

These deficiencies mean that ash that happens to pass the EP Test cannot be assumed to be environmentally benign. Indeed, based on total chemical composition, there is no discernible difference in the metal content of ashes that pass or fail the EP Test. Moreover, much of the ash that has been tested has passed or failed the test by only a small margin; it clearly makes little sense to worry a great deal about ash that leaches cadmium at 1.1 parts per million (ppm) -- just over the regulatory standard of 1.0 ppm that defines a hazardous waste -- only to ignore the hazards of ash that leaches cadmium at 0.9 ppm. Attachment B is a fully referenced paper I have published that documents the characteristics of incinerator ash and the many risks posed by its improper management -- risks that do not depend on whether or not the ash fails the EP Toxicity Test.

Given the risks that accompany the management of any ash, it is critical that ash that passes the EP Toxicity Test nevertheless be subject to stringent regulation that ensures its long-term containment during all stages of its management, from the moment of generation through final disposal. Specifically, the management of ash must be regulated during its storage, transportation, and handling -- both at incinerators and at ash disposal sites -- in a manner that completely precludes release of the ash or any liquids associated with ash at any time. While much of this can be accomplished through institution of good operating practices, it is critical that such practices be specified in a regulatory program in a manner that is both enforceable and actively enforced.

In EDF's view, an effective regulatory program for ash must embody several additional fundamental objectives (these are discussed in more detail in Attachment C):

* Test and consider managing fly and bottom ash separately.

* Dispose of ash separately from other wastes (monofilling) and only in secure landfills. EDF has developed, and fully documented the need for, a specific set of design and operating requirements for state-of-the-art ash monofills, which is included in this testimony as Attachment D.

* Encourage or require treatment of ash prior to disposal or utilization using methods demonstrated to effectively reduce both its present and future hazards; develop a full regulatory program tailored specifically to ash utilization prior to permitting such utilization, which provides only for the utilization of bottom ash and assures that ash will only be utilized in an approved application.

* Keep toxic metals out of products that find their way into the municipal wastestream and keep materials containing such metals out of incinerators. Source separation and recycling must be optimized both to reduce the amount of waste that must be incinerated, and to reduce the risks of both air emissions and ash residues resulting from incineration.

ISSUE 4: NEED TO ASSURE ASH DISPOSAL CAPACITY PRIOR TO PERMITTING INCINERATOR CONSTRUCTION

An integral part of the planning process for an incinerator must be planning for ash management capacity. For both economic and environmental reasons, the public has a right to know from the outset that proper ash management will not be an afterthought, but will be assured. Experience with other incinerators around the country indicates that the only feasible means of providing such an assurance is to tie the permitting of the construction of an incinerator to a demonstration that proper ash management capacity will be available by the time the incinerator is operational.

As one example of what can transpire in the absence of such a requirement, a facility operated by Wheelabrator Environmental Systems in

Claremont, NH came on line more than a year before its ash monofill was ready to accept ash. Emergency provision had to be made for disposal of the ash in a leaking landfill in Vermont -- which is under consideration for inclusion on the Superfund National Priority List -- because the municipalities utilizing the incinerator had few, if any, other options for trash disposal. When the monofill still was not ready after the interim time period originally specified for ash disposal at this substandard site had expired, an extension was granted. In addition to the potential for furthering environmental damage through improper ash disposal, all of this came at a tremendous cost with respect to public trust of the incinerator authority, the landfill operators, and the regulatory authorities in both New Hampshire and Vermont.

The nearby Vicon incinerator in Rutland, VT, which was allowed to begin operating without provision for proper ash disposal, had to resort to long-distance hauling of the ash to other states, at a cost which was the major factor leading to the company's bankruptcy. That facility has remained idle for almost two years as the affected municipalities seek a purchaser or the funds to operate it themselves.

Both of these situations could have been avoided through proper advanced planning. The need for such planning has been recognized and addressed in ash management regulations or policies in several states, including Massachusetts, Florida, and New York, and is included in pending federal ash management legislation. EDF refers the committee and DEP to the relevant sections of New York's recently adopted incinerator ash management regulations, which specify several mechanisms by which a demonstration of five years of ash management capacity must be made as a prerequisite to obtaining an incinerator construction permit. We strongly urge the adoption of a requirement for demonstrating at least five years of capacity for disposing of ash in compliance with all applicable regulations as part of applications for both new permits and renewals.

On behalf of EDF, I appreciate the opportunity to present my views to the Committee today, and look forward to working with the state in crafting a protective ash management program as one element of an effective solid waste management system.

ATTACHMENT A

ENVIRONMENTAL DEFENSE FUND

1616 P Street,
Washington,
(202) 387-35

March 21, 1990

<u>Deficiencies of the EP Toxicity Test as a Sole Indicator of Ash Toxicity</u>

EP toxicity is a far-from-complete indicator of the hazardousness of ash. The EP Test is designed to determine the <u>water</u> solubility, under mildly acidic conditions, of eight metals and six pesticides in wastes and cannot detect trace organics or other substances strongly adsorbed onto particles. Nor can the EP test adequately predict long-term phenomena, such as biological degradation, formation and degradation of organic complexing agents, pH changes, and oxidation/reduction reactions, which may affect metal leachability and can occur over time.

Sole reliance on the EP test rests upon the unjustified assumption that exposure only occurs after substances are leached off soils, dust or particulate material. This completely fails to account for exposure to toxic substances that are still adsorbed to ash particles, through inhalation or ingestion of contaminated soils, dust or particulates. Only a complete chemical analysis that measures the <u>total</u> quantity of particular metals and organics in the ash can provide the data needed to assess the significance of these exposure routes. (See Attachment B.)

Even as a measure of short-term leachability, the EP toxicity test provides an incomplete characterization of metal leachability from the ash. The test is entirely unable to assess metal leachability under other than mildly acidic conditions. Because ash is generally alkaline, particularly when derived from facilities having acid gas scrubbers, and because of the growing use of monofills for such ash, it is critical to assess leachability under the "native" alkaline conditions of the ash itself. Use of a distilled water or rainwater extraction test is therefore needed; when such tests have been applied to alkaline ash, lead and in some cases other metals have been found to readily leach from the ash.

ATTACHMENT B

Approaches to Minimizing the Risks of MSW Incinerator Ash

Richard A. Denison, Ph.D.
Senior Scientist, Toxic Chemicals Program
Environmental Defense Fund
1616 P Street, NW Suite 150
Washington, DC 20036

presented at the
International Conference on Municipal Waste Combustion
Hollywood, Florida

Wednesday, April 12, 1989

---

* The author wishes to gratefully acknowledge the contributions of two other EDF staffmembers to this paper: Dr. Ellen K. Silbergeld and Michael Herz.

20x

ABSTRACT

The central focus of the debate over MSW incineration has shifted from its apparent management advantages to unresolved risk issues. This shift results from the lack of comprehensive consideration of incinerator-associated risks. I discuss the need to expand incinerator risk assessment beyond the limited view of incinerators as stationary air pollution sources to encompass: other products of incineration, ash in particular, and pollutants other than dioxins, metals in particular; exposure routes in addition to direct inhalation; health effects in addition to cancer; and the cumulative nature of exposure and health effects induced by many incinerator-associated pollutants.

Rational MSW management planning requires that the limitations as well as advantages of incineration be recognized. Incineration is a waste Incineration is a waste processing -- not a waste disposal -- technology, and its products pose substantial management problems of their own. Consideration of the nature of these products suggests that incineration is ill-suited to manage the municipal wastestream in its entirety. In particular, incineration greatly enhances the mobility and bioavailability of toxic metals present in MSW. These factors suggest that incineration must be viewed as only one component in an integrated MSW management system. The potential for source reduction, separation, and recycling to increase the safety and efficiency of incineration should be counted among their many benefits. Risk considerations dictate that alternatives to the use of toxic metals at the production stage also be examined in designing an effective, long-term MSW management strategy.

This paper is composed of two major sections. First, it discusses EDF's views on the appropriate role of incineration in managing municipal solid waste, given the nature of its risks and its potential to affect the use of other waste management options. Second, it provides a more detailed discussion of a topic that has emerged as the major unresolved risk issue associated with incineration: the hazards of incinerator ash and key objectives in its proper management.

INCINERATION AND THE SOLID WASTE CRISIS

It has become commonplace to refer to the nation's solid waste "crisis." Striking indicators of such a crisis abound: the wandering garbage barge, the growing list of instances of groundwater contamination from municipal landfills, Philadelphia's recent unsuccessful attempts to export its incinerator ash to Panama and other countries, international litigation over the proposed Detroit incinerator -- these all suggest that things are going badly wrong. While dwindling landfill capacity and environmental contamination have precipitated new enthusiasm for incineration, growing problems with attempts to exclusively rely on this approach have given rise to a serious, though still nascent, resurgence in interest in recycling.

The final ingredient in this witch's brew is the steadily growing amount of garbage. In part, this is a function of rising population. But the U.S. also generates more trash per capita with every passing year, and exceeds by two to three times the per capita generation rates of most other developed countries.

As a nation, we are belatedly coming to realize that we have done little systematically to cope with managing municipal solid waste (MSW). City after city claims -- sometimes legitimately, sometimes not -- to be confronted with a management problem of crisis proportions, and decision-making within these constraints is often considerably less than reasoned or deliberate. The perceived pressure to make immediate decisions, often in the face of diminishing landfill capacity, makes it increasingly difficult to persuade decisionmakers to consider long-term, efficient strategies of comprehensive management over admittedly attractive offers of short-term and incomplete (albeit often highly expensive) solutions to the immediate crisis.

The nation is on the threshold of a significant shift in the way in which it handles the 150 million tons of MSW generated each year. The rapid disappearance of landfill space, rising costs, and increasing awareness of environmental dangers suggest the imminent demise of present waste management strategies. The major challenge facing us is how to resolve legitimate issues of risk -- risk to environmental protection and public health -- while dealing effectively and expeditiously with MSW.

In EDF's view, a major impediment to this resolution has been a failure to comprehensively assess risks associated with various options, particularly with incineration as a method of waste processing. Given this present lack of resolution, the extent to which incineration can be deployed to serve waste management is still questionable. It will be unfortunate if we are unable to optimize use of incineration as a waste management tool, since it may provide useful advantages if implemented as part of a comprehensive waste management program.

COMPREHENSIVELY ASSESSING THE RISKS OF INCINERATION

Incineration, while increasingly adopted or proposed as the method of choice for dealing with MSW, is widely perceived as risky and remains highly controversial. Despite this, the major focus of the risk debate has failed to encompass all, or even the major, types of risks which this technology can pose. Incinerators have primarily been characterized as stationary sources of toxic air pollutants, that is, with reference to their impacts upon ambient air quality. Even within this limited context, risk analyses have usually been further restricted: of the wide array of toxic air pollutants which are emitted by incinerators (in amounts highly dependent upon control technology and operations), major concern has focused almost exclusively on the complex organic molecules known generically as dioxins.

A truly comprehensive assessment of the risks associated with incineration must be expanded beyond the limited view of incinerators as stationary air pollution sources to encompass: other products of incineration, ash in particular, and pollutants other than dioxins, metals in particular; routes of exposure additional to direct inhalation; health effects in addition to cancer; and the cumulative nature of exposure and health effects induced by many incinerator-associated pollutants.

It is our contention that risk issues -- not the apparent advantages of incineration as a tool for waste management -- have emerged as the central focus of the debate over this technology. An inaccurate depiction of such

22x

risks only encourages inadequate and misdirected strategies for control, and compromises our ability to further moderate those risks through control over the role that incineration plays in overall waste management.

WHAT IS AN APPROPRIATE ROLE FOR INCINERATION IN MSW MANAGEMENT?

It is critical to rational MSW management planning to recognize the limitations as well as advantages of incineration. Incineration is a waste processing -- not a waste disposal -- technology; while it provides the important benefit of reducing the amount (particularly the volume) of waste requiring disposal, its products pose substantial management and disposal problems of their own. Moreover, while incineration is appropriate for certain components of the municipal wastestream, it is ill-suited to manage without discrimination the mass of consumer and commercial products that comprise MSW. In particular, incineration greatly enhances the mobility and bioavailability of toxic metals contributed to MSW by many waste materials.

The challenge is to manage a highly heterogeneous municipal wastestream in as economically efficient and environmentally benign a manner as possible. In EDF's view, the key to a successful strategy is integration: reliance on more than one waste management technique. It follows that incineration must be viewed as only one component in an integrated MSW management system. Opportunities for source reduction, separation, and recycling must first be maximized, not only to reclaim reusable materials, but also to maximize the safety and efficiency of any subsequent incineration. Finally, risk considerations dictate that we examine alternatives to the use of toxic metals at the production stage as a critical element in designing an effective, long-term MSW management strategy.

This view is <u>not</u> consistent with current or planned practices in most municipalities. In general, solid waste managers have yet to consider recycling a serious tool of waste management. Rather, the emphasis has been on attempting to implement incineration as a wholesale alternative to landfilling. Hundreds of municipalities are planning or building incinerators with capacities that equal or even exceed the entire local wastestream. This "mass-burn" approach to incineration is propelled forward by the same myth that led to our disastrous reliance on mass landfilling: namely, that the municipal wastestream can be managed as a monolithic material, using a single management technique.

The interaction of incineration with other strategies for waste management is of particular concern: indiscriminate use of incineration may limit other options for waste management that are either more desirable or could serve to optimize the efficient and safe use of incineration. Indeed, communities that decide to recycle or recover components of MSW -- approaches which are rapidly gaining in both political and economic acceptance -- may find themselves in direct competition with incineration. For example, contracts or ordinances that require a municipality or region to guarantee a minimum tonnage of waste to the incinerator, often for the lifetime of its operation, clearly have the potential to compromise or entirely eliminate incentives to reduce the amount of waste generated by the jurisdiction.

While EDF believes that incineration has a role to play, it involves tremendous economic, and significant environmental, costs. Decisions to employ incineration -- including both the scale of its use and the particular form of incineration technology -- should be preceded by a thorough evaluation of all options for volume reduction (e.g., packaging controls, recycling), including methods presently available as well as those likely to become available during the lifetime of the incinerator. In this context, other volume reduction options should be viewed as serious waste management tools that can serve two useful functions: they can reduce the amount of waste needing to be incinerated or otherwise managed, and they can increase the overall safety and efficiency of subsequent management technologies.

The need to manage MSW more effectively without simply transferring risks, thereby continuing to incur long-term environmental and public health problems, requires that the full range of risks be recognized and addressed. Both short- and long-term solutions need consideration. In the short term, appropriate technological and operating controls should be imposed on incinerators, including BACT air pollution controls, maximally feasible on-line monitoring and periodic stack testing to ensure compliance with specific health-based emissions limits, and cradle-to-grave ash management under the rubric of RCRA, that is, based upon the characteristics of the ash.

Of course, the most efficient method of reducing the risks of incineration requires that we return to the broad systems view of MSW management discussed earlier, in which the use of incineration is one fully integrated component. This view requires planners and managers to step back from the crisis mentality that now dictates management decisions, to consider all steps in the product cycle: production, use, discard, collection, recycling and recovery, processing, and ultimate disposal. Comprehensive planning of this type conducted on a regional or national basis can in turn affect available markets sufficiently to support a greatly enhanced recycling component of the MSW management system.

Strategies of upstream intervention intended to condition the wastestream by restricting certain production practices must be comprehensive to be effective. Initiatives directed towards reducing the use of certain metals (e.g., cadmium) in consumer products, particularly those (such as disposable plastic items) that are used and discarded in large amounts after limited use are clearly warranted. It is increasingly apparent, however, that such metals are contributed by many diffuse sources (e.g., printing inks, plastic stabilizing agents) as well as by more easily identified materials such as lead-acid batteries. Thus, only comprehensive source-based strategies are likely to prove successful in acheiving significant reductions in the metal content and toxicity of MSW and incineration by-products.

Our present approach to MSW management has avoided solving difficult problems only by transferring them to later stages in the materials flow system. Many of the risks that characterize the final stage of the product cycle -- disposal -- result from decisions made at the earliest stages of production, packaging, and marketing. It is unreasonable to expect economics and technologies of waste disposal to efficiently manage such risks: indeed, the most difficult and expensive method of reducing the risk of exposure to toxic metals in products is to delay action until after incineration has refined metals into a highly bioavailable and concentrated form. Both efficiency and the generally accepted goal of promoting prevention over remediation dictate that we examine alternatives to the use of such metals at the production stage. Such risk reduction strategies require expansion of the decision-making rubric beyond RCRA to include the tools for controlling product composition available under the Toxic Substances Control Act (TSCA).

THE HAZARDS OF INCINERATOR ASH AND FUNDAMENTAL OBJECTIVES OF ASH MANAGEMENT

Foremost among the underexplored risks of MSW incineration are the hazards posed by the frequent presence of high levels of dioxins and the routine presence of several toxic metals in ash residues. Ironically, the growing use of more efficient air pollution control devices on modern incinerators results in ash containing even higher levels of these toxic substances in even more bioavailable forms.

The most fundamental and important measure of ash toxicity is its total toxic metal and dioxin content, given the potential for direct exposure (e.g., inhalation and adsorption into the lung or direct ingestion of toxin-laden ash particles). Indeed, a full accounting of the hazards of ash posed during all phases of its management requires knowledge of its total chemical composition.

Table I compares typical concentration ranges of lead and cadmium in MSW incinerator fly ash to those found in natural soils, illustrating their extreme enrichment in this waste. Less extreme but still significant metal enrichment characterizes bottom ash. Table I also illustrates that the total metal content of incinerator ash is comparable to other materials clearly regarded or classified as hazardous. Emission control sludge from secondary lead smelters -- a waste listed as hazardous under federal regulations -- exhibits a range of lead and cadmium content quite similar to incinerator fly ash.[1] A recent Washington state study[2] documented levels of several carcinogenic metals in both fly and bottom ash that were sufficiently high to classify the ashes as dangerous or extremely hazardous wastes under state regulations.

Metals are chemical elements, and can neither be created nor destroyed by incineration; their amounts in the wastestream before incineration must therefore equal the sum of their amounts in air emissions and ash left after incineration. The process of incineration, however, is uniquely unsuited for managing metals. Incineration essentially destroys the bulky matrix -- paper, plastics, or other materials -- which contains metals in MSW and which acts to retard their entrance and dispersion into the environment (see, for example, ref. 3). In this respect, incinerators can be compared to secondary metal smelters; by burning combustible materials they release metals, which are subsequently mobilized in air emissions or concentrated in the residues in highly bioavailable form.

SOURCES OF LEAD AND CADMIUM IN MSW ASH

Many different consumer products contribute the wide variety of toxic metals found in the municipal wastestream. Some of the sources of these metals are obvious, others less so. For lead and cadmium -- two of the most troublesome and dangerous toxic metals in incinerators -- EPA has recently quantified the major sources, which are briefly discussed in Table II.

These EPA data indicate that batteries and plastics are major contributors of both lead and cadmium to MSW. With respect to the levels of metals found in incinerator ash, plastics and other pigment uses may well comprise the largest source, given their preponderance in the combustible portion of the wastestream.

While recycling of batteries through the establishment of collection systems and prohibitions on their disposal are currently the most viable approaches to reducing their contribution of toxic metals to the wastestream, such approaches are far more difficult to institute for plastics and other pigment uses. The ubiquitous and diffuse nature of plastics and pigment uses -- and the many different types of consumer products conatining these materials -- pose serious economic and logistical (though hopefully not insurmountable) obstacles to efficient recycling. Waste reduction approaches -- aimed at reducing the amount or toxicity of such materials -- offer additional alternatives that deserve serious consideration, and may prove essential to reducing the toxicity of incinerator ash.

HEALTH EFFECTS OF METALS MOBILIZED BY INCINERATION

Many of the heavy metals of concern with respect to incineration have well-defined health effects, demonstrable in numerous studies of exposed populations. Their effects are not solely as carcinogens, although many of the heavy metals are carcinogenic; they can also exert a broad spectrum of devastating neurological, hepatic, renal, hematopoietic, and other adverse effects, both in humans and in other biota. Arsenic, cadmium, beryllium, and lead are carcinogenic metals; arsenic, lead, vanadium, cadmium, and mercury are neurotoxic; zinc, copper, and mercury are acutely toxic to aquatic life.

Because of their permanent nature, heavy metals are accumulated both in environmental compartments and within the human body. Thus, long-term releases even at low levels have the potential to increase substantially metal levels in critical environmental compartments (e.g., surface dusts) and humans. The strong correlation in the U.S. between automobile lead emissions and body lead burdens demonstrates how individually small but widely dispersed releases can significantly impact upon general population exposure.

DIOXINS

In addition to metals, highly toxic dioxins have been detected in all samples of incinerator fly ash tested, in some cases at levels that greatly exceed government guidelines[4] (Denison, unpublished data). While dioxins appear to be lower in fly ash from newer facilities, the ability of such facilities to consistently achieve acceptably low levels remains to be demonstrated. As is the case for metals, more efficient air pollution control devices will act to increase the concentration of dioxins detected in ash residues. In addition, combustion controls designed to increase burnout and reduce dioxin formation may also increase ash toxicity. Recent data indicate that the bioavailability of fly ash-bound dioxins to fish is inversely related

TABLE I: METALS CONCENTRATIONS IN INCINERATOR FLY ASH, SECONDARY LEAD SMELTER SLUDGE, AND NATURAL SOILS

METAL	RANGE OF CONCENTRATIONS (parts per million) FLY ASH	SMELTER SLUDGE[a]	NATURAL SOILS[b]
Lead	2,300-50,000	up to 50,000	10-13
Cadmium	100-2,000	340	0.1-0.2

[a] EPA, 1980 (Reference 1)
[b] Vogg et al., 1986 (Reference 44)

TABLE II. MAJOR SOURCES OF LEAD AND CADMIUM IN THE MUNICIPAL WASTESTREAM

LEAD

* Lead comes in large part from the disposal of lead-acid automotive batteries, and EPA recently estimated that, nationally in 1986, almost two-thirds of the lead in MSW came from batteries.

* The next largest source of lead is other non-combustible items such as electrical equipment, leaded glass in TV sets, and leaded ceramics. At least some of these sources are unlikely to contribute to the toxic metals found in incinerator air emissions or to the leachable metals found in incinerator ash, since they are bound up in materials that do not burn.

* Of the combustible portion of MSW -- which is most likely to contribute to the toxicity of air emissions and ash -- EPA estimates that 71% of the lead in this fraction is contributed by plastics, with the largest portion of that coming from packaging materials. Lead is used as a stabilizer in polyvinyl chloride (PVC) plastics, and as a pigment in many different types of plastics. Other uses of lead pigments besides plastics (e.g., in colored printing inks that may be used on paper or plastic packaging) account for another 24% of the lead in combustible MSW.

CADMIUM

* The major source of cadmium in MSW appears to be batteries, in this case, the rechargeable nickel-cadmium batteries used in a growing number of small appliances.

* The next largest source of cadmium in MSW is plastics: 28% of all cadmium in MSW in 1986 came from plastics, with more than a third of that coming from packaging materials. Like lead, cadmium is used as a stabilizer in PVC and as a pigment in many different types of plastics.

* Of the combustible portion of MSW, almost all (88%) of the cadmium comes from plastics. Other uses of cadmium pigments besides plastics (e.g., in colored printing inks used on paper or plastic packaging) account for virtually all of the rest (11%) of the cadmium in combustible MSW.

SOURCE: Franklin Associates, 1989 (Reference 46) to the organic carbon content of the ash,[5] so that reduction in dioxin air emissions through better combustion and stack controls may nevertheless yield an ash that poses a greater risk of dioxin exposure.

LEACHABILITY OF METALS IN INCINERATOR ASH

The leachability of metals present in incinerator ash is another measure of hazard. Table III presents a summary of data on ash from more than 45 U.S. incinerators tested for leaching using the federally mandated Extraction Procedure (or EP) Toxicity Test (See 40 C.F.R. 261.24). These test data -- on ash from new and old facilities employing a wide range of technologies -- demonstrate that:

* virtually every sample of fly ash tested has exceeded federal standards defining a hazardous waste, usually for both lead and cadmium.

* at almost half of the facilities where bottom or combined ash has been tested, the sample mean for that facility has also exceeded the standard for lead.

These results indicate that incinerator ash routinely exhibits the EP toxicity characteristic of hazardous waste. In the heat of the debate surrounding the suitability of the EP test for incinerator ash, one fact is frequently overlooked: the vast majority of this ash is disposed of in sanitary landfills along with unburned waste[4] -- exactly the disposal scenario which the EP test is designed to simulate. Large amounts of incinerator ash are managed by even less controlled means, such as open disposal, use as landfill cover, use as fill material in marshy areas, use as construction aggregate, or use as deicing grit on winter roads. These uses clearly provide even greater opportunities for dispersal of ash-borne toxic metals or dioxins into the environment.

The increased leachability of metals in incinerator ash arises from several phenomena associated with combustion. First, several toxic metals are volatilized and then condense onto the surface of fly ash particles, and their concentrations increase with decreasing particle size.[6,7,8,9] The small particle size increases the available surface area exposed to the leaching medium,[6] and the presence of metals at or near the surface of such particles also enhances leachability.[7,10] In addition, the high chlorine content of MSW results in significant complexation of metals as metal chlorides,[11,12,13] which generally are much more soluble in water than most other speciated forms of metals.

Another chemical property of certain metals becomes critical when evaluating the quality of ash generated by facilities equipped with acid gas scrubbers. Through the operation of these devices, a slurry or powder of lime is introduced to neutralize acid gases, and is intimately mixed into fly ash to form a scrubber residue removed by downstream particulate control devices. For the several U.S. facilities now in operation that possess such scrubbers, data indicates that the introduction of lime produces ash -- even the combined ash resulting from mixing bottom and fly ash -- which is highly alkaline; pH values of 11-12 or higher are typical.[14,15]

29X

TABLE III. SUMMARY OF AVAILABLE EXTRACTION PROCEDURE TOXICITY TEST DATA FOR LEAD AND CADMIUM FROM MSW INCINERATOR ASH

	LEAD	CADMIUM	EITHER
FLY ASH: 23 Facilities			
No. of Samples Analyzed	185	97	185
No. of Samples Over EP Limit	168	94	173
% of Samples Over EP Limit	91%	97%	94%
Mean of All Samples (mg/L)	22.0[a]	37.3	--
No. of Facilities Over EP Limit[b]	20	21	22
Mean of Facility Means (mg/L)	23.4	31.8	--
BOTTOM ASH: 22 Facilities			
No. of Samples Analyzed	773	271	773
No. of Samples Over EP Limit	276	5	278
% of Samples Over EP Limit	36%	2%	36%
Mean of All Samples (mg/L)	6.39	0.25	--
No. of Facilities Over EP Limit	9	1	9
Mean of Facility Means (mg/L)	7.18	0.41	--
COMBINED ASH: 47 Facilities			
No. of Samples Analyzed	933	806	933
No. of Samples Over EP Limit	373	115	390
% of Samples Over EP Limit	40%	14%	42%
Mean of All Samples (mg/L)	6.45	0.59	--
No. of Facilities Over EP Limit	22	6	22
Mean of Facility Means (mg/L)	6.26	0.48	--

---

[a] Underlined values exceed EP limits defining a hazardous waste:

lead: 5.0 milligrams per liter (mg/L)
cadmium: 1.0 mg/L

[b] Number of facilities for which mean of all available samples exceeds limit

NOTE: Due to the large number of individual samples analyzed from certain facilities, the aggregate data tend to be skewed and overly dependent on the quality of ash from those few dominating facilities. Caution should be exercized in drawing conclusions about overall exceedance rates.

Source: Environmental Defense Fund database; a full list of references is available upon request.

Certain toxic metals -- most notably, lead -- are readily soluble in water under such highly alkaline conditions, due to their amphoteric nature: significant solubility at both low and high pH values. In tests of the ash from each of the U.S. facilities possessing scrubbers[14,15,16,17] and from a similar Canadian incinerator[5], lead has leached at high levels, often in excess of federal or state standards defining a hazardous waste, and often even when leached using distilled water or rain water, rather than the somewhat acidic medium employed in the EP test. The amphoteric behavior of lead in ash is shown in Figure 1 using test data from an operating facility.

A recent Swedish report[18] lends further weight to these findings. In leaching studies using simulated rain water, lime-based scrubber residues containing fly ash were found to readily release large amounts of lead, cadmium, mercury, copper, and zinc; leaching of these metals -- particularly lead and zinc -- was significantly enhanced relative to fly ash lacking lime, and greatly enhanced relative to bottom ash or raw MSW. The report concludes that the enhanced leaching of toxic metals from such residues "is a major problem that will cause difficulty when it comes to disposal."

The increased alkalinity of ash from facilities possessing acid gas scrubbers may also increase the leachability of organic chemicals present in the ash. Recent Canadian studies have found a marked increase in the solubility of a wide range of organic chemicals present in fly ash as pH increases.[19] These findings raise new concerns about the potential for acid gas scrubbers to enhance leaching of dioxins or other toxic substances from ash that are normally relatively insoluble in water -- a possibility that has yet to be tested at any U.S. facility possessing such scrubbers.

BIOAVAILABILITY AND DIRECT TOXICITY OF INCINERATOR ASH

The hazards of ash must also be evaluated by direct bioavailability and toxicity testing, particularly with respect to the potential for ecosystem effects. Several studies demonstrate that toxic metals and dioxins present in ash are bioavailable to plants and animals,[20,21,22,23,24,25] and direct ash toxicity -- attributable to toxic metals and/or dioxins -- has also been shown.[25,26,27] In addition to the potential for direct environmental damage, these data document the plausibility of human exposure through contamination of the food chain.

Bioavailability is enhanced by the small particle size of a large fraction of ash, which allows direct inhalation or ingestion of such particles. Moreover, their small size promotes both short- and long-range dispersion, as is well documented for metal-containing particles released by various stationary and mobile sources,[28,29,30,31] and has been demonstrated for MSW incinerators as well.[32,33] These properties take on added significance in light of the permanent (metals) or persistent (dioxins) nature of the ash's toxic constituents.

