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May 15, 2009

Mr. Jae Lee
US Environmental Protection Agency Region V
77 West Jackson Boulevard
Chicago, IL 60604-3590

RE: Part B Permit Renewal Application
Mercury Sensitivity Analysis
Essroc Cement Corp.
Logansport, Cass County, Indiana
IND 005 081 542

Dear Mr. Lee;

Thank you for the opportunity to discuss your concerns and our evaluation regarding the continued adequacy of Essroc's Logansport facility risk assessment at our meeting on April 14, 2009. Based on your January 9, 2009 letter and our meeting discussion, Essroc understands your request to update the mercury fish ingestion pathway via comparative analysis to the 2003 risk assessment. Essroc subsequently agreed to perform a mercury comparative analysis for the fish ingestion pathway to document the impact of the updates we have discussed to the 2003 original risk assessment results as part of the Part B renewal process. The attached report therefore includes updates to the 2003 Risk Assessment and Essroc's previous submittal (Attachment 11-2 to the May 2008 Part B permit renewal application) based on the following parameters discussed during our meeting:

- Revised air dispersion modeling to address mercury dry vapor deposition, as requested in your January 9 letter,
- Documentation and calculations regarding France Park Lakes, as requested in your January 9 letter,
- Revised Hg emission rates, in accordance with the transition to HWC MACT emission limits,
- Revisions in the 2005 HHRAP that correct the 1998 version for fish tissue concentrations and methyl mercury HQ calculations for fish ingestion, and
- Incorporating the adjusted parameters documents by EPA's previous risk assessor.

Regarding the revised air dispersion modeling, Essroc has performed the requested additional air dispersion modeling to include dry deposition as requested by EPA. We are also in the process of performing additional updated air modeling to incorporate the updated meteorological processing suggested in our meeting. The approach and conduct of the revised modeling is being

worked through between Essroc's consultant and EPA's air modeling contact; however, this update will take additional time, therefore it is not included in this submittal.

We wanted to point out that the focus of the updated document is to provide an evaluation of sensitivity surrounding some of the more critical parameters for the fish ingestion pathway as described above. All other previously submitted and approved assumptions from the 2003 risk assessment process have not been updated as part of this analysis; rather the comparison was performed to document the changes due to the specifically outlined items. As discussed during our meeting, we do not believe that the collection of additional or updated facility-specific information is justified as Essroc has not had changes in the facility or surrounding community that would bring into question a change in risk since the previous risk assessment was performed. Yet in order to address additional items noted in your January 9 letter, Essroc is utilizing updated industry mercury speciation data collected through the Portland Cement Association to replace the default assumptions previously used. As noted during our meeting, the requirement to collect mercury input concentrations in feed streams on an ongoing basis, and documentation of mercury inputs versus emissions (system removal efficiency) has been in place for cement kilns since the onset of the 1991 Boiler and Industrial Furnace rules. And, as documented in Essroc's May 2008 submittal, particle size distribution data for the industry tends to be fairly similar and has not been found to significantly impact the results of risk assessment. This point is also discussed in the EPA Region 6 Sensitivity Analysis to risk assessment modeling (*Model Parameter Sensitivity Analysis Volume 1 of 2, U.S. EPA Region 6 Center for Combustion Science and Engineering, May 23, 1997*).

In accordance with our discussions on the adequacy of the previous risk assessment, and considering the updates in the attached report, we look forward to your response regarding the upcoming CPT test and confirming our documentation showing that additional site-specific testing and/or risk assessment is not necessary. If you have any questions or need additional information, please contact me at (573) 657-0378 on behalf of Essroc.

Sincerely,

SCHREIBER, YONLEY & ASSOCIATES

Carrie Yonley, P.E.
Vice President

CY:bah
Enclosures
cc: Gary Molchan - Essroc
Corey Conn - Essroc
Richard Pleus - Intertox

# MERCURY COMPARATIVE ANALYSIS

## ESSROC CEMENT CORP.
## LOGANSPORT, INDIANA

**MAY 15, 2009**

**Prepared for:**

**ESSROC CEMENT CORP.**

**LOGANSPORT, INDIANA**

**Project No. ESRLOG 070239**

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## ATTACHMENTS

## 1.0 INTRODUCTION

This document provides results of a 2009 comparative review of the 2003 Risk Assessment document[1] for the Essroc Cement Corp. (Essroc) Logansport, Indiana facility. The 2003 risk assessment was submitted, reviewed and approved by the U. S. Environmental Protection Agency (EPA) as part of the original Part B permitting process. The purpose of this update is to support the current Part B permit renewal process, and to update certain information provided in Section 11, Attachment 2 of Essroc's May 2008 RCRA permit renewal application[2].

The updates addressed in this comparative analysis are based on EPA's response letter of January 22, 2009 and Essroc's subsequent meeting with EPA on April 14, 2009, including:

- Revised air deposition modeling to include dry deposition;
- Revised mercury emissions, based on HWC MACT limits;
- Incorporation of updated assumptions documented by EPA in a 2003 memo regarding the 2003 Essroc Risk Assessment; and
- Certain revisions published in the final 2005 HHRAP guidance that revise the 1998 HHRAP for methyl mercury calculations related to the fisher consumption pathway
- Revised industry specific speciation

Neither the methodology for the risk assessment nor other assumptions and parameters used in the 2003 assessment and previously approved by EPA have been modified as part of the comparative process except for those items that are specifically listed.

The intent of the comparative analysis is to document the potential effect of the changes on the estimated hazard quotient (HQ) values due to exposure to methyl mercury from fish ingestion from local water bodies from facility operations. The main focus of the 2005 Human Health Risk Assessment Protocol (2005 HHRAP)[3] guidance document, with regard to mercury, was to update the 1998 HHRAP[4] guidance by revising certain assumptions pertaining to mercury pathways and fish uptake of mercury.

The approach for and the results of the comparative analysis on the estimated methyl mercury hazard HQs are presented in this report. An uncertainty discussion is also presented in the last section in order to acknowledge uncertainty surrounding the assumptions that were updated in this report and other assumptions that were retained from the approved 2003 report. As discussed in the April 14 meeting with EPA, this analysis is not intended to update and replace the 2003 risk assessment conclusions in entirety. Rather it is intended to look at the sensitivity surrounding the outlined assumptions to readdress the fish ingestion pathway for methyl mercury.

