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April 17, 2008

FOR PLACEMENT IN THE ADMINISTRATIVE RECORD

Eve Stolov Vaudo, Esq.
U.S. EPA, Region 1
1 Congress Street, Suite 1100
Boston, MA 02114-2023

Re: Centredale Manor Restoration Project Superfund Site – Response to September 20, 2007 Exponent Memorandum Submitted by NECC Customer Group

Dear Eve:

As you know, Emhart Industries, Inc. ("Emhart") disputes U.S. EPA's assertion in the Interim-Final Remedial Investigation Report, dated June 30, 2005 ("RI Report"), that Metro-Atlantic, Inc.'s ("Metro-Atlantic") hexachlorophene ("HCP") manufacturing operation was a source of dioxin at the Centredale Manor Restoration Project Superfund Site ("site"). In support of its position, Emhart submitted the October 19, 2006 report of Dr. J. Ronald Hass, entitled "Evaluation and Opinions on the Conceptual Site Model Contained in U.S. EPA's Interim-Final Remedial Investigation Report and Human Health and Ecological Risk Assessment Reports" ("Hass Report"). The Hass Report analyzed and tested the conceptual site model ("CSM") presented in the RI Report regarding the source of dioxin. As you may recall, the CSM assumes that HCP was produced at the site by reacting materials such as 2,4,5-trichlorophenol ("TCP") and 2,4,5-trichloroaninsole, and that Metro-Atlantic's HCP manufacturing process generated dioxins, furans, and 1,2,4,5,7,8-hexachloro(9h)xanthene ("HCX") as byproducts, which were subsequently discharged into the Woonasquatucket River.[1]

The Hass Report demonstrated that the HCP manufacturing process employed at Metro-Atlantic, in fact, would not have generated HCX, dioxins or furans. Moreover, the Hass Report established that the CSM did not consider other potential sources of dioxins and furans at the site. The Hass Report evaluated information regarding the drum reconditioning business operated by New England Container Company ("NECC") at the site, and concluded that NECC's reconditioning process and the materials contained in drums sent to NECC for reconditioning were a more likely source of the dioxin/furan contamination reported at the site.

[1] The term "dioxin and furans" are interchanged with "polychlorinated dibenzo-*p*-dioxins (PCDDs) or polychlorinated dibenzofurans (PCDFs)."

In response to the Hass Report's findings, an ad hoc group of NECC customers retained the Exponent and Limno-Tech consulting firms to seek to refute the Hass Report. A series of written exchanges ensued in which the respective parties disputed each others' views regarding the source of the dioxin and polychlorinated biphenyl ("PCB") contamination reported at the site.[2] The enclosed sets of comments prepared by Dr. J. Ronald Hass regarding dioxin issues, and by AMEC Earth & Environmental, Inc. ("AMEC") regarding PCB issues, respond to the September 20, 2007 Exponent/Limno-Tech ("Exponent") Memorandum submitted by the NECC Customer Group to U.S. EPA.

In distilling the parties' exchange of views, the core of the remaining technical dispute regarding the dioxin contamination appears to be whether, as Emhart alleges, NECC's drum reconditioning operation or, as the NECC Customer Group alleges, the "loss" of TCP during Metro-Atlantic's HCP manufacturing process, was the more likely source of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin ("2,3,7,8-TCDD") reported at the site. On behalf of the NECC Customer Group, Exponent has stated that "[w]e do not dispute [Dr. Hass's] assertion that the [Metro-Atlantic] process *could not have formed 2,3,7,8-TCDD.*" April 4, 2007 Exponent Memo, at 3 (emphasis added). Moreover, Exponent does not dispute Dr. Hass's description of the HCP manufacturing process.[3] *See id.* Nor does Exponent contend that the HCP manufacturing process was the source of any polychlorinated dibenzo-*p*-dioxins ("PCDDs") or polychlorinated dibenzofurans ("PCDFs") other than 2,3,7,8-TCDD. *See* Sept. 20, 2007 Exponent Memo, at 3.

Rather, Exponent's theory is based on speculation that TCP containing significant amounts of 2,3,7,8-TCDD was released into the environment as part of the HCP manufacturing process.[4] Exponent claims that 12 to 21% of the TCP used in the HCP manufacturing process was "lost" during the purification stage. *See* Sept. 20, 2007 Exponent Memo, at 4. Exponent further assumes, without documentary or testimonial support, that the "lost" TCP necessarily contained 12 to 21% of the 2,3,7,8-TCDD allegedly present in the TCP solution that Metro-Atlantic received from Diamond Alkali. *See* April 4, 2007 Exponent Memo, at 5. Based on its unsupported assumptions, Exponent speculates that this "lost" TCP was disposed, possibly

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[2] Submissions to U.S. EPA for inclusion in the site Administrative Record were made by the NECC Customer Group in memoranda dated April 4, 2007 and September 20, 2007, and by Emhart in comments dated July 20, 2007.

[3] Initially, Exponent claimed that between 335,597 and 447,463 kg of TCP solution was used by Metro-Atlantic to manufacture HCP. *See* April 4, 2007 Exponent Memo, at 5. Following its review of Dr. Hass's comments of July 19, 2007, Exponent acknowledged that the best information available (Mr. Cleary's deposition testimony) indicates that Metro-Atlantic used, at most, 25,000 kg of TCP solution. *See* Sept. 20, 2007 Exponent Memo, at 6. Exponent does not explain how it so grossly overestimated the amount of TCP solution in its earlier report or how its significant miscalculation affects the validity of its other statements or the conclusions it has drawn concerning the Metro-Atlantic HCP manufacturing process.

[4] Exponent also claims, without citation to any record or sworn testimony, that Mr. Cleary has stated that "filter and carbon were washed with solvent," and that 2,3,7,8-TCDD *possibly* was transferred to the solvent, which, in turn, *possibly* was disposed on the site or in the River. *See* April 4, 2007 Exponent Memo, at 7; Sept. 20, 2007 Exponent Memo, at 8. Given that Exponent has repeatedly insisted that Mr. Cleary "did not have day-to-day knowledge of the process," *see* Sept. 20, 2007 Exponent Memo, at 6, 7, and has failed to provide a citation to any sworn testimony in support of its assertions, no weight should be accorded to Exponent's pure conjecture.

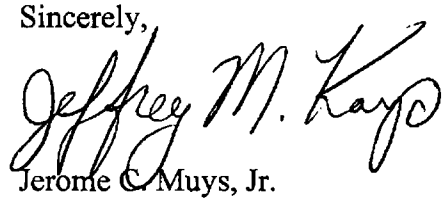
through "direct discharge to the river with the solids being entrained in the discharge" or disposed on site, "possibly involving the use of drums." *See* Sept. 20, 2007 Exponent Memo, at 4.

In addition to offering no credible evidence concerning the amount of 2,3,7,8-TCDD that it alleges may have been in the "lost" TCP, Exponent ignores testimony and other evidence that directly refutes its theory. For example, Vincent Buonanno, NECC's former president, testified that there were "no drums connected with" the HCP operation. Dep. of Vincent Buonanno, *Emhart Indus., Inc. v. Home Ins. Co.*, No. 02-053-S (D.R.I), Mar. 25, 2003, at 27. Moreover, Vincent Buonanno stated that he never saw any discharges to the Woonasquatucket River from the building in which HCP was manufactured. *See id.* at 61-62. In fact, such discharges could not have occurred. *See* Dep. of Joseph Buonanno, Jr., *Emhart Indus., Inc. v. Home Ins. Co.*, No. 02-053-S (D.R.I), Jan. 17, 2003, at 76 (stating that he was not aware of any plumbing system outlets from the HCP building to the river). Since Exponent has no factual support for its conjecture, its "lost" TCP theory should be disregarded.

Regarding the presence of PCBs at the site, Exponent seeks to summarily discount the CSM, in which EPA identified NECC and its customers as the source of the PCB contamination. *See* Sept. 20, 2007 Exponent Memo, at 16. However, Exponent has failed to specify any activity undertaken by Metro-Atlantic or others at the site that may provide a credible alternative source for the PCB contamination at the site.

Please include in the Administrative Record for the site this letter and the enclosed comments prepared on Emhart's behalf by Dr. Hass and AMEC in response to the Sept. 20, 2007 Exponent Memo. If you have any questions or would like to schedule a meeting to discuss the issues addressed in Emhart's enclosed comments, please do not hesitate to contact us.

Sincerely,



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Enclosures

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FOR INCLUSION IN THE ADMINISTRATIVE RECORD

Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Response to the September 20, 2007 Exponent/Limno-Tech External Memorandum Regarding EPA's Conceptual Site Model

J. Ronald Hass, Ph.D.
March 25, 2008

This document is in response to the External Memorandum from Exponent/Limno-Tech to the NECC Customer Group dated September 20, 2007 regarding EPA's Conceptual Site Model for the Centredale Manor Restoration Project Superfund Site ("Exponent Response").

Exponent/Limno-Tech ("Exponent") disputes the view expressed in my response to its prior memorandum[1] and in my earlier report concerning EPA's Conceptual Site Model,[2] that New England Container Corporation ("NECC"), by virtue of its reconditioning of drums containing hazardous substances, is a more likely source of the 2,3,7,8-tetrachlorodibenzo-*p*-dioxin ("2,3,7,8-TCDD") reported at the Centredale Manor Restoration Project ("CMRP") site than is Metro-Atlantic Chemical Co.'s ("MA") hexachlorophene ("HCP") manufacture. Exponent lists six points to support its position. This document addresses each of those points, which are restated prior to my responses thereto, and demonstrates their invalidity.