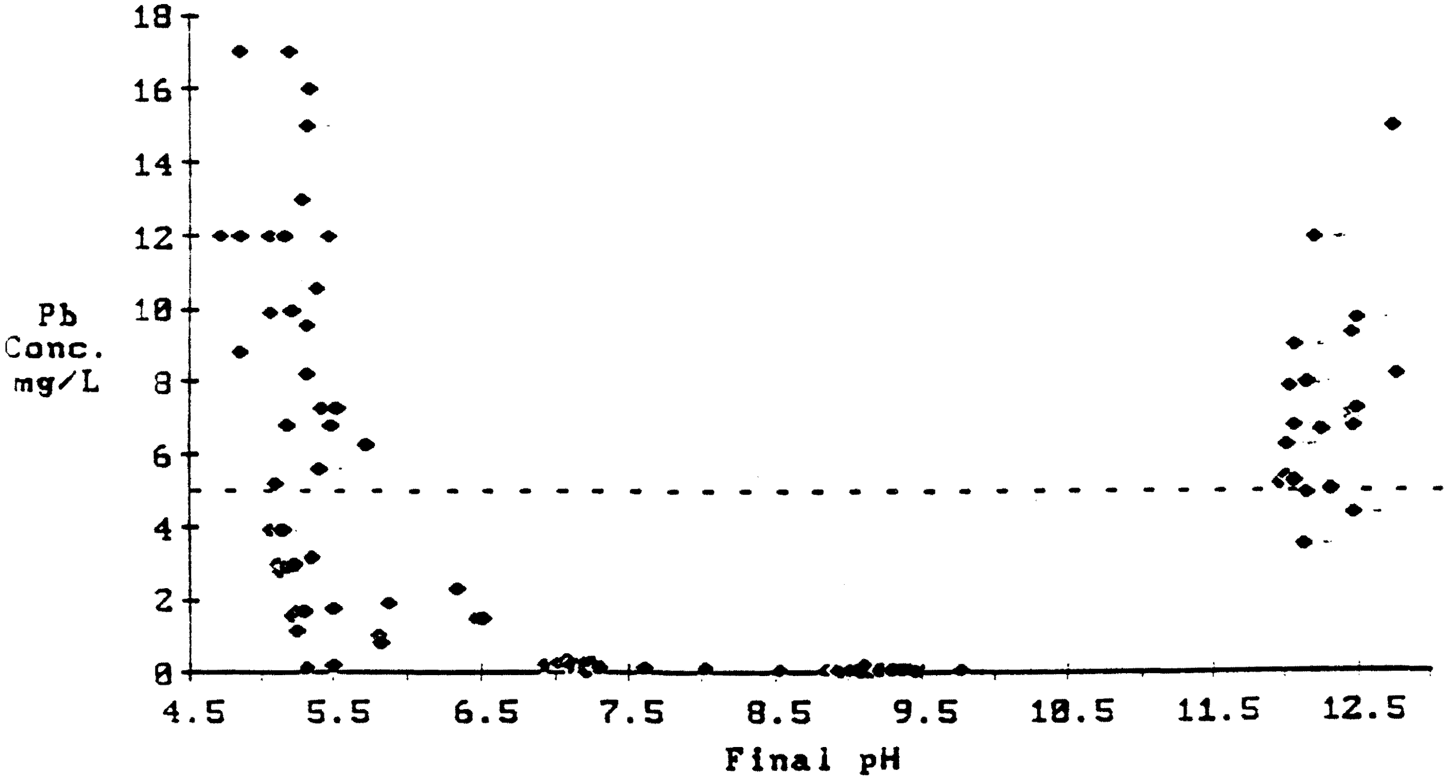
ROUTES OF EXPOSURE TO INCINERATOR ASH

Highly relevant exposure pathways exist not only from ultimate ash disposal, but from all earlier steps: onsite handling from the time of generation, storage, transport, and handling and depositing at the landfill

31x

Figure 1. Concentration of Lead in Leachates of Combined Fly Ash, Scrubber Residue, and Bottom Ash as a Function of Leachate pH. (The dotted line represents the regulatory limit for lead in the EP Toxicity Test, 5.0 milligrams per liter.)

Source: R. Denison, Environmental Defense Fund, based on Resource Analysts, Inc., 1987 (15)



until time of final cover. In each case, significant potential exists for both air-borne and water-borne dispersal of fugitive releases. Moreover, post-disposal exposure can occur as a result of direct ground or surface water contamination by leachate -- whether as a result of deliberate discharge of leachate, failure of the leachate collection system, a breach in containment systems, or the lack of maintenance of such systems that will inevitably follow the end of any required post-closure period. In addition, exposure can result from the handling and disposal of leachate or quench water (wastes which have themselves been found in some cases to contain toxic metals at levels near or exceeding hazardous waste limits -- see refs. 4, 14), as well as any residues generated through their treatment.

Few data are available to adequately characterize actual leachate quality from ash disposal sites. Very limited data (nine samples) were reported in a recent EPA study of three ash-only landfills.[4] The values for various parameters varied over a wide range; for lead, all but one exceeded the current drinking water standard, and the average value exceeded the lead standard by more than 12-fold. Recent monitoring of leachate from a New York ash-only landfill during its first year of operation[34] found that many pollutants increased significantly over the monitoring period, and that average levels frequently exceeded drinking water standards; moreover, during this first year, pollutant levels in the leachate almost always exceeded (often dramatically) the highest levels predicted to occur at any time during the first 25 years of operation, based on laboratory simulations.[35]

The potential for leachate contamination is not limited solely to the soluble fraction of metals or organic chemicals. Typically, leachate contains appreciable amounts of suspended solid material, which in the case of an ash-only disposal site consists of fine ash particles. Given that metals and dioxins preferentially concentrate on smaller particles, leachate may provide a significant vector even for very insoluble toxins.

EPA has recently raised several concerns regarding the effect of ash leachates on clay soils and liners, which are typically the only barrier material present in ash disposal sites. In particular, EPA has stated that the high alkalinity and salt content characteristic of such leachates are known to cause rapid deterioration of clay liners.[36] EPA further states that some data indicate that chloride complexes of lead and cadmium in ashes move rapidly through clay soils.[37] These concerns may well be critical in assessing the proper design for containment systems for ash landfills.

In addition to the permanent or persistent nature of ash-borne toxic substances, other properties of ash emphasize the need for long-term, secure containment. Studies have documented that under a range of circumstances, ash-borne metals can have significant mobility in soils, and that these metals can be taken up from ash-amended soil by plants.[20,21,38] Thus, the potential for erosion of the final cap over time, transport of metals out of the landfill by plant uptake or other means, and anticipated end uses following landfill closure (e.g., as recreational areas) must all be seriously considered in assessing exposure routes.

A final indication of the potential for improperly disposed ash to actually result in human exposure to toxic metals is provided by numerous studies on similar materials such as metal smelter dusts.[29,39,40] These studies demonstrate the reality and significance of virtually all of the exposure routes just discussed -- even long after initial disposal.

Perhaps the most graphic illustration of the lack of serious consideration of incinerator ash hazards is the fact that, to our knowledge, not a single quantitative risk assessment of incinerator ash has ever been conducted for a proposed incinerator project.

FUNDAMENTAL OBJECTIVES OF ASH MANAGEMENT

Given the clear hazards of ash, the major objective of any initiative to accomplish more environmentally sound ash management must be to reduce the hazardous character of the ash. In EDF's view, any approach to reducing the hazards of ash must provide for the development of strong incentives and regulations to accomplish the following:

* Separately test and manage fly and bottom ash.

* Dispose of ash separately from other wastes.

* Encourage or require treatment of ash prior to disposal using methods demonstrated to effectively reduce both its present and future hazards.

* Keep toxic metals out of products that find their way into the municipal wastestream and keep materials containing such metals out of incinerators.

The first three means of reducing the hazards of ash are clearly within the scope of what is normally considered to be waste management. All three, however, involve management at the back end, that is, after hazardous ash has been generated. The last objective may at first glance appear to be beyond the scope of standard approaches to waste management. If, however, steps were taken to remove metals from trash prior to incineration, management of the resulting cleaner ash could be accomplished in a manner that is more protective than disposal of toxic ash even in a state-of-the-art landfill. Incentives to reduce the toxicity of ash at the source will be weakened or eliminated if less than fully protective -- and generally less expensive -- ash management provisions are adopted.

Unfortunately, in EDF's view, the current federal and most state approaches to ash management do not provide sufficient means to accomplish any of these key objectives. Each of these objectives is discussed briefly below.

Separately test and manage fly and bottom ash. There is clear and growing evidence indicating that for both economic and environmental reasons, separate management of fly and bottom ash is essential. Separate management of fly ash (which is only 5-10% of the total amount of ash) would reduce the total amount of ash that would have to be managed as a hazardous waste. In addition, mixing compromises our ability to effectively contain or treat toxic ash, since containment and treatment are more effective (and cost-efficient) when applied to a smaller volume/more concentrated waste.

34x

EDF believes that separate testing of fly and bottom ash must also be required: among other benefits, this would provide the information needed to demonstrate on a facility-specific basis the benefits of separate management.

Dispose of ash separately from other wastes. Co-disposal is recognized by virtually all parties, including the incinerator industry itself, to actually increase the hazards posed by disposal of incinerator ash. Recent data clearly indicate that the so-called buffering capacity provided by the alkaline nature of ash is insufficient to ensure long-term stability of toxic metals in disposed ash.[6]

In EDF's view, monofilling -- the separate disposal of ash -- is a necessary but not sufficient component of proper ash management. Monofilling should be required. However, monofilling does not supplant the need for full state-of-the-art containment with leachate collection and groundwater monitoring as additional essential design components.

As discussed earlier, the increasing use of acid gas scrubbers on new incinerators appears to be resulting in an actual enhancement in the leaching of lead from the ash generated by such facilities, even when the highly alkaline ash is leached using water, rather than an acidic leaching medium. These data call into serious question the assumption that monofilling is a sufficient management approach, namely that monofilled ash is sufficiently less leachable than co-disposed ash so as to necessitate any less rigorous technological controls.

Encourage or require treatment of ash prior to disposal using methods demonstrated to effectively reduce both its present and future hazards. The need for treatment as well as separate management of fly ash prior to land disposal has been recognized in studies of ash contaminant leachability conducted by the Canadian government.[6,41] A broad range of approaches is under investigation for treating incinerator ash to reduce metal leaching and the potential for fugitive releases of ash-borne toxins. These methods, most of which are derived from similar methods applied to other hazardous wastes or to coal ash, include metal recovery or extraction techniques and various solidification approaches such as vitrification and cement or lime stabilization.

While such methods have considerable potential to reduce ash toxicity and should be aggressively pursued, it is equally critical that they be fully validated with respect to both their applicability to incinerator ash and their long-term as well as immediate effectiveness. Indeed, given the long-term hazards posed by metals in incinerator ash, any allowed treatment should be demonstrated to be effective under a range of conditions (e.g., multiple freeze-thaw cycles, pressure effects on structural integrity) that may occur even well beyond the end of the useful life of a disposal facility.

Ash treatment should be implemented through a treatment permit requirement, so that regulatory control over the means by which treatment is carried out can be exerted in order to ensure that the mandated treatment is carried out effectively and safely. Moreover, treatment must be carried out in a manner that provides full protection and containment during all management steps up to and including ultimate disposal.

Ash Utilization: A related issue that is gaining considerable attention as ash disposal regulations are tightened is the potential for beneficial utilization of ash. (A related EDF paper discusses this issue in greater detail; see ref. 42.) In EDF's view, it is premature to allow full-scale ash utilization before thorough environmental testing has been conducted and the appropriate standards and regulations have been implemented.

Because ash utilization (e.g., in roadbuilding or construction activities) allows the placing ash or ash-derived products into the general environment, this activity involves potential exposures that extend well beyond those from ash disposal, both in magnitude and duration. Moreover, our ability for long-term control over ash or for remedial action is lost in most utilization applications, raising the threshhold for demonstrating safety. In the absence of sufficient demonstration of safety, ash utilization may only postpone rather than eliminate exposures.

Based on presently available information, EDF believes that only bottom ash residues should be considered for utilization. This limitation is justified on the basis of the clearly greater toxicity of fly and combined ash; such a limitation is also consistent with the policies and actual practice in other countries.

The need for a complete chemical and physical characterization of ash -- both before and after any treatment preceding utilization -- is even more critical in this context than for ash destined for disposal. In EDF's view, bottom ash must be thoroughly tested prior to any utilization, using a battery of tests capable of accounting for all routes of both short- and long-term exposure. Leaching tests measure only one of the numerous pathways of exposure to ash that are relevant to evaluating the risks of utilization. The permanent nature of toxic metals (being basic chemical elements, they cannot be degraded) increases the relevance of these pathways of direct exposure to ash, as recently noted by EPA's Science Advisory Board:[43]

> "Beyond considerations of mobility and identity, the environmental persistence of the compounds [present in incinerator ash] should be explored. Persistence is easily as important to fate prediction as is mobility, since a compound that has the potential to migrate but is not persistent poses little hazard. *Conversely, a compound that does not migrate but does persist can pose a serious problem through mechanisms other than leaching*."

Routine testing on a batch or lot basis should be instituted as a precondition for utilization. Performance standards must be established by regulation and met prior to any utilization; these must demonstrate the safety of the proposed utilization under the range of conditions likely to be encountered in the environment (e.g., repeated freeze-thaw cycles; compressive strength tests). In addition, comprehensive environmental monitoring of the "utilization environment" must be conducted.

Keep toxic metals out of products that find their way into the municipal wastestream and keep materials containing such metals out of incinerators. Strong incentives are needed to reduce the toxicity of ash at the source, through approaches such as product or process substitution, recycling, source separation, and preprocessing. The true costs of using and disposing of toxic materials in our trash are not reflected in a scheme that allows for less than fully protective management of ash residues. Such a scheme essentially codifies a subsidy for continued use and improper disposal of such materials.

These same factors will also promote the continued use of the mass burn approach to incineration; this approach ignores the need to dissect the wastestream in order to use incineration only for those materials that can be safely burned. In EDF's view, the problem of toxic ash is a direct result of this blind approach to the use of incineration. In addition to providing oppportunites to remove materials that contribute toxic metals to the incinerated wastestream, preprocessing technologies can reduce the likelihood or frequency of upsets or reductions in combustion efficiency caused by trying to feed items to the incinerator that simply do not burn.[43]

Even more serious, the growing reliance on mass burn incineration is acting to preclude use of recycling and other trash processing technologies that could serve to complement the use of incineration, to reduce the amount of incineration we must carry out, and to increase its safety with respect to both air emissions and ash toxicity. Recycling and source separation are essential elements in the safe and rational use of incineration. If we cannot move beyond the mere lip service paid to implementing and maximizing the use of these technologies that characterizes much of the incineration debate, we will simply perpetuate the same myth that brought us to the brink of the present landfill crisis: namely, that a single management technique can somehow manage our entire municipal wastestream.

REFERENCES

1. Environmental Protection Agency (1980) Background Document, Resource Conservation and Recovery Act, Subtitle C -- Hazardous Waste Management, Section 3001 -- Identification and Listing of Hazardous Waste, Book 11, Office of Solid Waste, Washington, D.C.

2. Knudson, J.C. (1986) Study of Municipal Incineration Residue and Its Designation as a Dangerous Waste, Solid Waste Section, Department of Ecology, State of Washington, Olympia, WA.

3. Wilson, D.C., Young, P.J., Hudson, B.C., and Baldwin, G. (1982) "Leaching of Cadmium from Pigmented Plastics in a Landfill Site," Environ. Sci. Technol. 16: 560-566.

4. NUS Corporation, Characterization of Municipal Waste Combustor Ashes and Leachates from Municipal Solid Waste Landfills, Monofills, and Codisposal Sites, 7 Volumes, EPA Contract No. 68-01-7310, prepared for U.S. Environmental Protection Agency, Office of Solid Waste, October 1987.

5. Kuehl, D.W., Cook, P.M., Batterman, A.R., Lothenbach, D.B., Butterworth, B.C., Johnson, D.L. (1985) "Bioavailability of 2,3,7,8-Tetrachlorodibenzo-p-dioxin from Municipal Incinerator Ash to Freshwater Fish," Chemosphere 14(5): 427-438.

6. Sawell, S.E., Bridle, T.R., and Constable, T.W. (1986) Assessment of Ash Contaminant Leachability, NITEP Phase II - Testing of the FLAKT Air Pollution Control Technology at the Quebec City Municipal Energy from Waste Facility, Industrial Programs Branch, Wastewater Technology Centre, Environment Canada, Burlington, Ontario.

7. Norton, G.A., DeKalb, E.L., and Malaby, K.L. (1986) "Elemental Composition of Suspended Particulate Matter from the Combustion of Coal and Coal/Refuse Mixtures," Environ. Sci. Technol. 20: 604-609.

8. Carlsson, K. (1986) "Heavy Metals from 'Energy from Waste' Plants -- Comparison of Gas Cleaning Systems," Waste Management & Research 4: 15-20.

9. Greenberg, R.R., Zoller, W.H., and Gordon, G.E. (1978) "Composition and Particle Size in Refuse Incineration," Environ. Sci. Technol. 12: 566-573.

10. Wadge, A. and Hutton, M. (1987) "The Leachability and Chemical Speciation of Selected Trace Elements in Fly Ash from Coal Combustion and Refuse Incineration," Environ. Pollution 48: 85-99.

11. Brunner, P.H. and Monch, H. (1986) "The Flux of Metals Through Municipal Solid Waste Incinerators," Waste Management and Research 4: 105-119.

12. Bridle, T.R., Cote, P.L., Constable, T.W., and Fraser, J.L. (1987) "Evaluation of Heavy Metal Leachability from Solid Wastes," Water Sci. Technol. 19: 1029-1036.

13. Brunner, P.H. and Baccini, P. (1987) "The Generation of Hazardous Waste by MSW-Incineration Calls for New Concepts in Thermal Waste Treatment," manuscript prepared for the Second International Conference on New Frontiers for Hazardous Waste Management, Pittsburgh, PA, Sept. 27-30, 1987.

14. State of Oregon, Department of Environmental Quality (1987) "Extraction Procedure Toxicity Characterization of Municipal Incinerator Ash from Ogden Martin, Brooks," prepared by Claude H. Shinn of the Laboratory Division, Portland, OR.

15. Resource Analysts, Inc. (1987) Extraction Procedure Toxicity Test results for combined fly and bottom ash from the New Hampshire-Vermont Solid Waste Project Incinerator, tests conducted for Signal Environmental Systems, Inc. Reports dated 6 April, 1987, 30 May, 1987, 29 June, 1987, Hampton, NH.

16. Commerce Refuse-to-Energy Authority, letters to Dr. David Leu, California Department of Health Services, dated 11 May, 21 July, 12 November, 13 November, 1987, Whittier, CA.

17. Roy F. Weston, Inc. (1987) "Framingham Incinerator Ash Sampling and Analysis Report," prepared for ESI, Inc., Southborough, MA, reported dated June 5, Burlington, MA.

18. Hartlen, J. and Elander, P., Swedish Geotechnical Insititute, Residues from Waste Incineration: Chemical and Physical Properties, June 1986, Report No. 172, Linkoping, Sweden.

19. Karasek, F.W., Charbonneau, G.M., Reuel, G.J., and Tong, H.Y. (1987) "Determination of Organic Compounds Leached from Municipal Incinerator Fly Ash by Water at Different pH Levels," Analytical Chemistry 59(7): 1027-1031.

20. Wadge, A. and Hutton, M. (1986) "The Uptake of Cadmium, Lead, and Selenium by Barley and Cabbage Grown on Soils Amended with Refuse Incinerator Fly Ash," Plant and Soil 96: 407-412.

21. Giordano, P.M., Bethel, A.D., Lawrence, J.E., Solleau, J.M., and Bradford, B.N. (1983) "Mobility in Soil and Plant Availability of Metals Derived from Incinerated Municipal Refuse," Environ. Sci. Technol. 17: 193-198.

22. Van den Berg, M., Olie. K., and Hutzinger, O. (1983) "Uptake and Selective Retention in Rats of Orally Administered Chlorinated Dioxins and Dibenzofurans from Fly-Ash and Fly-Ash Extract," Chemosphere 12(4-5): 537-544.

23. Van den Berg, M., Van Greevenbroek, M., Olie, K., and Hutzinger, O. (1986a) "Bioavailability of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans on Fly Ash After Semi-Chronic Oral Ingestion by the Rat," Chemosphere 15(4): 509-518.

24. Van den Berg, M., de Vroom, E., Olie, K., and Hutzinger, O. (1986b) "Bioavailability of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans on Fly Ash After Semi-Chronic Oral Ingestion by Guinea Pig and Syrian Golden Hamster," Chemosphere 15(4): 519-533.

25. Opperhuisen, A., Wagenaar, W.J., van der Wielen, F.W.M., van den Berg, M., Olie, K., and Gobas, F.A.P.C. (1986) "Uptake and Elimination of PCDD/PCDF Congeners by Fish After Aqueous Exposure to a Fly-Ash Extract from a Municipal Incinerator," Chemosphere 15(9-12): 2049-2053.

26. Kuehl, D.W., Cook, P.M., Batterman, A.R., and Butterworth, B.C. (1987) "Isomer Dependent Bioavailability of Polychlorinated Dibenzo-P-Dioxins and Dibenzofurans from Municipal Incineration Fly Ash to Carp," Chemosphere 16(4): 657-666.

27. Bronzetti, G., Bauer, C., Corsi, C., Del Carratore, R., Nieri, R., and Paolini, M. (1983) "Mutagenicity Study of TCDD and Ashes from Urban

Incinerator 'In Vitro' and 'In Vivo' using Yeast D7 Strain," Chemosphere 12 (4-5): 549-553.

28. Environmental Protection Agency (1986) Air Quality Criteria for Lead, 4 vols.. EPA-600/8-83028aF-dF.

29. Harper, M., Sullivan, K.R., and Quinn, M.J. (1987) "Wind Dispersal of Metals from Smelter Waste Tips and Their Contribution to Environmental Contamination," Environ. Sci. Technology 21: 481-484.

30. Nriagu, J.O., (ed.) (1984) Changing Metal Cycles and Human Health, Springer-Verlag, Berlin.

31. Roberts, T.M., Hutchinson, T.C., Paciga, J. Chattopadhyay, A., Jervis, R.E., VanLoon, J., and Parkinson, D.K. (1974) "Lead Contamination Around Secondary Smelters: Estimation of Dispersal and Accumulation by Humans," Science 186: 1120-1123.

32. Hutton, M., Wadge, A., and Milligan, P.J. (1988) "Environmental Levels of Cadmium and Lead in the Vicinity of a Major Refuse Incinerator," Atmospheric Environment 22(2): 411-416.

33. Berlincioni, M. and di Domenico, A. (1987) "Polychlorodibenzo-p-dioxins and Polychlorodibenzofurans in the Soil Near the Municipal Incinerator of Florence, Italy," Environ. Sci. Technol. 21: 1063-1069.

34. Westchester County, Monitoring Report for the Westchester County Sprout Brook Residue Disposal Facility: Leachate Physical and Chemical Parameters, samples taken between October 1, 1986 and May 29, 1987.

35. Cundari, K.L. and Lauria, J.M. (1986) "The Laboratory Evaluation of Expected Leachate Quality from a Resource Recovery Ashfill," presented at the 1986 Triangle Conference on Environmental Technology, Chapel Hill, NC.

36. U.S. Environmental Protection Agency, Draft Guidance on Municipal Waste Combustion Ash, EPA Office of Solid Waste, Washington, D.C., dated March 14, 1988.

37. U.S. Environmental Protection Agency, Offcie of Solid Waste, "Status of OSW's Municipal Waste Combustion Ash Efforts," Briefing for the EPA Science Advisory Board, April 26, 1988.

38. Mika, J.S. and Feder, W.A. (1985) Resco Incinerator Residue Research Program: Results, Evaluations and Recommendations, prepared for Refuse-Energy Systems Company, University of Massachusetts, Waltham.

39. Landrigan, P.J., Gehlbach, S.H., Rosenblum, B.F., Shoults, J.M., Candelaria, R.M., Barthel, W.F., Liddle, J.A., Smrek, A.L., Staehling, N.W., and Sanders, J.F. (1975) "Epidemic Lead Absorption Near an Ore Smelter," New England Journal of Medicine 292(3): 123-129.

40. Roels, H.A., Buchet, J., Lauwerys, R.R., Bruaux, P., Claeys-Thoreau, F., Lafontaine, A., and Verduyn, G. (1980) "Exposure to Lead by the Oral and

Pulmonary Routes of Children Living in the Vicinity of a Primary Lead Smelter." Environmental Research *22*: 81-94.

41. Sawell, S.E., Bridle, T.R., and Constable, T.W. (1987) "Leachability of Organic and Inorganic Contaminants in Ashes from Lime-Based Air Pollution Control Devices on a Municipal Waste Incinerator," presented at the Annual Meeting of the Air Pollution Control Association, New York, NY, June 21-26, 1987.

42. Denison, R.A. (1989) "Ash Utilization: An Idea Before Its Time?" in Proceedings of a Conference on Ash Utilization held in Philadelphia, PA October 13-14, 1988, in press.

43. Science Advisory Board, U.S. Environmental Protection Agency (1988) *Evaluation of Scientific Issues Related to Municipal Waste Combustion*, Report of the Municipal Waste Combustion Subcommittee, Environmental Effects, Transport, and Fate Committee, April 1988, Washington, D.C.

44. Hershkowitz, A., "Burning Trash: How It Could Work," Technology Review, July 1987, pp. 26-34.

45. Vogg, H., Braun, H., Metzger, M., and Schneider, J. (1986) "The Specific Role of Cadmium and Mercury in Municipal Solid Waste Incineration," Waste Management and Research *4*: 65-74.

46. Franklin Associates, *Characterization of Products Containing Lead and Cadmium in Municipal Solid Waste in the United States, 1970 to 2000*, EPA Office of Solid Waste, Washington, D.C., January 1989.

ATTACHMENT C

ENVIRONMENTAL DEFENSE FUND

1616 P Street, NW
Washington, DC 20036
(202) 387-3500

March 21, 1990

Fundamental Objectives of Ash Management

In light of the clear hazards of ash, sound ash management requires taking steps both to reduce the inherent toxicity of ash and to fully contain it during all phases of management. Meeting these objectives requires at least the following measures:

* Test and consider managing fly and bottom ash separately.

* Dispose of ash separately from other wastes and only in secure landfills.

* Encourage or require treatment of ash prior to disposal using methods demonstrated to effectively reduce both its present and future hazards.

* Keep toxic metals out of products that find their way into the municipal wastestream and keep materials containing such metals out of incinerators.

The first three means of reducing the hazards of ash are clearly within the scope of what is normally considered to be waste management. All three involve management at the back end, that is, <u>after</u> hazardous ash has been generated. The last objective is often considered to lie beyond the scope of standard approaches to waste management, but offers the most effective solution: if steps are taken to remove metals from trash prior to incineration, the resulting ash will be cleaner. Such ash can then be managed in a manner that is inherently more protective than management of a more toxic ash by any currently available method, even disposal in a state-of-the-art landfill.

If less than fully protective -- and generally less expensive -- ash management provisions are adopted, incentives to reduce the toxicity of ash at the source will be weakened or eliminated. Unfortunately, in EDF's view, the current federal and many state regulations applicable to ash management do not provide sufficient means to accomplish any of these key objectives. Each of these objectives is discussed briefly below.

1. Test and consider managing fly and bottom ash separately

Though it is common for incinerators to mix fly and bottom ash, the two generally exhibit different characteristics and levels of toxicity and may best be managed separately. Fly ash has a considerably higher concentration of many toxic substances than does bottom ash. In addition, fly ash has been found to fail the EP toxicity test because of high lead and cadmium levels, even where combined fly and bottom ash does not.

Rather than blindly combining fly and bottom ash, incinerator operators should be required to test them separately as well as in combined form, and to handle and dispose of the ashes appropriately in light of the test results. Several factors must be considered in using test results to determine proper ash disposal and management requirements. First, present Federal regulations require that ash failing the EP toxicity test be managed as a hazardous waste. While this requirement has been highly controversial and could be changed by passage of legislation now pending before Congress, EPA continues to hold to this requirement.

Separate testing of fly and bottom ash will allow a determination as to whether one or both streams must be managed as hazardous. Until and unless current regulations that apply to ash are changed, it is highly likely that fly ash will have to be managed as a hazardous waste because it is virtually always EP toxic. Data compiled by EDF on ash from more than 20 U.S. incinerators revealed that virtually every sample of fly ash tested using the EP toxicity test has exceeded federal standards defining a hazardous waste, usually for both lead and cadmium.

When such standards are exceeded, all ash generated during the period corresponding to such analyzed samples must be transported and disposed of as hazardous waste, in full compliance with the requirements of Subtitle C of the Resource Conservation and Recovery Act (RCRA), as well as any other state laws and regulations governing hazardous wastes.

The ash testing data also show that combined ash has more frequently displayed leachate levels exceeding federal standards for hazardous wastes than has bottom ash alone. Separate testing and management of fly and bottom ash can thus help to minimize the amount of ash that must be managed as hazardous waste. Incinerators produce 10 to 20 times as much bottom ash as fly ash; put another way, fly ash is only 5% to 10% of the total amount of ash. Keeping fly ash separate from bottom ash -- a simple task, since the two types of ash are generated in separate places in an incinerator -- could greatly reduce the total amount of ash that would have to be managed as a hazardous waste.

Separate handling and testing of fly and bottom ash can also determine the effects of mixing the two streams. Such mixing frequently results in little more than dilution of the more toxic fly ash, with a concomitant contamination of a much larger volume of ash. Frequently heard claims of beneficial effects of mixing can only be assessed through testing of both the separate and combined ashes at each facility.

Finally, keeping fly and bottom ash separate would improve our ability to manage toxic ash by means in addition to direct disposal. Containment and treatment technologies are more effective (and cost-efficient) when applied to a smaller volume/more concentrated waste. In addition, any potential for utilization of ash (see below) will likely be limited only to bottom ash, yet another reason to at least provide for the capability to manage the two streams separately.

2. Dispose of ash separately from other wastes and only in secure landfills

While existing hazardous waste laws and regulations may be sufficient to handle any ash which fails to meet EP toxicity test standards, it is critical that even ash that is found not to be EP toxic be handled carefully during all stages of management and disposed of in secure facilities separate from other solid wastes.

