ATTACHMENT 3

CLARIFICATION LETTER FROM IBM TO EPA
DATED FEBRUARY 3, 2000

International Business Machines Corporation

East Fishkill Facility
1580 Route 52
Hopewell Junction, NY 12533-6531
914 / 894-2121

February 3, 2000

George C. Meyer, P.E.
Chief, RCRA Compliance Branch
Division of Enforcement and Compliance Assistance
United States Environmental Protection Agency
Region 2
290 Broadway
New York, NY 1007-1866

Re: Project XL Proposal
International Business Machines Corporation
East Fishkill Facility
F006 Sludge Recycling Project

Dear Mr. Meyer:

This is in response to your letter dated October 25, 1999 regarding the International Business Machines Corporation (IBM) East Fishkill facility's proposal entitled, "Project XL Proposal - IBM East Fishkill Facility F006 Sludge Recycling Project." In that correspondence you provided IBM with the guidance it requested with regard to the development of a strategy for identifying and convening a stakeholder group, as well as presenting a number of technical comments/questions regarding the proposal based on discussions with representatives of EPA's Office of Solid Waste and Office of Reinvention in Washington, D.C.

We will address the items in your correspondence in the order presented.

Stakeholder Outreach Options

As part of advancing the IBM - East Fishkill Project XL Proposal, we intend to develop a Stakeholder Outreach Plan (SOP). The SOP will be consistent with the spirit of the Agency's Stakeholder Involvement Guidance Document, as well as the guidance offered in your October 25, 1999 correspondence. That correspondence included specific examples of acceptable, previously approved SOPs, including an SOP developed in support of the IBM Burlington facility XL Project.

Included as Exhibit A is a draft outline of the Stakeholder Outreach Plan that we are proposing to utilize as a "blueprint" for implementing Stakeholder and Commentator involvement in the IBM-East Fishkill Project XL Proposal process.

Responses to Technical Comments

Comment 1

"Based on discussions with representatives of EPA's, Office of Solid Waste (OSW) and Office of Reinvention in our Washington, D.C. headquarters, there is additional information required regarding the comparison of your F006 sludge and the material it is intended to replace. IBM needs to identify the material that the sludge will replace and the ratio with which it will be replaced. For example, will the sludge replace limestone or the typical raw mix and will the replacement be in equal quantities (i.e., every pound of sludge used, reduces need for limestone by the same amount)."

Response to Comment 1

The purpose of this project has never been to "replace" the aggregate typically utilized in the manufacture of Portland Cement with F006 sludge. The reason for this is twofold. First the IBM East Fishkill sludge is primarily lime which makes it similar in composition to many of the naturally occurring substances such as chalk, clay, limestone, shale and marl that are part of a typical "raw mix" at a cement kiln. Second, IBM does not generate sufficient quantities of the F006 sludge to allow it to be used as an entire replacement for any individual component of the raw mix.

As we have stated on pages 3-1 and 3-3 of our most recent proposal, based on our past experience in actually recycling F006 sludge at the Independent Cement Company between 1989 and 1991, as well as in pilot scale studies completed prior to that recycling program, we believe a resulting mixture of approximately 200:1; that is, 200 parts typical raw mix to approximately one part F006 sludge, was the usual mixture considering the feed rate requirements of the kiln and the amount of IBM sludge available at any given time. This ratio, of course, could vary depending upon the composition of the raw mix and the type of cement being manufactured.

Comment 2

"Furthermore, while Table 10 (page 2-21) of the proposal package was revised to include a column with data for the sludge, it still lacks all the necessary information to confirm the similarities between the sludge and the material it will replace. The row labeled as "Loss On Ignition" represents a substantial percentage of most of the materials but is not further defined or identified.

Response to Comment 2

The "loss on ignition" category constitutes a major portion of the raw material which is fed into the kiln and generally comprises all of the constituents contained in the raw materials which is not one of the five chief components critical to the production of cement (i.e., silicon dioxide, aluminum oxide, ferric oxide, calcium oxide and magnesium oxide). In addition, gaseous products liberated as a result of the reactions occurring within the kiln also constitutes a significant portion of this material. The material within this category includes the following:

Water Water is primarily associated with moisture naturally occurring within the raw material. Upon entering the kiln, the water is converted to a gas (evaporated) and exhausted through the stack. This water also includes any water contained interstitially within a molecule, due to the hygroscopic properties of the material, which evolves from the material during heating. Since water is not one of the five chief components critical to the production of cement, the quantity of water as moisture or in hydrate form in the raw material is grouped in the category of "loss on ignition."