1. *MA is known to have brought 2,4,5-trichlorophenol (2,4,5-TCP) containing the 2,3,7,8-TCDD to the site for use in its HCP manufacturing process, which operated in or around 1965.*

   According to Mr. Thomas Cleary, approximately 25,000 kg of 2,4,5-trichlorophenol ("2,4,5-TCP") were brought to the CMRP site for use in MA's HCP manufacturing process.[3] HCP manufacture reportedly occurred at the CMRP site during 1965, a period approximating 5% of the duration of NECC's drum reconditioning activities on the site. Unbeknownst to MA, the 2,4,5-TCP may have contained between approximately 0.20 kg and 0.95 kg

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[1] Hass, J. R., *Response to the April 4, 2007 Exponent/Limno-Tech Extemal Memorandum Regarding EPA's Conceptual Site Model,* July 13, 2007.

[2] Hass, J. R., *Evaluation and Opinions on the Conceptual Site Model Contained in U. S. EPA's Remedial Investigation Report and Human Health and Ecological Risk Assessment Reports,* Oct. 19, 2007.

[3] Cleary, T., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.,* No. 02-053 S (D.R.I.) Feb. 10, 2003, Exhibit 15.

of 2,3,7,8-TCDD. As noted in my earlier response,[4] 25,000 kg constituted approximately 8% of Diamond Alkali's ("DA") 1965 2,4,5-TCP production, and may be a generous estimate of what Mr. Cleary described to be a transaction made possible by his personal relationship with DA personnel.[5] DA documents at the time indicate that the company did not ordinarily sell 2,4,5-TCP. Rather, their policy was to use their entire 2,4,5-TCP production to make 2,4,5-triclorophenoxyacetic acid ("2,4,5-T").[6]

2. *MA's HCP process was not 100% efficient with respect to the processing of 2,4,5-TCP and by association the 2,3,7,8-TCDD which it contained. It is known that some of the 2,4,5-TCP used by MA would have been lost in the initial purification stage.*

While Exponent's assumption that MA's processing of 2,4,5-TCP was less than 100% efficient may be plausible, I strongly disagree that 2,3,7,8-TCDD reported at the CMRP site would be associated with any 2,4,5-TCP "lost" in the MA HCP process. The reasons for my disagreement are clearly documented, based upon published literature and well known and accepted scientific principles, in my previous report.[7] Additionally, I am not aware of any evidence to suggest that 2,4,5-TCP was dumped anywhere on the CMRP site.

The building reportedly used for HCP manufacture was constructed after 1960.[8] MA was connected to the municipal sewerage system at the time.[9] There is no reason to believe the HCP building was not connected as well to the municipal sewerage system during its construction. Accordingly, any aqueous waste from the 2,4,5-TCP purification process would have been transported off site and not disposed on site, as Exponent suggests.

Using the most conservative assumptions, under Exponent's theory, the TCP lost in a single batch of HCP would have been adequate to raise the average TCP concentration in the entire Allendale Pond above the LC50 for blue gills

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[4] Hass, J. R., *Response to the April 4, 2007 Exponent/Limno-Tech External Memorandum Regarding EPA's Conceptual Site Model,* July 13, 2007, Page 3.

[5] Cleary, T., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.,* No. 02-053 S (D.R.I.) Feb. 10, 2003, Page 52, Lines 2-4.

[6] *Dioxin Registry Report. Report Prepared by Review Documents from Diamond Shamrock Corporation, Diamond Alkali Company, Newark, New Jersey, Report No. 117.16.* Division of Surveillance, Hazard Evaluations and Field Studies, National Institute for Occupational Safety and Health, Centers for Disease Control, Cincinnati, Ohio, June 1986, Page 13.

[7] Hass, J. R., *Response to the April 4, 2007 Exponent/Limno-Tech External Memorandum Regarding EPA's Conceptual Site Model,* July 13, 2007, Page 2.

[8] Cleary, T., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.,* No. 02-053 S (D.R.I.) Feb. 10, 2003, Exhibit 11.

[9] Sarracino, G., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.,* No. 02-053 S (D.R.I.), Feb. 27, 2003, Page 8, Lines 9-18; Page 60, Lines 2-16.

and trout,[10] which would have resulted in a significant fish kill. However, I am not aware of recurring fish kill reports during the period of MA HCP manufacture. In short, Exponent's speculation that MA dumped large quantities of 2,4,5-TCP is completely unfounded, and contrary to the available facts.

3. *Material and waste handling procedures in the 1960s were largely unregulated, and there is testimonial evidence that MA used an on-site dump for waste disposal and also discharged wastewaters to the Woonasquatucket River.*

This point is inapplicable to the MA HCP process and hence the source of 2,3,7,8-TCDD. The testimonial evidence that MA disposed of waste materials in an on-site dump relates to the 1950's and early 1960's.[11] There is clear, undisputed testimony that by the time HCP manufacture occurred at the site, MA was disposing solid waste off-site.[12,13] As noted above, there is no reason to believe the newly-constructed facility for HCP manufacture was not connected to the city sewerage system. The testimony Exponent refers to about discharges into drains relates to the older buildings that had nothing to do with 2,4,5-TCP purification or HCP manufacturing.[14]

4. *Forensic analysis of site data shows that the 2,3,7,8-TCDD found in sediments at the site is consistent with past use of 2,4,5-TCP; 2,3,7,8-TCDD is poorly correlated with all other dioxin and furan congeners, but correlates with detected concentrations of 2,4,5-TCP.*

This point is both irrelevant and incorrect. The "forensic analysis" mentioned by Exponent does not address the question of whether the reported 2,3,7,8-TCDD contamination could have originated with NECC drum reconditioning activities for its customers known or reasonably expected to be using 2,4,5-TCP and/or other likely combustion precursors to 2,3,7,8-TCDD.

Furthermore, Exponent makes assertions about the lack of correlation between 2,3,7,8-TCDD and other congeners without providing sufficient detail

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[10] ECOTOX Database (http://cfpub.epa.gov/ecotox/)

[11] Nadeau, R., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.), Dec. 17, 2002,Page 16, Lines 5-16; Page 41, Line 18-Page 43, Line 4.

[12] *See, e.g.,* Turcone, J., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.), Dec. 16, 2002, Page 9, Lines 4-12; Page 11, Line 21-Page 12, Line 9; Page 14, Line 8-Page 15, Line 10; Page 43, Line 9-Page 45, Line 9; Turcone, J., Administrative Deposition Transcript, *In the Matter of Centredale Manor Superfund Site, North Providence, Rhode Island* (U.S. EPA Region 1), Nov. 30, 1999, Page 13, Line 24-Page 15, Line 24.

[13] Nadeau, J., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.), Dec. 17, 2002, Page 43, Line 8-Page 44, Line 2; Page 52, Line 11-Page 53, Line 19; Page 54, Line 9-Page 55, Line 7.

[14] Nadeau, J., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.), Dec. 17, 2002, Page 35, Line 16-Page 36, Line 2.

to evaluate any basis for their statements. As is discussed in more detail in Attachment I, proper statistical analysis of the available valid Source Area data reveals a strong correlation between 2,3,7,8-TCDD and each of the other PCDD congeners, suggesting a common source for the entire PCDD set, which is not MA's HCP manufacturing process.

Because there are no samples with valid data for both 2,3,7,8-TCDD and 2,4,5-TCP, valid statistical analysis cannot be performed. Using invalid data to investigate quantitative relationships between sample constituents is inappropriate because it adds an unquantifiable degree of uncertainty to the analysis. This point is discussed in more detail in Attachment II.

5. *Sampling results show high concentrations of 2,3,7,8-TCDD and 2,4,5-TCP in soils near the location of MA's former HCP manufacturing building in contrast to other parts of the site. High 2,3,7,8-TCDD concentrations are also seen at the area on the southern tip of the site, where it has been reported that MA trucked its wastes. Groundwater in the well near the former MA HCP manufacturing building also shows high 2,3,7,8-TCDD concentrations, whereas the groundwater sampled from monitoring wells in other areas of the site does not.*

The sampling results demonstrate that there is nothing unique about the CMS-451 or CM-SO-MW-05 locations. There are 75 other samples in which the 2,4,5-TCP detection limit is above the highest valid result for 2,4,5-TCP reported at these locations. There are 18 samples in which the 2,4,5-TCP detection limit is greater than the maximum possible concentration at these two locations.

High concentrations of other chemicals present are the cause of the high 2,4,5-TCP detection limits in many cases. In some cases, the high concentration chemicals were reported to have been handled by NECC's customers. An explanation consistent with the complete data set is that the CMS-451 and CM-SO-MW-05 locations contain more NECC waste from 2,4,5-TCP-contaminated drums than the waste from drums contaminated with other NECC customers' chemicals found at the other site locations. This point is discussed further in Attachment III, and examples are provided.

There is substantial testimony that NECC dumped the contents of its ash pit on the southern tip of the site.[15] This ash is the likely repository for much of the 2,3,7,8-TCDD originating from 2,4,5-TCP combustion by NECC. Little or no 2,4,5-TCP should remain after combustion in NECC's drum reconditioning process, explaining the absence of 2,4,5-TCP in these locations.

6. *Sampling results indicated that detected 2,4,5-TCP and 2,3,7,8-TCDD concentrations correlate with each other in similar fashion to samples of*

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[15] Nadeau, R., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.,* No. 02-053 S (D.R.I.), Dec. 17, 2002, Page 11, Line 23-Page 12, Line 13.