Co-disposal of ash and MSW is recognized by virtually all parties, including the incinerator industry itself, to actually increase the hazards posed by disposal of incinerator ash. As noted above, MSW landfills contain acids that are produced by bacteria in the process of decomposing garbage. The acidic conditions that develop in the landfill can increase the leachability of a broad range of toxic chemicals present in ash.

Ash is a much more homogenous material than is MSW; when managed separately, it can be compacted to occupy a relatively small volume and to exhibit reduced permeability, which reduces the amount of liquid that comes into contact with the ash, and therefore, the extent of leachate formation and contamination. These factors, together with the exclusion from ash-only monofills of organic material subject to decomposition, produce a smaller, more stable and predictable disposal environment.

The growing use of acid gas scrubbers on new incinerators has the potential to cause an increase in the amount of lead leaching from the ash produced by such facilities. These data call into question any assumption that monofilling alone suffices to ensure safe disposal. In EDF's view, monofilling is a necessary but not sufficient component of proper ash management. While monofilling should be required, it does not eliminate the need for full state-of-the-art containment with leachate collection, leak detection, and groundwater monitoring as essential design components of the ash disposal site. In addition, use of impermeable final cover systems and certain operating controls are critical to assuring long-term containment.

3. Encourage or require treatment of ash prior to disposal using methods demonstrated to effectively reduce both its present and future hazards

The need for treatment as well as separate management of fly ash prior to land disposal has been recognized in various studies of ash contaminant leachability, including several excellent studies conducted by the Canadian government. A broad range of approaches is being explored for treating incinerator ash to reduce both metal leaching and the potential for dispersal of ash. These methods, most of which are derived from similar methods applied to other hazardous wastes or to coal ash, include techniques for recovering or extracting metals as well as techniques to solidify and stabilize ash either by adding cement or other chemicals, or by "vitrification" (heating so that the ash fuses together to form a glass-like material).

While such methods have considerable potential to reduce ash toxicity and should be aggressively pursued, they should not blindly be adopted without careful assessment of whether they are effective when applied to incinerator ash, both initially and over the long term. Indeed, given the permanent hazards posed by metals in incinerator ash, any treatment method should be demonstrated to be effective under a range of conditions (such as multiple freeze-thaw cycles) that may occur even well beyond the end of the useful life of a disposal facility.

In order to ensure that treatment is carried out safely and effectively, permits for treatment should be required. Such permits should require the use of a validated type of treatment, and also should require testing of the treated ash and monitoring to assure that the treatment procedure is effective and is conducted in a manner that provides full protection of personnel and containment during all management steps up to and including ultimate disposal.

Ash Utilization: As increasingly stringent regulations governing ash disposal are developed, interest is rapidly growing in developing "beneficial" utilization of ash. It is critical to ensure that the risk considerations that have led to more stringent regulation of ash disposal are not neglected in assessing the potential for ash utilization, an activity that allows the placing of ash or ash-derived products into the general environment, rather than a controlled disposal environment. In EDF's view, it is premature to allow full-scale ash utilization before thorough environmental testing has been conducted and the appropriate standards and regulations have been implemented.

Because ash utilization (e.g., in roadbuilding or construction activities) allows the placing ash or ash-derived products into the general environment, this activity involves potential exposures that extend well beyond those from ash disposal, both in magnitude and duration. Moreover, our ability for long-term control over ash or for remedial action is lost in most utilization applications, raising the threshhold for demonstrating safety. In the absence of sufficient demonstration of safety, ash utilization may only postpone rather than eliminate exposures.

Based on presently available information, EDF believes that only bottom ash residues should be considered for utilization. This limitation is justified on the basis of the clearly greater toxicity of fly and combined ash; such a limitation is also consistent with the policies and actual practice in other countries.

The need for a complete chemical and physical characterization of ash -- both before and after any treatment preceding utilization -- is even more critical in this context than for ash destined for disposal. In EDF's view, bottom ash must be thoroughly tested prior to any utilization, using a battery of tests capable of accounting for all routes of both short- and long-term exposure. Leaching tests measure only one of the numerous pathways of exposure to ash that are relevant to evaluating the risks of utilization. The permanent nature of toxic metals (being basic chemical elements, they cannot be degraded) increases the relevance of these pathways of direct exposure to ash.

Routine testing on a batch or lot basis should be instituted as a precondition for utilization. Performance standards must be established by regulation and met prior to any utilization; these must demonstrate the safety of the proposed utilization under the range of conditions likely to be encountered in the environment (e.g., repeated freeze-thaw cycles; compressive strength tests). In addition, comprehensive environmental monitoring of the "utilization environment" must be conducted.

Research into the feasibility of ash utilization has only just begun to address the significant environmental and public health concerns involved. In EDF's view, considerable additional research will be needed to provide a sufficient basis for determining whether full-scale ash utilization can be conducted safely, and if so, for what applications and under what conditions. In addition, full-scale ash utilization must be preceded by the development of comprehensive test procedures and a comprehensive regulatory program.

4. Keep toxic metals out of products that find their way into the municipal wastestream and keep materials containing such metals out of incinerators.

The least expensive and most effective way to protect public health from the toxic metals in ash is to keep those metals out of the ash in the first place. Doing so can be accomplished through a variety of approaches. At the most fundamental level, manufacturers can reconfigure their products to replace metals, for example substituting non-toxic organic or water-based pigments for heavy metal-based inks. Where used, metal-containing products can be separated out of the waste stream for recycling, stockpiling, or direct landfilling (for some materials, such as batteries, disposal in hazardous waste landfills would be required), rather than incineration.

While such approaches can involve significant expense, so does improper ash management in the long run. In essence, an insufficiently protective ash disposal system does not account for -- indeed, it subsidizes -- the continued use and improper disposal of the materials that make ash toxic.

ATTACHMENT 2

ENVIRONMENTAL DEFENSE FUND

1616 P Street, NW
Washington, DC 20036
(202) 387-3500

March 3, 1989

EDF PROPOSAL FOR DESIGN OF MSW INCINERATOR ASH MONOFILLS

EDF proposes that ash monofills be designed with two liners and two leachate collection systems (see Figure 1), and after filling, be covered with a composite cap, overlain by a vegetative cover, as specified below:

The liner system should consist of an upper (primary) flexible membrane liner (FML) constructed of, or equivalent to, a 60-mil thickness of high density polyethylene (HDPE). The lower (secondary) liner should be a composite liner consisting of two components: an upper FML identical to the primary liner, immediately underlain by a minimum 3-foot thickness of clay or other natural soil compacted to a maximum hydraulic conductivity of 1×10^{-7} centimeters per second (cm/sec).

A primary leachate collection system should be required to be installed above the primary liner, capable of maintaining a hydraulic head not to exceed 12 inches. A secondary leachate collection system, which serves the additional function of a leak detection system for the primary liner, should be required to be installed between the primary and secondary liners.1/

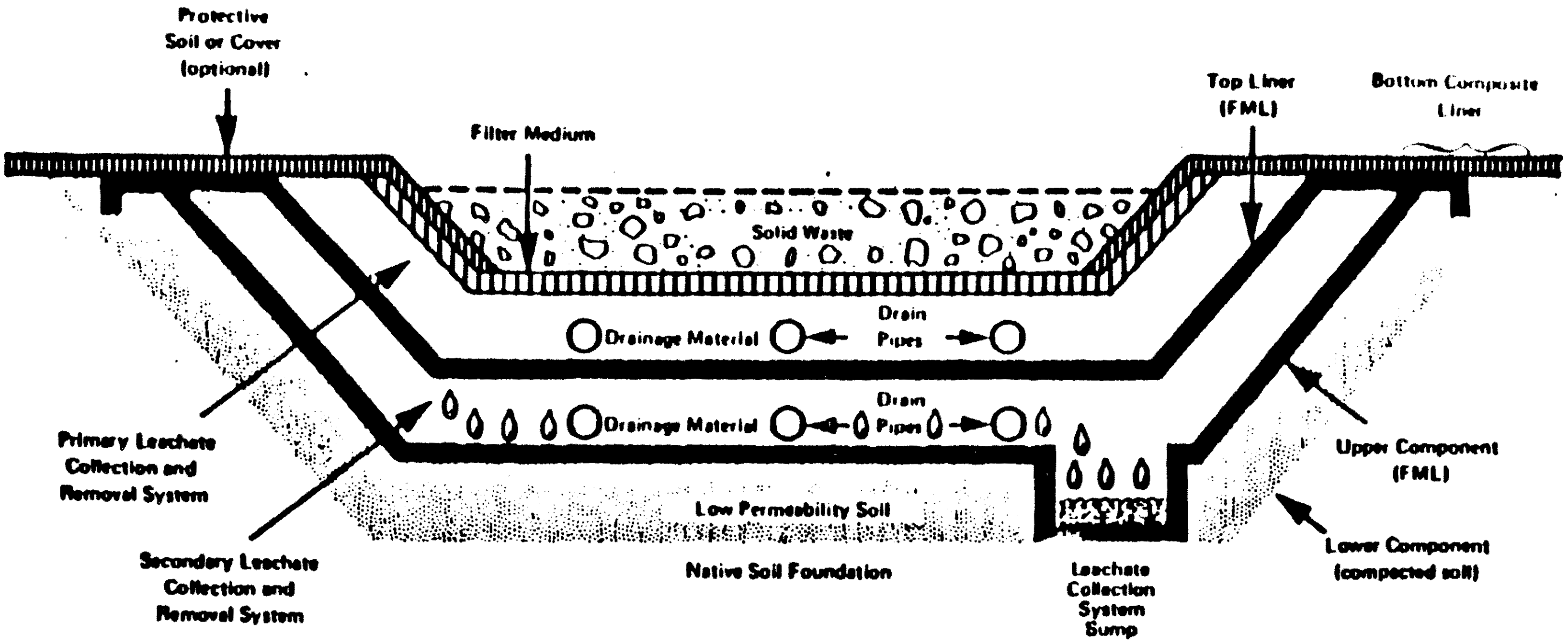
Upon closure, monofills should be required to install a final composite cover consisting of an upper FML immediately underlain by a minimum 2-foot thickness of clay or other natural soil compacted to a maximum hydraulic conductivity of 1×10^{-7} centimeters per second (cm/sec). The cover system should be overlain by a vegetative cover graded to control run-on and run-off.

---

1. This system is essentially identical in design to the primary leachate collection system; its location between the liners allows it to function as a leak detection system for the primary liner.

FIGURE 1

SCHEMATIC OF A DOUBLE LINER AND LEAK DETECTION SYSTEM FOR A LANDFILL



BEING PROPOSED AS THE LEAK DETECTION SYSTEM

(Not to Scale)

BILLING CODE 6560-50-C

48x

The remainder of this paper will first describe the rationale for this design and will then present available cost information on our recommended design, demonstrating its cost-effectiveness.

Rationale: Each Element of the Recommended Baseline Design is Necessary for Proper Landfill Function

EDF considers the standard for ash monofill design described above to be necessary not only from the perspective of environmental protection, but also to enable any landfill containment system to function properly. Indeed, each of the components is an essential element of the containment system.

Our recommended standard is consistent with -- indeed, is necessary to achieve -- the goals of EPA's liquids management strategy, which was developed in the context of hazardous waste disposal but applies similarly to monofills (see, for example, 52 Fed. Reg. 20221, May 29, 1987). This strategy has two objectives: (1) to minimize leachate generation in waste management units, and (2) to maximize leachate removal at the earliest practicable time. Achievement of these two goals provides the framework for the following discussion of the rationale for inclusion of each of the design components recommended by EDF.

1. Need for a Double Liner with Double Leachate Collection

One of the advantages of a double-lined system over a single-lined one is obvious: liners are neither impermeable nor permanent, so some degree of what may appear to be "redundancy" is needed to provide effective containment. As EPA has clearly stated on several occasions:

> "Although a liner is a barrier to prevent migration of liquids out of the unit, no liner can be expected to remain impervious forever. As a result of waste interaction, environmental effects, and the effects of construction processes and operating practices, liners eventually may degrade, tear, or crack and may allow liquids to migrate out of the unit.... It is evident to the agency that single-lined units allow

substantially greater migration of hazardous constituents than would double-lined units." (52 Fed. Reg. at 20220-21, May 29, 1987)

Efficient leachate collection and removal is a second advantage of a double-lined system. As EPA stated in 1987, "the double liner system is the mechanism by which leachate collection and removal can be maximized." Background Document on Bottom Liner Performance, page 2-20. In addition to providing two systems (rather than one) for collecting and removing leachate, buildup of any appreciable hydraulic head on the ultimate barrier -- the secondary liner -- is avoided by collecting the great majority of leachate off of the primary liner. Thus, even where leaks exist in the primary liner, in most cases the majority of leachate can still be removed and kept from ever reaching the secondary liner.

Early leak detection is a third critical advantage of double-lined systems. The leachate collection system between the liners serves several functions: it collects and removes any leachate that migrates through the primary liner, thus minimizing the hydraulic head on the secondary liner; it provides a means of detecting leaks in the primary liner at a time <u>before</u> such leaks have allowed contaminants to migrate out of the unit; and it provides a means of assessing the magnitude of such leaks, thereby increasing both the ability to respond to leakage and to assess the effectiveness of such responses. Obviously, a leak detection system offering these significant advantages is not possible without a double-liner system.

2. Need for a Secondary Composite Liner

The bottom liner in a double-lined system needs to provide several functions: (1) maximization of the detection capability of the leak detection

50X

system; (2) maximization of leachate collection and removal from the secondary liner; and (3) minimization of migration of leachate and contaminants through the liner and into the environment. On all three counts, EPA and others have clearly documented the need for a composite bottom liner, rather than either a synthetic or natural liner alone. See 52 Fed. Reg. at 12566 (April 17, 1987); 52 Fed. Reg. at 20218 (May 29, 1987); and the accompanying Background Document on Bottom Liner Performance for documentation of these advantages, which are briefly summarized below.

The use of an upper FML component in the composite liner provides a highly impermeable layer off of which to collect leachate; the minimal migration of leachate through such a liner also increases the sensitivity of leak detection. In contrast, use of a more permeable natural soil or clay liner alone allows significant amounts of liquid to penetrate into the liner and eventually migrate out of the unit; such penetration also greatly reduces the ability to both detect and assess the extent of leakage.

The lower compacted clay or natural soil component of the composite liner optimizes liner function in several ways: it serves as a backup in the event of a breach in the FML component; its greater thickness reduces the likelihood of puncture or other damage during installation or landfill operations; it provides some attenuation of certain leachate contaminants that are capable of chemically binding to such soil materials; and, because it is in immediate contact with the overlying FML, it helps to "plug" any leaks in the FML that may exist or develop over time. EPA has indicated that a minimum thickness of 3 feet is necessary to assure the stability of the clay or other natural soil component of a composite liner (52 Fed. Reg. at 10710; March 28, 1986).

Finally, EPA has raised several concerns regarding sole reliance on clay liners for containing ash leachates. In particular, EPA has stated that the high alkalinity and salt content of such leachates are known to cause rapid deterioration of clay liners (Draft Guidance on Municipal Waste Combustion Ash, EPA Office of Solid Waste, Washington, D.C., dated March 14, 1988). They further state that some data indicate that chloride complexes of lead and cadmium in ashes move rapidly through clay soils ("Status of OSW's Municipal Waste Combustion Ash Efforts," Briefing for the EPA Science Advisory Board, April 26, 1988). These concerns offer additional rationale for the need for bottom composite -- rather than compacted clay -- liners in ash monofills.

3. Need for a Composite Final Cover

While the design elements discussed above are intended to contain and effectively remove liquids that enter or are generated in landfills, an equally important objective of EPA's liquids management strategy is to minimize leachate generation in waste management units. In addition to controls over liquids disposal (which the agency has proposed largely to prohibit), the major controllable element in reducing leachate generation is to reduce infiltration of liquid into the unit, which primarily enters in the form of precipitation. The final cover is critical in this regard in that it, along with appropriate run-on/run-off controls, provides the most effective means for reducing infiltration, particularly after closure of an active unit. As EPA stated in 1982 when it required composite final covers for hazardous waste landfills: "While liners may remain effective at preventing migration from the unit until well after closure, their principal role occurs during the active life. After closure, EPA believes that a protective cap becomes the prime element of the liquids management strategy" (47 Fed. Reg. at 32285, July 26, 1982).

A principal factor in determining the nature of the final cover is the permeability of the unit's liner system, since a cover that is more permeable than the liner(s) can result in the buildup of liquid in the unit (the so-called "bathtub effect"). For this reason, EPA has generally required final cover materials to be no more permeable than the unit's liner system. This, in turn, dictates the use of FML covers for landfills that employ FML liners. The greater durability and thickness of clay materials, along with the previously discussed advantages of using a combination of FML and clay liner materials rather than either alone, provide technical justification for the proposed requirement of a composite final cover. See 47 Fed. Reg. at 32314 (July 26, 1982) for further discussion of the rationale for this cover requirement.

4. Need for Additional Operating Practices To Minimize Leachate

Given the predominant role of infiltration of precipitation in the formation of leachate, especially during the active life of a landfill, steps must be taken to minimize the period of time during which wastes are exposed to precipitation. It is increasingly recognized that a phased filling operation can greatly decrease leachate generation. Phased filling involves the sequential filling of landfill cells, which are relatively small areas that can be filled quickly and then sealed with final cover.

We strongly support the use of a phased filling operation. In our view, a maximum period of time during which an active cell may remain open must be specified. Based on state regulatory or permit requirements, we recommend a maximum active cell life of no more than 12-18 months.

Cost Data

Several sources of information on the cost of designing a landfill to meet the double liner standard we recommend are available. EPA itself commissioned an extensive study of the costs of compliance with its revised hazardous waste landfill rule that would require such a design. The EPA study[2/] derived estimates that allow a direct comparison between the costs of the double-liner system we propose and a single composite liner system. That is, the study estimates the incremental cost of adding an additional FML and leak detection system (LDS) to a design consisting of a leachate collection system underlain by a composite (upper FML and lower clay) liner. Moreover, it estimates these costs as a function of landfill size. Average annual incremental costs per ton of waste (assuming a 20-year time frame) for the additional design components varies according to landfill size (expressed in tons per year, or tpy) as follows:

tpy	1 Composite Liner, 1 LCS ($/ton)	1FML/1Composite Liner + 2 LDS ($/ton)	Added Cost ($/ton)	% Increase
550	647.82	676.18	28.36	4.4
1100	402.55	418.91	16.36	4.1
2200	277.73	287.45	9.73	3.5
6600	181.82	186.36	4.55	2.5
16500	81.91	84.73	2.82	3.4
38500	60.09	61.91	1.82	3.0
66000	51.64	53.09	1.45	2.8
110000	45.91	47.09	1.18	2.6
165000	41.45	42.36	0.91	2.2

---

2. See Pope-Reid Associates, Inc., "Engineering Costs Documentation for Baseline and Proposed Double Liner Rule, Leak Detection System Rule, and CQA Program Costs for Landfills, Surface Impoundments, Waste Piles, and Land Treatment," EPA Contract 68-01-7310, Office of Solid Waste, March 1987.

These cost estimates, which include labor and materials, indicate a modest increase (2.2% to 4.4%) in total landfill costs for the added liner and leak detection system. For landfills serving 100,000 or more people (about 66,000 or more tons per year (tpy) of waste), added costs would be on the order of $1.50/per ton or less. Even for smaller landfills, while per-ton costs are higher, the percent increase in total landfill cost for the added protection is still small and relatively constant with size.

[It should be noted that the above cost data are expressed in terms of costs per ton of waste. Costs for disposal of incinerator ash could be substantially less due to the generally greater density of ash. This issue is more fully discussed below.]

Several other sources of cost data provide support for this relatively minor increase in cost to add an additional synthetic liner and LCS. New York State recently prepared cost estimates for its new regulations that require double composite liners for all new municipal solid waste landfills. While it did not examine economies of scale for landfills of various sizes, it did provide unit costs (i.e., cost per unit area for liners and leachate collection systems). These cost estimates are summarized in the table below. The New York cost data have been converted into cost-per-ton-<u>of-ash</u> estimates by assuming a 60-foot depth of ash at capacity, which represents 18 tons of ash per square yard of filled area (at 1800 pounds per cubic yard).

NEW YORK STATE UNIT COSTS

Component	Cost/yd^2	Cost/ton of ash
40-mil FML (for cover)	$ 4.63	$0.26
60-mil FML (for liner)	6.42	0.36
Clay liner, 3 feet thick (10^{-7} cm/sec)	15.33	0.85
Leachate collection system	1.22	0.07

Cost figures include materials, installation, and quality assurance/quality control.

Using these unit costs (as well as the costs for the requisite drainage layers, filter fabric, etc.), New York estimates that its double composite liner/double leachate collection system would cost \$49.05/yd^2, or \$4.09/ton of MSW. A final composite cover (with a gas venting layer) is estimated to cost \$24.70/yd^2, or \$2.06/ton of MSW. After accounting for the greater density of ash (typically 1800 pounds per cubic yard, versus 1200 for MSW), these costs would be \$2.73 per ton of ash for the liner system and \$1.37 per ton of ash for the final cover.

EDF's proposed liner and cover design standards differ somewhat from New York's more stringent requirement; using New York's unit costs, EDF's double liner proposal would be slightly less expensive: \$2.61 per ton of ash. Adding to this the cost of EDF's composite cover design (\$1.17 per ton) results in a total additional design cost of \$3.78 per ton of ash.

This value can be further translated into two other useful cost estimates. Because incinerators significantly reduce the weight of MSW, a ton of MSW generates considerably less ash. Assuming a typical weight reduction of 75%, the <u>increase in the incinerator tipping fee</u> (the amount charged per ton of MSW received) that would result from EDF's proposed design would be only 95 cents per ton (i.e., 25% of \$3.78). <u>The added cost to an individual</u>

citizen, who typically generates about two-thirds of a ton of MSW each year, would therefore be about 63 cents per year, a truly trivial expense for the added protection of EDF's design.

Several other studies provide comparable estimates of unit costs for the same or similar materials. (It is not clear whether these estimates include only materials, or also installation costs). These studies and their estimates (expressed in terms of dollars per ton of ash) are as follows:

MBS *	60-mil FML ($/ton)	
	0.25	
GLEBS **	??-mil FML ($/ton)	3 feet Clay ($/ton)
	0.25-0.50	0.05-0.19

* Multinational Business Services (MBS), "Potential Subtitle D Compliance Costs for Municipal Landfills -- An Analysis," June 1987

** Glebs, R.T., "Landfill Costs Continue to Rise," Waste Age, March 1988, pp. 84-93.

Actual construction costs for an ash monofill provides further support for these estimates. A 6-acre monofill (with capacity for 202,500 yd^3 of ash) equipped with a composite liner and a composite cover was recently constructed in Marion County, Oregon; county officials report that the total cost (for land acquisition, design and construction, and operating and maintenance) was $16.50 per ton (Randall Franke, Marion County Commissioner, presentation at a seminar on MSW Incinerator Ash sponsored by the Northwest Center for Professional Education, held in Orlando, FL on December 1, 1988).

The Pope-Reid, New York, MBS, Glebs and Marion County data are all relatively consistent, and indicate modest incremental costs for meeting the design standard we recommend for ash monofills, subject to only slight economies of scale; total landfill costs should be increased by considerably less than 10%. When judged in the context of the tremendous increase in containment system performance and the concomitant environmental benefits, we simply see no justification for requiring anything less.

prime element of the liquids management strategy" (47 Fed. Reg. at 32285, July 26, 1982).

A principal factor in determining the nature of the final cover is the permeability of the unit's liner system, since a cover that is more permeable than the liner(s) can result in the buildup of liquid in the unit (the so-called "bathtub effect"). For this reason, EPA has generally required final cover materials to be no more permeable than the unit's liner system. This, in turn, dictates the use of FML covers for landfills that employ FML liners. The greater durability and thickness of clay materials, along with the previously discussed advantages of using a combination of FML and clay liner materials rather than either alone, provide technical justification for the proposed requirement of a composite final cover. See 47 Fed. Reg. at 32314 (July 26, 1982) for further discussion of the rationale for this cover requirement.

4. Need for Additional Operating Practices To Minimize Leachate

Given the predominant role of infiltration of precipitation in the formation of leachate, especially during the active life of a landfill, steps must be taken to minimize the period of time during which wastes are exposed to precipitation. It is increasingly recognized that a phased filling operation can greatly decrease leachate generation. Phased filling involves the sequential filling of landfill cells, which are relatively small areas that can be filled quickly and then sealed with final cover.

We strongly support the use of a phased filling operation. In our view, a maximum period of time during which an active cell may remain open must be specified. Based on state regulatory or permit requirements, we recommend a maximum active cell life of no more than 12-18 months.

These cost estimates, which include labor and materials, indicate a modest increase (2.2% to 4.4%) in total landfill costs for the added liner and leak detection system. For landfills serving 100,000 or more people (about 66,000 or more tons per year (tpy) of waste), added costs would be on the order of $1.50/per ton or less. Even for smaller landfills, while per-ton costs are higher, the percent increase in total landfill cost for the added protection is still small and relatively constant with size.

[It should be noted that the above cost data are expressed in terms of costs per ton of waste. Costs for disposal of incinerator ash could be substantially less due to the generally greater density of ash. This issue is more fully discussed below.]

Several other sources of cost data provide support for this relatively minor increase in cost to add an additional synthetic liner and LCS. New York State recently prepared cost estimates for its new regulations that require double composite liners for all new municipal solid waste landfills. While it did not examine economies of scale for landfills of various sizes, it did provide unit costs (i.e., cost per unit area for liners and leachate collection systems). These cost estimates are summarized in the table below. The New York cost data have been converted into cost-per-ton-<u>of-ash</u> estimates by assuming a 60-foot depth of ash at capacity, which represents 18 tons of ash per square yard of filled area (at 1800 pounds per cubic yard).

AMERICAN
REF-FUEL™
CONSTRUCTION OF ESSEX COUNTY, INC.

COMMENTS ON PROPER MANAGEMENT OF RESIDUAL ASH FROM RESOURCE RECOVERY FACILITIES

Testimony of William J Glover, Vice President
America Ref-Fuel of Essex County

Assembly Waste Management Planning and Recycling Commitee

Thursday March 22, 1990

60 BLANCHARD STREET • NEWARK, NEW JERSEY 07105
TELEPHONE 201/344-7704 • TELECOPIER 201/344-7839

American Ref-Fuel Company of Essex County, and American Ref-Fuel Company of Bergen County (together, "Ref-Fuel"), are the developers and will be the owners and operators of Resource Recovery Facilities in those respective countries. The Essex County facility will be operating in late 1990 and the Bergen county facility is in advanced development. Ref-Fuel is familiar in detail with the procedures that are currently incorporated in New Jersey Department of Enviromental Protection (NJDEP) regulations, and is presently in the process of planning for operations in compliance with the regulations as currently interpreted. As the provider of disposal service at Essex County and Bergen County, Ref-Fuel has the obligation to provide for the protection of the environment through compliance with its permits and regulatory procedures.

We believe that the current procedures established by NJDEP with respect to residual ash testing and disposal were intended to provide for adequate environmental protection regarding ash disposal. We further believe, however, that alternatives to those regulatory procedures are available which provide equal protection to the environment at substantially lower cost to the public. These alternatives are suggested by the preproposal itself and should be pursued in the public interest.

Analysis of the current regulations reveal three problems. First, the regulatory protocols currently called for are incomplete and will not succeed in practice as envisioned. Second, the procedure starts with a basic assumption of toxicity which has been refuted in a number of court cases and important scientific studies. Third, there needs to be an understanding that the proposed special waste classification can, in fact, provide for the environmental protection that DEP is seeking.

As to the first issue, specifically, the current procedure requires the retention of ash at the facility until test results are available, which at best experience creates a costly storage requirement of twelve days. The regulations suggest that eventually ash may be shipped without test results, but still require that testing occur on samples composited over periods of one month. This poses the question of how the responsible parties deal with a retroactive test failure and the potential liability for having improperly manifested, transported and disposed in a landfill of material that has subsequently been determined to be a hazardous material.

It is suggested that, as long as the sampling and testing requirements are continued without amendment of current regulations, the responsible parties would have no recourse but to perpetually continue the practice of ash retention to avoid potentially improper manifesting, shipment and disposal of material later deemed to be hazardous. In this way, the regulations will not resolve a "characterization" of the ash even if the initial test results were successful.

60X

With regard to the second problem, newly released scientific studies, subjected to peer review in New Jersey, have established clear evidence that the leaching characteristics of ash are very low and are not accurately reflected in the current test procedure. A recently completed study commissioned by EPA and CORRE (Coalition on Resource Recovery and the Environment) and performed by the NUS corporation has found that leachate tests from ash from five resource recovery plants are close to drinking water standards and that the EP toxicity test greatly exaggerates the amount of substances that might leach from ash in the actual landfill. The results were released in February 1990.

Further, federal court determinations have established that MSW incinerator ash is non-hazardous material and is not subject to RCRA Subtitle C. NJDEP should follow the exclusion of resource recovery wastes contained in the Federal Resource Conservation and Recovery Act, which supports the special waste designation. Based upon the evidence available to date, we believe that no other classification system is needed. The RCRA exclusion has recently been upheld by both courts who have reviewed it (Environmental Defense Fund v. Wheelabrator Technologies, U.S.D.C.S.D.N.Y. 30 ERC 1609, No. 88 CIV. 0560 (11/22/89) and EDF v. City of Chicago, U.S.D.C.N.IL 30 ERC 1624, No. 88 C 769 (11/29/89)). All States who have adopted any statute on residual ash (NY, MA, CT, IL, MI, PA) have also adopted the RCRA exclusion. New Jersey is the only state, among all the States with a trash disposal crisis, to regulate resource recovery ash based on the unreliable and inappropriate EP toxicity test.

As to the third issue of adequate environmental protection under a special waste classification, disposal of ash in a correctly designed Subtitle D landfill provides adequate environmental safeguards through composite liners, leachate testing and leak detection. If adequate liner and leachate capture specifications are provided, the ash can either be monofilled or codisposed.

New Jersey's proposed sanitary landfill construction regulations provide ample protection for the environment. Monofills or additional construction requirements, while desireable, are not needed for safe ash management.