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[1] Horizon Environmental (March 2003) "Comprehensive Risk Assessment for the Cement Kiln Operations at the Essroc Cement Corporation in Logansport, Indiana;" Horizon Environmental Corporation: Grand Rapids, MI.
[2] Essroc Cement Corporation, Logansport, Indiana (May 2008) "Part B Permit Application" (renewal)
[3] USEPA (2005) "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities," EPA530-R-05-006.
[4] USEPA (1998) "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities," EPA530-D-98-001.

## 2.0 AIR MODELING COMPONENT

The original air modeling exercise from the 2003 Risk Assessment document included determinations of ambient mercury concentrations and wet mercury deposition values. The air modeling analysis has been revised to additionally account for dry mercury deposition for each modeling area. The revised modeling analysis follows the air modeling protocol and assumptions from the approved 2003 Risk Assessment. The original wet mercury deposition values have been summed with the new dry mercury deposition values on a receptor-by-receptor basis to derive a "total" wet and dry deposition value for mercury for the modeling areas. As in the 2003 Risk Assessment, the individual receptor values were then averaged according to their respective grid areas to determine the average annual deposition rates to be used in the risk analyses. For comparative purposes, the original wet deposition rates would be analogous to the new total deposition rates. The relative increases in annual deposition rates for the Wabash and Eel Rivers watershed area and France Park Lake watershed area are presented in the following table:

**Table 1: Revised Air Modeling Results**

| Air Modeling Area | Magnitude of Increase in Total Deposition * |
|---|---|
| Wabash and Eel Rivers water shed area | 7.43 |
| France Park Lake watershed area. | 1.74 |

*Increase over wet deposition values in the 2003 Risk Assessment

As seen in the above table, the total deposition rates predicted for the Wabash and Eel Rivers watershed area and the France Park Lake watershed area are 7.43 and 1.74 times their respective originally predicted wet deposition rates. A significant portion of the noted increases can obviously be attributed to the fact that the 2003 Risk Assessment document modeling did not include dry mercury deposition. However, there are additional factors that may also have significantly contributed to the increases.

A modeling feature that contributed to the magnitude of the deposition increase is the type of grid used for the original and revised analysis. The grid is polar, and the receptor spacing gradually increases with distance from the source. Analysis of the area weighting indicates that about 75% of the deposition occurs in the outer portions of the grid, which is being driven by the area weighting procedure itself. The procedure follows typical area-weighting criteria in that the area weighting applied to an outer receptor is larger than that applied to an inner receptor due to the receptor spacing being greater for the outer receptor. However, the area increases by a power of 2 with linear distance from the source, which unrealistically skews the deposition toward the outer portions of the grid.

Also, based on the wind roses[5] presented in the 2003 Risk Assessment, the most prevalent wind directions are all toward the river grid. The wind roses also indicate that a predominant amount of time winds are blowing into the grid, they are medium in strength (4-6 and 7-10 knots), which is the condition when dry deposition would occur. This wind directionality somewhat exacerbates the impacts due to the polar grid being used as the model uses a set of grouped wind directions instead of an infinite wind directionality and the preset wind directions line up with a polar grid. This allows the wind direction to align with a string of polar grid receptors heading away from the source.

The air dispersion and deposition modeling files are included in Attachment 1.

## 3.0 RISK ASSESSMENT COMPONENT

The approach included in this document using a comparative analysis allows certain factors affecting the results of the estimated mercury HQ from the fish ingestion pathway to be put into perspective with the original 2003 Risk Assessment in accordance with discussions between EPA and Essroc. The analysis focuses on specific factors that affect the mercury risk results and compares the approved 2003 Risk Assessment with updated information and assumptions as agreed on during the April 14, 2009 meeting with EPA. The analysis is performed for the adult and child for the fish ingestion pathway with the calculated fish concentrations and corresponding HQs shown in relation to the 2003 model results. Fish concentration values are used to estimate HQs. The final results also take into account the air deposition modeling results described above to present the overall comparative results.

The specific factors addressed are as follows:

- Bioaccumulation factors for methyl mercury in fish
- Removal of the methyl mercury bioaccumulation factor (BAF) values from non-methylated divalent mercury
- Replacement of emission rates from the 1999 test values to the updated emission rates due to implementation of the HWC MACT standards.
- Knowledge of industry-specific mercury emissions speciation data

Each of these factors and the calculated effect on the mercury risk results (HQs) are discussed in the following paragraphs. The risk assumptions that are described each result in decreased mercury HQs while the revised air modeling results increase the HQs. The uncertainty section of this report also discusses key 2003 assumptions that if modified could also increase the calculated HQ results. All of the updated default assumptions of the 2005 HHRAP are not addressed in this analysis, as the 2003 risk assessment included parameters that were documented and approved by EPA at that time. Again the factors addressed in this document are the factors previously discussed with EPA to demonstrate how they affect mercury HQs for fish ingestion.

[5] Horizon Environmental (March 2003) "Comprehensive Risk Assessment for the Cement Kiln Operations at the Essroc Cement Corporation in Logansport, Indiana;" Horizon Environmental Corporation: Grand Rapids, MI, Chapter 4.

## 3.1 Bioaccumulation Factor for Methyl Mercury in Fish

The BAF is the ratio of the methyl mercury concentration in the fish to the methyl mercury concentration in the water column. The BAF value for methyl mercury in fish that was used in the 2003 Risk Assessment was 6.8E+06 L/kg, as noted in the 1998 HHRAP guidance. As verified and documented in EPA's June 2003 internal memo on the 2003 Essroc risk assessment, this value is based on the highest trophic level fish (Level 4) from deep water lakes, which is viewed as a conservative approach for the local conditions. As noted in the EPA memo, data has since been compiled from fish in multiple trophic levels in different types of water bodies. This data was presented in a 2001 EPA water quality criterion document,[6] discussed in a 2003 EPA memo[7] and is summarized in the following table.