Passaic River sediments (where MA's provider of the raw material 2,4,5-TCP operated and discharged the same two contaminants.)

Exponent's comparison of the Passaic River to the CMRP Source Area soil is not a valid comparison. The river system and the CMRP Source Area soil are not subject to valid comparison because of their vastly different current and historic inputs of chemicals. Further, the data used by Exponent to make the comparisons between these systems are not consistent. The data from the CMRP site, the quality of the data not withstanding, are primarily from soil borings, whereas the data from the Passaic River are apparently from river sediments. This is an "apples to oranges" comparison and thus invalid. Finally, as noted above, there are no valid data to examine whether any relationship exists between 2,4,5-TCP and 2,3,7,8-TCDD at the CMRP site.

Exponent misquotes my report and the available evidence to advance positions that do not address the points presented.

1. *Exponent Position 1:* Exponent states that Mr. Cleary's testimony indicates that between 12% and 21% of the 2,4,5-TCP is not recovered during the 2,4,5-TCP purification process ("ZEP" process). They incorrectly imply that a similar fraction of 2,3,7,8-TCDD would be associated with this "lost" 2,4,5-TCP, and thus entered the environment.

   a. I did not assert that no 2,4,5-TCP was lost during the ZEP process. Rather, I pointed out that, contrary to the CMRP Remedial Investigation ("RI") Conceptual Site Model ("CSM"), there is no evidence of a large quantity of 2,4,5-TCP being dumped into a river over a brief period of time during one of its lowest flow periods. This lack of evidence (historical and current) is a serious flaw in the CSM.

   b. Any "lost" 2,4,5-TCP would be in solution and hence incapable of entraining[16] anything. The waste stream to which Exponent refers was a solution with the solids (and anything sorbed to the solids) removed by centrifugation, as they acknowledge. Exponent seems to agree that there would not be significant 2,3,7,8-TCDD in the post-centrifugation solution. There are no suspended solids. Therefore, there is no "lost" 2,3,7,8-TCDD for which to account.

   c. The recovery specification is for the entire ZEP process. The recovery during the initial re-crystallization step is neither specified nor discussed in Mr. Cleary's testimony.

   d. Any 2,3,7,8-TCDD would be strongly adsorbed to the solid 2,4,5-TCP retained during the initial re-crystallization and each of the following steps.

[16] Entrain: Chemistry. To carry (suspended particles, for example) along in a current. www.answers.com/topic/entrain. Downloaded Oct. 26, 2007. Since all particles were removed in the centrifugation step, there can be no entrainment of anything in the waste stream from the initial re-crystallization in the ZEP process.

My research has not revealed any data regarding the amount, if any, of 2,3,7,8-TCDD that actually would be associated with "lost" 2,4,5-TCP (e.g., that 2,4,5-TCP which remains in solution during the re-crystallization). The best models available suggest the concentration would be more than 100 million-fold below that in the original feedstock, or in the range of parts per trillion to parts per quadrillion in the effluent,[17] which likely would have been discharged to the sanitary sewer.

e. In summary:

   i. The maximum possible discharge of 2,3,7,8-TCDD by MA through this route would not add a measurable amount to the "background" levels in the above-listed locations.

   ii. Any 2,3,7,8-TCDD associated with any solid waste would have been strongly bound to activated carbon. Solid HCP process waste disposal would have resulted in the presence of activated carbon in the field samples. This activated carbon would have caused low internal standard recoveries that were not observed. This observation confirms the testimony that solid waste was being removed from the site during the period of MA HCP manufacture.

   iii. All other material related to the HCP process was likely recycled or shipped off-site.

   iv. Therefore, the 2,3,7,8-TCDD reported at the CMRP site is not a consequence of waste disposal associated with the MA HCP manufacturing process.

   v. The CMRP CSM must be incorrect.

2. Exponent Position 2: MA possibly recycled the activated carbon, washing it between uses, and discharged the waste wash solvent.

   a. We have not been provided a transcript of the phone call that Exponent asserts was held with Mr. Cleary, nor were we able to ask questions to clarify any statements made during the alleged call.

   b. There is no evidence to suggest recycling of filter materials by MA on any occasion. To recycle a relatively cheap and readily available material (10 pounds of Nuchar/batch HCP) at the risk of wasting an expensive and scarce feedstock (1,000 pounds of 2,4,5-TCP/batch HCP)[18] defies any

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[17] Hass, J. R., *Evaluation and Opinions on the Conceptual Site Model Contained in U. S. EPA's Remedial Investigation Report and Human Health and Ecological Risk Assessment Reports*, Oct. 19, 2007, Pages 6-7.

[18] Cleary, T., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.) Feb. 10, 2003, Exhibit 8.

business logic or simple common sense. It is also contradicted by Mr. Cleary's emphatic testimony regarding the great importance of starting with very pure 2,4,5-TCP in order to obtain a HCP product that would be accepted by the client.[19] In fact, Exponent quite clearly states that Mr. Cleary "*did not have any direct knowledge of day-to-day practices*," calling into question any statements made regarding the use and recovery or disposal of filter material and/or activated charcoal.

c. The conditions necessary to remove 2,3,7,8-TCDD from activated charcoal were not used by MA in any documented process and, in fact, were unknown at the time.[20]

d. Treating the activated charcoal with sufficient rigor to remove 2,3,7,8-TCDD would be far more expensive than merely replacing it with fresh material.

e. Therefore, even if the charcoal were recycled, no significant amount of 2,3,7,8-TCDD would be removed in any plausible process used by MA.

3. Exponent Position 3: Only toxic congeners are important in establishing the source of chemical contamination. Exponent continues to confuse a forensics study with a risk assessment.

a. The fact that only one chemical can be the most active one present does not lessen the importance of the presence or absence of other chemicals in identifying the likely source of the most active chemical:

b. My report addresses the question of whether MA is the likely source of certain chemicals at the CMRP site.

c. My report does not and is not intended to address the issue of whether any of these chemicals are hazardous, toxic or could potentially cause a human or environmental health risk.

d. My report does not and is not intended to address the issue of whether any of these chemicals are "driving" the CMRP site remediation.

e. The CSM (and hence, neither Exponent nor I) claims that MA is the likely source of PCDD/PCDF contamination reported at the site. It appears that Exponent agrees that MA is not the likely source of all the PCDD/PCDF contamination reported at the CMRP site. If the CSM authors withdraw the claim that MA is the source of all PCDD/PCDF, then my objection

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[19] Cleary, T., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.,* No. 02-053 S (D.R.I.) Feb. 10, 2003, Page 22, Lines 7-14.

[20] Cutie, S. S., *Recovery Efficiency of 2,3,7,8-Tetrachlorodibenzo-p-dioxin from Active Carbon and Other Particulates,* Analytica Chimica Acta, **1981** *123*, 25-31.

becomes unnecessary and will be withdrawn. Until that occurs, my objection stands.

f. At most, the MA HCP process can explain only one of the congeners observed at the CMRP site. Each and every other congener present refutes the CSM, as quoted in my initial review of the CMRP RI. This flaw in the CSM is not related to whether these compounds are toxic. Rather, it is related to their presence at the CMRP site. A valid CSM will address all the data. Until a properly developed CSM appears, I will continue to respond to the present one.

g. My reports do address the chemical impossibility of MA being the source of the 2,3,7,8-TCDD and/or octachlorodibenzo-*p*-dioxin ("OCDD"), which is present in higher concentration than the 2,3,7,8-TCDD reported on the CMRP site. My reports also explain that a scientifically logical basis exits for NECC to be the source of both of these chemicals. These scientific points remain unrefuted. As discussed in Attachment I, the correlation between 2,3,7,8-TCDD and all the other Source Area PCDD congeners for which data are available supports a common origin, which cannot be the MA HCP process. It is scientifically invalid to ignore a hypothesis that explains a larger fraction of the data than the hypothesis that is being advocated. The hypothesis that NECC combustion is the source of the PCDD/PCDF explains all of the PCDD/PCDF and 2,4,5-TCP results. The hypothesis that MA is the source of the PCDD/PCDF is incorrect, as I think we all agree. The hypothesis that MA is the source of just the 2,3,7,8-TCDD does not explain the remainder of the data, and is contradicted by well-established chemistry and its correlation with the other PCDD congeners.

h. Exponent minimizes the importance of explaining the OCDD levels reported at the CMRP site. The formation of OCDD from pentachlorophenol ("PCP") combustion occurs with lower yield than 2,3,7,8-TCDD from 2,4,5-TCP.[21] Since the levels of OCDD exceed those of 2,3,7,8-TCDD, it is likely that larger quantities of PCP were combusted than 2,4,5-TCP. There is no record of PCP use by MA. However, there is a record of PCP use by NECC customers, just as there is a record of NECC customer use of 2,4,5-TCP.[22] The more plausible explanation of the OCDD reported at the CMRP site is the NECC drum reconditioning operation. There is no reason to assume that NECC customers with both PCP- and 2,4,5-TCP-contaminated drums sent the former, but not the latter, to NECC for reconditioning.

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[21] Hashimoto, Shunji, Tanaka, Yuichiro, Ikuta, Satoshi, Miyazaki, Toru, All Congener Analysis of PCDD/Fs and PCBs on Pyrolysis of CNP and PCP, Kanyo Kagaku, **2005** *15(4)*, 813-34.