Ash can be used as daily and intermediate cover material in a codisposal landfill since the normal problems associated with MSW - ordors, fires, and vermin - are not problems with ash. Ash moisture should be sufficient to avoid fugitive dust. Final cover should be placed over the ash.

The same postclosure provisions as applied to MSW landfills should be observed, including a program to ensure that the leachate collection system and monitoring wells are properly maintained. However, methane controls are not required for the ash monofill.

6K

Another issue which should be considered is the impact of current DEP policy on the available hazardous waste landfill capacity in the United States. New Jersey has no hazardous waste landills but this policy could result in the export of a very large stream of incinerator ash which would seriously deplete the available hazardous waste landfill capacity in the region. New Jersey would also be placed in the posture of advocating the export of hazardous waste as a policy. New Jersey can no longer afford to classify ash differently than all of its neighbors and exclude ash from landfills where it may legally and saftely be disposed of in other states, based on an inaccurate test procedure.

In summary, while the current policy is intended to provide for protection of the environment, the policy results in an cumbersome and costly procedure which will notfunction as DEP originally intended it to function. Alternatives exist which provide equal protection to the environment and it is imperative that these alternatives be more fully explored.

OGDEN MARTIN SYSTEMS, INC.

40 LANE ROAD
CN 2615
FAIRFIELD, NEW JERSEY 07007-1093

MATTHEW L. ROOT
GOVERNMENT RELATIONS REPRESENTATIVE
(201) 882-7304

March 16, 1990

Catherine Tormey, Assitant Director
Division of Regulatory Affairs
New Jersey Department of
Environmental Protection
CN 402
Trenton, New Jersey 08625

Dear Ms. Tormey,

Ogden Martin Systems (OMS) is pleased to be given the opportunity to respond to the New Jersey Department of Environmental Protection (NJDEP) pre-proposed rulemaking regarding the management of resource recovery ash. OMS as a company designs, builds and operates facilities to recover energy and materials from municipal solid waste while reducing its volume through controlled combustion. As a member of the Institute of Resource Recovery, we would like to complement their submittal with our own comments as follows.

Regarding solid waste management (SWM), OMS advocates an integrated approach which includes source reduction, recycling, resource recovery and landfilling. Resource recovery is an essential component of the strategy to handle the growing volume of trash generated by Americans. Some of the benefits provided by this necessary SWM option include: the volume reduction of solid waste by upwards of 90%, resulting in the extension of valuable landfill capacity; the recovery of energy in the form of steam or electricity, thus reducing our reliance on foreign and fossil fuel power sources; the recovery of marketable metals from the waste combustion ash; and the processing and reuse of the ash material itself as a roadbed fill, an aggregate for asphalt, cement, etc., and other useful applications.

Regarding the issues outlined by the NJDEP in their notice of pre-proposed rulemaking (22 NJR 108: January 16, 1990) OMS's comments are as follows:

1. How best to manage the residual ash of the resource recovery facility with particular regard to handling the residual ash from the various equipment generating residual ash and the storage of the residual ash at the facility.

65X

Ogden Martin's experience dictates that the residue ash is best handled as a wetted, combined ash stream which is conveyed from the ash discharger to an enclosed residue building. From the residue building the ash is loaded (via front-end loaders) on to containerized, leak-proof trucks and carted to a dedicated ash monofill. The ash is wetted to minimize dusting during transport.

2. The collection and sampling for analyses of the residual ash.
   Sampling and analysis should be conducted specifically for the purpose of scientific characterization of the ash and not to determine the disposal scenario. The data should be used to establish a baseline on the physical and chemical characteristics of the ash. Specifically, to determine how changes in the waste stream (e.g. as would occur with extensive recycling) would modify the ash characteristics over time. The collection method should be developed with this understanding in mind. For example, grab samples obtained using ASTM approved methods (e.g., belt cut method) on any hourly basis, over the course of a work shift (8 hours), may be composited and subsampled to obtain an adequate sample for analysis.

3. The analytical parameters to be tested for on the residual ash.
   The analytical parameters chosen should characterize the ash and provide an indication of shifts in the waste stream due to recycling efforts or other significant factors which may effect the waste stream. Typical analytical parameters may include a total metals analysis of the ash, as required by Michigan's legislation adopted in June 1989 (Public Act Number 52: Michigan's revision to the State Solid Waste Management Act.) Another recommended analysis is the determination of the leaching potential using the CO2 saturated deionized water extraction method developed by the U.S. EPA and the Coalition on Resource Recovery and the Environment (CORRE). This procedure gives a realistic leaching potential of the ash in an ash monofill environment and is recommended for use by the regulatory authorities in New York State (Dept. of Environmental Conservation) and Massachusetts (Dept. of Environmental Protection).

4. The classification system for the residual ash.
   Residue ash from a resource recovery facility should be classified and managed as a solid waste and deposited in a properly designed/dedicated landfill unit. Two recent court cases (EDF vs. Wheelabrator Technologies, Inc. and EDF vs. the City of Chicago) have upheld the position that resource recovery ash is exempt from regulations as a hazardous waste if the resource recovery facility satisfies the criteria of §3000(i) of the Hazardous and Solid Waste Amendments of 1984.

U6x

5. The performance requirements for residual ash management at the resource recovery facility.
An ash management plan should be developed following the requirements specified by Congressman Luken in his RCRA reauthorization bill, HR-3735, and in section 130 of the Seante Clean Air Act Amendments, S-1630. Both bills specify that ash must be managed in lined land disposal units. Well-documented ash management plans may be found in New York State's revised regulations (6NYCRR Part 360) and Massachusetts policy document SWM-7-8/88. The applicable parts of these documents are attached.

6. The transportation of the residual ash from the resource recovery facility to the sanitary landfill.
The residue ash should be transported from the facility to the ash disposal site in covered, leak resistant trucks which minimize's the potential for ash spillage during transport over public access roads.

7. The appropriate design and construction of the sanitary landfill receiving the residual ash for disposal (monofill versus cofill).
OMS believes that the appropriate design and construction of the landfill receiving the residue ash is detailed within the framework discussed in Item #5. These design requirements may be summarized as requiring a composite lined monofill or a double lined codisposal unit, both with leachate collection and groundwater monitoring systems.

8. The proper operational technique to be utilized at the sanitary landfill for disposal of the residual ash.
The residue ash should be placed in the land disposal unit without a requirement for daily cover.

9. The performance requirement for residual ash management at the sanitary landfill.
(See Item #5).

10. The potential reuse and recycling of the residual ash. Research on the potential reuse and recycling of ash residue is continuing, and many potential uses have been investigated and demonstrated. The most important factor, however, in preventing widespread reuse of ash is the lack of a formal regulatory program.

    One type of reuse practiced today is the recovery and recycling of ferrous scrap from the post-combustion residue. During calendar year 1989 Ogden Martin recovered 54,000 tons of scrap iron from ash. This recovered scrap iron represents between 1.5 to 3.5 percent by weight of the raw refuse which enters the facility.

Should you wish more information, please contact me or David B. Sussman (703-754-2523).

Sincerely yours,

Matthew L. Root

Testimony

of

DAVID SUSSMAN

Vice President, Environmental Affairs

Ogden Martin Systems, Inc.,

on behalf of the

Institute of Resource Recovery

before

New Jersey State Legislature

Assembly Waste Management,

Planning and Recycling Committee

Trenton, New Jersey

March 22, 1990

Mr. Chairman, my name is David Sussman. I am Vice President of Environmental Affairs for Ogden Martin Systems, Inc. which is a member firm of the Institute of Resource Recovery (IRR). The IRR is comprised of firms that design, build and operate facilities to recover energy and materials from trash while reducing its volume through controlled combustion. The IRR is a component of the National Solid Wastes Management Association (NSWMA), a trade group with over 2500 members of the private waste services industry.

Mr. Chairman, we commend you and your committee members for your leadership on the important issue of resource recovery ash management with regard to solid waste management. The IRR advocates an integrated approach to solid waste management which includes source reduction, recycling, resource recovery and landfilling. Resource recovery is an essential component of the strategy to handle the growing volume of trash generated by Americans. Some of the benefits provided by this necessary solid waste management option include:

- the volume reduction of solid waste by up to 30%, resulting in the extension of valuable landfill capacity;
- the recovery of energy in the form of steam or electricity, thus reducing our reliance on foreign power sources;
- the recovery of marketable metals from the waste combustion ash;
- and the processing and reuse of the ash material itself as a roadbed fill, an aggregate for asphalt, cement, etc., and other useful applications.

70X

One of the key issues associated with the waste to energy industry and its growth is ash: how it is managed, reused and tested. The standard laboratory tests used to determine MSW ash toxicity, most notably the EP Tox test, are recognized to overstate the toxicity of solid waste ash and yield inconsistent results. Recently completed investigations have further concluded that MSW ash is not hazardous and should not be required to be managed as such. This was the finding of two independent ash studies, one completed by Resources for the Future, and the other by the EPA and the Coalition on Resource Recovery and the Environment (CORRE). In addition, the California Department of Health Services recently approved a nonhazardous ash classification and management program for the Stanislaus, California resource recovery facility. Based on these important findings and given the growing volume of ash to be managed in New Jersey, it is entirely appropriate to establish an ash management program that does not rely on case-by-case testing.

Complementing the growing body of scientific opinions that assert ash to be nonhazardous are recent court decisions that have also ruled it nontoxic. In two 1989 court cases, EDF vs Wheelabrator Technologies, Inc. and EDF vs. City of Chicago decisions were rendered that MSW is excluded from hazardous waste regulation. More specifically, the Courts concluded that ash remaining after the burning of MSW is exempt from regulation if the resource recovery facility satisfies the criteria of 3001(i) of RCRA.

Notwithstanding these recent decisions, the IRR supports ash management procedures which offer a significant measure of protection not required by current law. Specifically, the IRR supports two pieces of federal legislation, Section 307 of the proposed amendment to the Clean Air Act now being considered by the Senate and Section 2 of the Municipal Solid Waste Incinerator Act of 1989 currently in the House of Representatives. These bills call for an ash management regime which contains standards for monofills in which ash alone is disposed and cofills where ash and garbage is disposed together. Monofills would either consist of a single composite liner, ground water monitoring and leachate collection or an alternative monofill design of two or more flexible membrane liners, a leachate collection system above and between such liners and ground water monitoring. The cofill design includes a double liner consisting of one flexible membrane liner and a composite liner with a leachate collection system above and between such liners and groundwater monitoring.

At the state level, legislation calling for similar ash disposal standards has been enacted. Massachusetts policy document SWM-7-8/88 classifies MSW ash as a solid or "special" waste not subject to hazardous waste disposal practices. The New York State Department of Environmental Conservation published technical standards for solid waste management facilities effective December 1988 for ash to be managed as a non-hazardous solid waste. A law passed in Michigan last year provides yet another example of a non-hazardous ash classification and management regime. Each of these state laws outlines responsible ash management practices that do not require hazardous waste disposal practices.

Subjecting MSW ash to enforcement of EPA Subtitle C regulations as hazardous waste additionally ignores economic, financial and social repercussions to the SWM planning issue. This is indeed a very critical issue in New Jersey. Any requirement for MSW ash disposal in Subtitle C landfills would seriously reduce the capacity available for hazardous wastes, a capacity that is a limited resource (non-existent in New Jersey) and should be reserved for the disposal of those wastes which truly require that level of management. Likewise, subjecting all MSW ash to Subtitle C regulation reduces incentive for finding ways to reduce ash toxicity through treatment or source reduction measures.

In summary, the IRR strongly feels that it is inappropriate for MSW ash to be designated as a hazardous waste. The continuous testing of MSW ash for hazardous properties is likewise unnecessary to ensure full protection of human health and the environment. Ash testing can be useful in building a database of ash characteristics over time for analytical purposes but should not be used to define disposal scenarios. Management under Subtitle D regulations fully ensures responsible handling of MSW ash.

The above mentioned documents are attached and serve to clarify and strengthen the IRR's recommended positions on ash management. Thank you for allowing the IRR the opportunity to testify on this important issue in New Jersey.

LIST OF ATTACHMENTS

1. CORRE / EPA Ash Study, February 1990
<u>Final Characterization of Municipal Waste Combustion Ash, Ash Extracts, and Leachates</u>

2. **California Department of Health Services Notification Regarding Classification of Stanislaus Waste Energy Company Facility Ash,** February 1990

3. **Resources for the Future Ash Study**
Managing Ash From Municipal Waste Incinerators, November 1989

4. **Lawsuit Judgments:**
<u>EDF v. Wheelabrator Technologies, Inc.</u>
<u>EDF v. City of Chicago</u>
These 1989 judgments concluded that under RCRA Section 3001(i), ash remaining after the burning of household waste and non-hazardous commercial waste is exempt from Subtitle C regulation.

5. **U.S. Senate Clean Air Act, S-1630, Section 307**
Ash Disposal Provisions in proposed Durenberger Amendment
Establishes a specific regulatory program, which inc[illegible] Subtitle D enforcement, for MSW ash which is protective of human health and the environment but is not contingent upon testing.

6. **H.R. 2162 Municipal Solid Waste Incinerator Act of 1989, Section 2: Municipal Solid Waste Incinerators and Municipal Solid Waste Incinerator Ash**
Authorizes MSW ash management standards which are not subject to Subtitle C regulation.

7. **New York State/Department of Environmental Conservation, 6 NYCRR Part 360 Section 360-3.5, Solid Waste Management Facilities, Title 6 of the Official Compilation of Codes, Rules and Regulations, Effective December 31, 1988**
Establishes technical standards to manage ash as a nonhazardous waste.

8. **Massachusetts Policy Document SWM-7-8/88**
Authorizes MSW ash classified as solid waste or "special waste," and not to be managed as hazardous waste.

9. **State of Michigan, 1989 Public Act No. 53**
Revises Michigan's state Solid Waste Management Act exempting MSW ash from hazardous waste regulations and designates acceptable landfill designs for landfills holding MSW ash.

Attachments, continued

10. David L. Sokol, Chairman, IRR
Testimony Before the Subcommittee on Transportation and Hazardous Materials, May 11, 1989
Testimony to support passage of HR 2162, the Municipal Solid Waste Incinerator Act of 1989, which clearly states that combustion ash disposal should be governed by Subtitle D of RCRA rather than Subtitle C.

Lorraine Gold
21 Hardwick Road, Blairstown
New Jersey 07825
(201)362-8724

Assembly Waste Management Planning and Recycling Committee
State House Annex
CN-068
Trenton, NJ 08625-0068

Attn.: Leonard Colner

Re: Residual Ash Policy - Testimony

Dear Mr. Colner and Committee members:

I endorse the most stringent ash management policy that the Department of Environmental Protection can devise. I oppose any classification change of hazardous ash to a "special waste" designation if this means the landfill requirements will be less restrictive. Handling and storage of residual ash should be performed in a manner that best prevents its introduction into the environment. The collection and sampling for analyses should be the most comprehensive state of the art procedure. Fly ash should be separated from bottom ash and fly ash should always be handled as hazardous waste, and the bottom ash should be tested with utmost care. The monofill ash landfill should be monitored with the state of the art procedures. All incinerators should require front end MRFs to remove metals.

I attended a Cook College Short Course entitled "Ashes to ??: Problems, Perceptions and Prospects in Municipal Waste Ash Management", June 15th, 1989, presented by the NJDEP and the Committee for Ash Stabilization and Utilization Research. Most of the opinions expressed in this commentary are derived from that course.

I learned that much work, money and time will be devoted to making the concept of ash utilization into practical reality. For instance, $800,000 of NJDEP money for recycling research will be used for the road project.

All participants at the seminar stressed that ash in the environment <u>can</u> have environmental impact and public health impact. This is because the toxic metals are "microscale" and easily inhaled, and very dangerous when ingested. Furans and dioxins are also present in ash and present a problem. (Although mentioned by several speakers as being present in ash, no in-depth discussion of dioxins or furans took place at the conference.)

Practically the same amount of toxic metals is present in the ash as there was pre-burn (although it was admitted that some amount of the metal vaporizes and is released into the air). After the burn process the toxic metals are of small particle size and are in high concentration in the ash.

A good portion of the workshop discussed removing the sources of lead, cadmium and other metals from the waste stream before burning. Car batteries are a major problem as are other batteries. A comprehensive recycling program is the least expensive and most effective way of removing non-combustibles and correcting the composition of the ash to a less hazardous state. Pigments and plastics then become the major contributors to problem ash. Comprehensive recycling programs, a battery collection program, hazardous waste collection systems, and MRFs to remove metals should be required before any incinerator can receive a permit.

Removing the metals after combustion is also being studied. This is a more "high tech" and expensive proposition, yet to be fully developed. Similarly, vitrification is in the labs and may provide a solution to ash problems by using ash for glass.

One of the things I learned at this conference is that no one likes the EP Tox test, it is not really reliable or efficient in determining ash safety or toxicity. In order to get better results with Warren County ash Mr. Winka said the DEP worked with the lab to change the testing methods. They're adding the acid differently; they keep testing to get the lower samples (a batch can be tested many times before they get the right mix of samples which will test "good"); and they've made sure to add the bigger particles. As Dr. Kosson of Rutgers said "you can play with it (the test)", and you can add more lime. I asked Dr. Kosson what effects the high pH of our ash has on the safety and quality of our ash over time and he said "we don't know". Passing the test only means that at the time the the test is performed, with the particular mix of samples used, the toxins do not leach out. It doesn't mean that they are not there in the ash. We need a better method of testing ash.

The concerns about ash involve dusting, leaching and the quantity of ash. The dusting aspect is of special concern for those handling the ash and working with it in any disposal or utilization process. The occupational exposure is something each employee should take seriously and proper safeguards should be used.

Lead has toxic effects at lower levels than previously thought. The Federal government is in the process of reducing the allowable amount of lead in drinking water to make the standards ten times more stringent; and cadmium standard may be cut in half. The new standards will effect the classification of ash because all the standards are derived from the drinking water standards.

The leachability is of real concern; even in pure water. Chemical or microbial changes which happen over time in a landfill (or in a roadbed, or elsewhere where ash is "disposed" or "used") can mean more leachability. The toxins can get into the environment through drinking water, through irrigation (plants do take these metals up), through food and feed, through milk, through dermal (skin) absorption. The metals do migrate in soil, especially eastern acidic soils. Again, the particles are very small and they're in high concentration. Besides leaching concerns, run off is also a concern.

Any project using ash must be watched and tested from "cradle to grave". The toxic metals never go away.

As to ash treatment, it was clear that this needs much more research. Lime can be used to stabilize the ash, but under certain pH conditions lime also has the potential to increase the leaching of lead.

A roadbed will freeze and thaw, it will be pressurized by vehicles, it will be rained and snowed on, and it will naturally deteriorate over time. No one, as of yet, knows how or even if the toxins in ash can be contained and prevented from entering the environment.

Ash was used in asphalt in several projects between 1974 and 1979 (in PA., D.C., Texas and MA.) and although these projects had results that ranged from excellent to poor, they were assessed only from an engineering standpoint, illustrating that from an engineering standpoint it is possible to utilize ash for roads. No environmental assessment was done at these sites. Also, the Houston project, which was listed as having excellent results was only a 200 foot - 6 inch base, project. So, in comparison, the one half mile proposed N.J. experiment is quite large.

My main impression from the conference is that the utilization of incineration ash in the environment is a new and unproven and in some ways undeveloped technology. The true costs, financially and environmentally, are unknown. Proposals are just being made now and regulations are just beginning to be established. Mr. Chesner, an engineer involved in the DEP's ash utilization process, mentioned that he was involved with a proposal to use ash on Long Island and he said a suitable site could not be found, mostly because of concerns about the health effects and possible environmental damage.

Because the standards for ash disposal are relatively stringent and the regulations for ash utilization have not been set, the avoidance of costs of disposal are driving this idea of using ash. Until we know a lot more about the results and costs of utilization, it would be prudent to proceed with utmost caution. The phrase "it's a weird bird that fouls its own nest" came to my mind while envisioning the ash being introduced out into our habitat in asphalt, in cement, and in other materials.

Dr. Richard Denison explained some basic quidelines to use in any project:

1. Use only bottom ash since most leachable metals are in fly ash and up to 40% of fly ash can dissolve in water;

2. Have an extensive testing and monitoring program in place - long term as well as short term;

3. See that the project demonstrates the safety of workers and nearby inhabitants is protected, this includes making sure no volatilization occurs if heat is applied in the process (If fly ash is included this is especially important since cadmium volatilizes at relatively low temperature.);

4. Do not begin any project until the regulations have been established;

5. Take special care to avoid wetlands because, as well as concerns about toxic metals and dioxins, there are salts in the ash which leach out;

6. Use the ash either as base or a center layer, cover with regular asphalt; and,

7. (As mentioned by several other speakers), Establish <u>liability</u> in case of failure.

We need to be very prudent. Our life support systems of air, water and soil are stressed; and, the local, state, and national budgets are stressed. We will not have the resources needed to cushion our mistakes. We need to develop an ethic which means making sure we do not selfishly or carelessly use up and poison this beautiful planet earth, but instead love it, heal it, help nurture it and leave its' beauty and sustenance for generations to come. Lessening the stringency of regulations on incinerator ash in any manner can only lead to a worsening of our environmental quality and greater monetary costs in the long run.

Your committee held a hearing on this matter and gave undue credence to the very people and companies who have the most to gain monetarily from minimizing the hazards of ash. I find this very imprudent of you. Furthermore, more than enough resources of time, money, attention, and planning have been devoted to furthering incineration. It is time for the real work of fostering recycling, reuse, and waste reduction, to take place. Your committee should be paying special attention to the issue of markets for recycled materials.

FOX

Thank you for this opportunity to express my comments and opinions.

Very truly yours,
Lorraine Gold
LORRAINE GOLD
Warren County Trustee
Association of N.J. Environmental
Commissions (ANJEC),
WCSWAC Representative,
Hardwick Township Recycling
Coordinator

ps - please let me know any determinations
on this issue made by your committee.
Thank you
L.G.

HEALTH EFFECTS OF EXPOSURE TO TOXIC METALS

CADMIUM: breathing in fumes and/or dust causes emphysema, and olfactory (nose) damage. If exposure comes through the food chain or water pollution, kidney damage can result. There is also suspected danger of increases in lung and prostrate cancer.

LEAD: Major toxic effects include abdominal problems such as cramps, diffuse and often intractable stomach pain with nausea, and vomiting; anorexia and constipation can also result from exposure. Another major toxic effect is to the blood in that lead interferes with red blood cells. Also the nervous system can be effected causing irritability, incoordination, restlessness, paranoia, headache, dizziness, fainting, and disorientation, and goes on to more serious manifestations of nervous system damage including paralysis, seizures, blindness and coma. There is suspicion that lead poisoning causes brain damage that shows itself through mental and physical retardation, especially in children. There is also an increased incidence of spontaneous abortions and miscarriages.

MERCURY: Water and grains can be contaminated by mercury. Among other problems, mercury produces severe neurological damage. Mercury poisoning results in numbness, difficulty in speaking and walking, hearing problems, blindness and permanent brain damage. Paralysis, coma and death can result from mercury poisoning. Mercury in the system is well absorbed from the intestinal tract and can pass through the placenta into the fetus of a pregnant woman. This can cause cerebral palsy, mental retardation and in some cases death. Like lead and dioxin, mercury is suspected to be especially damaging to children.

The Warren County ash has never "as of yet" been tested for any of the dioxins.

R-33-9-9-11

FINAL

CHARACTERIZATION OF MUNICIPAL WASTE COMBUSTION ASH, ASH EXTRACTS, AND LEACHATES

COALITION ON RESOURCE RECOVERY
AND THE ENVIRONMENT

EPA WORK ASSIGNMENT NUMBER 90
CONTRACT NUMBER 68-01-7310

NUS PROJECT NUMBER 9S83

FEBRUARY 1990

NUS
CORPORATION

83x

NUS CORPORATION
WASTE MANAGEMENT SERVICES GROUP

PARK WEST TWO
CLIFF MINE ROAD
PITTSBURGH PA 15275-1071
(412) 788-1080

R-33-9-9-11

FINAL

CHARACTERIZATION OF MUNICIPAL WASTE COMBUSTION ASH, ASH EXTRACTS, AND LEACHATES

COALITION ON RESOURCE RECOVERY
AND THE ENVIRONMENT

EPA WORK ASSIGNMENT NUMBER 90
CONTRACT NUMBER 68-01-7310

NUS PROJECT NUMBER 9S83

Dr. Walter Shaub
CORRE, Project Manager

Dr. Doreen Sterling
EPA, Project Manager

FEBRUARY 1990

SUBMITTED FOR NUS BY:

GREGORY L. ZIMMERMAN, P.E.
PROJECT ENGINEER

APPROVED:

Haia Roffman
HAIA K. ROFFMAN, Ph.D.
PROJECT MANAGER

84x

EXECUTIVE SUMMARY

This report has been prepared for the United States Environmental Protection Agency (EPA) and the Coalition on Resource Recovery and the Environment (CORRE). EPA and CORRE have cosponsored this study, conducted by NUS Corporation, to enhance the data base on the characteristics of Municipal Waste Combustion (MWC) ashes, laboratory extracts of MWC ashes, and leachates from MWC ash disposal facilities.

The Coalition on Resource Recovery and the Environment (CORRE) was established to provide credible information about resource recovery and associated environmental issues to the public and to public officials. In providing information, CORRE takes no position as to the appropriateness of one technology compared to others. CORRE recognizes that successful waste management is an integrated utilization of many technologies which taken as a whole, are best selected by an informed public and informed public officials.

Incineration of municipal solid waste (MSW) has become an important waste disposal alternative because it provides an effective means of reducing the volume of MSW as well as an important source of energy recovery. Currently, 10 percent of MSW is incinerated. Based on the number of municipal waste combustion (MWC) facilities being planned across the country, this percentage is expected to increase to roughly 16-25 percent by the year 2000.

As incineration has grown in popularity, so has concern over the management of increasing volumes of ash. Ashes from MWC facilities have, on occasion, exhibited a hazardous waste characteristic as determined by the EP Toxicity Test. The debate regarding the regulatory status of ash and the representativeness and validity of the EP test continues. Congress is considering several legislative initiatives that would give EPA clear authority to develop special management standards for ash under Subtitle D of RCRA.

To conduct this study, NUS collected combined bottom and fly ash samples from five mass-burn MWC facilities and leachate samples from the companion ash disposal facilities.

The facilities sampled were selected by CORRE to meet the following criteria:

- The facilities were to be state-of-the-art facilities equipped with a variety of pollution control equipment.

- The facilities were to be located in different regions of the United States.

- The companion ash disposal facilities were to be equipped with leachate collection systems or some means of collecting leachate samples.

The identities of the facilities are being held in confidence.

The ash and leachate samples collected were analyzed for the Appendix IX semivolatile compounds, polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs), metals for which Federal primary and secondary drinking water standards exist, and several miscellaneous conventional compounds. In addition, the ash samples were analyzed for major components in the form of oxides. The ash samples were also subjected to six laboratory extraction procedures and the extracts were then analyzed for the same compounds as the ash samples. The following six extraction procedures were used during this study:

- Acid Number 1 (EP-TOX).
- Acid Number 2 (TCLP Fluid No. 1).
- Acid Number 3 (TCLP Fluid No. 2).
- Deionized Water (Method SW-924), also known as the Monofill Waste Extraction Procedure (MWEP).
- CO_2 saturated deionized water.
- Simulated acid rain.

These extraction procedures have been used separately by a variety of researchers on MWC ashes but never have all six procedures been used on the same MWC ashes. This study was designed to compare the analytical results of the extracts from all six procedures with each other and with leachate collected from the ash disposal facilities used by the MWC facilities.

All sampling, laboratory preparation, and laboratory analysis followed stringent EPA quality assurance/quality control (QA/QC) procedures. The work was performed in accordance with the Work Plan (Appendix A) prepared by NUS for this project and with a QA/QC Plan prepared by NUS and approved by EPA. A detailed listing of the positive results is presented in a data base which is included in this Report as Appendix B (Ash), Appendix C (Leachate), and Appendix D (Ash Extracts). The results in the data base are presented as reported by the laboratories, complete with the laboratory's qualifications. Summaries of the results are presented in Sections 2.0 through 7.0. These summaries include the laboratory's qualifiers and also qualifiers placed on the data as a result of data validation.

When the laboratories did not report a positive value for a compound (i.e., the compound was not present above laboratory detection limits), the compound was reported as not detected (ND) in the tables in the text. The laboratory detection limits are the method detection limits for each specific method, unless interferences were encountered during the analysis. When interferences occurred, the laboratory adjusted the method detection limits by an appropriate dilution factor. The analytical methods used in this study were selected so that the method detection limits were well below present levels of human, environmental, or regulatory concerns.

The EPA publication "Interim Procedures for Estimating Risk Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs and CDFs)" was used to evaluate the dioxin data. These procedures use Toxicity Equivalency Factors (TEFs) to express the concentrations of the different isomers and homologs as an equivalent amount of 2,3,7,8-Tetrachloro Dibenzo-p-Dioxin (2,3,7,8-TCDD). The Toxicity Equivalents, as calculated by using the TEFs, are then totaled and compared to the Centers for Disease Control (CDC) recommended upper level of 2,3,7,8-TCDD Toxicity Equivalency of 1 part per billion in residential soil (Kimbrough, 1984).

The major features of the five MWC facilities are provided in Table ES-1, and the major features of the MWC Ash Disposal Facilities are provided in Table ES-2. Pertinent information regarding the operating conditions of the MWC facilities, as well as information about the air pollution control equipment used by the facilities, is also provided in Table ES-1.