**Table 2: Methyl Mercury BAF Values (L/kg)**

| Water Body Type | Trophic Level 3 | Trophic Level 4 | Average |
|---|---|---|---|
| Lake | 1.3E+06 | 6.8E+06 | 4.05E+06 |
| River | 1.6E+06 | 2.5E+06 | 2.05E+06 |

As noted above, the BAF value used in the 2003 Risk Assessment document was 6.8E+06 L/kg which is intended to be a conservative value. As the reported HQ was for a fisher population using the Wabash River as the maximum impacted receptor, a more representative BAF value was described by EPA to be an averaging of the BAF values from trophic level 3 and trophic level 4 fish from rivers. As documented in the 2003 EPA memo, an averaging of the trophic level 4 and trophic level 3 values is justifiable as it is unlikely all of the fish caught from the Wabash River would be from the "game fish" category of trophic level 4. The average BAF methyl mercury value of 2.1E+06 L/kg is only 30% of the BAF used in the 2003 Risk Assessment document. As the BAF value affects the estimated methyl mercury concentration in fish in an essentially linear manner, by using the averaged value shown above, the estimated methyl mercury HQ would be expected to be only 30% of the value reported in the 2003 Risk Assessment document.

In a similar manner, the average BAF methyl mercury lake value of 4.1E+06 L/kg is only 60% of the BAF used in the 2003 Risk Assessment document. By using the averaged methyl mercury BAF for fish in lakes value of 4.1E+06 L/kg, the estimated methyl mercury fish concentration would be expected to be only 60% of the value reported in the 2003 Risk Assessment document.[8]

[6] USEPA (2001) "Water Quality Criterion for the Protection of Human Health: Methylmercury (Final)

[7] Data in this table was presented in the June 27, 2003 EPA Region 5 Waste Management Branch memo from Mario Mangino (Toxicologist) to Jae Lee (Permits Section).

[8] Horizon Environmental (March 2003) "Comprehensive Risk Assessment for the Cement Kiln Operations at the Essroc Cement Corporation in Logansport, Indiana;" Horizon Environmental Corporation: Grand Rapids, MI, Table 5-6.

## 3.2 Removing the Application of the Methyl Mercury BAF Values to Non-Methylated Divalent Mercury

The HHRAP methodology to calculate the methyl mercury concentration in fish tissue from the uptake of methyl mercury from the dissolved-phase of the total water column uses the methyl mercury dissolved-phase water concentration value multiplied by the methyl mercury BAF value. In accordance with HHRAP guidance, the values of the dissolved-phase water concentrations of the different applicable forms of mercury are used to calculate concentrations of mercury in fish. The dissolved-phase concentrations of mercury used in the 2003 Risk Assessment for the Wabash and Eel Rivers watersheds are listed in the table below.

**Table 3: Dissolved Phase River Water Mercury Concentrations**

| Mercury Species | Mercury Concentration (mg/L)[9] |
|---|---|
| Methyl Mercury | 1.42E-09 |
| Divalent Mercury | 5.99E-08 |
| Methyl + Divalent | 6.13E-08 |

The 2003 Risk Assessment approach used the sum[10] of the estimated dissolved-phase water concentrations for the divalent and methyl forms of mercury species. The resulting sum was multiplied by the BAF for methyl mercury to estimate a total methyl mercury fish concentration. Per the 2005 HHRAP guidance, only the methyl mercury dissolved-phase water concentration should be multiplied by the methyl mercury BAF value in order to calculate the concentration of methyl mercury in fish from the uptake of methyl mercury in the dissolved phase.

The methyl mercury dissolved-phase water concentration value of 1.42E-09 mg/L is only 2.3% of the divalent mercury plus methyl mercury summed dissolved-phase water concentration used in the 2003 Risk Assessment document. As the BAF value affects the estimated methyl mercury concentration in fish in essentially a linear manner, the concentration of methyl mercury in fish affects the estimated hazard quotient in essentially a linear manner. By using the lower methyl mercury dissolved-phase water concentration value of 1.42E-09 mg/L, the estimated methyl mercury hazard quotient is expected to be only 2.3% of the value reported in the 2003 Risk Assessment document. This level of adjustment would be expected due to the revision of the 1998 HHRAP guidance that was documented in the final HHRAP guidance released in 2005.

In a similar manner, the dissolved-phase lake concentrations of mercury used in the 2003 Risk Assessment are listed in the table below.

[9] Ibid.
[10] Ibid., Section 5.4.2, page 67.

**Table 4: Dissolved-Phase Lake Water Mercury Concentrations**

| Mercury Species | Mercury Concentration (mg/L)[11] |
|---|---|
| Methyl Mercury | 7.04E-08 |
| Divalent Mercury | 8.41E-07 |
| Methyl + Divalent | 9.11E-07 |

The methyl mercury dissolved-phase water concentration value of 7.04E-08 mg/L is only 7.7% of the divalent mercury plus methyl mercury summed dissolved-phase lake water concentration used in the 2003 Risk Assessment document. By using the lower methyl mercury dissolved-phase water concentration value of 7.04E-08 mg/L, the estimated methyl mercury hazard quotient is expected to be only 7.7% of the value reported in the 2003 Risk Assessment document.

## 3.3 Mercury Emission Rates

The 2003 Risk Assessment document used a mercury emission rate of 6.16E-03g/sec (representing 2 kilns) obtained during the facility's March 1999 RCRA trial burn as the basis for the risk calculations and estimation of mercury HQ. However, since the 1999 RCRA trial burn, the facility emissions became regulated by HWC MACT[12] limits, as described in the 2003 Risk Assessment. The regulations provide for two methods of compliance with a maximum concentration limit for mercury that the facility must not exceed; maximum theoretical emission concentration (MTEC) calculations or total mercury feed rate limits. The actual site-specific mercury emissions must be less than the MACT concentration limit at all times. Also, normal operating mercury inputs and related mercury emissions from the facility have been and will continue to be less than the maximum potential limits. For example, the kilns do not both operate 365 days per year over the entire length of the risk assessment study period. The updated mercury emission limit for the facility has been calculated based on the following:

- The HWC MACT regulatory limit for mercury emissions of 120 µg/dscm was calculated to an equivalent emission rate for one kiln using the average historical stack gas flow rate[13] of 28.3 dscm/s.

$$\begin{pmatrix}\text{Max MACT Hg}\\ \text{emission limit}\end{pmatrix}\times\begin{pmatrix}\text{stack gas}\\ \text{flow rate}\end{pmatrix}\times\frac{\text{1.0E - 06 g}}{\text{ug}}=$$

$$\frac{120\ ug}{dscm}\times\frac{28.3\,dscm}{s}\times\frac{1.0E-06\ g}{ug}=\frac{3.4E-03\ g}{s}$$

[11] Ibid.,Table 5-6.
[12] 40 CFR 63 Subpart EEE National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors (HWC MACT).
[13] Average stack flow data from recent operational records.