[22] Baker, R. T., *New England Container Company, Inc.: Supplemental Response to CERCLA § 104(e) Information Requests, Centredale Manor Restoration Site,* Aug. 22, 2002.

i. The combustion yield of PCDD/PCDF from materials such as 2,4,5-T[23,24] and non-precursor chlorinated materials, such as polyvinyl chloride ("PVC"), is approximately 4 to 6 orders of magnitude lower than the 2,3,7,8-TCDD yield from 2,4,5-TCP combustion/pyrolysis.[25] This means that even though the "combustion fingerprint" products are somewhat lower in concentration than the 2,3,7,8-TCDD from 2,4,5-TCP combustion, much larger quantities of the former were burned, consistent with NECC being the source of all PCDD/PCDF.

j. There is no reason to expect a spatial or temporal correlation between the PCDD/PCDF formed from combustion of non-precursor compounds (PVC, for example) and 2,3,7,8-TCDD formed from the combustion of 2,4,5-TCP and/or PCDD formed from the combustion of PCP. The relative amounts will vary, depending upon changes in the ratio of the "raw materials" arriving at the site in NECC customers' drums.

4. Exponent Position 4: MA is the only conceivable source of 2,4,5-TCP at the CMRP site. Exponent continues to imply that forensic evidence linking 2,3,7,8-TCDD to 2,4,5-TCP establishes MA HCP manufacture to be its source.

   a. The forensic evidence does not distinguish between MA and NECC as the source of the 2,3,7,8-TCDD or the implied 2,4,5-TCP.

   b. An understanding of their respective processes eliminates MA, but not NECC, as the 2,3,7,8-TCDD source.

5. Exponent Position 5: Burning or pyrolysing 2,4,5-TCP results in the observation of penta- and hexachlorodibenzo-*p*-dioxins whose concentrations should correlate with the 2,3,7,8-TCDD.

   a. Exponent does not cite any reference that supports their assertion that 2,4,5-TCP combustion and/or pyrolysis will lead to substantial amounts of PCDD congeners other than 2,3,7,8-TCDD. This position is contradicted by all literature of which I am aware, including the references cited in the Exponent Response. This point is discussed in more detail in Attachment IV.

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[23] Stehl, R. H. and Lamparski, L. L., *Combustion of Several 2,4,5-Trichlorophenoxy Compounds: Formation of 2,3,7,8-Tetrachlorodibenzo-p-dioxin,* Science, **1971** *197*, 1008-09.

[24] Katami, T., Yasuhara, A., Toshikazu, O., and Takayuki, S., *Formation of PCDDs. PCDFs and Coplanar PCBs from Polyvinyl Chloride during Combustion in an Incinerator*, Environ. Sci. Technol., **2002** *36*, 1320-24.

[25] Lahaniatis, E. S., Clausen, E., Bieniek, D, and Korte, F., *Bildung von 2,3,7,8-TCDD bei der Thermolyse von Ausgewaehlten Chlorierten Organischen Verbindungen,* Chemosphere, **1985** *14(2),* 233-38.

b. As noted above, correlations between 2,3,7,8-TCDD and the other PCDDs exist, contrary to Exponent's assertion.

c. Combustion of PCP and/or OCDD will lead to penta, hexa, and hepta congeners, as well as some 2,3,7,8-TCDD. That is, PCP leads to combustion products that include those postulated by Exponent as originating from 2,4,5-TCP combustion. The presence of these compounds would confound any attempt to correlate penta and/or hexa CDD congeners with the combustion of 2,4,5-TCDD, even if, contrary to the published literature, such compounds were formed.

d. Only a very small fraction of the hundreds of thousands of drums, reconditioned by NECC must have contained 2,4,5-TCP in order to produce much larger quantities of 2,3,7,8-TCDD than the total amount of 2,4,5-TCP reportedly used in the HCP process.

    i. According to the available evidence, no more than 1 kg of 2,3,7,8-TCDD[3,6] was present in the 2,4,5-TCP reportedly used for HCP manufacture. The testimony concerning the residual material in NECC customers' drums ranges from "little" to as much as 1/4 full.[26,27,28,29] There is no testimony that any attempt was made to weigh the drums' residues. Rather, the estimates depend upon the operator's ability to gauge the weight manually, and do not take variation of drum tare weight into account. Assuming as little as 5 lbs. (2 kg) of residual 2,4,5-TCP in a drum, as few as 5 to 25 drums received by NECC at the site would yield more 2,3,7,8-TCDD than the total 2,4,5-TCP reportedly brought on site for HCP manufacture. If the residual were 1/2 pound, then 50 to 250 drums would be adequate to exceed the amount of 2,3,7,8-TCDD in the 2,4,5-TCP reportedly used in the HCP process.

    ii. There is no evidence that arrival of 2,4,5-TCP-contaminated drums at NECC was controlled or consistent.

        1. Therefore, 2,3,7,8-TCDD output could fluctuate over a wide range during the period of NECC's operation at the CMRP site.

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[26] Buonanno, V., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.), Mar. 25, 2003, Page 8, Line 20-Page 9, Line 1; Page 21, Line 6-Page 22, Line 12.

[27] Cifelli, J, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.), Feb. 13, 2003, Page 52, Line 23-Page 53, Line 14.

[28] Nadeau, J., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.), Dec. 17, 2002, Page 13, Line 2-Page 14, Line 7.

[29] Nadeau, R., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.), Dec. 17, 2002, Page 11, Lines 4-7.

iii. There is no evidence to suggest that arrival of PCP-contaminated drums at NECC was controlled or consistent.

1. Therefore, OCDD, HpCDD, HxCDD and PeCDD output could fluctuate over a wide range during the period of NECC's operation at the CMRP site.

iv. 2,3,7,8-TCDD would correlate with the other PCDD congeners only to the extent that arrival of 2,4,5-TCP- and PCP-contaminated drums correlate temporally.

v. Therefore, there is no reason to expect the correlation between 2,4,5-TCP and PCP combustion products to be as strong as the internal correlation of PCP combustion products. Any variability in the relative amounts of 2,4,5-TCP and PCP in NECC customers' drums would be reflected in the variability of the relative amounts of their respective combustion by-products. The PCP combustion by-products' relative concentrations would not have this source of variability. The result would be a stronger correlations for these compounds ([PeCDD], [HxCDD], [HpCDD] and [OCDD]) than would be observed for their correlation with [TCDD] originating with 2,4,5-TCP.

vi. Any correlation found between 2,3,7,8-TCDD and the higher chlorinated congeners would indicate a common and consistent source for the 2,4,5-TCP- and PCP-contaminated drums, as is shown in Attachment I.

6. Exponent Position 6: Organic solids and/or activated carbon are not effective at removing 2,3,7,8-TCDD from aqueous systems.

a. Exponent's assertion that I am ignoring the loss of 2,4,5-TCP during the ZEP process is incorrect. Elementary chemical equilibria, which have been explained in detail in my earlier report,[30] demonstrate that no significant amount of 2,3,7,8-TCDD could have been associated with any "lost" 2,4,5-TCP. The contamination of the site by 2,4,5-TCP is not alleged in the CMRP RI Report or my prior reports.

b. Exponent apparently misunderstands the purpose of my statement that any 2,3,7,8-TCDD that might have escaped the initial purification would have been shipped to Kalo Labs, and could not have entered the environment at the CMRP site. The purpose of this statement is that no amount of 2,3,7,8-TCDD that could have measurably increased the background levels reported at the site would have been released even if, as Exponent alleges, much more 2,3,7,8-TCDD escaped the initial

[30] Hass, J. R., *Evaluation and Opinions on the Conceptual Site Model Contained in U. S. EPA's Interim-Final Remedial Investigation Report and Human Health and Environmental Risk Assessment Reports*, Oct. 19, 2006, Pages 2-5.

purification step than the best theories available predict. Therefore, the MA HCP manufacturing process could not be the source of the 2,3,7,8-TCDD reported at the CMRP site.

c. I clearly explain in my report that the DA data cited by Exponent to show that carbon was not effective in removing 2,3,7,8-TCDD from 2,4,5-TCP are invalid.[31] No attempt is being made to use these invalid data to prove anything other than that they cannot be used to support the conclusion reached by Exponent.

d. Exponent seems to miss the practical difficulty of coating 0.14g of finely divided carbon onto the surface of 0.86 g of finely divided polyurethane foam ("PUF") as would be necessary if the claim in US Patent #4,102,816 were accurate. The patent presents no data to support the assertion that the carbon resides on the surface of the PUF (electron microscopic images, for example) instead of the other way around. In any case, the activated carbon has been diluted 6:1 with a much lower activity material. To claim the removal of 2,3,7,8-TCDD from this diluted material somehow refutes the published (and peer reviewed) work of a reputable scientist[20] is not reasonable or appropriate.

7. Exponent Position 7: Exponent assigns erroneous purposes to my statements.

a. I have been very clear in my purposes:

i. Review the CMRP CSM, as quoted in my first report on the subject.

ii. Based upon that review and other evidence in the record, identify portions of the RI Report that conflict with scientific principles and/or the available evidence.

iii. Based upon the above research, form an opinion as to whether the MA HCP manufacturing process could be the source of the 2,3,7,8-TCDD reported at the CMRP site.

b. In the course of my research, I came to the conclusion that the MA HCP process could not be the source of the 2,3,7,8-TCDD reported at the CMRP site, and that the combustion activities of NECC could explain the available facts. On this basis, I further concluded that the CSM was incomplete in that its authors did not conduct an adequate investigation of possible alternate sources of the 2,3,7,8-TCDD.