87X

TABLE ES-1

MAJOR FEATURES OF MWC FACILITIES

Operational Features	Facilities				
	ZA	ZB	ZC	ZD	ZE
Facility Type	Energy recovery, continuous feed, reverse-reciprocating grate.	Energy recovery, continuous feed, reciprocating grate	Energy recovery, continuous feed, reverse-reciprocating grate.	Energy recovery, continuous feed, reciprocating grate.	Energy recovery, continuous feed, reciprocating grate
Startup Date	May 1986	Early 1987	January 1987	1975	September 1987
Capacity	275 tons/day/boiler 2 boilers	75 - 100 tons/day/boiler 2 boilers	400 tons/day/boiler 3 boilers	750 tons/day/boiler 2 boilers	750 tons/day/boiler 2 boilers
Combustion Temperature	1,800-2,000°F at stoker	1,800°F	1,750-1,800°F	1500-1700°F flue gas as it enters superheater	1,800°F at the grate
Temperature of air entering the boiler	Under fire: 250°F Over fire: ambient	Under fire: ambient Over fire: ambient	Under fire: 380°F Over fire: ambient	Under fire: ambient Over fire: ambient	Under fire: ambient Over fire: ambient
Volume of air entering boiler	Under fire: 70,000-90,000 lb/hour Over fire: 41,000 lb/hour	Under fire: 10,890 cu ft/min Over fire: 5,900 cu ft/min	Under fire: 34,000 ft^3/min Over fire: 11,000 ft^3/min	Under fire: 48,000 ft^3/min Over fire: 32,000 ft^3/min	
Source of ash quench water	Floor drains, rain water.	Cooling tower and boiler blowdowns, septic system discharge, floor drains	Tertiary effluent from neighboring sewage treatment plant	Cooling tower and boiler blowdowns.	Wastewater from plant processes.
Air pollution control equipment	Lime slurry is injected into flue gas after economizer, fabric filter baghouses.	Dry lime is injected into flue gas after economizer, fabric filter baghouses. Fly ash has phosphoric acid added to it and is agglomerated before being mixed with bottom ash.	Electrostatic precipitators	Electrostatic precipitators	Lime slurry is injected into flue gas after economizer, electrostatic precipitators. Fly ash has water added to it and is agglomerated before being mixed with bottom ash
Approximate waste composition	Residential: 40% Commercial/ Light Industrial: 60%	Residential: 80% Commercial/ Light Industrial: 20%	Residential: 60% Commercial/ Light Industrial: 40%	Residential: 90% Commercial/ Light Industrial: 10%	Residential: 65% Commercial/ Light Industrial: 35%

TABLE ES-1
MAJOR FEATURES OF MWC FACILITIES
PAGE TWO

Operational Features	Facilities				
	ZA	ZB	ZC	ZD	ZE
Amount of electricity generated	13.1 megawatts/hour	4.5 megawatts/hour	29 megawatts/hour	35 megawatts/hour	45 megawatts/hour
Amount of electricity used internally by facility	1.7 megawatts/hour	0.63 megawatts/hour	2.5 megawatts/hour	2.5 to 3.5 megawatts/hour	7 megawatts/hour
Material removed from incoming refuse	Large appliances, other unacceptable material diverted to demolition landfill.	Large appliances, material that will not pass through the boilers.	Large appliances, material that will not pass through the boilers.	Large appliances, material that will not pass through the boilers.	Large appliances, material that will not pass through the boilers.
Material removed from ash	Ferrous metal removed from ash at the MWC facility	None	Ferrous metal removed from ash at the MWC facility.	Ferrous metal removed from ash at the MWC facility	Items greater than 10 inches in diameter

R339911

TABLE ES-2

MAJOR FEATURES OF MWC ASH DISPOSAL FACILITIES

Operational Features	Facilities				
	ZA	ZB	ZC	ZD	ZE
Facility Type	Monofill - single clay liner	Monofill - double liner (HDPE and compacted till soil)	Codisposed facility - bottom-clay liner synthetic sidewall liners	Monofill - unlined. Ash is placed over trash deposited before 1975	Monofill - double liner (HDPE and clay)
Startup Date	1986	October 1988	Landfill - 1984 Ash Disposal - 1985	1975	1987
Disposal Capacity	83,400 cubic yards	90,000-100,000 tons	Total capacity 9 million tons	Remaining capacity - 990,000 tons (6 years)	Permitted for 20 years, approximately 3.8 million tons
Amount of Ash Disposed	150 tons/day	60 tons/day	400,000 tons/year 40% ash (2/3 of ash from ZC MWC facility)	450 tons/day	525 tons/day
Materials other than Ash disposed of	None	None	Non-burnable materials from 2 MWC facilities. Overflow from 2nd MWC facility.	None	None
Leachate Collection System	Perforated PVC pipe in a coarse aggregate envelope	Slotted HDPE	Main header - PVC collection trenches - gravel with fabric filter	None - leachate samples were collected from well points installed in the ash	Slotted HDPE
Cover	Final cover - soil and HDPE	Daily cover - sand. Non working face covered by plastic to limit leachate generation	Daily - native soil and shredded tires. Intermediate - native soils Final - native soils	Daily cover - soil. Intermediate - soil compacted to 10^{-6} permeability. Final - clay or HDPE.	Daily cover - soil. Intermediate - soil compacted to 10^{-6} permeability. Final - clay of HDPE
Compaction of Ash	Only as bulldozer spreads ash in ash fill.	Bulldozer spreads and compacts ash in 8-12 inch lifts.	Track mounted compactor	Only as bulldozer spreads ash in ash fill	Vibrating roller.

60X

The major findings of the ash sampling and analyses during this study are described in the following paragraphs.

Of the five ash samples (one from each facility) analyzed for the Appendix IX semivolatile compounds, four samples contained bis(2-ethylhexyl)phthalate, three contained di-n-butyl phthalate, and one contained di-n-octyl phthalate. Two PAHs, phenanthrene and fluoranthene, were detected in only one of the five ash samples. These semi-volatile compounds were detected in the parts per billion (ppb) range.

The results for the five ash samples (one from each facility) analyzed for PCDDs/PCDFs are presented in Table ES-3. This table also includes the calculated Toxicity Equivalents (TE) for each homolog of PCDD/PCDF. These TEs were calculated using EPA's methodology (EPA, March 1987). The data in this table indicate that PCDDs/PCDFs were found at extremely low levels in each ash sample. The Total TE for each ash sample was below the Centers for Disease Control (CDC) recommended 2,3,7,8-TCDD Toxicity Equivalency limit of 1 part per billion in residential soil (Kimbrough, 1984).

All 25 of the ash samples (five daily composites from each facility) were analyzed for the metals on the primary and secondary drinking water standards lists as well as for the oxides of five major ash components. Although, the results from these analyses indicate that the ash is heterogeneous, this heterogenicity appears to have been reduced by the care taken when compositing the ash samples during this study. Comparison of the results of this study with results reported in the literature (EPA, October 1987) indicates that the variability of results for each compound appears to have been reduced in this study.

Metals showing the widest range of concentrations among samples collected at each facility included barium (ZB); cadmium (ZB); chromium (ZD, ZE); copper (ZA, ZB, ZC); lead (ZD); manganese (ZA, ZC); mercury (ZE); zinc (ZB, ZD, ZE); and silicon dioxide (ZA).

Metals showing the widest variation of concentrations between the facilities included barium (results for Facility ZC are lower than the results for the other facilities); iron (results for each facility vary from all of the other facilities); lead (results for Facility ZD are higher than the results for the other facilities); mercury (results for Facilities ZC and ZD are lower than the results for the other facilities);

TABLE ES-3

ASH DIOXIN RESULTS

Compound	Toxicity Equivalency Factor (TEF)[1]	Samples (pg/g or ppt)									
		ZA-AH-003		ZB-AH-001		ZC-AH-003		ZD-AH-003		ZE-AH 003	
		Value	Toxicity Equivalents	Value	Toxicity Equivalents	Value	Toxicity Equivalents	Value	Toxicity Equivalents	Value	Toxicity Equivalents
2,3,7,8-TCDD	1	10	10	24	24	16	16	35	35	10	10
Other TCDD	0.01	206	2.06	351	3.51	281	2.81	541	5.41	120	1.2
2,3,7,8-TCDF	0.1	263	26.3	617	61.7	236	23.6	626	62.6	176	17.6
Other TCDF	0.001	1,688	1.69	3,721	3.72	1,208	1.21	2,633	2.63	1,136	1.14
1,2,3,7,8-PeCDD	0.5	33	16.5	118	59	71	35.5	ND	0	35	17.5
Other PeCDD	0.005	317	1.59	759	3.80	1,051	5.26	1,910	9.55	248	1.24
1,2,3,7,8-PeCDF	0.1	61	6.1	194	19.4	64	6.4	151	15.1	52	5.2
2,3,4,7,8-PeCDF	0.1	46	4.6	162	16.2	56	5.6	171	17.1	43	4.3
Other PeCDF	0.001	484	0.484	1,527	1.53	607	0.607	1,736	1.74	448	0.448
1,2,3,4,7,8-H_XCDD	0.04	12	0.48	40	1.6	66	2.64	86	3.44	11	0.44
1,2,3,6,7,8-H_XCDD	0.04	17	0.68	34	1.36	90	3.6	148	5.92	11	0.44
1,2,3,7,8,9-H_XCDD	0.04	28	1.12	79	3.16	120	4.8	194	7.76	22	0.88
Other H_XCDD	0.0004	154	0.062	342	0.137	925	0.37	853	0.34	104	0.042
1,2,3,4,7,8-H_XCDF	0.01	74	0.74	336	3.36	218	2.18	654	6.54	95	0.95
1,2,3,6,7,8-H_XCDF	0.01	131	1.31	524	5.24	279	2.79	660	6.60	134	1.34
1,2,3,7,8,9-H_XCDF	0.01	36	0.36	127	1.27	193	1.93	479	4.79	45	0.45
2,3,4,6,7,8-H_XCDF	0.01	5	0.05	54	0.54	70	0.70	124	1.24	20	0.20
Other H_XCDF	0.0001	281	0.0281	939	0.0939	635	0.0635	1,686	0.169	280	0.028
1,2,3,4,6,7,8-H_PCDD	0.001	159	0.159	319	0.319	1,849	1.85	1,555	1.56	122	0.122
Other H_PCDD	0.00001	140	0.0014	288	0.00288	1,511	0.0151	1,384	0.0138	0	0
1,2,3,4,6,7,8-H_PCDF	0.001	139	0.139	539	0.539	653	0.653	1,842	1.84	155	0.155
1,2,3,4,7,8,9-H_PCDF	0.001	8	0.008	48	0.048	83	0.083	119	0.119	16	0.016
Other H_PCDF	0.00001	51	0.00051	197	0.00197	254	0.00254	384	0.00384	44	0.00044
OCDD	0	313	0	544	0	6,906	0	4,519	0	294	0
OCDF	0	66	0	243	0	563	0	893	0	59	0
TOTAL TEs			74.5		211		119		189		63.7

(1) Toxicity Equivalency Factors are EPA's current recommended Factors, (EPA, March 1987)

ND Not detected below 221 pg/g.

92x

sodium (results for Facilities ZD and ZE are lower than the results for the other facilities); calcium oxide (the results for Facilities ZA and ZB are higher than the results for the other facilities); and silicon dioxide (the results for Facility ZC are higher than the results for the other facilities).

Some additional findings of the ash sampling and analyses are as follows:

- The ashes are alkaline with the pH ranging from 10.36 to 11.85.
- The ashes are rich in chlorides and sulfates. The total soluble solids in the ashes varied from 6,440 to 65,800 ppm.
- The ashes contained unburnt total organic carbon (TOC) ranging from 4,060 ppm (0.4 percent) to 53,200 ppm (5.32 percent).

The major findings of the leachate sampling and analysis during this study are summarized in the following paragraphs.

Only four Appendix IX semivolatile compounds were found in the leachates from the ash disposal facilities. Benzoic acid was found in both leachate samples collected at one of the five ash disposal facilities. Phenol, 3-methylphenol, and 4-methylphenol were found in some of the leachate samples from one of the other facilities. All of these compounds were detected at very low levels (2-73 ppb).

PCDDs/PCDFs were only found in the leachate from one facility. The homologs found are the more highly chlorinated homologs. The data obtained during this study appears to indicate that PCDDs/PCDFs do not readily leach out of the ash in the ash disposal facilities. The low levels found in the leachates of the one facility probably originated from the solids found within the leachate samples because these samples were not filtered nor centrifuged prior to analysis.

None of the leachate samples exceeded the EP Toxicity Maximum Allowable Limits established for the eight metals in Section 261.24 of 40 CFR 261. In addition, the data from this study indicate that although the leachates are not used for drinking purposes, they are close to being acceptable for drinking water use, as far as the metals are concerned.

93X

Some other findings of the leachate sampling and analyses are as follows:

- Sulfate values ranged from 14.4 mg/L to 5,080 mg/L, while Total Dissolved Solids (TDS) ranged from 924 mg/L to 41,000 mg/L.
- The field pH values ranged from 5.2 to 7.4.
- Ammonia (4.18-77.4 mg/L) and nitrate (0.01-0.45 mg/L) were present in almost all leachate samples.
- Total Organic Carbon values ranged from 10.6 to 420 ppm.

The major findings from the analysis of the ash extracts during this study are summarized as follows:

- Of the five composite samples of the deionized water (SW-924) extracts analyzed for the Appendix IX semivolatile compounds (one from each facility), only one sample contained low levels of benzoic acid (0.130 ppm).
- None of the extracts contained PCDDs/PCDFs. These data confirm the findings of the actual field leachate samples that PCDDs/PCDFs are not readily leached from the ash.

The data obtained during the metals analyses of the ash extracts indicate that, in general, the extracts from the EP Toxicity, the TCLP 1, and the TCLP 2 extraction procedures have higher metals content than the extracts from the deionized water (SW-924), the CO_2, and the Simulated Acid Rain (SAR) extraction procedures. The EP Toxicity Maximum Allowable Limits for lead and cadmium were frequently exceeded by the extracts from the EP Toxicity, TCLP 1, and TCLP 2 extraction procedures. One of the extracts from the EP Toxicity extraction procedure also exceeded the EP Toxicity Maximum Allowable Limit for mercury.

None of the extracts from the deionized water (SW-924), the CO_2, and the Simulated Acid Rain (SAR) extraction procedures exceeded the EP Toxicity Maximum Allowable Limits. In addition, the majority of the extracts from these three extraction procedures also met the Primary and Secondary Drinking Water Standards for metals.

Table ES-4 compares the range of concentrations of the metals analyses of the ash extracts with the range of concentrations for leachate as reported in the literature (EPA, October 1987) and the range of concentrations for the leachates as determined in this study. For the facilities sampled during this study, the data in Table ES-4 indicate that the extracts from the deionized water (SW-924), the CO_2, and the SAR extraction procedures simulated the concentrations for lead and cadmium in the field leachates better than the extracts from the other three extraction procedures.

TABLE ES-4

COMPARISON OF ASH EXTRACT METAL ANALYSES RESULTS WITH LEACHATE METAL ANALYSES RESULTS

Parameter	Samples (μg/L)							
	EP TOX Extracts	TCLP 1 Extracts	TCLP 2 Extracts	CO_2 Extracts	DI H_2O Extracts	SAR Extracts	Leachate (Literature)(1)	Leachate (CORRE)
Arsenic	ND-31	ND	ND-60	ND-53	ND-45	ND	5-218	ND-400
Barium	23-455	161-1,850	12-809	126-530	139-3,050	129-3,960	1,000	ND-9,220
Cadmium	25-1,200	ND-1,150	ND-1,560	ND-354	ND-7.6	ND-6.0	ND-44	ND-4
Chromium	ND-86	ND-8.0	ND-799	ND-9.8	ND-16	ND-10	6-1,530	ND-32
Copper	24-5,170	5-858	5.4-1,400	8.8-620	12-534	8.5-610	22-24,000	ND-12
Iron	ND-82,000	ND-7,220	ND-162,000	ND-304	ND-115	ND-97	168-121,000	108-10,500
Lead	ND-19,700	ND-10,500	ND-26,400	ND-504	ND-3,410	ND-3,940	12-2,920	ND-54
Manganese	250-8,540	ND-5,170	3.8-7,370	ND-2,390	ND-20	ND-6.4	103-4,570	310-18,500
Mercury	ND-203	ND-3.8	ND-4.6	ND-155	ND-0.96	ND-1.1	1-8	ND
Selenium	ND	ND	ND	ND	ND	ND-23	2.5-37	ND-340
Silver	ND	ND	ND	ND-16	ND	ND	70	ND
Sodium	33,600-225,000	1,380,000-1,640,000	38,700-228,000	24,800-168,000	24,100-209,000	24,200-201,000	200,000-4,000,000	188,000-3,800,000
Zinc	67-95,600	9.7-79,500	26-164,000	5-127,000	5.4-1,340	12-1,290	ND-3,300	5.2-370

TABLE ES-4
COMPARISON OF ASH EXTRACT METAL ANALYSES RESULTS WITH LEACHATE METAL ANALYSES RESULTS
PAGE TWO

Parameter	Samples (µg/L)							
	EP TOX Extracts	TCLP 1 Extracts	TCLP 2 Extracts	CO_2 Extracts	DI H_2O Extracts	SAR Extracts	Leachate (Literature)(1)	Leachate (CORRE)
Aluminum Oxide*	ND-150,000	ND-62,800	ND-152,000	ND-90,700	ND-203,000	ND-118,000	NR	ND-920
Calcium Oxide*	592,000-4,810,000	666,000-2,750,000	692,000-3,640,000	398,000-1,920,000	141,000-1,740,000	142,000-1,800,000	21,000	64,600-8,390,000
Magnesium Oxide*	27,300-130,000	55-375,000	623-137,000	207-59,300	21-379	12-430	NR	14,800-367,000
Potassium Monoxide*	10,100-189,000	14,600-210,000	15,100-1,110,00	12,300-155,000	13,100-189,000	14,500-181,000	21,500	79,700-1,620,000
Silicon Dioxide*	5,090-98,700	379-51,700	820-143,000	418-71,800	402-3,990	364-3,770	NR	470-15,300

ND Not Detected.
NR Not Reported in the literature.
(1) EPA, October 1987.
* The ash extracts were analyzed as ions for these compounds and reported as oxides. The leachates were analyzed and are reported as ions for these compounds.

97x

7.0 SUMMARY OF RESULTS

This section presents a summary of the data presented in Sections 2.0 through 6.0. It also compares the data generated during this present study with data reported in a previous EPA sponsored study (EPA, October 1987).

7.1 CHEMICAL CHARACTERIZATION OF ASH

Table 7-1 presents the results of the Appendix IX semivolatile analyses for the ash samples from each facility. The data in this table indicate that phthalates were found in the ash samples from each MWC facility, except for Facility ZE, and that two PAHs were detected in the ash from Facility ZD.

Table 7-2 compares the range of concentrations of semivolatile compounds found in the combined fly/bottom ash from this study with the range of concentrations found in fly ash, and bottom ash reported in the literature, as summarized in a previous report (EPA, October 1987). The data in this table indicate that fewer compounds were found in the ash during this present study as compared to the data provided in the literature. The concentrations of the compounds which were found in this study are generally similar to those reported in the literature.

Table 7-3 presents the results of the PCDD/PCDF analyses of the ash samples from each facility. This table also presents the Toxicity Equivalency Factor (TEF) for each PCDD/PCDF homolog, the Toxicity Equivalency (TE) for each homolog calculated according to EPA's Methodology (EPA, March 1987), and a Total TE for each sample. Although PCDDs/PCDFs were detected in each ash sample, the levels found were below the Centers for Disease Control (CDC) recommended upper level of 2,3,7,8-TCDD Toxicity Equivalency of 1 part per billion in residential soils (Kimbrough, 1984).

Table 7-4 compares the ranges of concentrations of PCDDs/PCDFs found in ash samples during this study with the ranges of concentrations of PCDDs/PCDFs reported in the literature and summarized in a previous report (EPA, October 1987). The data in this table indicate that the levels of PCDDs/PCDFs found in the ash during this present study are generally lower than the range of PCDDs/PCDFs found in other ash samples, as reported in the literature.

Table 7-4 also presents the range of concentrations of PCBs in fly ash, bottom ash, and combined ash. The data in this table indicate that only Dichloro Biphenyl was found in the ash during this present study.

Table 7-5 presents the range of results of the metals analyses for the ash from each facility. Metals showing the widest range of concentration among samples collected at each facility included barium (ZB); cadmium (ZB); chromium (ZD, ZE); copper (ZA, ZB, ZC); lead (ZD); manganese (ZA, ZC); mercury (ZE); zinc (ZB, ZD, ZE) and silicon dioxide (ZA).

Metals showing the widest variation of concentrations between the facilities included barium (results for Facility ZC are lower than the results for the other facilities); iron (results for each facility vary from all of the other facilities); lead (results for Facility ZD are higher than the results for the other facilities); mercury (results for Facilities ZC and ZD are lower than the results for the other facilities); sodium (results for Facilities ZD and ZE are lower than the results for the other facilities); calcium oxide (the results for Facilities ZA and ZB are higher than the results for the other facilities); and silicon dioxide (the results for Facility ZC are higher than the results for the other facilities).

Table 7-6 compares the ranges of concentrations of metals found in the ash during this study with the ranges of concentrations of metals found in fly ash, bottom ash, and combined ash as reported in the literature and summarized in a previous report (EPA, October 1987). The data in this table indicate that the results obtained during this study are generally similar to the previous results.

Several compounds (aluminum, cadmium, calcium, mercury, and potassium) exhibited higher levels during this study than those reported previously for combined ash. The levels of copper found during this study are higher than the results reported previously for combined ash, but are still lower than the results reported previously for bottom ash. The magnesium results reported in this study are higher than the results reported previously for all three types of ash. However, the results for magnesium are close to those previously reported. The levels of silicon found in the ash during this study are much higher than the levels found in previous studies.

Table 7-7 presents the range of results of the conventional analyses for the ash from each facility. Compounds showing the widest range of values between samples at each facility included TOC (ZA, ZB, ZD, ZE); ammonia (ZA, ZB, ZE); nitrate (ZC, ZD); total alkalinity (ZB, ZC, ZE); chloride (ZB, ZD); sulfate (ZB, ZD); and total soluble solids (ZE).

Compounds showing the widest variation between facilities included TOC (results for Facilities ZD and ZE are higher than the results for the other facilities); total soluble salts (results for Facilities ZA and ZB are higher than the results for the other facilities); ammonia (results for Facilities ZC and ZD are lower than the results for the other facilities); total alkalinity (results for Facility ZA are higher than the results for the other facilities); chloride (results for Facilities ZA and ZB are higher than the results for the other facilities); and sulfate (results for Facility ZC are higher than the results for the other facilities).

7.2 CHEMICAL CHARACTERIZATION OF LEACHATES

Table 7-8 presents the range of results of the Appendix IX semivolatile analyses for the leachate samples from each facility. The data in this table indicate that phenols were detected in the leachate from the ashfill serving MWC Facility ZA and that benzoic acid was detected in the leachate from the ashfill serving MWC Facility ZE.

Table 7-9 compares the ranges of concentrations of the semivolatile compounds found in the leachates in this study with the ranges of concentrations of organic compounds reported in the literature and summarized in a previous report (EPA, October 1987). The data in this table indicate that very few semivolatile compounds were found in the leachates during this study. The levels of phenol detected in the leachates during this study are much lower than the levels of phenol found in the leachates from the MSW landfills or co-disposal sites.

Table 7-10 presents the range of concentrations of PCDDs/PCDFs found in the leachate samples from each facility. PCDDs/PCDFs were only found at extremely low levels in the leachates from the ashfill for Facility ZA.

Table 7-11 compares the ranges of concentrations of PCDDs/PCDFs found in the leachates during this study with the ranges of concentrations of PCDDs/PCDFs found in leachates during a previous study (EPA, October 1987). The data in this table indicate that the leachates did not contain significant quantities of PCDDs/PCDFs. The data in this table also indicate that the homologs most often found in leachates from ash monofills are the more highly chlorinated homologs (HpCDD, HpCDF, OCDD, OCDF) which are also the homologs with the relatively lower Toxicity Equivalency Factors (TEFs).

Table 7-12 presents the results of the metals analyses of the leachate from each facility. For comparison, this table also presents the EP Toxicity Maximum Allowable Limit, and the Primary and Secondary Drinking Water standards established under the Safe Drinking Water Act (EPA: BNA, June 1989 and EPA: BNA, October 1988). The data in this table indicate that all of the metals were below their EP Toxicity Maximum Allowable Limit. The data in this table also indicate that, although the leachates are not used for drinking purposes, the majority of the metals results met the Primary or Secondary Drinking Water Standards.

Table 7-13 compares the ranges of concentrations of metals in the leachates from this study with the ranges of concentrations of metals in leachates found in the literature and summarized in a previous NUS report (EPA, October 1987). The data in this table indicate that the EP Toxicity Maximum Allowable Limits were not exceeded by the leachates from ash monofills in either this study or in the previous NUS report. The data in this table also indicate that a number of compounds are reported as having higher concentrations in the leachates from this study than the leachates from the previous study.

Table 7-14 presents the range of results of the conventional analyses for the leachate from each facility. Sulfate values ranged from 14.4 mg/L to 5,080 mg/L, and TDS values ranged from 924 mg/L to 41,000 mg/L.

7.3 CHEMICAL CHARACTERIZATION OF ASH EXTRACTS

The only Appendix IX semivolatile compound detected in the deionized water extracts (SW-924) was benzoic acid, which ranged from below the detection limits to 130 µg/L. Table 7-15 compares the ranges of concentrations of semivolatile compounds found in the deionized water ash extracts (SW-924) during this study

101X

with the ranges of concentrations of organics found in ash extracts from a previous report (EPA, October 1987). All studies show that MWC ash extracts are generally free of semivolatile compounds.

Table 7-16 compares the ranges of concentrations of the metals analyses of the ash extracts found during this study with the ranges of concentrations of metals analyses of extracts as reported in the literature and summarized in a previous NUS report (EPA, October 1987). The data in this table indicate that the extracts from the EP Toxicity, the TCLP 1, and the TCLP 2 extraction procedures contained generally higher levels of metals than the extracts from the other extraction procedures.

The data in this table also indicate that the extracts from the deionized water extraction procedure (SW-924), both from this study and from the literature, and the extracts from the CO_2 and the SAR extraction procedures meet the EP Toxicity Allowable Limits. The extracts from the EP Toxicity, TCLP 1, and the TCLP 2 extraction procedures occasionally exceeded the EP Toxicity Maximum Allowable Limits for some metals.

For the facilities sampled during this study, the data indicate that the extracts from the deionized water (SW-924), the CO_2, and the SAR extraction procedures simulated the concentrations for lead and cadmium in the field leachates better than the extracts from the other three extraction procedures.

TABLE 7-1

COMPARISON OF ASH SEMIVOLATILE RESULTS

Parameter	Samples (µg/kg)				
	ZA-AH-003	ZB-AH-001	ZC-AH-003	ZD-AH-003	ZE-AH-003
Bis(2-ethylhexyl) phthalate	250,000	810JB	310JB	390JB	ND
Di-n-octyl phthalate	2,000T	ND	ND	ND	ND
Di-n-butyl phthalate	430JB	ND	400JB	270JB$_1$	ND
Fluoranthene	ND	ND	ND	170J	ND
Phenanthrene	ND	ND	ND	310J	ND

ND	Not detected.
J	Indicates approximate value because contaminants were detected at levels below Method Detection Limits, but above the instrument detection limits.
B	Laboratory identified compound as not being detected substantially above the level reported in laboratory blanks. Laboratory may be the source of the compound.
B$_1$	Compound was identified during data validation as not being detected substantially above the level reported in the laboratory blanks. Laboratory may be the source of the contamination.
T	The mass spectrum does not meet EPA CLP criteria for confirmation, but compound presence is strongly suspected.

TABLE 7-2

RANGES OF CONCENTRATIONS OF SEMIVOLATILES IN FLY ASH, BOTTOM ASH, AND COMBINED ASH FROM MUNICIPAL WASTE INCINERATORS

Constituent	Range, Fly Ash (ppb)	Range, Bottom Ash (ppb)	Range, Combined Ash (ppb)
Naphthalene	270-9,300	570-580	ND
Biphenyl	2-1,300	NR	ND
Acenaphthylene	ND-3,500	37-390	ND
Anthracene	1-500	53	ND
Fluorene	0-100	ND-150	ND
Phenanthrene	21-7,600	500-540	ND-310J
Di-n-butyl phthalate	ND	360	ND-430JB
Fluoranthene	0-6,500	110-230	ND-170J
Pyrene	0-5,400	150-220	ND
Butyl benzyl phthalate	ND	180	ND
Chrysene	0-690	ND-37	ND
Bis(2-ethylhexyl)phthalate	85	2,100	ND-250,000
Benzanthrene	0-300	NR	ND
Benzo(k)fluoranthene	ND-470	ND-51	ND
Benzo(a)pyrene	ND-400	ND-5	ND
Benzo(g,h,i)perylene	0-190	ND	ND
Diethyl phthalate	6,300	NR	ND
Acenaphthene	NR	28	ND
Normal alkanes	50,000	NR	ND
Chlorobenzenes	80-4,220	17	ND
Chlorophenols	50.1-9,630	0	ND
Di-n-octyl phthalate	NR	NR	ND-2,000T
Country	USA, Canada, Japan and The Netherlands	USA and Canada	USA

ND	Not detected.
NR	Not reported in the literature.
J	Indicates approximate value because contaminants were detected at levels below Method Detection Limits, but above the instrument detection limits.
B	Laboratory identified compound as not being detected substantially above the level reported in laboratory blanks. Laboratory may be the source of the compound.
T	The mass spectrum does not meet EPA CLP criteria for confirmation, but compound presence is strongly suspected.

Source: Fly ash and bottom ash ranges are from "Characterization of MWC Ashes and Leachates from MSW Landfills, Monofills, and Co-Disposal Sites," EPA 530-SW-87-028A, October 1987. Combined Ash ranges are from this study.