- Essroc operates two kilns. Complying with the HWC MACT MTEC approach assumes zero system removal efficiency (SRE) thereby regulating mercury at the feed end of the kilns. In order to derive an appropriate emission rate for both kilns, and considering a comparison to mercury in feed using the MTEC approach, 3 years of recent mercury input values and historical SREs were compiled and evaluated. The analysis shows that a mercury emission rate of 3.4E-3 g/s represents a long-term limit that is conservative when complying with MACT. Using this emission rate to represent both kilns is based on using the same mercury feedrate as the MTEC approach, doubling the feed for two kilns, and applying a conservative[14] SRE of 50%.

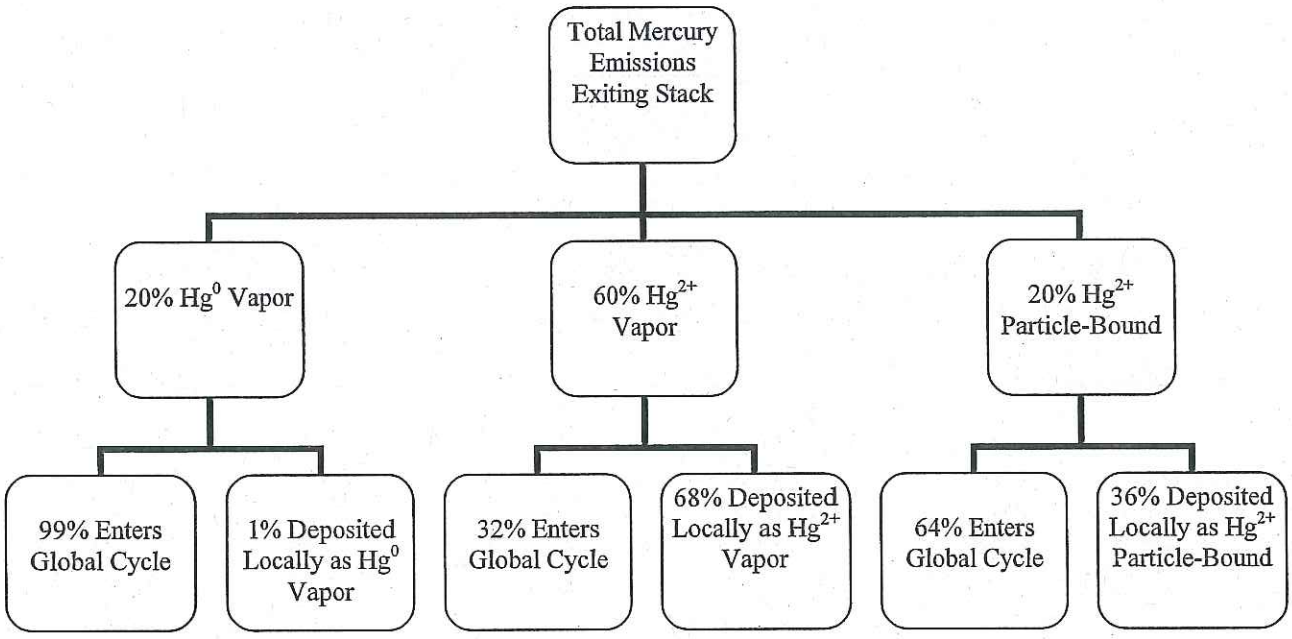
The MACT based mercury emission limit of 3.4E-03 g/sec is 55% of the mercury emission rate used in the 2003 Risk Assessment document. The mercury emission rate is known to affect the estimated hazard quotient in essentially a linear manner. By using the lower mercury emission rate of 3.4E-03 g/sec, the estimated methyl mercury hazard quotient is expected to be only 55% of the value reported in the 2003 Risk Assessment document.

## 3.4 Mercury Speciation

The 2003 Risk Assessment document used the 1998 HHRAP default mercury speciation to determine the amount of mercury attributed to the global cycle, versus that portion that is available to deposit locally using the mercury emission value of 6.16E-03 g/sec. Mercury emissions can exist in different phases (vapor or particle-bound) and also can exist in different forms (elemental or divalent). The allocation of the mercury emissions into these different categories as assumed by the 1998 HHRAP document is depicted in Figure 1. Figure 1 also indicates what percent of each mercury species enters the global cycle and how much mercury is available for local deposition.

[14] The 1999 Trial Burn Report, "RCRA Trial Burn for the Burning of Waste-Derived Fuels for Energy Recovery at Essroc Cement Corp.," APCC, Ltd., March 1999, documented mercury SRE of greater than 90%.

**Figure 1 - 1998 HHRAP Phase Allocation and Speciation of Mercury in Air**




These allocation values have remained the same in the 2005 HHRAP guidance. Using this default distribution, 52% of the emitted mercury enters the global cycle:

Mercury to global cycle = [(20%) x (99%)] + [(60%) x (32%)] + [(20%) x (64%)]
= [19.8%] + [19.2%] + [12.8%]
= 52%

Most of the remaining 48% of emitted mercury is deposited in a divalent (2+) form. It is a fraction of this divalent form that is methylated (i.e., is converted to methyl mercury). It is the methyl mercury form of mercury that has uptake in fish and is the driving factor in the resulting mercury concentration in fish in the risk assessment analysis. It was assumed that 15% of the deposited divalent mercury was methylated in the water body in the 2003 risk assessment.

However, in preparation for the recently signed Portland Cement MACT proposed rule, available industry mercury speciation data for different types of cement kiln systems has been gathered and this data[15] is now available to represent the most recent industry knowledge on mercury speciation. Based on evaluating the database, the trend for wet process cement kilns shows that a substantive portion of the mercury emitted is actually in the elemental phase. The average speciation is as follows:

[15] Portland Cement Association, R&D Number SN3091 (2009), "Compilation of Mercury Emissions Data," Schreiber, R. J. and Kellet, C.D. available at: http://www.cement.org/bookstore/profile.asp?store=&pagenum=&pos=0&catID=&id=16901