The original task was expanded to include the following additional purpose:

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[31] Hass, J. R., *Response to the April 4, 2007 Exponent/Limno-Tech External Memorandum Regarding EPA's Conceptual Site Model,* July 13, 2007, pages 4 – 5.

i. Demonstrate that not all plausible hypotheses for the 2,3,7,8-TCDD reported at the CMRP site have been considered in the CSM.

   1. I did this by pointing out that at least one more likely explanation than the CSM hypothesis exists.

   2. Proving, in a legal sense, that NECC is the source of the 2,3,7,8-TCDD has never been one of my purposes. This issue is raised simply to demonstrate that other plausible and scientifically more likely sources of the 2,3,7,8-TCDD should be investigated. There is no intent to limit the scope of further investigation to just NECC. As examples, the asphalt plant, cement plant, and railroad activities on the Johnston bank of the Woonasquatucket River merit more investigation than the casual inquiries I have found referenced in the RI Report.

   3. Proving, in a legal sense, that any particular NECC customer is a source of the 2,3,7,8-TCDD, OCDD, or any of the precursor compounds has never been one of my purposes. This issue is raised simply to demonstrate that plausible sources of 2,3,7,8-TCDD, OCDD and precursor chemicals exist for NECC to be the 2,3,7,8-TCDD source at the CMRP site.

Attachment I

TCDD – PCDD Correlations

Exponent seeks to build a case that the combustion of 2,4,5-TCP should result in the formation of pentachlorodibenzo-*p*-dioxin ("PeCDD") and hexachlorodibenzo-*p*-dioxin ("HxCDD") congeners. They cite papers describing the combustion of 2,4,5-trichlorophenoxyacetic acid ("2,4,5-T") esters as support of their assertions, as discussed in the main body of my response. In addition to being the wrong compound, these papers clearly refute the Exponent assertions, even for the case of 2,4,5-T.

Exponent apparently failed to consider the complexity of the chemical signatures from the NECC drum reconditioning operation. The testimony and NECC's responses to U.S. EPA's CERCLA Section 104(e) information requests are clear that drums arrived and were processed in batches from a variety of sources. Variations in the feedstock would have introduced an unknown variability to the combustion by-products from the drum reconditioning operation. An additional source of variability is the chemistry occurring in the NECC ash pit. For example, the yield of 2,3,7,8-TCDD from 2,4,5-TCP and/or OCDD from pentachlorophenol ("PCP") is enhanced by caustic conditions. Thus, even if the 2,4,5-TCP and/or PCP supply of contaminated drums were consistent, the amount of 2,3,7,8-TCDD and/or OCDD formed would vary depending on other materials contributing to the ash pit.

The CSM suggests that NECC is the likely source of the pesticide contamination found at the CMRP.[1,2] EPA has described PCP as one of the most widely used biocides prior to 1987.[3] Dioxin precursors in pesticide formulations, including PCP, have been found to be an important source of OCDD.[4] Thus, the reconditioning of pesticide contaminated drums adds to the variability of the PCDD formation by NECC.

PCP produces OCDD, among other products, when combusted. The thermal degradation products of OCDD include PeCDD, HxCDD and heptachlorodibenzo-*p*-dioxin ("HpCDD"). PCP includes the same polychlorodibenzo-*p*-dioxin ("PCDD") congeners as impurities. Given the high levels of OCDD found at the site, this additional source of PeCDD and HxCDD certainly confounds any study of the correlation between 2,3,7,8-TCDD and PeCDD or HxCDD that might originate with 2,4,5-TCP combustion. Exponent presents no indication that they either recognized or considered this confounding factor in their analysis.

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1 Anon., *Interium Final Remedial Investigation Centredale Manor Restoration Project Superfund Site North Providence, Rhode Island*, June 30, 2005, Appendix E, Page 423.

2 *Ibid.* Section 7, Page 83.

3 Anon., *Preliminary Risk Assessment Pentachlorophenol ("Penta"), HCB and Dioxin: Questions and Answers*, April 2007, http://www.epa.gov/opp00001/factsheets/chemicals/pentachlorophenol.htm, downloaded March 5, 2008.

4 Holt, E., von der Recke, R., Vetter, W, Hawker, D., Alberts, V., Kuch, B., Weber, R. and Gaus, C., *Assessing Dioxin Precursors in Pesticide Formulations and Environmental Samples As a Source of Octachloro-p-dioxin in Soil and Sediment*, Environ. Sci. Technol., **2008**, **42**, pages 1472 – 1478.

Moreover, the available data do not permit a meaningful assessment of any relationships between [2,3,7,8-TCDD][5] and the other [PCDD] congeners in the Source Area of the CMRP site. Fewer than 10% of the Source Area samples even had the full set of congeners measured. There are 11 soil/sediment samples in the March 2007 version of the centredale.mdb data base originating in the Source Area Group that are not flagged as having a data quality issue, and have all 7 PCDD congeners reported. These samples all originate from the tailrace area. They cannot inform the question of [TCDD] – [PCDD] relationships in the lower dump area where NECC disposed of the ash from its operations, in NECC's "damaged" drum storage area, or in NECC's drum storage area closer to the HCP building.

Nevertheless, these samples are useful for examining the tailrace area. Exponent notes that when the concentration of each congener other than 2,3,7,8-TCDD is plotted as a function of the 2,3,7,8-TCDD concentration, no statistically significant correlation is observed. However, when a simple log transformation is performed, similar to Exponent's treatment of their 2,4,5-TCP – TCDD data, then every PCDD has a statistically significant correlation with each other one at the 95 to 99+% level of confidence. As shown in Table 1, the 2,3,7,8-TCDD least-squares correlation coefficients are in the same range as that reported by Exponent for 2,4,5-TCP – 2,3,7,8-TCDD, which they assert is sufficiently strong to establish a correlation in their analysis using invalid data. Using Exponent's criteria, the results in Table 1 are adequate to demonstrate that the 2,3,7,8-TCDD comes from the same source as the other PCDDs. A correlation that accounts for 40 to 60% of the variance is certainly well within the bounds of reason for the correlation of TCDD with the other congeners, given the process complexity described above.

It is noteworthy that the TCDD – OCDD correlation has the highest coefficient of the group and the TCDD – PeCDD correlation has the lowest of the group. The strength of the TCDD – OCDD correlation suggests a common source with process variations, such as would be the case for NECC's drum reconditioning operation.

The use of log transformations to improve the apparent correlation coefficients of environmental data has been criticized.[6] When the data set is tested for belonging to a Normal distribution, as is assumed in any least-squares analysis, we find that none of the untransformed data are Normally distributed and only the Log[OCDD], Log[HpCDD] and Log[TCDD] distributions meet the Shapiro-Wilk W[7] test criteria for a Normal distribution. That is, the only data that meets the minimum requirement for least-squares analysis is the log transformed [OCDD] and [HpCDD] correlated with the log transformed [TCDD].

The data set was analyzed using the Kendall's *tau* correlation coefficients. This approach makes no assumptions concerning the distribution (i.e., Normal distribution) of

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5 The [X] notation denotes the concentration of X.

6 Singh, A. K., Singh, A., and Engelhardt, M., *The Lognormal Distribution in Environmental Applications*. EPA Technology Support Center Issue, Office of Research and Development, EPA/600/R-97/006, Dec. 1997.

7 JMP 6.0.2 SAS Institute, Cary NC, 2006.

the data. The results are summarized in Table 2 for [2,3,7,8-TCDD]'s correlations with the other reported congeners. In all cases, a significant and strong correlation is observed.

Since the other PCDDs cannot come from the MA HCP process, we have shown that, at least for the tailrace samples, the 2,3,7,8-TCDD could not have originated with MA and did originate with the source of the remaining PCDD congeners.

Samples were excluded for some of the PCDD congeners that have unflagged results by application of the above criteria. The data were re-examined for the relationship between [2,3,7,8-TCDD] and each other congener using all unflagged data for each congener. Since this evaluation will have the effect of including more results near the limit of quantification and thus increased random variance, we can expect the correlation coefficients to decrease.

The unflagged data and the log transformed unflagged data distributions were tested for Normality using a Shapiro-Wilk W test.[7] None of the untransformed data met the criteria for a Normal distribution. Of the log transformed data, only [OCDD] and [2,3,7,8-TCDD] were Normally distributed. Thus, least-squares correlations of none of the untransformed and only the log[OCDD] vs. log[TCDD] are statistically valid, putting aside any issues concerning log transformations.

The Kendall's *tau* results are in Table 3. We see that even with the inclusion of data with higher variability, the correlations remain significant and moderate-to-strong. Thus, the hypothesis that the TCDD and other PCDD share a common origin cannot be dismissed on statistical grounds. Since MA HCP manufacture cannot be the source of the other PCDD, it is not the source of the TCDD, either.

TABLES

	R^2	Prob > F
OCDD	0.59	0.0055
1,2,3,4,6,7,8-HpCDD	0.55	0.0094
1,2,3,4,7,8-HxCDD	0.45	0.0232
1,2,3,6,7,8-HxCDD	0.46	0.0210
1,2,3,7,8,9-HxCDD	0.48	0.0185
1,2,3,7,8-PeCDD	0.40	0.0363

Table 1: Least-squares correlation coefficients for [TCDD] – [PCDD] log transformed concentrations from CMRP Source Area samples for which all PCDD congers reported with unflagged data.