TABLE 7-3

ASH DIOXIN RESULTS

Compound	Toxicity Equivalency Factor (TEF)(1)	Samples (pg/g or ppt)									
		ZA-AH-003		ZB-AH-001		ZC-AH-003		ZD-AH-003		ZE-AH-003	
		Value	Toxicity Equivalents	Value	Toxicity Equivalents	Value	Toxicity Equivalents	Value	Toxicity Equivalents	Value	Toxicity Equivalents
2,3,7,8-TCDD	1	10	10	24	24	16	16	35	35	10	10
Other TCDD	0.01	206	2.06	351	3.51	281	2.81	541	5.41	120	1.2
2,3,7,8-TCDF	0.1	263	26.3	617	61.7	236	23.6	626	62.6	176	17.6
Other TCDF	0.001	1,688	1.69	3,721	3.72	1,208	1.21	2,633	2.63	1,136	1.14
1,2,3,7,8 PeCDD	0.5	33	16.5	118	59	71	35.5	ND	0	35	17.5
Other PeCDD	0.005	317	1.59	759	3.80	1,051	5.26	1,910	9.55	248	1.24
1,2,3,7,8-PeCDF	0.1	61	6.1	194	19.4	64	6.4	151	15.1	52	5.2
2,3,4,7,8 PeCDF	0.1	46	4.6	162	16.2	56	5.6	171	17.1	43	4.3
Other PeCDF	0.001	484	0.484	1,527	1.53	607	0.607	1,736	1.74	448	0.448
1,2,3,4,7,8 HxCDD	0.04	12	0.48	40	1.6	66	2.64	86	3.44	11	0.44
1,2,3,6,7,8-HxCDD	0.04	17	0.68	34	1.36	90	3.6	148	5.92	11	0.44
1,2,3,7,8,9-HxCDD	0.04	28	1.12	79	3.16	120	4.8	194	7.76	22	0.88
Other HxCDD	0.0004	154	0.062	342	0.137	925	0.37	853	0.34	104	0.042
1,2,3,4,7,8-HxCDF	0.01	74	0.74	336	3.36	218	2.18	654	6.54	95	0.95
1,2,3,6,7,8-HxCDF	0.01	131	1.31	524	5.24	279	2.79	660	6.60	134	1.34
1,2,3,7,8,9 HxCDF	0.01	36	0.36	127	1.27	193	1.93	479	4.79	45	0.45
2,3,4,6,7,8-HxCDF	0.01	5	0.05	54	0.54	70	0.70	124	1.24	20	0.20
Other HxCDF	0.0001	281	0.0281	939	0.0939	635	0.0635	1,686	0.169	280	0.028
1,2,3,4,6,7,8, HpCDD	0.001	159	0.159	319	0.319	1,849	1.85	1,555	1.56	122	0.122
Other HpCDD	0.00001	140	0.0014	288	0.00288	1,511	0.0151	1,384	0.0138	0	0
1,2,3,4,6,7,8-HpCDF	0.001	139	0.139	539	0.539	653	0.653	1,842	1.84	155	0.155
1,2,3,4,7,8,9 HpCDF	0.001	8	0.008	48	0.048	83	0.083	119	0.119	16	0.016
Other HpCDF	0.00001	51	0.00051	197	0.00197	254	0.00254	384	0.00384	44	0.00044
OCDD	0	313	0	544	0	6,906	0	4,519	0	294	0
OCDF	0	66	0	243	0	563	0	893	0	59	0
Total TEs			74.5		211		119		189		63.7

(1) Toxicity Equivalency Factors are EPA's current recommended factors (EPA, March 1987)
ND Not detected below 221 pg/g

TABLE 7-4

RANGES OF CONCENTRATIONS OF PCDDs, PCDFs, and PCBs IN FLY ASH, BOTTOM ASH, AND COMBINED ASH FROM MUNICIPAL WASTE INCINERATORS

Constituent	Range, Fly Ash (ppb)	Range, Combined Ash (Literature) (ppb)	Range, Bottom Ash (ppb)	Range, Combined Ash (CORRE) (ppb)
Mono CDD	2.0	NR	ND	NA
Di CDD	0.4-200	NR	ND	NA
Tri CDD	1.1-82	NR	ND	NA
Tetra CDD	ND-250	0.14-14	<0.04-0.65	0.130-0.576
Penta CDD	ND-722	1.9-50	ND-3	0.283-1.91
Hexa CDD	ND-5,565	1.4-78	ND-2.3	0.148-1.28
Hepta CDD	ND-3,030	1.4-120	ND-6.3	0.122-3.36
Octa CDD	ND-3,152	0.84-89	ND-29	0.294-6.91
2,3,7,8-TCDD	0.1-42	0.02-0.78	<0.04-0.7	0.010-0.035
Total Poly CDD	5.23-10,883	6.2-350	ND-110	RNR
Mono CDF	41	NR	1.1	NA
Di CDF	ND-90	NR	0.63	NA
Tri CDF	0.7-550	NR	ND	NA
Tetra CDF	ND-410	2.3-91	0.15-1.4	1.31-4.34
Penta CDF	ND-1,800	1.6-37	0.07-6.2	0.543-2.06
Hexa CDF	Tr-2,353	1.2-35	ND-2.5	0.527-3.6
Hepta CDF	Tr-666	0.62-36	ND-6.9	0.198-2.345
Octa CDF	ND-362	0.18-8.4	ND-3.7	0.059-0.893
2,3,7,8-TCDF	0.1-5.4	0.41-12	ND-10	0.176-0.626
Total Poly CDF	3.73-3,187	6.14-153.9	ND-65	RNR

TABLE 7-4
RANGES OF CONCENTRATIONS OF PCDDs, PCDFs, and PCBs FROM MUNICIPAL WASTE INCINERATORS (ppb)
PAGE TWO

Constituent	Range, Fly Ash (ppb)	Range, Combined Ash (Literature) (ppb)	Range, Bottom Ash (ppb)	Range, Combined Ash (CORRE) (ppb)
Mono CB	0.29-9.5	ND	ND-1.3	ND
Di CB	0.13-9.9	0.126-1.35	ND-5.5	98-107
Tri CB	ND-25	0.35-14.3	ND-80	ND
Tetra CB	0.5-42	16.5-16.5	ND-47	ND
Penta CB	0.87-225	ND	ND-48	ND
Hexa CB	0.45-65	NR	ND-39	ND
Hepta CB	ND-0.1	NR	ND	ND
Octa CB	ND-1.2	NR	ND	ND
Nona CB	ND	NR	ND	ND
Deca CB	ND	NR	ND	ND
Total PCB	ND-250	ND-32.15	ND-180	ND
Country	USA, Canada, W. Germany, The Netherlands, Japan	USA	USA, Canada, Japan	USA

NA	Not analyzed.
ND	Not detected.
NR	Not reported in the literature.
RNR	Results not reported in this manner. 2,3,7,8-TCDD toxicity equivalents were calculated and are reported in Table 7-3.
Tr =	0.01 < Tr < 0.1 ng/g.
Source:	Results in first three columns are from "Characterization of MWC Ashes and Leachates from MSW Landfills, Monofills, and Co-Disposal Sites," EPA, October 1987. Results in last column are from this study.

TABLE 7-5

ASH METALS ANALYSES
RANGES OF CONCENTRATIONS

Parameter	Samples				
	ZA-AH-001 - ZA-AH-005	ZB-AH-001 - ZB-AH-005	ZC-AH-001 - ZC-AH-005	ZD-AH-001 - ZD-AH-005	ZE-AH-001- ZE-AH-005
METALS	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Arsenic	37-51	28-56	28-36	30-54	15-20
Barium	436-554	260-1,000	193-331	411-545	391-792
Cadmium	32-56	52-152	42-52	39-69	18-38
Chromium	55-93	53-118	45-57	52-199	67-665
Copper	946-7,360	674-9,330	524-4,470	959-1,800	930-1,820
Iron	44,100-63,300	13,600-22,200	20,000-25,000	22,900-37,100	33,900-45,100
Lead	1,180-1,820	1,070-1,740	1,710-2,630	2,860-22,400	1,170-1,600
Manganese	587-1,360	508-846	518-1,200	574-965	531-640
Mercury	10.4-25.1	7.7-12	1.1-3.2	0.55-2.10	3.2-13.0
Selenium	ND	ND-5.7	ND	ND-3.9	ND-4.7
Silver	4.1-8.7	5.4-10.0	5.6-12	6.3-11.0	4.4-13.0
Sodium	9,350-11,000	8,200-10,600	7,370-8,940	5,890-6,500	5,880-7,770
Zinc	4,310-6,900	4,360-15,800	4,110-7,170	4,260-8,000	2,120-8,280
METAL OXIDES	(%)	(%)	(%)	(%)	(%)
Aluminum Oxide	8.52-9.85	7.39-10.3	5.93-8.64	9.9-13.0	9.7-11.0
Calcium Oxide	15.1-22.2	19.4-25.7	9.70-11.4	10.0-12.0	13.0-15.0
Magnesium Oxide	1.21-1.50	1.19-1.62	1.02-1.30	1.8-2.2	1.6-2.0
Potassium Monoxide	1.10-1.24	0.827-0.941	0.875-1.07	0.79-1.4	0.95-1.4
Silicon Dioxide	21.9-43.8	19.0-29.4	48.4-62.9	32.0-37.0	30-35

ND Not Detected.

TABLE 7-6

RANGES OF CONCENTRATIONS OF INORGANIC CONSTITUENTS IN FLY ASH, COMBINED ASH, AND BOTTOM ASH FROM MUNICIPAL WASTE INCINERATORS

Parameter	Fly Ash (ppm)	Combined Bottom and Fly Ash (Literature) (ppm)	Bottom Ash (ppm)	Combined Bottom and Fly Ash (CORRE) (ppm)
Arsenic	15-750	2.9-50	1.3-24.6	15-56
Barium	88-9,000	79-2,700	47-2,000	193-1,000
Cadmium	<5-2,210	0.18-100	1.1-46	18-152
Chromium	21-1,900	12-1,500	13-520	45-665
Lead	200-26,600	31-36,600	110-5,000	1,070-22,400
Mercury	0.9-35	0.05-17.5	ND-1.9	0.55-25.1
Selenium	0.48-15.6	0.10-50	ND-2.5	ND-5.7
Silver	ND-700	0.05-93.4	ND-38	4.1-13.0
Aluminum	5,300-176,000	5,000-60,000	5,400-53,400	5.93-13.0(1)
Antimony	139-760	<120-<260	NR	NA
Beryllium	ND-<4	0.1-2.4	ND-<0.44	NA
Bismuth	36-<100	NR	ND	NA
Boron	35-5,654	24-174	85	NA
Bromine	21-250	NR	NR	NA
Calcium	13,960-270,000	4,100-85,000	5,900-69,500	9.7-25.7(1)
Cesium	2,100-12,000	NR	NR	NA
Cobalt	2.3-1,670	1.7-91	3-62	NA
Copper	187-2,380	40-5,900	80-10,700	524-9,330
Iron	900-87,000	690-133,500	1,000-133,500	13,600-63,300
Lithium	7.9-34	6.9-37	7-19	NA
Magnesium	2,150-21,000	700-16,000	880-10,100	1.02-2.2(1)
Manganese	171-8,500	14-3,130	50-3,100	508-1,360
Molybdenum	9.2-700	2.4-290	29	NA
Nickel	9.9-1,966	13-12,910	9-226	NA

TABLE 7-6
RANGES OF CONCENTRATIONS OF INORGANIC CONSTITUENTS IN FLY ASH, COMBINED ASH, AND BOTTOM ASH FROM MUNICIPAL WASTE INCINERATORS
PAGE TWO

Parameter	Fly Ash (ppm)	Combined Bottom and Fly Ash (Literature) (ppm)	Bottom Ash (ppm)	Combined Bottom and Fly Ash (CORRE) (ppm)
Phosphorus	2,900-9,300	290-5,000	3,400-17,800	NA
Potassium	11,000-65,800	290-12,000	920-13,133	0.79-1.4(1)
Silicon	1,783-266,000	NR	1,333-188,300	19.0-62.9(1)
Sodium	9,780-49,500	1,100-33,300	1,800-33,300	5,880-11,000
Strontium	98-1,100	12-640	81-240	NA
Tin	300-12,500	13-380	40-800	NA
Titanium	<50-42,000	1,000-28,000	3,067-11,400	NA
Vanadium	22-166	13-150	53	NA
Yttrium	2-380	0.55-8.3	NR	NA
Zinc	2,800-152,000	92-46,000	200-12,400	2,120-15,800
Gold	0.16-100	NR	NR	NA
Chloride	1,160-11,200	NR	NR	766-44,200
Country	USA, Canada	USA	USA, Canada	USA

(1) Results are for oxides and are expressed as percents.
NA Not analyzed, as it was not part of the scope of work for this project.
ND Not detected.
NR Not reported in the literature.
Source: The results in the first three columns are from "Characterization of MWC Ashes and Leachates from MWS Landfills, Monofills, and Co-Disposal Sites," EPA 530-SW-87-028A, October 1987. The results in the last column are from this study.

110X

TABLE 7-7

ASH CONVENTIONAL ANALYSES RANGES OF CONCENTRATIONS

Parameter	Samples (mg/kg)				
	ZA-AH-001- ZA-AH-005	ZB-AH-001- ZB-AH-005	ZC-AH-001- ZC-AH-005	ZD-AH-001- ZD-AH-005	ZE-AH-001- ZE-AH-005
Ammonia-Distilled (as N)	2.89-11.5	3.69-10.6	1.33-2.10	0.90-1.08	2.77-8.69
Total Organic Carbon	11,400-35,600	14,600-29,600	9,020-17,800	11,400-53,200	4,060-43,300
Chloride	16,300-23,700	18,600-44,200	3,870-5,860	766-2,190	7,550-14,100
Sulfate	3,770-6,100	764-3,130	5,900-10,300	1,680-5,580	1,500-2,790
Solids, Dissolved @ 180°C	46,500-52.400	36,700-65,800	22,000-26,100	6,440-13,200	11,200-35,500
Total Alkalinity	7,540-8,100	1,590-6,650	1,210-3,040	558-922	2,990-7,590
Nitrate (as N)	2.22-4.23	1.45-2.87	0.09-6.46	0.44-1.59	2.9-4.51
Orthophosphate	ND	ND	ND	ND-0.05	ND
pH	11.68-11.85	10.91-11.67	11.58-11.82	10.36-10.69	11.4-11.82

ND Not Detected.

TABLE 7-8

LEACHATE SEMIVOLATILE RESULTS RANGES OF CONCENTRATIONS

Parameter	Samples (µg/L)				
	ZA-LE-001- ZA-LE-007	ZB-LE-001	ZC-LE-001- ZC-LE-002	ZD-LE-001- ZD-LE-003	ZE-LE-001- ZE-LE-002
Benzoic acid	ND	ND	ND	ND	52-73
Phenol	2J-32	ND	ND	ND	ND
3-Methylphenol	ND-6J	ND	ND	ND	ND
4-Methylphenol	ND-6J	ND	ND	ND	ND

ND Not Detected.

J Indicates approximate value because contaminants were detected at levels below Method Detection Limits, but above the instrument detection limit.

112X

TABLE 7-9

CONCENTRATIONS OF ORGANIC CONSTITUENTS IN LEACHATE FROM MUNICIPAL WASTE LANDFILLS, ASH MONOFILLS, AND CO-DISPOSAL SITES

Constituent	Range (Literature) (µg/L)	NUS Municipal (µg/L)	NUS Codisposal (µg/L)	Ash Monofill (CORRE) (µg/L)
Acetone	140-11,000	4-4,600	ND-1,500	NA
Benzene	2-6,080	ND	ND	NA
Benzoic Acid	NR	NR	NR	ND-73
Bromomethane	10-170	ND	ND	NA
1-Butanol	50-360	ND	ND	NA
Carbon tetrachloride	2-398	ND	ND	NA
Chlorobenzene	2-237	ND	ND	NA
Chloroethane	5-860	ND	ND	NA
Bis(2-chloroethoxy)methane	2-25	ND	ND	ND
Chloroform	2-1,300	ND	ND	NA
Chloromethane	10-170	ND	ND	NA
Delta BHC	0-5	ND	ND	NA
Dibromomethane	5-25	ND	ND	NA
1,4-Dichlorobenzene	2-37	ND	ND	ND
Dichlorodifluoromethane	10-450	ND	ND	NA
1,1-Dichloroethane	2-6,300	ND	ND	NA
1,2-Dichloroethane	0-11,000	ND-16	ND	NA
Cis-1,2-Dichloroethene	4-190	ND	ND	NA
Trans-1,2-Dichloroethene	4-2,760	ND	ND	NA
Dichloromethane	2-3,300	ND	ND	NA
1,2-Dichloropropane	2-100	ND-230	ND	NA
Diethyl phthalate	2-330	ND	ND	ND
Dimethyl phthalate	4-55	ND	ND	ND
Di-n-butyl phthalate	4-150	ND-23	ND	ND
Endrin	0-1	ND	ND-250	NA
Ethyl acetate	5-50	ND	ND	NA
Ethyl benzene	5-4,900	ND	ND-15	NA
Bis(2-ethylhexyl)phthalate	6-150	ND	ND	ND

113x

TABLE 7-9
CONCENTRATIONS OF ORGANIC CONSTITUENTS IN LEACHATE
FROM MUNICIPAL WASTE LANDFILLS, ASH MONOFILLS, AND CO-DISPOSAL SITES
PAGE TWO

Constituent	Range (Literature) (µg/L)	NUS Municipal (µg/L)	NUS Codisposal (µg/L)	Ash Monofill (CORRE) (µg/L)
Isophorene	10-16,000	ND	ND	ND
Methyl ethyl ketone	110-28,000	290-12,000	ND-2,200	NA
Methyl isobutyl ketone	10-660	ND	ND	NA
3-Methylphenol	NR	NR	NR	ND-6J
4-Methylphenol	NR	NR	NR	ND-6J
Napthalene	4-68	ND	ND	ND
Nitrobenzene	2-120	ND	ND	ND
4-Nitrophenol	17-40	ND	ND	ND
Pentachlorophenol	3-470	ND	ND	ND
Phenol	10-28,800	ND-2,100	ND-2,100	ND-32
2-Propanol	94-10,000	ND	ND	NA
1,1,2,2-Tetrachloroethane	7-210	ND	ND	NA
Tetrachloroethene	2-620	ND	ND	NA
Tetrahydrofuran	5-260	ND	ND	NA
Toluene	2-3,200	ND-1,100	ND-120	NA
Toxaphene	0-5	ND-16	ND	NA
1,1,1-Trichloroethane	0-2,400	ND	ND	NA
1,1,2-Trichloroethane	2-500	ND	ND	NA
Trichloroethene	1-1,120	ND	ND	NA
Trichlorofluoromethane	4-100	ND-230	ND	NA
Vinyl chloride	0-110	ND	ND	NA
m-Xylene	21-79	ND	ND	NA
p-Xylene and o-Xylene	12-50	ND-23	ND-290	NA

NA	Not analyzed, as it was not part of the scope of work for this study.
NR	Not reported in the literature.
ND	Not detected.
J	Indicates approximate value because contaminants were detected at levels below Method Detection Limits, but above the instrument detection limit.

Source: The first three columns are from "Characterization of MWC Ashes and Leachates From MSW Landfills, Monofills, and Co-Disposal Sites," EPA, October 1987. The last column is from this study.

114X

TABLE 7-10

LEACHATE DIOXIN RESULTS
RANGES OF CONCENTRATIONS

Parameter	Samples (ppb)				
	ZA-LE-001-ZA-LE-007	ZB-LE-001	ZC-LE-001-ZC-LE-002	ZD-LE-001-ZD-LE-003	ZE-LE-001-ZE-LE-002
2,3,7,8-TCDD	ND	ND	ND	ND	ND
TCDD-TOT	ND	ND	ND	ND	ND
PeCDD	ND	ND	ND	ND	ND
HXCDD	ND	ND	ND	ND	ND
HPCDD	ND-0.222	ND	ND	ND	ND
OCDD	ND-0.107	ND	ND	ND	ND
2,3,7,8-TCDF	ND	ND	ND	ND	ND
TCDF-TOT	ND	ND	ND	ND	ND
PeCDF	ND	ND	ND	ND	ND
HXCDF	ND	ND	ND	ND	ND
HPCDF	ND-0.076	ND	ND	ND	ND
OCDF	ND	ND	ND	ND	ND
2,3,7,8-TCDD(1) Equivalency ppb	2×10^{-4}	ND	ND	ND	ND

ND Not Detected.

(1) 2,3,7,8-TCDD equivalency calculated using Toxicity Equivalency Factors currently recommended by EPA (EPA, March 1987).

TABLE 7-11

CONCENTRATIONS OF PCDDs/PCDFs IN LEACHATES FROM ASH MONOFILLS RANGES OF CONCENTRATIONS

Compound	Field Leachate Monofill B (ppb)	Field Leachate Monofill C (ppb)	Field Leachate Monofill D (ppb)	Field Leachate Facility ZA (ppb)
2,3,7,8-TCDD	<0.06-0.28	<0.05-1.6	<0.22-<0.26	ND
Total TCDD	<0.06-6.6	<0.05-28	0.13-0.27	ND
Total PeCDD	<0.05-25	<0.03-93	<0.22-0.4	ND
Total H_XCDD	<0.02-22	<0.02-130	2.1-2.2	ND
Total H_pCDD	0.009-21	<0.02-172	8.2-8.8	ND-0.222
Total OCDD	0.14-14	0.06-120	23-25	ND-0.107
Total Dioxin	0.149-88.6	0.06-543	33.93-36.17	NR
2,3,7,8-TCDF	<0.05-3.7	<0.08-11	0.37-0.4	ND
Total TCDF	<0.05-22	<0.08-65	2.9-3	ND
Total PeCDF	<0.02-17	<0.02-64	2.3-2.4	ND
Total H_XCDF	<0.01-16	<0.01-76	1.9-1.9	ND
Total H_pCDF	0.05-9.4	<0.03-60	1.2-1.3	ND-0.076
Total OCDF	0.05-1.9	0.04-15	0.81-0.84	ND
Total Furan	0.1-66.3	0.04-280	9.21-9.34	NR
2,3,7,8-TCDD (1) Equivalency (µg/kg or ug/L)	0.000-0.037	0.000-0.062	0.000-0.001	2×10^{-4}

ND Not detected.

NR Not reported, since the results were reported in another fashion.

(1) 2,3,7,8-TCDD equivalency calculuated using Toxicity Equivalency Factors currently recommended by EPA (EPA, March 1987).

Source: The results for Monofill B, Monofill C, and Monofill D are from "Characterization of MWC Ashes and Leachates from MSW Landfills, Monofills and Co-Disposal Sites," EPA, October 1987. The results from Facility ZA are from this study.

TABLE 7-12

LEACHATE METALS ANALYSES
RANGES OF CONCENTRATIONS

Parameter	Samples (in µg/L)					Standards/Criteria (in µg/L)		
	ZA-LE-001- ZA-LE-007	ZB-LE-001	ZC-LE-001- ZC-LE-002	ZD-LE-001- ZD-LE-003	ZE-LE-001- ZE-LE-002	EP Toxicity Maximum Allowable Limit	Safe Drinking Water Act(a) MCLs	Safe Drinking Water Act(b) SMCLs
Arsenic	47-400	ND	ND	ND	ND	5,000	50	SNA
Barium	ND	9,220	7.8-8.0	18-40	2,970-3,080	100,000	1,000	SNA
Cadmium	ND-1.7	4.0	ND	ND	ND	1,000	10	SNA
Chromium	ND-32	ND	ND	ND	ND	5,000	50	SNA
Copper	ND	8.8	ND	4.6-12	ND	SNA	SNA	1,000
Iron	120-3,400	840	108-115	187-523	7,480-10,500	SNA	SNA	300
Lead	8-54	ND	ND-34	ND	ND	5,000	50	SNA
Manganese	310-4,600	17,600	493-501	718-857	17,100-18,500	SNA	SNA	50
Mercury	ND	ND	ND	ND	ND	200	2	SNA
Selenium	24-340	ND	ND	ND	ND	1,000	10	SNA
Silver	ND	ND	ND	ND	ND	5,000	50	SNA
Sodium	3,000,000-3,800,000	2,450,000	188,000-191,000	1,340,000-2,580,000	2,430,000-2,470,000	SNA	SNA	SNA
Zinc	60-370	8.3	9-13	5.2-8.7	27-70	SNA	SNA	5,000
Aluminum	700-920	ND	ND	ND	ND	SNA	SNA	SNA
Calcium	3,270,000-5,360,000	8,390,000	64,600-65,800	386,000-477,000	5,570,000-5,670,000	SNA	SNA	SNA
Magnesium	51,000-70,000	17,300	22,600-23,000	340,000-367,000	14,800-15,000	SNA	SNA	SNA
Potassium	516,000-525,000	1,620,000	79,700-81,200	229,000-636,000	1,430,000-1,450,000	SNA	SNA	SNA
Silicon	2,100-5,700	3,150	4,570-4,840	8,760-15,300	470-498	SNA	SNA	SNA

ND	Not Detected
SNA	Standard Not Available
(a)	Primary Drinking Water Standards
(b)	Secondary Drinking Water Standards

117x

TABLE 7-13

RANGES OF LEACHATE CONCENTRATIONS OF INORGANIC CONSTITUENTS FROM MONOFILLS

Constituent	Concentration (Literature) (mg/L)	Concentration (CORRE Study) (mg/L)	EP Toxicity Maximum Allowable Limit (mg/L)	Primary Drinking Water Standard (mg/L)
Arsenic	0.005-0.218	ND-0.400	5.0	0.050
Barium	1.0	ND-9.22	100.0	1.000
Cadmium	ND-0.044	ND-0.004	1.0	0.010
Chromium	0.006-1.53	ND-0.032	5.0	0.050
Lead	0.012-2.92	ND-0.054	5.0	0.050
Mercury	0.001-0.008	ND	0.2	0.002
Selenium	0.0025-0.037	ND-0.340	1.0	0.010
Silver	0.07	ND	5.0	0.050
Aluminum	NR	ND-0.920	SNA	SNA
Beryllium	NR	NA	SNA	SNA
Boron	NR	NA	SNA	SNA
Calcium	21	64.6-8,390	SNA	SNA
Cobalt	NR	NA	SNA	SNA
Copper	0.022-24	ND-0.012	SNA	SNA
Iron	0.168-121	0.108-10.5	SNA	SNA
Lithium	NR	NA	SNA	SNA
Magnesium	NR	14.8-367	SNA	SNA
Manganese	0.103-4.57	0.310-18.5	SNA	SNA
Molybdenum	NR	NA	SNA	SNA
Nickel	ND-0.412	NA	SNA	SNA
Potassium	21.5	79.7-1,620	SNA	SNA
Sodium	200-4,000	188-3,800	SNA	SNA
Strontium	NR	NA	SNA	SNA
Tin	NR	NA	SNA	SNA
Silicon	NR	0.470-15.3	SNA	SNA

TABLE 7-13
RANGES OF LEACHATE CONCENTRATIONS OF INORGANIC CONSTITUENTS FROM MONOFILLS
PAGE TWO

Constituent	Concentration (Literature) (mg/L)	Concentration (CORRE Study) (mg/L)	EP Toxicity Maximum Allowable Limit (mg/L)	Primary Drinking Water Standard (mg/L)
Titanium	NR	NA	SNA	SNA
Vanadium	NR	NA	SNA	SNA
Yttrium	NR	NA	SNA	SNA
Zinc	ND-3.3	0.0052-0.370	SNA	SNA
Chloride	1,803-18,500	7,700-22,000	SNA	SNA
Sulfate	94	14.4-5,080	SNA	SNA
pH	8.04-8.3	5.2-7.4	SNA	SNA
TDS	11,300-28,900	924-41,000	SNA	SNA

ND Not detected.
NR Not reported in the literature.
NA Not analyzed, as it was not part of the scope of work for this study.
SNA Standard Not Available.
Source: First column is from "Characterization of MWC Ashes and Leachates from MSW Landfills, Monofills, and Co-Disposal Sites," EPA, October 1987. Second column is from this study.

119X

TABLE 7-14

LEACHATE CONVENTIONAL ANALYSES
RANGES OF CONCENTRATIONS

Parameter	Samples (in mg/L)					Standards/Criteria (in mg/L)		
	ZA-LE-001-ZA-LE-007	ZB-LE-001	ZC-LE-001-ZC-LE-002	ZD-LE-001-ZD-LE-003	ZE-LE-001-ZE-LE-002	EP Toxicity Maximum Allowable Limit	Safe Drinking Water Act(a) MCLs	Safe Drinking Water Act(b) SMCLs
Ammonia-Distilled (as N)	5.3-35	4.18	68.2-77.4	4.38-28.4	9.78-11.4	SNA	SNA	SNA
Total Organic Carbon	17-420	30	47.2-49.3	28.8-30.7	25.5-28.9	SNA	SNA	SNA
pH (field) (standard units)	6.7-7.4	6.5	6.9	NR	5.2	SNA	SNA	SNA
Sulfate	620-1,500	171	14.4-14.5	4,140-5,080	309-312	SNA	SNA	250
Solids, Dissolved @ 180°C	13,700-41,000	40,600	924-932	8,030-13,000	25,900-26,300	SNA	SNA	500
Total Alkalinity	44-120	65	560-566	709-744	95.2-117	SNA	SNA	SNA
Nitrate (as N)	ND-0.2	0.45	0.40-0.41	ND-0.04	0.01	SNA	10	SNA
Orthophosphate	0.18-1.2	0.01	ND	0.17-0.24	ND	SNA	SNA	SNA
Specific Conductivity	33,000-46,000 µmhos/cm	>10,000 µmhos/cm	1,800 µmhos/cm	9,400->10,000 µmhos/cm	>10,000	SNA	SNA	SNA
Chloride	7,700-22,000	NA	NA	NA	NA	SNA	SNA	250
Temperature (°C) (field)	NA	9	21	19-30	23	SNA	SNA	SNA
Kjeldahl Nitrogen	34-43	NA	NA	NA	NA	SNA	SNA	SNA

NA	Not analyzed, due to differences in scope of work.
ND	Not detected
NR	Not reported; pH meter not working properly
SNA	Standard not available
(a)	Primary Drinking Water Standards
(b)	Secondary Drinking Water Standards

TABLE 7-15

RANGES OF EXTRACT CONCENTRATIONS OF ORGANIC CONSTITUENTS FROM MUNICIPAL WASTE INCINERATOR COMBINED FLY ASH AND BOTTOM ASH FOR THREE LEACHING PROCEDURES

Constituents	Range of Concentrations (ppm)				
	Deionized Water Extraction Procedure (Literature)		Extraction Procedure Test (Literature)	Toxic Characteristic Leaching Procedure (Literature)	Deionized Water Extraction Procedure (CORRE)
	First Extraction	Second Extraction			
Naphthalene	ND	ND	ND-8	ND	ND
Methyl naphthalene	ND-0.080	ND	ND-18	ND	ND
Oleyl Alcohol(1)	ND-0.088	ND	ND	ND	ND
Methoxy ethane(2)	ND	ND	ND	ND	ND
Methoxy ethanol	ND	ND-0.006	ND	ND-0.013	ND
Dimethyl propdiol(3)	ND-0.160	ND-0.140	ND-0.190	ND-0.140	ND
Phenol	ND	ND-0.033	ND	ND	ND
Bis oxy ethanol(4)	ND-0.096	ND-0.018	ND	ND	ND
Ethoxy ethanol(5)	ND-0.310	ND-0.390	ND	ND	ND
Cycloocta decone(6)	ND-0.580	ND-1.2	ND	ND	ND
M. Furan dione(7)	ND	ND	ND	ND	ND
E. Dim dioxane(8)	ND-0.510	ND	ND	ND	ND
Benz, Di carboxy A	ND	ND-0.002	ND	ND	ND
Benzoic acid	NR	NR	NR	NR	ND-0.130

ND Not detected.
NR Not reported in the literature.
Source: "Characterization of MWC Ashes and Leachates From MWS Landfills, Monofills, and Co-Disposal Sites," EPA, October 1987. Last column are the results of this study.