**Table 5: Wet Kiln Mercury Speciation Allocation**

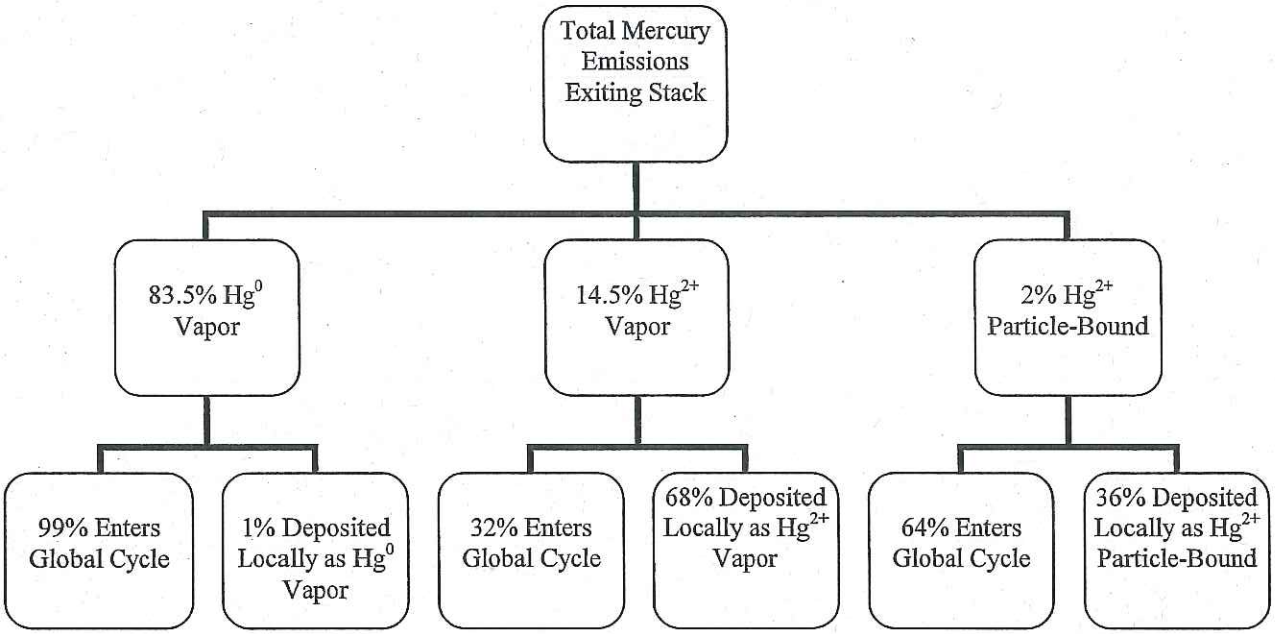
| Mercury Species | % of Mercury Emissions |
|---|---|
| Elemental Vapor | 83.5% |
| Divalent Vapor | 14.5% |
| Divalent Particle-Bound | 2% |

The Essroc Logansport cement kiln is a long wet type kiln. The industry speciation data shows that the wet kiln mercury emissions speciation profile actually differs quite a bit from other types of cement kiln systems. This is expected to be due to the differences in the heat profiles of wet kilns as compared to other types of kilns. In the wet kiln, the raw feed enters as slurry, and the first process that must occur is the evaporation of the water in the raw feed. This evaporation zone may allow for more of the elemental mercury to condense onto cement kiln dust particles that are later released from the dust and are emitted out the stack. In other cement kiln system types, the heat profile may allow for more time at temperatures conducive to the formation of other species of mercury compounds.

The Portland Cement Association (PCA) has compiled mercury speciation emissions data for wet process cement kilns.[16] Using the same calculation steps with wet kiln process-specific speciation data, the allocation of the emitted mercury would be as presented in Figure 2.

[16] Ibid.

**Figure 2 - PCA Wet Process Kiln Phase Allocation and Speciation of Mercury in Air**




Using this distribution, 88.6% of the emitted mercury enters the global cycle:

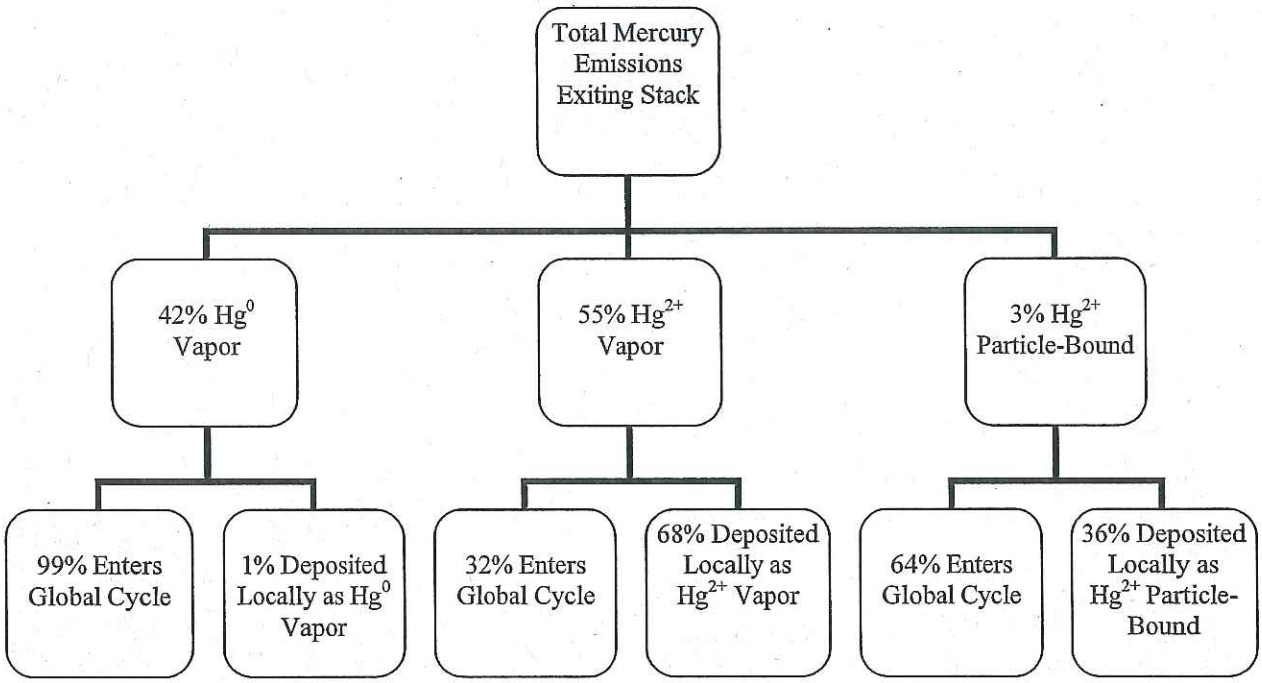
Mercury to global cycle = [(83.5%) x (99%)] + [(14.5%) x (32%)] + [(2%) x (64%)]
= [82.7%] + [4.6%] + [1.3%]
= 88.6%

Most of the remaining 11.4% of emitted mercury is deposited in a divalent (2+) form. The assumption that 15% of the deposited divalent mercury was methylated in the water body has not been amended from the 2003 risk assessment.