	Kendall's *tau*	Prob>|*tau*|
[OCDD]	0.56	0.0158
[1,2,3,4,6,7,8-HpCDD]	0.56	0.0158
[1,2,3,4,7,8-HxCDD]	0.56	0.0158
[1,2,3,6,7,8-HxCDD]	0.49	0.0356
[1,2,3,7,8,9-HxCDD]	0.53	0.0240
[1,2,3,7,8-PeCDD]	0.53	0.0240

Table 2: Kendall's *tau* correlation for [TCDD] – [PCDD] using untransformed concentrations from CMRP Source Area Samples for which all PCDD congeners reported with unflagged data.

	Kendall's *tau*	Prob>|*tau*|	Number of Samples
[OCDD]	0.36	0.0022	34
[HpCDD]	0.29	0.0157	34
[1,2,3,4,7,8-HxCDD]	0.49	0.0021	21
[1,2,3,6,7,8-HxCDD]	0.35	0.0041	33
[1,2,3,7,8,9-HxCDD]	0.38	0.0023	31
[1,2,3,7,8-PeCDD]	0.49	0.0021	21

Table 3: Kendall's *tau* correlation for [TCDD] – [PCDD] using untransformed concentrations from CMRP Source Area Samples and all unflagged data for each PCDD congener.

Attachment II

TCDD – TCP Correlations

Exponent hinges an important part of their theory attributing the 2,3,7,8-TCDD found at the CMRP site to the MA HCP operations on the alleged correlation between the reported concentration of 2,4,5-TCP and the reported concentration of 2,3,7,8-TCDD. Their discussion suffers from two fatal defects: (1) it is circular and (2) the underlying data do not support the conclusions they have drawn.

Circular Reasoning

The most that can be shown by the correlation Exponent alleges is that an association between 2,4,5-TCP and 2,3,7,8-TCDD cannot be excluded on mathematical grounds. However, the alleged correlation does not address the question of the source of the 2,4,5-TCP. Exponent simply is stating that if it is assumed that MA's HCP operation is the source of 2,4,5-TCP, they can demonstrate that MA could be the source of the 2,3,7,8-TCDD. Obviously, if they assume that NECC's drum reconditioning operation is the source of the 2,4,5-TCP, then they equally can demonstrate that NECC could be the source of the 2,3,7,8-TCDD.

The Underlying Data

The first step in any valid statistical analysis is to define the question to be addressed in terms that can be answered by statistical methods. Normally, this involves the statement of a hypothesis followed by a definition of what constitutes proof the hypothesis is false. The presumed hypothesis in this case is that the concentration of 2,3,7,8-TCDD is not related to the concentration of 2,4,5-TCP at the 95% confidence interval level.

The next step is to examine the data to eliminate any results that are not valid for use in the analysis. For data to be used in EPA matters, one important consideration is the data quality as reported by the laboratory and/or data validators. EPA has issued very clear guidance that the only use of flagged data that is permitted to determine whether an environmental release has occurred is data with a "J" flag.[1] The use of these data is limited to evaluating whether a sampling result is above or below a certain value for the sole purpose of determining whether a release occurred -- the upper limit is below the level of concern for a blank analysis or the lower limit is above the level of concern for a field sample by giving a "yes" or "no" answer to the question "Did a release occur?" Thus, flagged data are not considered by EPA to be of sufficient quality to be used for purposes such as establishing quantitative relationships between the concentrations of two chemicals.

[1] Anon. *Using Qualified Data to Document an Observed Release*, EPA Directive 9285.7-14FS, PB94-963311, EPA/540/F-94/028, July 1994.

By examining the CMRP site analytical measurements database (tbResultsLabAnal table of centredale.mdb), we find there are four (4) field samples with valid results for 2,4,5-TCP. Inspection of the database reveals a total of 10 unflagged samples for 2,4,5-TCP. Of those 10, five are spiked samples and one is a QC lab performance check sample, not field samples. Obviously, none of these QC results should be included in statistical analysis designed to answer a question about the relationship between the 2,4,5-TCP and 2,3,7,8-TCDD concentrations.

Of the four samples with valid 2,4,5-TCP results, all have flagged 2,3,7,8-TCDD results. Two are flagged as "undetected," contrary to Exponent's assertion that they plotted samples with "detected" 2,4,5-TCP and 2,3,7,8-TCDD. A third is flagged as "EB." The fourth sample has a "J" flag. In summary, the available data are not of adequate quality to support any attempt to correlate 2,4,5-TCP and 2,3,7,8-TCDD concentrations.

Figure 3 of the Exponent Response has a minimum of 10 points plotted for 2,4,5-TCP and 2,3,7,8-TCDD. Exponent did not provide sufficient detail to determine the specific samples they selected for their analysis. They report a linear regression with

$$\text{Log[2,4,5-TCP]} = 0.46 * \text{Log[2,3,7,8-TCDD]} + 4.72$$

and $R^2 = 0.51$.

By including invalid data, a similar correlation can be found. The linear regression gives

$$\text{Log[2,4,5-TCP]} = 0.46 * \text{Log[2,3,7,8-TCDD]} + 4.72$$

and $R^2 = 0.51$.

Although this correlation is invalid, it is still interesting. Using Log[2,3,7,8-TCDD] as the dependent variable for the same data subset, the linear regression equation becomes

$$\text{Log[2,3,7,8-TCDD]} = 1.12 * \text{Log[2,4,5-TCP]} - 3.96$$

and $R^2 = 0.51$ as expected.

This equation can be used to calculate an implied concentration of 2,3,7,8-TCDD in the 2,4,5-TCP by simply substituting a value for [2,4,5-TCP] and calculating the corresponding [2,3,7,8-TCDD], then dividing the calculated [2,3,7,8-TCDD] by the corresponding [2,4,5-TCP], assuming the Exponent model is correct.

If dumping of 2,4,5-TCP by MA is the source of the 2,3,7,8-TCDD, then the [2,3,7,8-TCDD]/[2,4,5-TCP] ratio should be constant. This is because a carefully controlled process was required to produce HCP of acceptable quality to MA's customer.[2] Moreover, all of the samples were derived from a small area and therefore should have experienced similar conditions. If NECC's drum reconditioning operation is the source, there should be a combination of low [2,4,5-TCP] with high [2,3,7,8-TCDD] from

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[2] Cleary, T., Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053 S (D.R.I.) Feb. 10, 2003, Page 22, Lines 7-14.

combustion and high [2,4,5-TCP] with low [2,3,7,8-TCDD] from leakage and dumping of material prior to processing.

When the calculation is performed for different 2,4,5-TCP concentrations, the plot in Figure 1 results as follows:

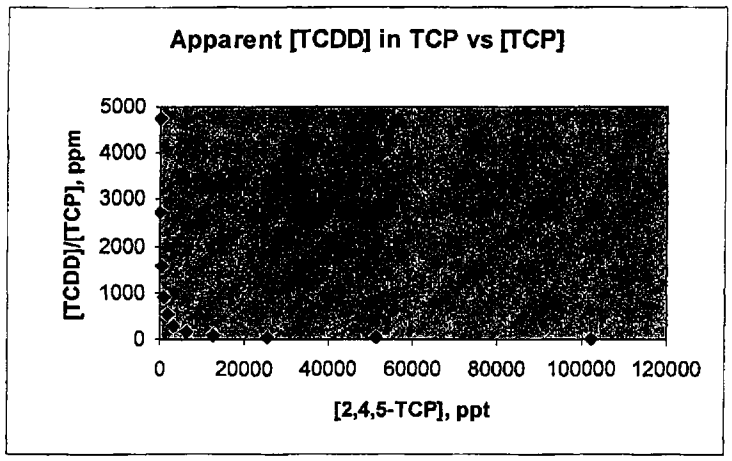

Figure 1: Apparent concentration of 2,3,7,8-TCDD in 2,4,5-TCP as a function of the 2,4,5-TCP soil/sediment concentration at the CMRP site using the Exponent model.

We see that, using the Exponent model, the [2,4,5-TCP]/[2,3,7,8-TCDD] ratio varies over orders of magnitude, contrary to expectation if MA's HCP operation were the 2,3,7,8-TCDD source. Thus, when using Exponent's correlation, which is based upon invalid data, the results show that while the 2,4,5-TCP could not have originated with the MA HCP process, it could have originated with NECC's drum reconditioning process.

Attachment III

High 2,4,5-TCP Detection Limits

Exponent notes that 2,4,5-TCP may be more widespread at the site than the two locations with valid results. They correctly point out that many samples have detection limits as high as or higher than the concentrations reported for locations CMS-451 and CM-SO-MW05-1012.

There are a total of 472 samples analyzed for 2,4,5-TCP that are flagged as non-detected. The mean reported detection limit is ≈ 4,100 ug/kg; the median detection limit is ≈ 1,000 ug/kg. The detection limit for 2,4,5-TCP is above the mean for approximately 25% of the reported samples.

Why are the detection limits so high in so many of the samples? Examination of the centredale.mdb database reveals that the immediate cause is extract dilution.

The analyses used for the CMRP site samples all have a limited dynamic range.[1] When samples are encountered that have a targeted compound whose concentration exceeds the highest level for which the instrument is calibrated, an estimated concentration for that compound can be obtained by an appropriate extract dilution to reduce the targeted compound's concentration in the extract to be within the calibrated range of the instrument. The amount of dilution is typically recorded as a "dilution factor." The apparent concentration of the targeted compound can be measured in the diluted sample, and then the original concentration can be estimated by adjusting the apparent concentration with the dilution factor.