Combustion of Organics This refers to the organic material contained within the raw material which is completely or incompletely combusted within the kiln. Due to the high temperatures within the kiln, the abundance of activation energy and the long residence time of the product gases within the kiln, it is assumed that most organic material will be completely combusted. The products of complete combustion of organic materials are primarily carbon dioxide and water. These compounds are generated in the gaseous phase and exit the kiln through the stack. In this respect, any organic material within the raw material actually acts as a supplemental fuel for the flame since it is completely destroyed yielding usable heat. It is important to note that this group does not include the fuel supplied directly to the flame since this fuel is not a part of the raw material. Since organic material is also not one of the five chief components critical to the production of cement, the quantity of carbon dioxide and water generated during the combustion of organic material in the raw material is grouped in the category of "loss on ignition."

Calcination Products Although defined specifically as the decomposition of calcium carbonate, calcination can be generalized to refer to the release of carbon dioxide from specific compounds during heating. When a carbonate compound (carbonate ion: CO_3^{+2}) is heated to high temperatures, carbon dioxide (CO_2) is driven from the molecule yielding an oxidized compound (O^{+2}). For example, in the case of calcium carbonate (limestone: $CaCO_3$), carbon dioxide evolves on heating yielding calcium oxide (lime: CaO). This reaction also occurs when magnesium carbonate ($MgCO_3$) yields carbon dioxide on heating to become magnesium oxide (MgO). Since

carbon dioxide is not one of the five chief components, the quantity of carbon dioxide in carbonate form in the raw material is grouped in the category of "loss on ignition."

Gas Products In addition to calcination, other gas-generating reactions can occur within the kiln. For example, oxygen, sulfur dioxide or sulfur trioxide are generated when raw materials that contain sulfate or phosphate compounds are heated to a high temperature. Upon generation, these gases may undergo further reaction within the kiln due to the heat and activation energy present or be conveyed to the appropriate air pollution control equipment. Since these gases are not one of the five chief components critical to the production of cement, they are grouped in the category of "loss on ignition".

Low volatility materials Some compounds, due to their low volatility, will vaporize in the kiln and then be either emitted through the stack or oxidized due to the heat and activation energy present. Since these materials are not one of the five chief components, the quantity of these materials in the raw material is grouped in the category of "loss on ignition."

It is important to note that due to the extremely high temperatures and an abundance of activation energy within the kiln, conditions are ideal for various types of chemical reactions to occur. Therefore, many of the gases evolving from the groups listed above will further react to create generally inert products such as carbon dioxide, water, and other oxidized species. This is especially true of most organic compounds which will completely combust within the kiln and not be emitted through the stack.

The "loss on ignition" category is calculated by summing the weight of all components in the raw material that are not one of the five chief components critical to the manufacture of cement as well as those compounds which must be liberated from the compounds within the raw materials to yield any of the five chief components. To illustrate this concept, we offer the following example. If 10,000 kilograms of pure calcium carbonate (limestone) constitute one of the raw materials, this would be represented by approximately 5,602.96 kilograms of calcium oxide (lime) and approximately 4,397.04 kilograms of "loss on ignition" (which represents the carbon dioxide lost during heating within the kiln). In other words, instead of noting this raw material as containing 100 percent calcium carbonate, it is noted as containing approximately 56 percent calcium oxide and approximately 44 percent "loss on ignition."

In terms of the data presented in Table 10 in the Project XL Proposal, the quantity of material listed under "loss on ignition" for the IBM sludge refers specifically to the following:

- The one mole of water released for every mole of calcium hydroxide heated resulting in the formation of one mole of calcium oxide.

- The one mole of oxygen gas released for every two moles of sulfate ion reacted resulting in the formation of two moles of sulfur trioxide.

- The three moles of oxygen gas released for every four moles of phosphate ion reacted resulting in the formation of two moles of phosphorus pentoxide (P_2O_5).

- The one mole of carbon dioxide and one mole of water produced during the combustion of one mole of miscellaneous hydrocarbon (denoted CH_2^{+2}).

We hope that this explanation clarifies the information presented in Table 10 and explains why it is necessary to group compounds in this manner.