The concentration of methyl mercury in fish affects the estimated HQ in essentially a linear manner. By using the more site-specific mercury speciation data, (11.4% of emitted mercury deposited locally instead of 48% of emitted mercury deposited locally) the amount of methyl mercury in the water body is expected to be only 23.6% of the value reported in the 2003 Risk Assessment document. As a result, the expected mercury fish concentration and estimated methyl mercury hazard quotient is expected to be only 24% of the value reported in the 2003 Risk Assessment document.

Another, more conservative, option would be to use mercury speciation data provided by the PCA that was not wet process kiln specific, but rather an industry average across all cement kiln types. Kiln mercury emissions speciation data that was collected across the cement industry and represents emissions from several different types of cement kilns is shown in Figure 3.

**Figure 3 - PCA All Kiln Types Phase Allocation and Speciation of Mercury in Air**




Using this distribution, 61% of the emitted mercury enters the global cycle:

Enters global cycle = [(42%) x (99%)] + [(55%) x (32%)] + [(3%) x (64%)]
= [41.6%] + [17.6%] + [1.9%]
= 61%

Most of the remaining 39% of emitted mercury is deposited in a divalent (2+) form. The assumption that 15% of the deposited divalent mercury was methylated in the water body has not been amended from the 2003 risk assessment.

The concentration of methyl mercury in fish affects the estimated HQ in a linear manner. By using the more industry-specific mercury speciation data (39% of emitted mercury deposited locally instead of 48% of emitted mercury deposited locally), the amount of methyl mercury in the water body is expected to be only 82% of the value reported in the 2003 Risk Assessment document. As a result, the expected mercury fish concentration and estimated methyl mercury HQ are expected to be only 82% of the value reported in the 2003 Risk Assessment document.

## 4.0 RESULTS OF COMPARITIVE ANALYSIS FOR METHYL MERCURY HQ FOR FISH EXPOSURE

The 2003 Risk Assessment document estimated the HQ[17] due to methyl mercury from fish exposure for the typical river adult fisher to be 0.567 and for the typical river child fisher to be 1.00. The high-end river adult fisher and high-end river fisher child HQs were reported as 6.26 and 4.87, respectively. Although these values exceeded the EPA target risk benchmark of a 0.25 HQ, documentation during the permitting process described the level of conservatism. This target risk limit of 0.25 is an adjustment downward from the typical hazard index limit of 1.0 for a constituent. This adjustment is to account for the potential presence of multiple metal constituents and the background contribution of metal from other sources in the vicinity of the area of study since the purpose of the HHRAP approach is to address just the combustion facility's contribution.

However, as documented above, the 2003 reported HQ values estimated the actual methyl mercury HQ for fish exposure by the application of previous air modeling and risk assessment parameters. The updated results estimated through this comparative analysis are based on addressing the parameters described above, and summarized as follows:

- Revised air modeling to include dry deposition
- Revised bioaccumulation factors for methyl mercury in fish
- Removing the application of the methyl mercury bioaccumulation factor (BAF) values from non-methylated divalent mercury
- Lowering emission rates from the 1999 test values to an emission rate based on the current HWC MACT standard
- Application of knowledge of industry-specific mercury emissions speciation data

Although the HQs for fish exposure have been compared and revised, as with any risk assessment document, it is important to consider the sensitivity of these and other assumptions. Therefore, the uncertainty discussion below presents a discussion to address these issues.

The updated air dispersion modeling data and the specific factors assessed above can be compiled for a final comparative analysis by documenting the overall anticipated differences in the 2003 Risk Assessment. The factors addressed are applied by assuming the revisions affect the estimated methyl mercury concentration in fish in an essentially linear fashion, since the mathematics of the models have essentially linear impacts for the parameters included in this report.

Adjustments to the methyl mercury concentration in fish tissue values would change as follows. In order to calculate a new fish tissue concentration value, the reported 2003 concentration of methyl mercury in fish tissue is multiplied by the revised sensitivity factors as demonstrated

[17] Horizon Environmental (March 2003) "Comprehensive Risk Assessment for the Cement Kiln Operations at the Essroc Cement Corporation in Logansport, Indiana;" Horizon Environmental Corporation: Grand Rapids, MI, Table 8-5.

below (example is provided for the river scenario) and summarized for both the river and lake scenarios in Table 6.

$$\frac{(09\text{revised air conc})}{(03\text{air conc-baseline})}\times\frac{(09\text{avg BAF})}{(03\text{max BAF})}\times\frac{(\text{Water conc HgMe})}{(\text{Water conc all Hg})}\times\frac{(\text{MaxMACT Hg ER})}{(99\text{trial burn Hg ER})}\times\frac{(\text{PCA Hg speciation})}{(03\text{ Hg speciation})}$$

Calculation of River Fish Methyl Mercury Concentration

$$2003\text{Fish conc mg/kg}\ x\frac{7.43}{1}x\frac{2.05\text{E+06L/kg}}{6.80\text{E+06L/kg}}x\frac{1.42\text{E-09mg/L}}{6.13\text{E-08mg/L}}x\frac{3.4\text{E-03g/s}}{6.16\text{E-03g/s}}x\frac{11.4\%}{48\%}=2009\text{Fish conc mg/kg}$$

$$5.79\text{mg/kg}x\frac{7.43}{1}x\frac{2.05\text{E+06L/kg}}{6.80\text{E+06L/kg}}x\frac{1.42\text{E-09mg/L}}{6.13\text{E-08mg/L}}x\frac{3.4\text{E-03g/s}}{6.16\text{E-03g/s}}x\frac{11.4\%}{48\%}=0.039\text{ mg/kg}$$