When such diluted samples are analyzed, the detection limit for all compounds is raised by the same dilution factor. This trade-off results in the case we see with the CMRP site samples, where many target compounds may be present at a significant level, but they are undetected as a consequence of the necessary dilution.

The data set is seriously, if not fatally, flawed when attempts are made to use it for forensic purposes, as the CMRP site case illustrates. The crucial question of 2,4,5-TCP distribution cannot be addressed because of inadequate data quality for that compound.

RES-11-424-01 is the field sample with the highest detection limit for 2,4,5-TCP reported in the CMRP database (280,000 ug/kg.) This detection limit is ~35-fold higher than the highest valid data reported at the CMRP site for this compound. Examination of the database reveals this sample was diluted by a factor of 10 prior to analysis. The target compounds with valid data[2] reported for this sample are all polycyclic aromatic

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1 The dynamic range is the highest concentration divided by the lowest concentration for which the system is validated, including instrument calibration.

2 That is, the compounds initially present with a concentration above the calibration range.

hydrocarbons ("PAHs"). These are well known combustion by-products. There is no evidence MA ever used PAHs for any purpose.

Sample CMS-417-A and CMS-417-B illustrate another important point. These samples both have reported 2,4,5-TCP detection limits of 35,000 ug/kg. The reported dilution factor is 50 for each sample extract. The targeted compounds with valid results are 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 4-chloroaniline, bis(2-ethylhexyl)phthalate, and PAHs. The PAHs are indicative of a combustion source; the 1,2,4-trichlorobenzene and bis(2-ethylhexyl)phthalate are products listed in NECC's 104(e) responses as chemicals used by their customers. The 4-chloroaniline is an intermediate in the manufacture of dyes and agro-chemicals[3] and hence likely originated with one or more NECC customers. There is no record of MA use of any of these chemicals.

In summary, the high detection limits for 2,4,5-TCP noted by Exponent is a consequence of high levels of chemicals more likely to have originated with NECC than MA. This observation of NECC customers' chemicals at the site is consistent with the 2,3,7,8-TCDD coming from the same source.

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[3] Boehncke, A, Kielhorn, J, Koennecker, G., Pohlenz-Michel, C., and Mangelsdorf, I., Concise International Chemical Assessment Document 48 4-CHLOROANILINE, World Health Organization, Geneva, 2003, Page 4.

Attachment IV

Exponent Literature Misquotations

Exponent alleges that my response to their earlier memorandum fails to cite relevant literature. They name a group of references they allege contain data relevant to the combustion products of 2,4,5-TCP.

The misquoted references are listed in the order encountered in the Exponent Response. Duplicate entries are not repeated. The various citation styles reflect the variety in the Exponent Response.

It appears that Exponent failed to realize that 2,4,5-T and 2,4,5-TCP are chemically different species. 2,4,5-T has a covalent bond attached to the phenolic oxygen, which severely limits its ability to undergo the nucleophilic displacement reaction necessary to form 2,3,7,8-TCDD. The chemistry of the other impurities that might be present in 2,4,5-T and its ester derivatives are irrelevant to the question of combustion by-products of 2,4,5-TCP.

In addition to being irrelevant to the question of 2,4,5-TCP combustion products, the cited literature do not support the theory that burning 2,4,5-T leads to sufficiently high relative amounts of penta and hexa PCDD to be useful for fingerprinting 2,4,5-T combustion. The literature Exponent cites is helpful in that it demonstrates that combustion of 2,4,5-T-contaminated drums is a plausible pathway by which 2,3,7,8-TCDD is likely to have been introduced to the CMRP site by NECC, and should be included in any complete CSM.

Specific Papers

C. Briois, S. Ryan, D. Tabor and B. K. Gullet (2007) Formation of Polychlorinated Dibenzo-*p*-dioxins and Dibenzofurans from a Mixture of Chlorophenols over Fly Ash: Influence of Water Vapor. *Environ. Sci. Technol.* **41**: 850-856

> This paper describes the combustion of low concentrations of 2-chlorophenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, and 2,3,4,6-tetrachlorophenol under conditions simulating a municipal waste incinerator ("MWI"). The stated purpose of the study is to investigate the use of these compounds as surrogates for the formation of PCDD/PCDF in MWIs to give operators a means to monitor incinerator performance to limit PCDD/PCDF formation in flue gases. Contrary to Exponent's assertion, this paper is not concerned with 2,4,5-TCP.
>
> The experiments were performed in a laboratory apparatus designed to simulate conditions in a MWI. Exponent presents no basis for the implicit assumption that the experimental conditions yield results that can be extrapolated to the open flame combustion utilized by NECC at its drum reconditioning operation at the CMRP site.

Harnly, M; Stephens, R; McLaughlin, C.; Marcotte, J; Petreas, M; Goldman, L. (1995) Polychlorinated dibenzo-*p*-dioxin and dibenzofuran contamination at metal recovery facilities, open burn sites, and a railroad car incineration facility. *Environ. Sci. Technol.* 29(3):677-684.

This paper describes the analysis of soil and ash samples from three metal recovery facilities where copper scrap was the dominant feed stream, three sites of open burning where evidence of copper recovery was visible, and from a railroad car incineration facility where wooden railroad cars were burned to recover the metal in the frames.

Contrary to the statement by Exponent, this paper has nothing to do with 2,4,5-TCP combustion. One could speculate that PCP-treated wood might have been burned at the railroad car incineration facility, but there is no direct evidence to establish whether this is the case.

Hutzinger, O; Essers, U; Hagenmeir, H; (1992) Untersuchungen zur Emission Halogenierter Dibenzodioxine und Dibenzofurane aus verbrennungsmortoren beim Betrieb mit handelsueblichen Betriebsstoffen. Universities of Bayreuth, Stuttgart und Tubingen, Germany. GSF-Forschungszentrum, Munich, Germany, ISSN 0937-9932.

This publication describes PCDD and PCDF emissions by internal combustion engines. Exponent fails to establish the relationship, if any, between the open flame conditions found at the CMRP site and the conditions within an internal combustion engine. There exists a substantial body of literature describing the mechanisms for PCDD/PCDF combustion that suggest internal combustion engine PCDD/PCDF emissions are not useful in attempting to understand the possible products from an open flame. I am unaware of any use of 2,4,5-TCP as a fuel or fuel additive.

In summary, this publication has no relevance to the question of 2,4,5-TCP combustion by-products from an open flame.

Oehme, M; Larssen, S; Brevik, E. M. (1991) Emission factors of PCDD/PCDF for road vehicles obtained by a tunnel experiment. *Chemosphere* 23:1699-1708.

This publication describes PCDD and PCDF emissions by automobiles, and light- and heavy-duty trucks by measuring air levels in a longitudinally ventilated tunnel. Exponent fails to establish the relationship, if any, between the open flame conditions found at the CMRP site and the conditions within automobile, and light- and heavy-duty truck engines. There exists a substantial body of literature describing the mechanisms for PCDD/PCDF combustion that suggest internal combustion engine PCDD/PCDF emissions are not useful in attempting to understand the possible products from an open flame. I am unaware of any use of 2,4,5-TCP as a fuel or fuel additive.

In summary, this publication has no relevance to the question of 2,4,5-TCP combustion by-products from an open flame.

Rappe, C., H. R. Buser, and H-P. Bosshardt. (1979) Dioxins, dibenzofurans and other polyhalogenated aromatics: Production, use, formation and destruction. *Annals of the New York Academy of Sciences* 320(1), 1-18.

> This is a review paper presented as a plenary lecture at a New York Academy of Sciences meeting. As such, limited original data are presented. My review of the paper revealed no discussion of 2,4,5-TCP combustion products. The publication does contain some discussion of 2,4,6-TCP and 2,4,5-T combustion, neither of which is relevant to the question of 2,4,5-TCP combustion.

Rappe, C., H. R. Buser, and H-P. Bosshardt. Identification and quantification of polychloro-*p*-dioxins (PCDD) and dibenzofurans (PCDF) in 2,4,5-T-ester formulations and herbicide orange (1978) *Chemosphere*, 5:431-438.

> This paper presents data describing the PCDD/PCDF impurities found in various 2,4,5-T formulations from the mid-1960s. As such, it is irrelevant to the question of 2,4,5-TCP combustion products.
>
> Exponent misquotes this paper when they claim it supports the presence of penta and hexa chloro congeners, even allowing for the confusion of 2,4,5-T for 2,4,5-TCP. Table 1 reports eight 2,4,5-T formulations. No PCDD is reported with more than four chlorines, with the exception of one sample where a single penta congener was reported at < 5% of the TCDD level for that sample. The paper ascribes the presence of TCDDs other than 2,3,7,8-TCDD to the presence of trace levels of 2,4,6-TCP in the particular formulations they studied.
>
> This paper presents no combustion product data.
>
> In summary, were this paper relevant to the 2,4,5-TCP combustion product question, it would completely refute the position asserted by Exponent.