(1) (2)-9 Octadecen-1-01 (CAS 143-28-2).
(2) 1-Methoxy-2-(methoxy methoxy)ethane (9C1) (CAS 74498-88-7).
(3) 2,2-Dimethyl-1,3-propanedial (CAS 162-30-7).
(4) 2,2-{1,2-Etharediylbis (oxy) bis-}ethanol (CAS 112-27-6).
(5) (2)-9 Octadecer-1-01 (CAS 143-28-2).
(6) 1,4,7,10,13,16-Hexaoxa cycloocta decane (CAS 17455-13-9).
(7) 3,4-Dimethyl-2,5-furadione (9C1) (CAS 766-39-2).
(8) 5-Ethyl-2,2-dimethyl-1,3,-dioxane (9C1) (CAS 25796-26-3).

TABLE 7-16

ASH EXTRACTS METALS ANALYSES
RANGES OF CONCENTRATIONS
COMPARISON OF LITERATURE VALUES WITH RESULTS OBTAINED DURING CORRE STUDY

Parameter	Samples (in µg/l)											Standards/Criteria (in µg/l)
	SW 924 (DI H_2O) (Literature)	DI H_2O Extracts (CORRE)	EP TOX Extracts (Literature)	EP TOX Extracts (CORRE)	TCLP Extracts (Literature)	TCLP 1 Extracts (Literature)	TCLP 2 Extracts (Literature)	TCLP 1 Extracts (CORRE)	TCLP 2 Extracts (CORRE)	CO_2 Extracts	SAR Extracts	EP Toxicity Maximum Allowable Limit
Arsenic	5-50	ND-45	5 100	ND-31	5-37	10-30	10 100	ND	ND 60	ND 53	ND	5,000
Barium	150-390	139-3,050	27-6,300	23-455	NR	100-3,200	50-630	161-1,850	12 809	126 530	129 3,960	100,000
Cadmium	5-30	ND-7.6	10-3,940	25-1,200	25-3,320	30 1,900	10-470	ND 1,150	ND-1,560	ND 354	ND 6 0	1,000
Chromium	2 5-20	ND-16	5 9-460	ND 86	25-439	200 320	10 160	ND-8 0	ND 799	ND 9 8	ND 10	5,000
Copper	2 5-190	12-534	39-1,190	24 5,170	2 5 19	50 90	20 20	5 858	5 4-1,400	8 8 620	8 5 610	SNA
Iron	2 5 38	ND-115	4,500- 143,000	ND 82,000	828 60,600	183,000- 230,000	2,180 6,330	ND 7,220	ND 162,000	ND 304	ND 97	SNA
Lead	25 2,980	ND 3,410	20-34,000	ND-19,700	655 30,100	900 47,000	50 6,100	ND 10,500	ND 26,400	ND 504	ND 3,940	5,000
Manganese	ND 10	ND 20	3,600-6,240	250 8,540	4,200 11,900	7,040 7,470	3,220 3,340	ND 5,170	3 8 7,370	ND 2,390	ND 6 4	SNA
Mercury	10-100	ND-0 96	ND-6,000	ND 203	4 4	50 60	ND 100	ND-3 8	ND-4 6	ND 155	ND 1 1	200
Selenium	2 5-50	ND	2-100	ND	2 5-25	10-10	10 50	ND	ND	ND	ND 21	1,000
Silver	ND-50	ND	1-100	ND	NR	20 40	10-50	ND	ND	ND 16	ND	5,000
Sodium	68,300- 85,300	24,100- 209,000	89,900- 100,000	33,600 225,000	NR	103,000- 110,000	1,410,000 1,500,000	1,380,000 1,640,000	38,700 228,000	24,800 168,000	24,200 201,000	SNA
Zinc	1 5 960	5 4-1,340	38,500- 726,000	67-95,600	23,300 373,000	72,200- 83,200	23,500- 32,000	9 7 79,500	26 164,000	5-127,000	12 1,290	SNA
Aluminum Oxide	170 29,400	ND-203,000	31,900 43,800	ND-150,000	NR	30,800- 32,800	90-90	ND 62,800	ND 152,000	ND 90,700	ND 118,000	SNA
Calcium Oxide	122,000 536,000	141,000- 1,740,000	77,000- 1,740,000	592,000- 4,810,000	NR	1,930,000- 1,990,000	362,000- 1,430,000	666,000 2,750,000	692,000 3,640,000	398,000 1,920,000	142,000 1,800,000	SNA
Magnesium Oxide	ND-190	21 379	22,800- 42,700	27,300- 130,000	NR	41,700- 41,800	140-27,900	55 375,000	623-137,000	207-59,300	12 430	SNA
Potassium Monoxide	85,200- 120,000	13,100- 189,000	10,000 154,000	10,100- 189,000	NR	106,000- 111,000	86,500- 93,900	14,600 210,000	15,100 1,110,000	12,400- 155,000	14,500 181,000	SNA
Silicon Dioxide	NR	402-3,990	NR	5,090-98,700	NR	NR	NR	379 51,700	820 143,000	418 71,800	163 1,770	SNA

ND Not detected
NR Not reported in the literature
SNA Standard not available

122X

MD1963MP

Westinghouse Electric Corporation

Resource Energy Systems Division

Cost Building
2400 Ardmore Boulevard
Pittsburgh Pennsylvania 15221
(412) 636 5800
WIN 261 5800

March 19, 1990

Mr. Leonard J. Colner
Assembly Waste Management Committee
Committee Aide
New Jersey State Legislature
State House Annex, CN068
Trenton, New Jersey 08625

Dear Mr. Colner:

Westinghouse is pleased to submit comments on resource recovery facility ash management. The Assembly Waste Management, Planning, and Recycling Committee is to be commended for having the foresight to consider legislation which will ensure the proper management of resource recovery facility ash. In addition to these comments, Westinghouse Electric Corporation, as a member of the Institute of Resource Recovery (IRR), participated in the preparation of written testimony to be provided at the March 22 hearing by the IRR. Westinghouse believes in an integrated approach to solid waste management and is in the process of implementing such a program in Mercer County, New Jersey. Effective management of resource recovery facility ash is a key component in an integrated solid waste management approach.

The current testing-based system used by the NJDEP which relys on test results to determine if ash is hazardous or non-hazardous is inappropriate. The laboratory test used in this system to determine "toxicity", is recognized to over predict the "toxicity" of ash and yields inconsistent, unreproducable results.

Westinghouse recommends that New Jersey develop special management standards for ash that allows ash to be managed as a non-hazardous waste. This is consistent with a proposal the NJDEP is currently considering that would declare ash to be a "special waste" requiring proper management from the point of generation through handling, storage, and transportation to final disposal or reuse. Many states have adopted such a plan, ostensibly due to findings mentioned above. Additionally, several federal legislative initiatives, most notably Section 307 of the proposed amendment to the Clean Air Act (CAA) now being considered by the U.S. Senate, have abandoned testing-based systems and have adopted special waste management standards.

Further support of our recommendation of managing ash as a non-hazardous waste is provided in the decisions of two recent court cases, EDF vs Wheelabrator and EDF vs City of Chicago. In both cases, decisions were rendered stating that ash remaining after the burning of MSW is exempt from hazardous waste regulation if the resource recovery facility satisfies the criteria of 3001(i) of RCRA.

Notwithstanding these recent decisions, Westinghouse supports ash management standards which offer a significant measure of protection not required by current law. Westinghouse supports ash monofills which contain only ash from MSW resource recovery facilities meeting appropriate design and operating criteria. Also, Westinghouse supports co-disposal of ash with MSW in a facility meeting advanced design and operating criteria. These recommendations are evidenced in Section 307 of the proposed amendment to the CAA. We also feel that fly ash and bottom ash should be allowed to be combined for handling, storage, transportation and disposal as there is adequate evidence that disposal of combined ash is an environmentally acceptable approach.

Subjecting ash to possible regulation under N.J.A.C. 7:26-1,3,7,8,9, 10,11,12,13 and 13A as a hazardous waste ignores environmental, economic and social realities. This is indeed a very critical issue in New Jersey. Any requirement for MSW ash disposal in hazardous waste landfills would seriously reduce the capacity available for hazardous wastes, a capacity that is a limited resource, (nonexistent in New Jersey), and should be reserved for the disposal of those waste which truly require that level of environmental protection.

In summary, Westinghouse strongly feels that it is wholly inappropriate for MSW ash to be designated as a hazardous waste. The continuous testing of MSW ash for hazardous properties is likewise unnecessary to ensure full protection of human health and the environment. Special Management Standards under Subtitle D regulations would fully ensure responsible handling of MSW ash.

I have attached supporting documentation which clarifies and strengthens our recommended position. If you have any questions on our submittal, please call me at 412/636-5834.

Sincerely,

Mick Pompelia

Mick Pompelia, Manager
Ash Programs

Attachment

SUPPORTING DOCUMENTATION TO COMMENTS MADE BY WESTINGHOUSE ON RESOURCE RECOVERY FACILITY ASH MANAGEMENT

Leaching Tests

The standard laboratory tests used to determine ash toxicity includes the Extraction Procedure Toxicity Test (EP Tox Test) and the Toxic Characteristic Leaching Procedure (TCLP). The EP Tox Test was designed to mimic what could happen to a waste under worst-case conditions, that is, if ash were landfilled with MSW where acids generated from the decomposition of MSW could mobilize the contaminants (eight metals, four insecticides and two herbicides). If ash is disposed of separately from MSW in an ash-only landfill or landfill cell dedicated solely to ash (monofill or ashfill) then the EP Tox Test is entirely inappropriate for the characterization of ash.

The TCLP test was proposed by EPA in 1986 as a modification to the EP Tox Test and is expected to eventually replace the EP Tox Test. It differs primarily in that a second extraction fluid is used for samples that are highly alkaline. It also analyzes 38 additional compounds. The underlying assumption of using an acid base leaching scenario similar to the EP Tox Test remains, and is likewise inappropriate for assessing the leaching potential of ash in an ash-only disposal environment.

The EP Tox Test and TCLP test have been determined to significantly overpredict the amount of substances that actually leach from ash. Comparisons of data from these tests with actual leachate data have shown this to be true (CORRE/EPA, 1990; OTA, 1989; Shaub, 1988; and EPA, 1987).

In the absence of decomposing MSW, no acids will be produced and therefore, virtually no metals will be leached. A recent study carried out by CORRE/EPA (1990) examined the relationship of data from ash testing and extraction testing. The tests, conducted by NUS Corp. of Pittsburgh, provided a state-of-the-art characterization of Resource Recovery Facility

125x

(RRF) ash, ash extracts andleachates. Samples of ash were taken from five modern MWC facilities, and monofill leachate samples were collected from the companion ash disposal facilities. This study showed that none of the leachate samples collected from the ash disposal facilities exceeded the EP Toxicity Maximum Allowable Limits established for the eight metals in 40 CFR 261.24. In addition, the data from this study indicate that although the leachates are not used for drinking water purposes, they are close to being acceptable for drinking use, as far as the metals are concerned. The data obtained during the metals analyses of the ash extracts indicate that, in general, the extracts from the EP Tox, the TCLP 1, and the TCLP 2 extraction procedures have higher metals content than the extracts from the deionized water (SW-924), the CO_2, and the Simulated Acid Rain (SAR) extraction procedures. The EP Toxicity Maximum Allowable Limits for lead and cadmium were frequently exceeded by the extracts from the EP Tox, TCLP 1 and TCLP 2 extraction procedures. One of the extracts from the EP Tox Test also exceeded the EP Toxicity Maximum Allowable Limit for mercury. None of the extracts from the deionized water (SW-924), the CO_2, and the Simulated Acid Rain (SAR) extraction procedures exceeded the EP Toxicity Maximum Allowable Limits. In addition, the majority of the extracts from these three extraction procedures also met the Primary and Secondary Drinking Water Standards for metals.

Table 1 compares the range of concentrations of the metals analyses of the ash extracts with the range of concentrations for leachate as reported in the literature (EPA, 1987) and the range of concentrations for the leachates as determined in EPA/CORRE study. For the facilities sampled during this study, the data in Table 1 indicate that the extracts from the deionized water (SW-924), the CO_2, and the SAR extraction procedures simulated the concentrations for lead and cadmium in the field leachates better than the extracts from the other three extraction procedures. This information suggest that the deionized water (SW-924), the CO_2, and the SAR extraction procedures are better predictors of leachate quality than either the EP Tox Test or the TCLP.

There are also other problems with using extraction tests to assess ash toxicity and determine disposal requirements. Studies have shown test results to be unreproducible (Ujihara, 1989). It is also believed that no currently available method can accurately predict concentrations of toxic substances in leachate (OTA, 1989). In order for ash testing to be used as a meaningful regulatory tool a representative sample needs to be obtained and test procedures must be able to accurately characterize the ash stream and its leaching potential. Due to the lack of homogeneity, obtaining a representative sample of ash is a difficult if not impossible task. Some large inert and metallic objects contained in the ash stream are not adequately accounted for in the sampling preparation stages of the test. Items contributing contaminants to ash are not readily acknowledged or known and sources suspected of contributing to contaminants in ash are unevenly distributed. For example, it has been shown that the largest single source of lead in MSW comes from lead-acid batteries (primarily automobile batteries). It has been estimated that even after significant recycling lead acid batteries made up 65% of the total lead loading in MSW (Franklin Assoc. 1986). It is unknown if the lead in batteries end up in the ash as leachable lead but it is easy to see how a single battery could significantly affect a particular sample by elevating the lead concentration in the ash near it.

EP Tox Test procedures consistently reveal troublesome variability in results. Studies have reported a wide range of results when splits of identical samples were analyzed by different laboratories. The studies conclude that laboratories interpret the EP Tox Test procedures differently, resulting in diverse results. Some point to the lack of precision in the laboratory technique for adjusting pH levels. Lead, for which there was the greatest variation in test results, is very sensitive to pH levels near 5.0 -- the value to which the test solution must be adjusted during the extraction procedure. Yet the EP Tox Test allows the pH level to vary by plus or minus 0.2. As a result, slight differences in technique for adjusting the pH level -- which are well within the allowable test procedures -- can produce widely different results (Ujihara, 1989). The amount of time that samples are stored prior to analysis and sample preparation methods may affect the results as well.

127X

Dioxin/Dioxin Testing

We believe it is unnecessary to require that ash be subjected to analysis for total 2,3,7,8,- TCDD (Dioxin) as currently called for in NJDEP issued Solid Waste Facility Permits.

Dioxins and furans bind tightly to ash and tend not to leach from it. Former EPA Administrator, Lee Thomas summarized the agency's position on dioxin and furans in April, 1988 by stating "Dioxins do not leach and do not appear to present a threat of ground water contamination where ash is landfilled" (Thomas, 1988).

Research has shown Dioxin to have a low solubility in water (Marple, 1986). This fact is evidenced in recent studies on the dioxin content of actual leachate from ash monofills.

The concentration of 2,3,7,8,- TCDD in ash is extremely low and the requirement for testing is burdensome, time comsuming and adds unnecessary cost. A recently published study by CORRE/EPA (1990) of five representative RRFs shows 2,3,7,8,- TCDD levels in combined ash to range between 0.010 ppb to 0.035 ppb. When converted to toxic equivalents using EPA toxic equivalent factors (TEFs) the results were identical (this is due to the fact that the TEF for 2,3,7,8,- TCDD is one). Other studies have shown similar results. Tests on combined ash from the Claremont, New Hampshire facility reported the total dioxin and furan content to be 0.028 ppb TEF (Eighmy, 1989). The report further states that this value is comparable to values reported for urban dust, river sediments and lake sediments. Dioxin and furan concentrations in a composited combined ash sample taken from the Indianapolis RRF was also analyzed. The concentration of all homologs of dioxin and furans were reported to be below one ppb (Versar, 1989).

The CORRE/EPA study analyzed leachate from the five ash disposal facilities serving the five RRFs. No 2,3,7,8,- TCDD was detected from any of the five facilities. In fact, PCDDs/PCDFs were only found in the leachate from one facility. The homologs found were the more highly chlorinated homologs (HPCDD, OCDD and HPCDF). The values reported for these three homologs ranged from nondetectable to 0.222 ppb. This is equivalent to a 2,3,7,8,- TCDD toxic equivalency of 2 x 10^{-4} ppb. The data obtained during this study appears to indicate that PCDDs/PCDFs do not readily leach out of the ash in the ash disposal facilities. It was suggested that the low levels found in the leachates of the one facility probably originated from the solids found within the leachate samples because these samples were not filtered nor centrifuged prior to analysis.

Other studies have also been performed to determine dioxin levels in actual leachate. 2,3,7,8,- PCDD was not detected in leachate from the Dodge/Olmsted Ash Monofill in Olmsted County, Minnesota (Cousino, 1989). Dioxin and furan concentrations in the leachate collected from an ash monofill serving the Indianapolis RRF were analyzed. The concentration of all homologs of dioxins and furans (tetra through octa) were reported to be below one ppt (Versar, 1989).

The CORRE/EPA study also performed extraction tests on the ash from the five RRFs. None of the extracts contained PCDDs/PCDFs. These data confirm the findings of the actual field leachate samples that PCDDs/PCDFs are not readily leached from the ash.

It is clear from the existing data that ash contains little if any dioxins or furans. Certainly the data indicates that the concentration of 2,3,7,8,- TCDD in ash is below the one ppb level stipulated by the NJDEP in current Solid Waste Facility Permits. Furthermore, analysis of actual leachate from ash disposal facilities indicate that dioxin levels in leachate are extremely low, well below the Center for Disease Control (CDC) recommended upper level of 2,3,7,8,- TCDD toxic equivalency of one ppb in residential soil. Based on these data, it can be concluded that dioxin does not leach out of ash in ash disposal facilities. Therefore, there is no need to routinely analyze ash samples for 2,3,7,8,- TCDD.

Management of Combined Ash

Presently, modern RRF design incorporates the combining of fly ash and bottom ash because there exists no environmental or economic incentives and benefits to separate the two ash streams. On the contrary, combining the two ash streams takes advantage of the inherent properties of the two materials. Fly ash, which contains the scrubber by-products and unused lime, exhibits pozzolanic activity which when mixed with the coarse bottom ash causes the ash to set-up like a weak concrete. When the combined ash is deposited in a landfill, the permeability is reduced which minimizes the interaction of precipitation with the ash. This in turn will minimize leachate contamination. Previously published technical reports (Forrester, 1989a and Forrester 1989b) support the idea of reduced ash permeability and the CORRE/EPA (1990) study presents data on actual leachate quality from ash monofills which verifies that leachate contamination is minimized. Risk Assessments using data on actual ash composition and actual monofill leachate have concluded that the disposal of MSW ash in a monofill does not add significantly to risks associated with the waste-to-energy option for waste disposal and that the potential health risk from groundwater contamination appears to be insignificant (Kellermeyer, 1989).

Subtitle C Disposal Facilities

Subtitle C disposal capacity is extremely limited in the US. Currently no Subtitle C disposal facilities exist in New Jersey. Also, several neighboring states lack Subtitle C disposal facilities. Disposal in Subtitle C facilities is also very expensive. It has been reported (New Jersey Department of Treasury, 1989) that the disposal costs incurred by a New Jersey RRF for ash disposal in a Subtitle C landfill would be:

- Approximately $254 per ton for transportation and disposal at the Chemical Waste Management Facility in Model City, New York or,
- Approximately $389 per ton for transportation and disposal at the Chemical Waste Management Facility in Emelle, Alabama.

130X

It should be noted that these costs are a direct function of the travel distance to the disposal facility. The cost presented above were calculated assuming transportation originating at Warren County, New Jersey.

A recent development in the state of Alabama is also appropriate to note. Alabama has adopted a law restricting hazardous waste shipments from states that have no Subtitle C waste disposal facilities. This development is especially significant in that Alabama is home to the largest hazardous waste disposal facility in the country at Chemical Waste Management's Emelle site (last year for example, more than one third of all superfund waste was sent there). This provincialism appears to be a growing trend. In October the Governor of Pennsylvania signed an Executive Order to ban the construction of new solid waste disposal facilities that plan to accept significant amounts of out-of-state waste in an effort to stop further importation of waste. Many other states are considering similar actions. Therefore, classification of ash as a hazardous waste severely limits ash disposal options. Subtitle C disposal capacity is a precious resource that should be used by waste that are <u>truly</u> hazardous. Based on real-world leachate data from operating ash monofills, ash is not a hazardous waste and therefore does not warrant disposal in a Subtitle C facility.

Recently, many states that are home to a large number of operating RRFs have adopted stringent requirements for the siting, design, construction, monitoring, closure, and post closure of ashfills and landfills accepting ash without relying on a testing-based management system or requiring ash to managed as a Subtitle C waste. A partial list of these states include Connecticut (which burns 5000 TPD MSW), Florida (9,300 TPD), Massachusetts (9,000 TPD), Maryland (5,100 TPD), Michigan (4,000 TPD), and New York (10,000 TPD). Current legislative initiatives such as Section 307 of the proposed amendment to the Clean Air Act (CAA) now being considered by the US Senate calls for similar ash disposal practices. These requirements often meet or exceed the requirements of Subtitle C landfills as stated in 40 CFR 264 Subpart N. Therefore, classifying ash as a hazardous waste does not mean the waste will be disposed of in a facility that incorporates greater environmental safeguards. Indeed, many states have adopted design and operating criteria for ash disposal facilities that provide an equivalent degree of environmental protection as that called for from Subtitle C facilities.

Current Permit Condition for Ash Storage are Unworkable

Conditions contained in Solid Waste Facility Permits issued by the NJDEP that require separate storage of each weeks residual ash over the first 8 weeks of facility start-up are unworkable.

For a typical 1000 TPD RRF, over 14,000 tons of ash could be produced during that eight week period. Assuming a turn-around time of 3 to 4 weeks to obtain samples, produce a weekly composite and have the laboratory analysis performed, 5000-7000 tons of ash would have to be stored. Since facilities are not designed to provide storage for this quantity of ash, temporary storage containers would have to be used. Assuming the use of roll-off containers for ash storage, this typical 1000 TPD RRF would require on-site storage of over one hundred to as many as three hundred containers at any given time. Many RRF sites will not have adequate room to store these containers for this extended period of time. For those facilities that may have available land space, safety and environmental dangers may be imposed by the loading, handling and outside storage of containers for this extended period of time. An ash management system that is not based on testing would alleviate these problems while at the same time provide an appropriate degree of environmental protection.

Ash Utilization

This initiative to develop new regulations for RRF ash must consider beneficial use of ash. We are aware of the various research and investigative efforts that New Jersey has undertaken to explore ash utilization. In fact, Westinghouse submitted a proposal (that is currently under review) to New Jersey to perform a full scale demonstration (in response to RFP X-009) utilizing ash from a RRF. These initiatives need to be complemented with regulatory initiatives to develop and promulgate regulations for ash utilization. These regulations should define a clear and decisive approach for the utilization of ash such that regulatory hurdles are minimized. Perhaps regulations should be developed that utilize a representative leaching test to assess suitability. Any ash treated or untreated that passes the test could be used in predetermined applications. Some applications that provide in-situ treatment (e.g. using raw ash in concrete) should be approved if the final product passes such test. Regardless of the approach, regulations that allow for the safe use of RRF ash in beneficial applications need to be developed as expeditiously as possible. Ash utilization completes the loop of an integrated solid waste management approach that calls for waste reduction, recycling and incineration while minimizing disposal. It is clear that regardless of the approach, a set of guidelines governing ash utilization need to be established to ensure adequate environmental protection.

REFERENCES

Marple, L. et al. 1986. Water Solubility of 2,3,7,8 - Tetrachlorodibenzo-p-dioxin. Environmental Science and Technology, Vol. 20, pp 180.

CORRE/EPA, February 1990. Characterization of Municipal Waste Combustion Ash, Ash Extracts and Leachates. Prepared by NUS Corp.

Eighmy, T. T. et al. September, 1989. Interim Report; Investigation into Leachate Characteristics from Amended and Unamended Combined Ash and Scrubber Residues.

Cousino, M. August 1989. News Release by the Olmsted Co. Public Works Department, 507/285-8231.

Versar Inc. June 1989. Analysis of Ash Residue and Ash Monofill Leachate from the Indianapolis Resource Recovery Facility, located in Indianapolis, Indiana.

Office of Technology Assessment, Congress of the United States, October 1989. Facing America's Trash: What Next for Municipal Solid Waste?

Shaub, W. M. June 1988. Incinerator Ash--Some Things I Would Like to Know About and Why. Presented at the 81st Meeting of APCA.

Ujihara, A. M. and Gough, M. November 1989. Managing Ash from Municipal Waste Incinerators - A Report. Center for Risk Management Resources for the Future.

Franklin Associates, 1986. Characterization of Products Containing Lead and Cadmium in Municipal Solid Waste in the United States 1970 to 2000. Prairie Village, Kansas.

New Jersey Department of Treasury, November 22, 1989. Addendum #1 to RFP X-009, Full-Scale Demonstration Project for the Utilization of Resource Recovery Combustion Residue.

Thomas, L. M. 1988. Statement before the Subcommittee on Transportation, Tourism, and Hazardous Materials, of the House Committee on Energy and Commerce, April 13.

EPA (U.S. Environmental Protection Agency). October 1987. "Characterization of MSC Ashes and Leachates from Landfills, Monofills, and Co-Disposal Sites." EPA 530-SW-87-028A, prepared by NUS Corporation, Pittsburgh, Pennsylvania, for Office of Solid Waste and Emergency Response, Washington, D.C.

Forrester, K. E. et al April 1989a. Engineering Management of MSW Ashes: Field Empirical Observations of Concrete-Like Characteristics. Presented at the International Conference of Municipal Waste Combustion, Hollywood, Florida.

Forrester, K. E. September 1989b. State-of-the-Art in Thermal Recycling Facility Ash Residue Handling, Reuse, Landfill Design and Management. Presented at the 3rd Annual MSW Incinerator Ash Conference, Elizabeth, New Jersey.

Kellermeyer, D. A. August 1989. What Are the Risks of Ash Monofills? Solid Waste & Power Magazine.

135x

INCINERATION FACT SHEET

Incinerators will pollute our environment, sicken and kill our children,
destroy our property values, greatly increase our tax burden
and still will not solve our solid waste problem!!

BAN ALL GARBAGE INCINERATION IN OUR STATE!

HERE ARE THE TRUE FACTS - (and we can document every statement)

1. For every 3 pounds of garbage burned, 1 pound becomes dangerous ash which still must be landfilled. The other 2 pounds do not disappear - they go into the air you breathe and the water you drink.
2. Incinerators will put millions of pounds of pollutants into our air every year. A 1,000 ton per day incinerator will put 4 million pounds of toxic pollutants and carcinogens (cancer causers) into our air each year.
3. The ash from incinerators will endanger our environment. In fact, 45% of the time it is classified as a hazardous toxic waste. The amount of ash from a 1,000 ton per day incinerator will be 219 million pounds per year. 98.5 million pounds of it will be hazardous toxic waste. Since toxic metals cannot be destroyed, decreasing the toxicity of the ash will only result in an increase in the toxicity of the air emissions and vice versa.
4. Ash from a Philadelphia incinerator contained more dioxin than the soil at Times Beach, Missouri where the government evacuated the whole town in 1983.
5. In Hempstead, New York, after dioxin testing revealed consistently high dioxin contamination, Hempstead elected to destroy their incinerator at a loss of $135 million rather than threaten the health of the entire area.
6. In New York State, Dr. Arnold Schecter, professor of Preventive Medicine at the University of New York, reported mothers' milk was found to contain levels of dioxin which would give cancer to 50% of the rats ingesting that quantity.
7. Dr. Jacqueline Verrett of the U.S. Food & Drug Administration (FDA) compared dioxin to thalidomide, the horror drug which caused more than 8,000 babies to be born with severe birth defects. Dr. Verrett said, "Dioxin is 100,000 to a million times more potent than thalidomide in causing birth defects in lab animals. Dioxin causes miscarriages, birth defects, cancer and death in lab animals at the lowest levels tested."
8. Dioxin is probably the most toxic chemical known to man. Every incinerator produces dioxin - that is a scientific fact. The only question is — how much is produced?
9. Dioxin is extremely dangerous even in minute quantities. It has been estimated that a single shovelful of dioxin in Lake Ontario would render the entire lake unusable for food products or normal recreational purposes.
10. Incinerators emit huge quantities of hydrochloric acid, sulfur dioxide, nitrogen oxides, carbon monoxide, lead, cadmium, mercury, arsenic and dioxin to name a few. Almost 300 chemicals have been identified as by-products of incineration.
11. Incinerators also emit huge quantities of ultra-fine particles. Particles so small that over one million can fit on the period at the end of this sentence. Particles so fine that their emission can not be prevented and the human body has no defenses against them. These particles are laden with chemicals and metals like lead and cadmium. They are breathed into the deepest recesses of our lungs and can travel for hundreds of miles from an incinerator site along with other gaseous pollutants.
12. Because the pollutants from incineration can travel for many, many miles from the incinerator, incineration is not a "NIMBY" (Not In My BackYard) issue. Garbage incinerators do not belong in anyone's backyard. They don't belong in our state or our nation. In Europe, on average, approximately 75% of the nitrogen oxides and 55% of the sulfur dioxide pollution in each country comes from other surrounding countries.
13. Our Department of Environmental Protection (DEP) has pushed our state into incineration. And where have most of the top DEP officials gone? Of course, to take high paying jobs in incineration companies!
14. Although there has been no study on the effects of incineration on our drinking water, we know two things for sure: first, incineration will surely pollute our drinking water; and second, that for every pound burned, the incinerator will consume 4 pounds (½ gallon) of our precious, pristine drinking water. A 1,000 ton per day incinerator will use one million gallons of clean drinking water each day.
15. There is no doubt that incineration companies and their consultants lie about costs. Upon checking the actual costs against the projected costs on at least 6 incinerators across the country, we found the following average increases over industry projections — tipping fees up 205%, cost overruns up 129%, deficits $6.5 million per year and repairs of $32 million per incinerator. In Ocean County, N.J., the proposed single incinerator is projected to cost much more than the total cost for all the schools in Ocean County.