Calculation of Lake Fish Methyl Mercury Concentration

$$2003\text{Fish conc mg/kg}\ x\frac{1.74}{1}x\frac{4.05\text{E+06L/kg}}{6.80\text{E+06L/kg}}x\frac{7.04\text{E-08mg/L}}{9.11\text{E-07mg/L}}x\frac{3.4\text{E-03g/s}}{6.16\text{E-03g/s}}x\frac{11.4\%}{48\%}=2009\text{Fish conc mg/kg}$$

$$6.27\text{mg/kg}x\frac{1.74}{1}x\frac{4.05\text{E+06L/kg}}{6.80\text{E+06L/kg}}x\frac{7.04\text{E-08mg/L}}{9.11\text{E-07mg/L}}x\frac{3.4\text{E-03g/s}}{6.16\text{E-03g/s}}x\frac{11.4\%}{48\%}=0.066\text{ mg/kg}$$

**Table 6: Reported 2003 and Revised 2009 Methyl Mercury Fish Tissue Concentrations**

| Fisher Receptor Source of Fish | 2003 Reported Fish Tissue Mercury Concentration (mg/kg)* | 2009 Revised Fish Tissue Mercury Concentration Using Wet Kiln Data (mg/kg)** | 2009 Revised Fish Tissue Mercury Concentration Using All Types Kiln Data (mg/kg)** |
|---|---|---|---|
| Wabash River | 5.79 | 0.039 | 0.134 |
| France Park Lake | 6.27 | 0.066 | 0.225 |

*Original fish tissue concentrations reported in 2003 Risk Assessment document Table 5-6
** Calculated value

Interestingly, as shown by the 2003 versus the revised 2009 fish tissue concentration results, one can see that the revised results are more in the magnitude generally found in U.S. waters as opposed to the much higher than normal results shown by the 2003 model results.

## 4.1 Comparative Analysis for Wabash River

In a similar manner, adjustments to the predicted methyl mercury HQ values would change as follows. In order to calculate a new HQ value, the reported 2003 HQ value would be multiplied by the revised sensitivity factors as follows:

$$\frac{(09\,\text{revised air conc})}{(03\,\text{air conc-baseline})}\times\frac{(09\,\text{avg BAF})}{(03\,\text{max BAF})}\times\frac{(\text{Water conc HgMe})}{(\text{Water conc all Hg})}\times\frac{(\text{MaxMACTHg ER})}{(99\,\text{trial burn Hg ER})}\times\frac{(\text{PCA Hg speciation})}{(03\,\text{Hg speciation})}$$

Calculation of Typical River Adult Fisher Methyl Mercury HQ

$$2003\text{HQ}\;x\frac{7.43}{1}x\frac{2.05\text{E+06L/kg}}{6.8\text{E+06L/kg}}x\frac{1.42\text{E-09mg/L}}{6.13\text{E-08mg/L}}x\frac{3.4\text{E-03g/s}}{6.16\text{E-03g/s}}x\frac{11.4\%}{48\%}=2009\text{estimated HQ}$$

$$0.567x\frac{7.43}{1}x\frac{2.05\text{E+06L/kg}}{6.8\text{E+06L/kg}}x\frac{1.42\text{E-09mg/L}}{6.13\text{E-08mg/L}}x\frac{3.4\text{E-03g/s}}{6.16\text{E-03g/s}}x\frac{11.4\%}{48\%}=0.004$$

Calculation of Typical River Child Fisher Methyl Mercury HQ

$$1.0x\frac{7.43}{1}x\frac{2.1\text{E+06L/kg}}{6.8\text{E+06L/kg}}x\frac{1.42\text{E-09mg/L}}{6.13\text{E-08mg/L}}x\frac{3.4\text{E-03g/s}}{6.16\text{E-03g/s}}x\frac{11.4\%}{48\%}=0.007$$

The newly calculated HQ values for the fisher scenario obtaining fish from the Wabash River are summarized in Table 7.

**Table 7: Revised Wabash River Fisher HQ Values**

| River Fisher Receptor | 2003 Reported River Fishers HQ* | 2009 Revised HQ Adjusted for Air Dispersion and Risk Factors Using Wet Kiln Data** | 2009 Revised HQ Adjusted for Air Dispersion and Risk Factors Using All Types Kiln Data** |
|---|---|---|---|
| Adult - Typical | 0.567 | 0.004 | 0.013 |
| Child - Typical | 1.00 | 0.007 | 0.023 |
| Adult - High End | 6.26 | 0.043 | 0.145 |
| Child - High End | 4.87 | 0.033 | 0.113 |

* Reported in 2003 Risk Assessment document Table 8-5

** Calculated value

## 4.2 Comparative Analysis for France Park Lakes

EPA also requested the evaluation of risk to fishers from the lakes in France Park. The 2003 Risk Assessment document did not present HQ values for the France Park lakes fishers since significant consumption was not believed to occur at the lakes, as discussed in the 2003 document and reconfirmed with recent conversations[18] with local residents and officials. The 2003 document did, however, include calculated values for mercury concentrations in fish in the lakes. Estimated mercury fish concentrations are directly related to HQ values by the following equation:

$$\frac{\left(\text{concentration HgMe in fish}\frac{\text{mg HgMe}}{\text{kg fish tissue}}\right) x \left(\text{ingestion rate}\frac{\text{kg fish tissue}}{\text{kg body weight/day}}\right)}{\left(\text{reference dose}\frac{\text{mg HgMe}}{\text{kg body weight/day}}\right)} = \text{HQ}$$

A method to estimate mercury HQs for lake fishers is to use the same ratio between the river fishers HQ and the river fish methyl mercury concentration and apply this ratio to the lake fish mercury concentration since the calculation for both the river and lakes would be applied in the same manner.

$$\frac{(\text{2003 reported HQ})}{\left(\text{2003 reported conc MeHg in fish}\frac{\text{mg HgMe}}{\text{kg fish tissue}}\right)} = \frac{(\text{2009 calcuated HQ})}{\left(\text{2009 reported conc MeHg in fish}\frac{\text{mg HgMe}}{\text{kg fish tissue}}\right)}$$

Below is an example using the typical adult river fisher receptor 2003 HQ value of 0.567 and the 2003 reported methyl mercury concentration in river fish of 5.799 mg/kg to calculate the ratio:

(2003 reported HQ) / (2003 fish tissue HgMe concentration) = Calculated Ratio

(0.567) / (5.799 mg/kg) = 0.098 kg/mg

Table 8 calculates this ratio for fisher receptors. The values in column two are divided by the values in column three to calculate the ratios listed in the last column.

[18] Schreiber, Yonley & Associates 2009 conversations with facility employees, local residents and France Park Superintendant Sandy Heckard and Indiana Northern Region Fisheries Biologist's Assistant Chip Long.