Schwind, K-H.; Thoma, H.; Hutzinger, O.; Dawidowsky, N.; Weberuss, U.; Hagenmeir, H.; Buehler, U.; Griener, R.; Essers, U.; Bessy, E. (1991) Emission halogenierter dibenzodioxine (PXDD) und dibenzofurane (PXDF) aus verbrennungsmotoren. UWSFZ. Umweltchem. Oekotox. 3, 291-298. [English translation]

> This publication describes PCDD and PCDF emissions by internal combustion engines. Exponent fails to establish the relationship, if any, between the open flame conditions found at the CMRP site and the conditions within an internal combustion engine. There exists a substantial body of literature describing the mechanisms for PCDD/PCDF combustion that suggest internal combustion engine PCDD/PCDF emissions are not useful in attempting to understand the possible products from an open flame. I am unaware of any use of 2,4,5-TCP as a fuel or fuel additive.
>
> In summary, this publication has no relevance to the question of 2,4,5-TCP combustion by-products from an open flame such as were the conditions at the CMRP site.

Ahling, B., A. Lindskog, B. Jansson, and G. Sundstrom (1977) Formation of polychlorinated dibenzo-*p*-dioxins and dibenzofurans during combustion of a 2,4,5-T formulation, *Chemosphere*, 8: 461 – 468

This paper describes the trace impurities in a commercial 2,4,5-T formulation. One of the trace impurities (~0.02 %) is 2,4,5-TCP. This material was combusted under a variety of conditions in a device intended to simulate a municipal solid waste incinerator.

There was a PCDD with more than four chlorines reported in 1 of 8 experiments. That experiment was under conditions such that the material was exposed to 750 °C for 3.7 seconds with 0.0% residual oxygen (at least a factor of 7 lower than any other reported experiment) and carbon monoxide of 5.5% (more than a factor of 5 higher than any other reported experiment) in the flue gas. In contrast, the simulated open flame conditions were 100 °C with a transit time of 1 second, residual oxygen of 17.5% and carbon monoxide of 0.0%. In the open flame conditions test, no PCDD with > 4 chlorines were reported.

This paper is irrelevant to the question of the combustion by-products of 2,4,5-TCP. If it were relevant, it would refute Exponent's position.

Stehl, Lamparski (1977) Combustion of several 2,4,5-Trichlorophenoxy Compounds: Formation of 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin. *Science* 197:1008-1009.

This paper discusses the combustion of several 2,4,5-T formulations under conditions designed to simulate open flame combustion of treated materials. The subject of 2,4,5-TCP is not mentioned, contrary to Exponent's assertion.

The only combustion product of 2,4,5-T reported in this paper is 2,3,7,8-TCDD. In no way are these findings supportive of Exponent's theory that combustion of 2,4,5-TCP, or, for that matter, 2,4,5-T, produces any product other than 2,3,7,8-TCDD.

This paper is completely irrelevant to the question of 2,4,5-TCP combustion by-products. If it were relevant, it would refute Exponent's theory.

FOR INCLUSION IN THE ADMINISTRATIVE RECORD

RESPONSE TO THE SEPTEMBER 20, 2007 EXPONENT/LIMNO-TECH MEMORANDUM REGARDING EPA'S CONCEPTUAL SITE MODEL FOR THE CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE

April 17, 2008

AMEC Earth and Environmental, Inc.
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By memorandum dated September 20, 2007, Exponent/Limno-Tech ("Exponent Memo") responded to AMEC Earth & Environmental's (AMEC's) comments on an earlier Exponent memorandum dated April 4, 2007, regarding EPA's conceptual site model for the Centredale Manor Restoration Project Site (site). The following discussion responds to the section of the Exponent Memo titled "Response to AMEC report on PCBs."

First, Exponent contests whether the EPA Remedial Investigation (RI) Report identifies New England Container Corporation (NECC) as the "most likely source" of PCBs in source area soils at the site. We have re-examined the RI Report to bring closure to this issue. EPA makes the following statements in the RI Report that identify NECC as the source of PCBs at the site and in downstream sediments.

EPA Statement 1: On Page 4-13 of the RI Report, EPA states the following:

> "The following conceptual model is consistent with the findings of the environmental forensics analysis:
>
> ...The former drum reconditioning operation in the source area likely washed pesticide and PCB residues into source area soils. Surface soil erosion and transport transported some of these residues to downstream locations."

EPA Statement 2: In the Environmental Forensics Review on page 4-12 of the RI Report, EPA states the following:

> "The former drum reconditioning facility probably received chemical shipping and storage containers from numerous sources and may be the original source of the PCBs."

EPA Statement 3a: EPA further states on Page 4-12:

> "The chlorinated pesticide signature in upstream background area samples contained a mixture of chlordane, endosulfan, and DDT-compounds. The source area samples shared this basic fingerprint with variations in the relative abundances of dieldrin, endrin, benzene hexachloride (BHC), and other pesticides. This chemical diversity is consistent with the drum reconditioning operation that received used drums from various sources."

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EPA Statement 3b: Moreover, on Page 4-12, EPA states:

> "Total PCB and total pesticide concentrations were moderately correlated (correlation coefficients >0.5), indicating that high concentrations of PCBs tended to occur with high concentrations of pesticides."

EPA Statements 1 and 2 clearly express EPA's belief that the forensic evidence regarding PCB releases and subsequent transport to the Woonasquatucket River sediments points to the NECC drum reconditioning operation as the source of PCBs.

EPA Statements 3a and 3b, taken together, further identify NECC as the source of PCBs reported at the site. In EPA Statement 3a, EPA states that the observed diversity of pesticides detected is consistent with the NECC drum reconditioning operations. In EPA Statement 3b, EPA suggests that pesticide and PCB concentrations are positively correlated. If pesticide and PCB concentrations are positively correlated and the pesticides resulted from NECC drum waste disposal, then it is reasonable to conclude that the disposal, and fate and transport, of these compounds are similar. It follows then that PCBs came from the same source as the pesticides (i.e., NECC), which is corroborated by EPA Statements 1 and 2.

Second, EPA has computed cancer and non-cancer health risks for residential and recreational anglers that are exposed to PCBs in fish caught from Allendale and Lyman Mill Ponds. The cancer and non-cancer health risks that EPA computed for PCBs are well above EPA's risk threshold for remedial action. While EPA computed cancer health risks for dioxin that are higher than those computed for PCBs, the fact remains that EPA computed risks for PCBs that are above the EPA Superfund risk range. Therefore, any remedies for the Allendale and Lyman Mill Pond sediments will be selected by EPA, at least in part, due to the presence of PCBs. As discussed above, EPA believes that the PCBs resulted from NECC's drum reconditioning operation washing PCB residues into source area soils with subsequent overland transport to Allendale and Lyman Mill Ponds. Thus, our prior comment regarding the impact of PCBs on the pond sediment remedy selection process is far from being a "pointless" discussion, as Exponent contends. Rather, as discussed, the contribution of PCBs to EPA's total estimated health risks is well above a *de minimis* level.

Third, EPA has estimated that over a thousand drums were present on the source area of the site as of 1970.[1] NECC's responses and supplemental responses to EPA's CERCLA § 104(e) information requests[2,3] and testimony in the *Emhart Indus., Inc. v.*

[1] USEPA, 2000. Aerial Photographic Analysis Centredale Manor Site Subarea, North Providence, RI. U.S. Environmental Protection Agency, Environmental Sciences Division. Las Vegas, NV. TS-PIC-20001120S. July.

[2] New England Container Company, Inc. Supplemental Response to CERCLA § 104(e) Information Requests. February 8, 2002.

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Home Insurance Co. litigation[4] corroborate that hundreds of thousands of drums were brought to the site during the course of NECC's drum reconditioning operations. Moreover, there is evidence that PCBs were brought to the site in drums.[5]

Though a drum labeled as containing PCBs was found on the NECC site, much of the PCBs from NECC's customers likely arrived at the site as components of mixtures. The Agency for Toxic Substances and Disease Control Registry (ATSDR) states that PCBs were used both in nominally closed applications (e.g., capacitors and transformers, and heat transfer and hydraulic fluids), and in open-end applications (e.g., flame retardants, inks, adhesives, microencapsulation of dyes for carbonless duplicating paper, paints, pesticide extenders, plasticizers, polyolefin catalyst carriers, slide-mounting mediums for microscopes, surface coatings, wire insulators, and metal coatings).[6] Given the profile of NECC's customers, PCBs likely were contained in drums that held any number of materials.

As an example, several companies whose drums were reconditioned by NECC manufactured products such as wire insulating coatings and/or used plasticizers.[7,8] Thus, it is plausible that drums delivered to NECC from these companies contained PCB residues or off-specification materials.

In light of the foregoing, EPA's identification of NECC in its conceptual site model as the likely source of the PCBs at the site and in the Woonasquatucket River sediments is both supportable and sensible.

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[3] New England Container Company, Inc. Supplement Response to CERCLA § 104(e) Information Requests, Centredale Manor Restoration Site. August 22, 2002.

[4] Cifelli, Joseph, Deposition Transcript, *Emhart Industries, Inc. v. Home Insurance Co.*, No. 02-053-S. p. 29. February 13, 2003.

[5] RIDEM, 1980. Memorandum from John Leo, Engineer, Division of Air and Hazardous Materials, Department of Environmental Management to File. Subject: Inspections of Barrels located on the old Metro-Atlantic Chemical Site in Centredale. December 10.

[6] ATSDR. 2000. Toxicological Profile for Polychlorinated Biphenyls. Agency for Toxic Substances and Disease Registry. U.S. Department of Health and Human Services.

[7] Shepard, Barry, S., Deposition Transcript, *Emhart Industries, Inc. v. New England Container Co.*, No. 06-218-S. pp. 106-108. January 18, 2008.

[8] Murray, William, J., Deposition Transcript, *Emhart Industries, Inc. v. New England Container Co.*, No. 06-218-S. pp. 38, 57-58. January 24, 2008.

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