Comment 3

"A side by side comparison of a total constituent analysis of the sludge and the material it is intended to replace will be required in order to gain approval for the proposed project. At a minimum, the analyses for each material should include the constituents found in Tables 10 and 11, as well as any Appendix VIII constituents identified in Table 5."

Response to Comment 3

In attempting to provide a response to this question we are assuming that EPA requires such a comparison for one of the following three reasons:

- To determine the chemical suitability of the material as a replacement for one of the raw materials. Specifically, does the IBM sludge contribute the same necessary components in the same proportions as the raw material it is intended to replace?

- To determine whether the IBM sludge contains hazardous constituents in excess of the concentrations of those constituents present in the raw material it is intended to replace. Specifically, does the IBM sludge contain the same general types and quantities of hazardous constituents as the raw material it is intended to replace?

- To determine if there is an increase in the number and/or concentrations of hazardous constituents in the final cement product or any waste stream generated during the production of cement due to the inclusion of the IBM sludge.

In regard to the first bullet, IBM sludge will not directly replace one of the raw materials on a ratio basis. Since the IBM sludge contains or will produce all five chief constituents critical to the manufacture of cement, as do the other raw materials, the IBM sludge will itself become a raw material. When the cement mill receives a load of IBM sludge or any other raw material, the material will be analyzed by the cement mill to determine the concentrations of the chief components within the raw material or those components which will yield chief components upon reaction within the kiln. Once this composition is known for each load of raw materials, the mill will input the concentrations into an iterating computer program which will determine the quantity of each raw material to be added to the kiln in order for the chief components to be in the correct proportions for the generation of cement. Since the composition of the raw materials must be known in order to determine how much of each to add, it is not practical for the IBM sludge to directly replace any of the other raw materials since the composition may not be exactly the same. Rather, the IBM sludge itself will become a raw material of known composition.

It is also important to understand that the quantity of IBM sludge which is available to be utilized as a raw material in the manufacture of cement at a typical kiln is far less than the quantity of any other naturally occurring material. Cement mills typically produce approximately 1,000 metric tons of cement per day. In order to meet this production, enormous amounts of raw materials are required on a daily basis (roughly 100 tons per hour). IBM produces approximately 800 metric tons of sludge *per year*. This amount is far less than the amount of the raw materials which are required each day. Therefore, since such a small quantity of sludge is produced by IBM each year and since the sludge would be combined with as many as ten other raw materials in order to achieve the correct mix, the IBM sludge would be fairly well commingled and the contribution of "loss on ignition" components or any metals would likely be virtually negligible. In other words, the inclusion of the IBM sludge as a raw material in the production of cement would not produce any significant changes in the composition of the final product or any waste stream.

In regard to the second bullet, we understand that EPA has undertaken a sampling program of raw material utilized in the manufacture of cement at a number of different kilns. The purpose of this program is to determine the types and concentrations of hazardous constituents typically contained in the raw materials utilized to manufacture cement. Once this sampling and analytical program has been completed and the analytical data provided to IBM, a detailed comparison of the IBM sludge to the raw materials will be conducted by IBM in support of this project.

With regard to the third bullet as far as any hazardous constituents which are contained in the IBM sludge are concerned, the kiln chemically destroys, entrains or fixates any components other than the chief components. The organic components are combusted yielding carbon dioxide and water, the volatile metals are entrained in the cement kiln dust (CKD) and the refractory metals are interstitially bound with the crystalline structure of the cement.

The hazardous constituents, if present, which are organic in nature, are combusted within the kiln yielding carbon dioxide, water and heat. For this reason, cement mills have intentionally added organic waste such as used motor oil, solvents, chemical byproducts and tires directly to the raw materials for use as fuel. These compounds are completely combusted to carbon dioxide and water. The waste gases pass through the kiln and are exhausted at the inlet side. Since a large proportion of the raw material is powdered limestone, a natural filter, the gases are "scrubbed" by the raw materials prior to entering the stack. Any remaining components are handled by the cement mill's pollution control equipment. For this reason, nearly 100 percent of the gases exhausted through the stack are common to the environment: carbon dioxide, nitrogen and water vapor.

The volatile metals are vaporized in the kiln and enter the gas stream where they condense on cement kiln dust (CKD) particulate and are collected by dust control equipment such as an electrostatic precipitator and baghouse. These types of pollution control technologies typically achieve a 99.8 percent removal efficiency. The majority of the collected CKD is returned to the kiln as a part of the raw feed. The remainder is properly managed for disposal or sold for uses such as liming or stabilizing agents.