(over)

136x

6. New Jersey is already one of the top states for cancer. Cancer is currently the leading killer of children aged 1 to 10 and women aged 30 to 40. To construct incinerators which will dump biologically large quantities of dioxin and many other carcinogens and hazardous chemicals into our air is INSANE!! Experts have concluded that 80% of all human cancers are likely to be environmentally induced.

7. Incinerators produce astronomical amounts of carbon dioxide, a "greenhouse" gas. A 1,000 ton per day incinerator will produce 292 million pounds per year of carbon dioxide. The presidents of the National Academy of Sciences, the National Academy of Engineers and the Institute of Medicine concluded, "We believe that global environmental change may well be the most pressing international issue of the next century." The "greenhouse" effect can destroy our planet as we know it today.

YOU MAY ALSO ADD THAT INCINERATION WOULD ALSO HAVE AN ADVERSE EFFECT ON OUR DRINKING WATER. EVEN THOUGH THIS IS A CERTAINTY — INCREDIBLY, OUR DEP HAS NEVER DONE AN ENVIRONMENTAL IMPACT STUDY OF INCINERATORS ON OUR DRINKING WATER — EVEN THOUGH THEY WERE PRESSING TO PUT AN INCINERATOR IN EVERY COUNTY.

THE SOLUTION

A. Recycling, composting and source reduction. (Talk about proven technologies, nature has been composting for millions of years.)

B. Based on national averages, municipal solid waste is 9% metal, 8% glass, 7% plastics and at least 6% newspapers. These can readily be recycled. There is an additional 35% of paper products which can be recycled or composted. There is 18% yard wastes and 8% food products which can produce high-quality compost. These all add up to 91% of the waste stream. In Ocean County, the proposed incinerator would only deal with approximately 35% of the total waste stream.

C. The savings in energy and pollution to produce new products from recycling instead of from scratch is tremendous. For example, besides the savings in energy and pollution, the recycling of the print run of just one Sunday edition of the New York Times would save 75 thousand trees; trees which reduce the carbon dioxide (greenhouse gas) in our atmosphere.

- JOIN US -

Protect our health, our economy, our property values, our future generations and our planet.

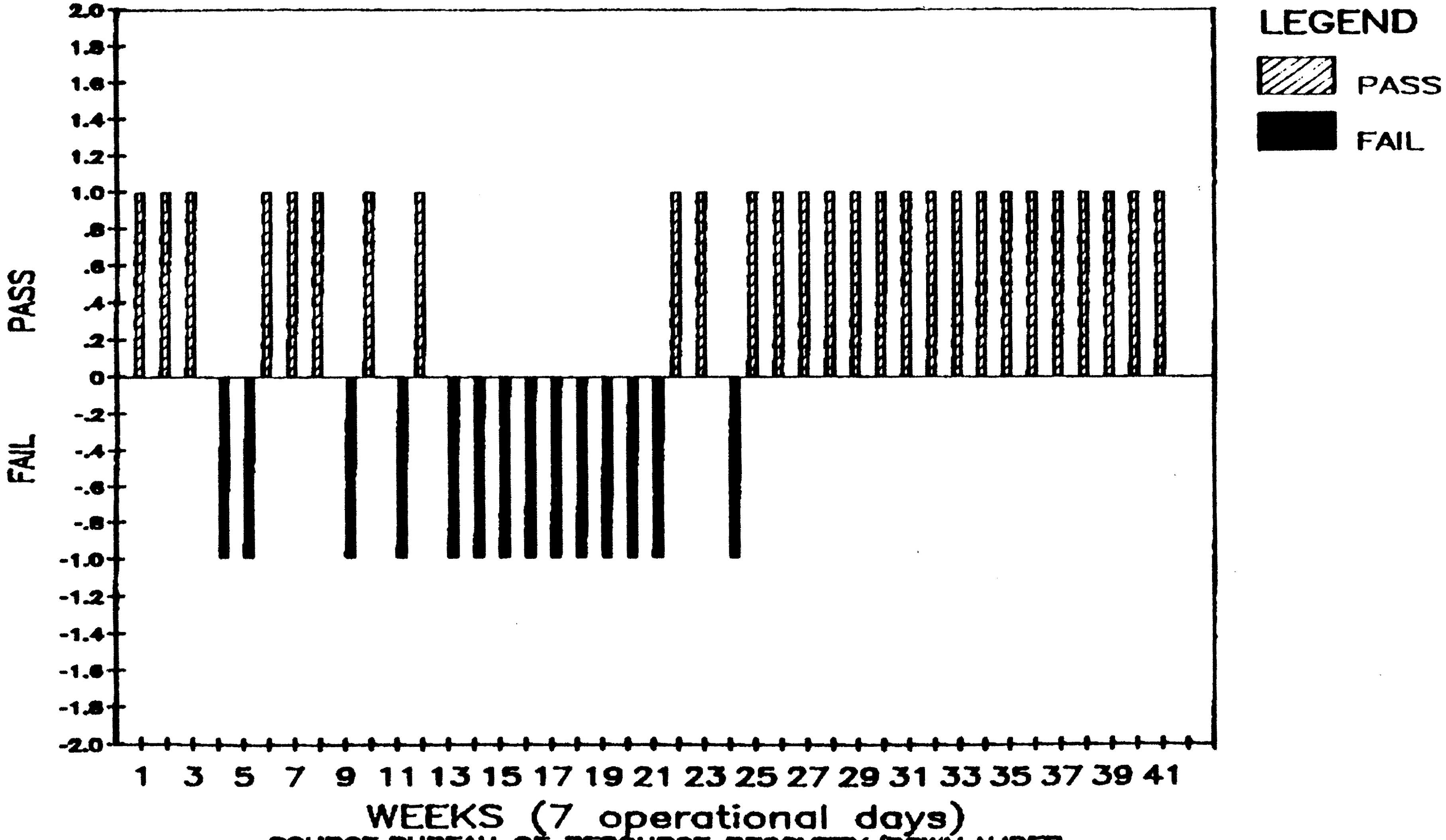
Help us to ban all garbage incineration in our state.

SAVE OUR OCEAN COMMITTEE
160 Pershing Blvd.
Lavallette, NJ 08735
(201) 793-6835

MEMBERSHIPS WELCOMED

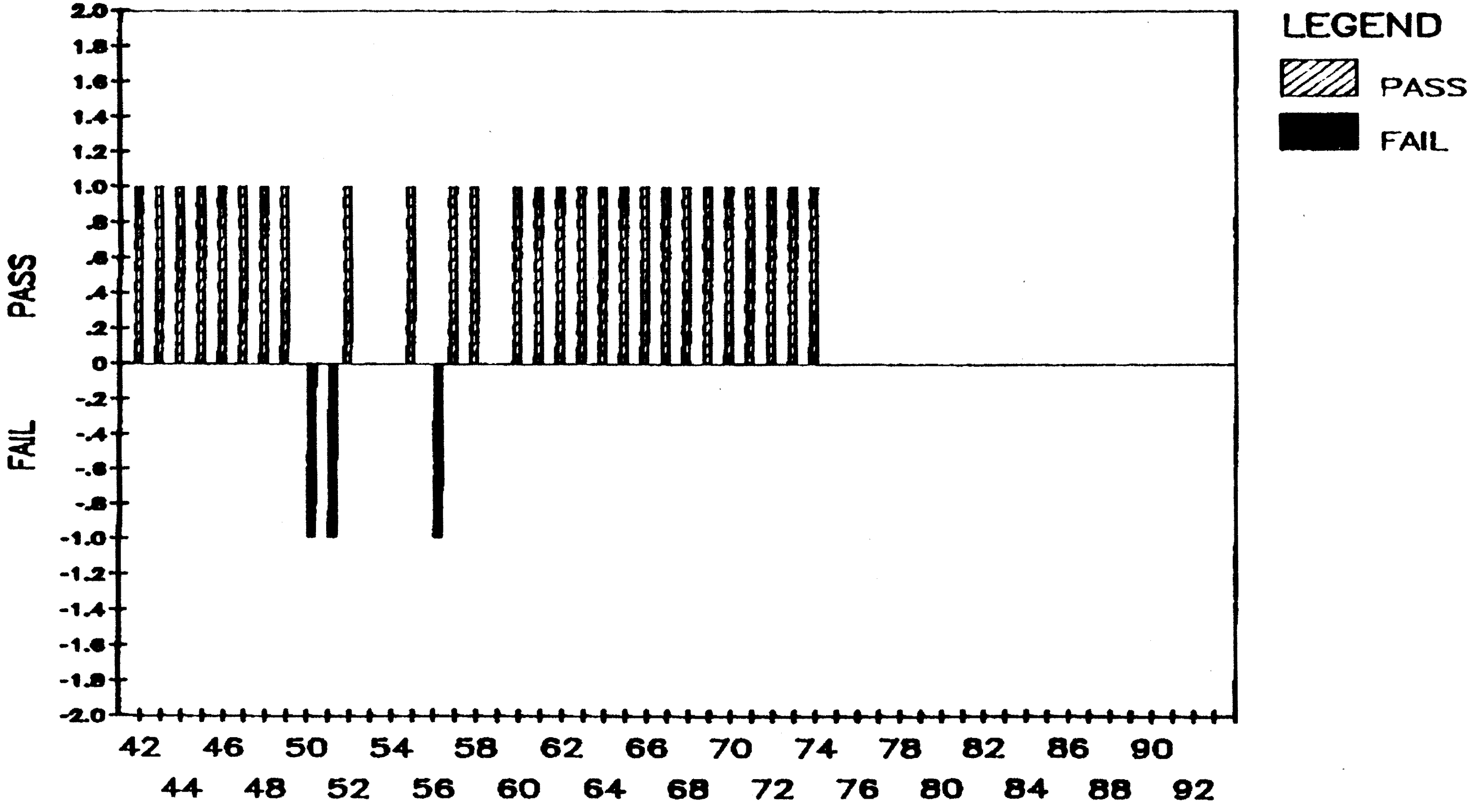
DONATIONS APPRECIATED

WARREN COUNTY RRF
E.P. TOX PASS/FAIL
FIRST YEAR 7/88-6/89



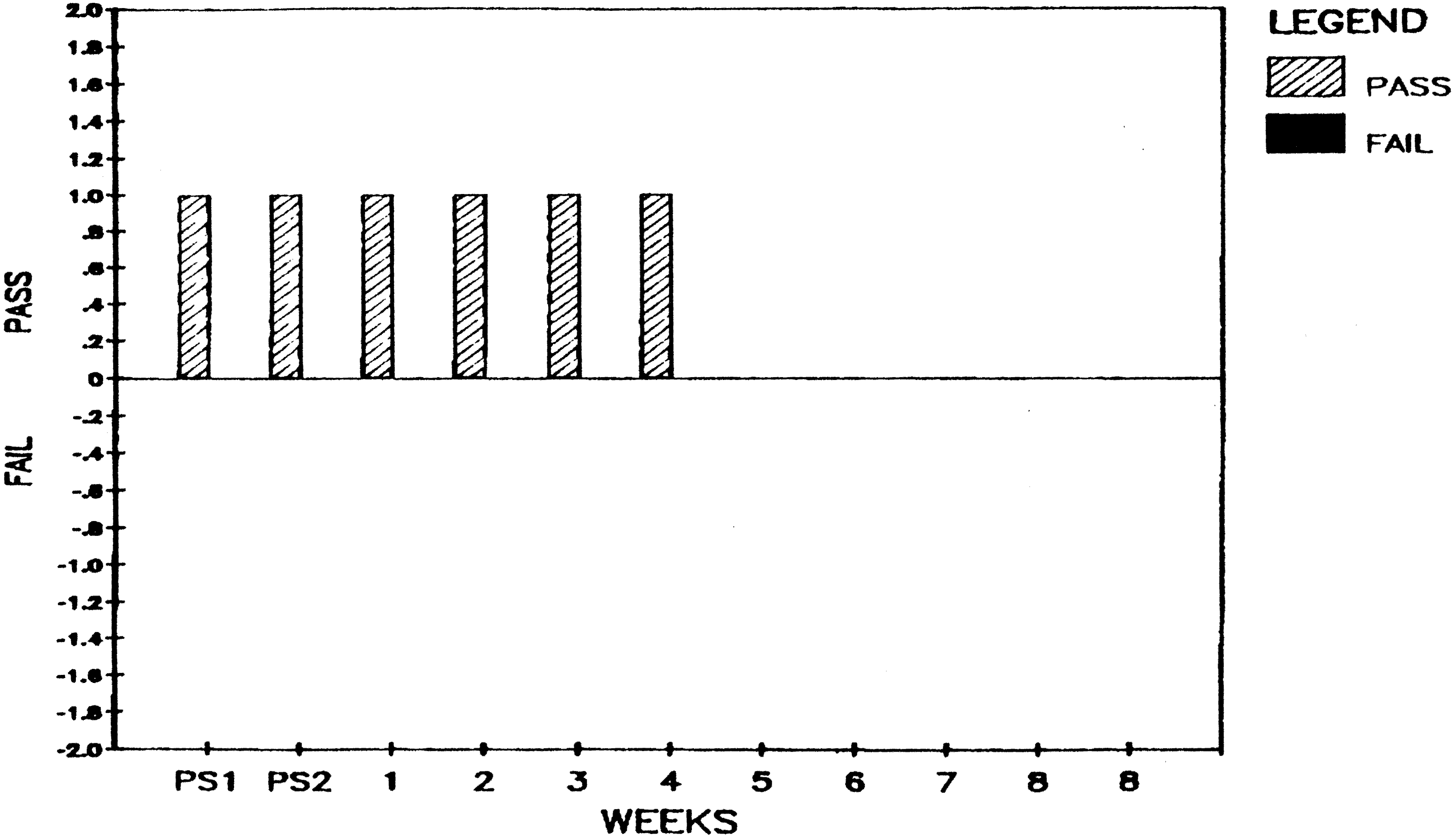
SOURCE:BUREAU OF RESOURCE RECOVERY/DSWM-NJDEP

WARREN COUNTY RRF
E.P. TOX PASS/FAIL
SECOND YEAR TO DATE 3/22/90



SOUCRE:BUREAU OF RESOUCRE RECOVERY/DSWM-NJDEP

GLOUCESTER COUNTY RRF
E.P. TOX PASS/FAIL
FIRST YEAR TO DATE 3/22/90



SOURCE:BUREAU OF RESOURCE RECOVERY/DSWM-NJDEP PS— prestart-up

140x

NEW YORK STATE ENERGY RESEARCH & DEVELOPMENT AUTHORITY

NYSERDA PROJECT

THE LONG ISLAND REGIONAL PLANNING BOARD
(WARREN CHESNER ENGINEERING, P.C.)
THE NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY
In Conjunction With
THE NEW JERSEY/NEW YORK PORT AUTHORITY
THE NEW JERSEY DEPARTMENT OF TRANSPORTATION
THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

THE NYSERDA PROJECT IS TO BE A FIELD DEMONSTRATION PROJECT TO DEMONSTRATE THE ENVIRONMENTAL AND PHYSICAL PERFORMANCE OF MUNICIPAL SOLID WASTE ASH IN BITUMINOUS CONCRETE PAVEMENT. THE FIELD INSTALLATION WILL CONSIDER THREE SECTIONS OF ROADWAY CONSTRUCTED BY NJDOT ON A NEW JERSEY SITE. ONE ROAD SECTION MAY UTILIZE PREPROCESSED BOTTOM ASH AS AN AGGREGATE: ONE SECTION MAY UTILIZE COMBINED BOTTOM/FLY ASH: AND THE LAST SECTION WILL USED AS A CONTROL SECTION. RIGOROUS PHYSICAL AND ENVIRONMENTAL TESTING AND MONITORING WILL BE CONDUCTED THROUGHOUT A 2 TO 3 YEAR PERIOD. THE DETAILED REPORTS AND RECOMMENDATIONS MAY BE USED TO DETERMINE ENVIRONMENTAL PROTOCOLS AND PHYSICAL PERFORMANCE SPECIFICATIONS RELATING TO THE USE OF MSW ASH AS A SUBSTITUTE AGGREGATE IN BITUMINOUS ROADWAY PAVEMENTS BY THE NJDOT.

ISSUANCE OF REQUEST FOR PROPOSALS

A Request for Proposals for ash utilization research projects was issued by the Ash Steering Committee and the Division of Solid Waste Management in September 1989. A mandatory bidders' conference was held on October 17, 1989.

Eleven proposals were received on January 9, 1990 in response to the request to provide a full-scale demonstration of the intermediate and final products developed from the reuse of resource recoveary facility ash residue.

PURPOSE OF RFP

The purpose of the RFP is to conduct a series of real-world environmental impact tests on ash residue, from the time it is generated and stored in piles prior to usage through its utilization in some product such as a road, or building materials. There will also be extensive testing conducted on the product after its usage to determine how it might react in the environment during the disposal phase. The research will examine the environmental, economic and commercial aspects of ash re-use to provide data for development of rational environmental regulations concerning ash management.

1.0 Purpose and Intent

The purpose of this Request for Proposal (RFP) is to engage a firm or organization to provide a Full-Scale Demonstration Project which will include a study and an field demonstration of the intermediate and final products developed from utilization and re-use of Resource Recovery Facility Combustion (RRFC) residue. Both the study portion and the field demonstration will examine the environmental, economic and commercial aspects of RRFC residue utilization and re-use.

Specifically each proposal shall address the following aspects of the project:

A) Chemical and physical characterization of the RRFC residue appropriate for the methodologies being proposed.

B) Environmental assessment, evaluation and testing of any proposed RRFC residue utilization and re-use program.

C) Economic analysis of any proposed RRFC residue utilization and re-use program, including a marketing analysis .

D) Technical narrative detailing all aspects of the proposed field demonstration; including details of the benefication processing of the RRFC residue if utilized; storage, handling, and transportation of raw material and resultant products; type of field testing environment proposed, and disposal if necessary.

As part of the material processing of the RRFC residue the successful bidder may employ one or more but not limited to the following benefication processes: Stabilization, Solidification, Vitrification, and Glassification. Some of the acceptable final products which could be employed in the field demonstration are; bituminous concrete , concrete, construction products, and metal recovery/extraction or utilization products.

The Department is currently managing or involved in other field research projects regarding RRFC residue. This RFP is intended not to duplicate these on going projects. Proposals which merely reinterate other on-going departmental projects will not be consider for award under this project. The following projects are currently being undertaken by NJDEP:

1. Demonstration of the utilization of Waste-to Energy Combustion Residues as a Substitute Aggregate in Bituminous Concrete Paving Applications. This is a combined effort between the Long Island Regional PLanning Board and the New York State Energy Research and Development Authority in conjunction with the New Jersey Interagency Engineering Committee and the New Jersey Department of Environmental Protection.

1.0 (cont)

2. Investigation and Evaluation of Trace Metals Separation and Recovery Processes from Incinerator Ash and Residue - Rutgers State University Department of Chemical and Biochemical Engineering and The New Jersey Department of Environmental Protection.

It is the intent of the State to award multiple contracts to highest ranking firms, if the proposals are such that funding would be available to allow multiple awards.

Preference will be given to the bidder or bidders who propose co-funding. Bidders must demonstrate the ability to obtain or provide co-funding for this project, see Section 5.5.3 for specific bid requirements. See Section 7.0 for evaluation criteria.

For complete details on the specific requirements of this RFP see section 8.0 Scope of Work. Review Section 5.0 for all proposal submission requirements.

144x

THE PORT AUTHORITY OF NY & NJ

World Trade & Economic Development Department
Essex County Resource Recovery
5 Marineview Plaza, Room 112
Hoboken, New Jersey 07030

April 3, 1990

Hon. Harry A. McEnroe
c/o Office of Legislative Services
State House Annex
Room 350
CN 068
Trenton, New Jersey 08625

Dear Mr. McEnroe:

The Port Authority of New York and New Jersey is pleased to submit to you and your committee our comments regarding the amending of the New Jersey Department of Environmental Protection regulations on municipal solid waste ash residue. This is a particularly important subject to us in light of our involvement in the Essex County Resource Recovery Facility which is due to begin start-up in September of this year.

The Port Authority stands ready to assist your committee and the homeowners of New Jersey in solving the current municipal solid waste crisis in our state and makes available to you our resources on the subject if you deem necessary.

Sincerely,

Deborah Schneekloth

Deborah Schneekloth
Project Manager
Resource Recovery
World Trade & Economic Development

Attachment

Bathgate Industrial Park
Bronx, NY
Brooklyn Piers Development
Brooklyn, NY
Industrial Park at Elizabeth
Elizabeth, NJ
Essex County Resource Recovery
Newark, NJ
Hoboken Waterfront Development
Hoboken, NJ
Hunters Point Waterfront Development
Queens, NY
Legal and Communications Center
Newark, NJ
Newark South Ward Industrial Park
Newark, NJ
Teleport
Staten Island, NY
The World Trade Center
New York, NY
Industrial Park at Yonkers
Yonkers, NY
Trade Development Offices
London, England
Tokyo, Japan
Zurich, Switzerland
The World Trade Institute
at The World Trade Center
XPORT—
The Port Authority
Trading Company
at The World
Trade Center

Writer's direct telephone: ______________ Fax # ____________

STATEMENT

4/03/90

The Port Authority of New York and New Jersey welcomes the opportunity to submit comments to the Assembly Waste Management, Planning and Recycling Committee on the management of residue ash from the combustion of solid waste at resource recovery facilities. The Port Authority unqualifyingly supports (1) amending New Jersey Department of Environmental Protection (NJDEP) existing rules and regulations governing the disposal of residual ash generated from the incineration of solid waste at resource recovery facilities; (2) eliminating the requirements for testing to characterize waste as either hazardous or non-hazardous and support the characterization of the ash residue as a "special waste" without testing as if it were similar to a commodity presently being accepted at sanitary landfills; and (3) allowing the disposal of Municipal Solid Waste (MSW) ash in state-of-the-art designed landfills, which should include two-layer flexible composite liners, leachate control system and upper aquifer ground monitoring. This cradle-to-grave disposal in environmentally sound ash landfills would provide the same or higher level of protection to the environment at significantly lower costs than proceeding with the concept that prescribes testing of ash and disposing of ash that tests hazardous to "hazardous waste landfills." State-of-the-art MSW ash monofills (landfills for a single substance) are constructed to the same technical standards as hazardous landfills and if reserved solely for MSW ash are significantly more manageable, ultimately more predictable and much more cost effective. In summary, it is critically important to the counties and municipalities associated with resource recovery facilities and to all other parties associated with the solid waste crisis in New Jersey that the State of New Jersey enact rules and regulations with regard to MSW ash disposal that are rational and provide the highest level of environmental protection in the most cost efficient manner. In this way, the resource recovery program can achieve the major environmental benefit yet help reduce the escalating cost of disposal to the New Jersey homeowners. MSW residue ash must be deemed a "special waste" and disposed of in state-of-the-art ash monofills, without the need for testing ash at the source.

DISCUSSION

The Port Authority of New York and New Jersey, the City of Newark, the County of Essex and American Ref-Fuel, Inc., have entered into contracts to construct and operate the Essex County Resource Recovery Facility. The Port Authority, a bi-state agency of New York and New Jersey created in 1921 with the consent of Congress, is responsible for contract development and project financing; Essex County is responsible for overall monitoring of the project as more fully described under Chapter 326 of the Solid Waste Laws of New Jersey, waste disposal contracts, waste stream control, governmental assistance in the form of grants or loans, landfill availability and public information consultation; and American Ref-Fuel is responsible for the design, construction and operation of the facility including assistance in such other matters as financing, permitting and public information. The Essex County Resource Recovery Facility is a mass burn/waste-to-energy plant capable of processing 2,250 tons per day of solid waste and generating 60,000 kilowatts of electrical energy - enough to serve 37,500 homes - when operating at peak capacity.

The United States is generating 160 million tons of municipal solid waste annually - more than 1/2 ton per person - and the rate is increasing steadily. In 1986, only about 10% of all MSW was recycled and 10% incinerated while 80% - 130 million tons - was being landfilled. Unfortunately, the United States Environmental Protection Agency (USEPA) estimates that 80% of existing permitted landfills will reach capacity and close within 20 years.

Closer to home, the MSW problems in the State of New Jersey are at crisis proportions. New Jersey generates almost 11 million tons of MSW per year and currently exports approximately 5 million tons of this to other states. This practice (exporting of MSW rather than in-state disposal) is dangerously at risk and can at best be considered an interim solution.

Currently, eighteen waste-to-energy plants are proposed to be constructed in New Jersey. Policies which encourage this environmentally sound method of solid waste disposal must be developed. Recognizing the large volume and special characteristics of waste-to-energy ash residue, we must develop environmentally acceptable alternatives to deal with ash residue disposal.

Legislation and regulations regarding MSW ash management at the federal level are in the formative stage and making their way through various legislative committees and regulatory agencies. In New Jersey at this time ash may be characterized as either hazardous or non-hazardous depending on the outcome of tests performed on the ash. This confusion is due to the adoption by the New Jersey Department of Environmental Protection of the definition of hazardous waste contained in the Hazardous Waste Regulations, N.J.A.C. 7:26-1,4, 7-13A, 16, 16A and 17. These regulations state that any material that is ignitable, corrosive, reactive or <u>toxic</u> shall be deemed a hazardous waste and treated, stored, transported and disposed of as such. It is the contention of the Port Authority that it was never the intention of the New Jersey legislature that MSW ash be regulated under this statute. Further, at the federal level the amendments to the Resource Conservation and Recovery Act contained in the 1984 National Solid Waste Amendment Section 3001(i) entitled "Clarification of the Household Waste Exclusion," state that all resource recovery facilities (incinerators that recover energy) "shall not be deemed to be...... managing hazardous waste" if they burn only municipal solid waste and therefore should <u>not</u> be managed under 40CFR Part 261, Subpart C, Appendix VIII (HW Regulation), but under Subtitle D - The Solid Waste Disposal Act.

There are numerous analytical testing procedures for ash characterization; at present, the prescribed test in New Jersey is the EP Toxicity Test. As mentioned previously, under the Resource Conservation & Recovery Act, the determination of hazardous is based on whether a material is corrosive, reactive, ignitable or toxic. Since ash fits none of the first three, the EP Toxicity Test evolved to mimic the leaching capacity of a material at a landfill; the leachate is thus analyzed for a number of constituents and if any of the constituents exceed levels set by the Environmental Protection Agency, the ash is deemed hazardous and managed as such. The EP Toxicity test is universally criticized, so much so, that it is soon to be replaced by the Toxicity Characteristics Leaching Procedure (TCLP). The jury is still out as to the efficacy of the TCLP test but much skepticism exists in the field as to whether any bench test procedure can duplicate what actually takes place in a landfill. Indeed, a recent study, jointly sponsored by the United States Environmental Protection Agency and the Coalition on Resource Recovery and the Environment (CORRE) found that MSW ash leachate from actual ash landfills tested out below the level that those two tests have generally indicated.

Landfills for MSW ash disposal should be located, designed and operated so as to protect human health and the environment. The Port Authority supports the "monofill" concept (the exclusive use for the disposal of MSW ash). The monofill shall have ground water monitoring and a leachate collection system; in addition, it shall have a double composite liner designed, operated and constructed of materials to prevent the migration of any constituent into such liner during such period as the unit remains in operation, including any post-closure monitoring period.

In conclusion, we encourage the committee to look carefully at present practice of our neighboring state of New York and language included in the amendments to the Clean Air Act which will be acted upon this year.

New York State has promulgated and is enforcing the Solid Waste Management and Ash Regulatory Program effective 12/31/88. This piece of legislation has designated ash as a "special waste" and specifies, as an option, monofills for disposal. This legislation was presented, in detail, at the "First International Conference on Municipal Solid Waste Combustion Ash Utilization" October, 1988. This paper was presented by the Director, Division of Solid Waste, New York State Department of Environmental Conservation. The success of New York's MSW program is a clear indication that ash management can be accomplished in a manner that protects both human health and the environment without imposing artificial barriers based on questionable testing protocols and severe disposal requirements.

At the federal level, the Clean Air Act amendment is moving swiftly through Congress and will certainly be acted upon by both the House and Senate this year. We direct your attention to March 15, 1990, Congressional Record - Senate, "Municipal Waste Combustion Ash" - Section 4011(a). This amendment provides that "....disposal of ash from municipal waste incineration units shall be subject to this section and subtitle and not subject to the provisions of Subtitle C....." The amendment also has language regarding disposal and treatment and in general promotes the management of MSW that parallels that of New York State.

Finally, we aggressively support the continued efforts on a state-wide basis to promote source reduction and increased recycling at the World Trade Center, which the Port Authority owns and operates. We have just expanded our recycling program and stand ready to support NJDEP's efforts in establishing a rational program of ash management. We believe that New Jersey's ash management regulations must have as their centerpiece the designation of municipal solid waste residue ash as a "special waste" with appropriate re-use provisions and landfilling as discussed in the proposed amendment to the Clean Air Act. This approach provides protection to the environment comparable to the protection provided to hazardous materials in the most cost effective manner.