The refractory metals become a part of the molten clinker and are interstitially bound within the crystalline structure of the cement itself. Eventually, these metals will become part of the concrete produced from the cement.

It is important to note that metals are typically present in cement kiln dust and the cement itself without the addition of the IBM sludge. A report prepared by the Portland Cement Association (PCA) entitled, "An Analysis of Selected Trace Metals in Cement and Kiln Dust," presents analytical results for metal analyses performed on cement and CKD and summarizes the average concentrations of metals present in each. Laboratory analyses performed utilizing the Toxicity Characteristic Leaching Procedure (TCLP) show that the these materials are not considered hazardous. Therefore, the total concentrations of these metals which are present in the cement or CKD do not readily leach from their product. Taking a specific example from the PCA report, chromium was detected at average concentrations of 76 mg/kg in cement and 41 mg/kg in CKD. However, chromium was detected by TCLP at average concentrations of 0.54 mg/L in cement

and 0.10 mg/L in CKD. As can be seen, it should be no surprise that the "20-times rule" is not applicable in this scenario. This is to be expected since the metals are not simply mixed in the cement and CKD, as is the case with soil, but are bound to or into the crystalline structure of the cement or CKD.

Based on information supplied in the PCA report," a typical cement mill requires 100 tons/hr of raw materials and generates 60 tons/hr of clinker (cement) and 5 tons/hr of cement kiln dust (CKD).

Utilizing these feed and production rates one can calculate the percentage of metals in the raw materials based on the concentrations detected in cement and CKD. The following table presents the calculated concentrations as compared to the concentrations of metals detected in the IBM sludge.

Constituents	Actual Concentration in Cement (mg/kg) from PCA Report	Actual Concentration in CKD (mg/kg) from PCA Report	Calculated Concentration in Raw Material (mg/kg)	Actual Concentration in IBM Sludge (mg/kg)
Arsenic	19	18	12.3	2.2
Cadmium	0.34	10.3	0.719	0.77
Chromium	76	41	47.65	20
Lead	12	434	28.9	16.8
Mercury	0.014	0.66	0.04140	Undetected
Silver	9.2	10.53	6.0465	1.4

As shown in the above table, the actual concentration of metals detected in the IBM sludge is at or below the calculated concentration of metals in the raw material input into the cement kiln.

Cement, which is an extremely fine gray powder, is utilized primarily in the production of concrete. As mentioned above, in the production of concrete, cement is mixed with water, air, sand and gravel or stone in the amounts of 11 percent cement, 16 percent water, 6 percent air, 26 percent sand and 41 percent gravel or crushed stone. Therefore, in the production of concrete, the cement and any impurities within the cement are further commingled by a ratio of 1:9 cement to other concrete raw materials.

We hope that the information provided above addresses EPA's request for additional information.

Please contact me at (914) 892-1629 if you have any questions or require further information.

Sincerely,

INTERNATIONAL BUSINESS MACHINES CORPORATION

Salvatore J. Tranchina

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Manager, Environmental/Chemical
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EXHIBIT A

OUTLINE FOR STAKEHOLDER OUTREACH PLAN

INTERNATIONAL BUSINESS MACHINES CORPORATION
EAST FISHKILL FACILITY

Outline for Stakeholder Outreach Plan

1.0 INTRODUCTION

2.0 INITIAL NOTIFICATION AND OUTREACH PROGRAM

2.1 Project Fact Sheet
2.2 Identification of Contacts
2.3 Announcement in Local Newspaper
2.4 Mailing to Local Town Officials
2.5 Internal Announcements

3.0 NOTIFICATION FOLLOW-UP

3.1 Identification of Stakeholders as Direct Participants, Commentors or Members of General Public
3.2 Informational Meetings and Facility Tour

4.0 PUBLIC PARTICIPATION GROUND RULES

4.1 Ground Rules on Authority of Direct Participants with Respect to the Project Sponsors
4.2 Ground Rules for Communicating to Commentors and the General Public
4.3 Access to Information

5.0 STAKEHOLDER PARTICIPATION DURING NEGOTIATION OF FORMAL PROJECT AGREEMENT

6.0 STAKEHOLDER PARTICIPATION DURING PROJECT IMPLEMENTATION

Appendices

A Example Fact Sheet

B Proposed List of Stakeholder Contacts

C Example Agenda and Information Package for Stakeholder Meeting /Facility Tour