**Table 8: Wabash River Fish Tissue Mercury Concentration to HQ Ratio Calculation**

| River Fisher Receptor | 2003 Reported River Fishers HQ* | 2003 Reported River Fish Tissue Methyl Mercury Concentration (mg/kg) ** | Calculated Ratio of HQ to Methyl Mercury Fish Concentration (kg/mg) |
|---|---|---|---|
| Adult - Typical | 0.567 | 5.799 | 0.098 |
| Child - Typical | 1.00 | 5.799 | 0.17 |
| Adult - High End | 6.26 | 5.799 | 1.08 |
| Child - High End | 4.87 | 5.799 | 0.84 |

* Fish Ingestion HQ for Methyl Mercury reported in 2003 Risk Assessment document Table 8-5
** Reported in 2003 Risk Assessment document Table 5-6

The calculated HQ to fish tissue mercury concentration ratio values from river data listed in Table 6 can be applied to the lake fish tissue mercury concentration values to estimate an HQ for lake fishers (based on the assumptions in the 2003 Risk Assessment) as demonstrated in the example below.

(Calculated ratio) x (2009 fish tissue HgMe concentration) = Calculated 2009 HQ

(0.098 kg/mg) x (0.066 mg/kg) = 0.006

Table 9 calculates the HQ for lake fisher receptors based on 2003 reported methyl mercury concentrations in lake fish, the 2003 risk assessment assumptions and incorporating the adjustments calculated above for the 2009 update. The values in column two are multiplied by the values in column three to calculate the values listed in the last column.

**Table 9: Revised France Park Lake Fisher HQ Values Using Wet Kiln Data**

| France Park Lake Fisher Receptor | Calculated Ratio of HQ to Methyl Mercury Fish Concentration (kg/mg) * | 2009 Revised Lake Fish Tissue Methyl Mercury Concentration Using Wet Kiln Data (mg/kg)** | 2009 Revised HQ Adjusted for Air Dispersion and Risk Factors Using Wet Kiln Data** |
|---|---|---|---|
| Adult - Typical | 0.098 | 0.066 | 0.006 |
| Child - Typical | 0.17 | 0.066 | 0.011 |
| Adult - High End | 1.08 | 0.066 | 0.071 |
| Child - High End | 0.84 | 0.066 | 0.055 |

* Calculated by Table 8
** Calculated value

The following results use the more conservative average mercury speciation data specific to the entire cement manufacturing industry to document another approach as summarized in Table 10.

**Table 10: Revised France Park Lake Fisher HQ Values Using All Types Kiln Data**

| France Park Lake Fisher Receptor | Calculated Ratio of HQ to Methyl Mercury Fish Concentration (kg/mg) * | 2009 Revised Lake Fish Tissue Methyl Mercury Concentration Using All Types Kiln Data (mg/kg)** | 2009 Revised HQ Adjusted for Air Dispersion and Risk Factors Using All Types Kiln Data** |
|---|---|---|---|
| Adult - Typical | 0.098 | 0.225 | 0.022 |
| Child - Typical | 0.17 | 0.225 | 0.039 |
| Adult - High End | 1.08 | 0.225 | 0.242 |
| Child - High End | 0.84 | 0.225 | 0.188 |

* Calculated by Table 8
** Calculated value

As expected, due to revisions in the 2005 HHRAP guidance on the fish pathway for mercury, in addition to addressing the revisions to the air deposition and other described parameters, the revised estimated mercury HQ results from fish exposure would decrease as shown in this analysis. This result documents that, although the air modeling revisions show an increase in the deposition to the water bodies, the combination of the revisions in guidance and the use of specific assumptions outweigh the increase due to the revised air modeling.

As shown, using these revised parameters the resulting HQs would be expected to be below the 0.25 benchmark for non-cancer risks, which continues the 2003 risk conclusions that the facility emissions are not expected to cause an adverse effect to human health.

## 5.0 UNCERTAINTY DISCUSSION

Essroc recognizes these additional items addressed in this report contribute to the uncertainty of the risk assessment and comparative analysis results. The following items provide a discussion of some of the uncertainty topics.

- Although not taken into account in the HQ adjustment calculations, the rate of conversion of mercury to methyl mercury (methylation rate) in water bodies of 15%, as adopted by the HHRAP guidance, appears to be overly conservative. As confirmed by EPA's June 2003 memo, a 6% methylation rate in river water bodies would be sufficient as a conservative estimate. The application of the 6% methylation rate would additionally adjust the HQs downward by a factor of 2.5.
- Because of the alignment of the polar grid receptor pattern with prevailing wind vectors used by the ISCST3 modeling program, using a Cartesian receptor grid pattern may alter

the air modeling results. Using a Cartesian receptor grid would also eliminate the area-weighting bias associated with the polar grid (power of 2 versus linear). Therefore, the application of another variation of air modeling may lower the impact of the mercury emissions at the water bodies evaluated in the risk assessment.

- The 2003 risk assessment used the five year average of the highest annual deposition values on the lakes to estimate methyl mercury concentrations in fish from the France Park Lakes. This same approach was used for France Park Lakes in the 2009 air modeling update. The use of the maximum discrete receptor deposition value likely results in a higher deposition value than the standard approach of averaging values over the water body or watershed area, as was applied to the Wabash River in the 2003 risk assessment. If the average deposition values for France Park Lakes (average of the two discrete receptors) were used to be more consistent with the averaging approach performed on the Wabash River watershed, the impact of mercury at the France Park water bodies would be lower by approximately 9%.
- HQ values are based on the facility operating with maximum allowable mercury emission rates 100% of the time for 30 years. It is not possible to operate the facility without any downtime in operations over this span of time, and the site-specific established mercury emission rate will always be lower than the MACT allowable. In addition, the trend for mercury content in waste fuels has been decreasing over time. Also, the general regulatory environment is to continue to decrease long term emissions of mercury.
- Although the default fish consumption rates in the 2005 HHRAP guidance are higher than the site specific values previously approved by EPA for the Essroc 2003 Risk Assessment, EPA confirmed in its 2003 memo that the fish consumption rates used by the 2003 Risk Assessment document are not expected to lead to an overestimate of the methyl mercury hazard index; rather the value is plausible. However, if the 2005 HHRAP default was applied to the results as opposed to the assumptions agreed on in 2003, the revised HQs would increase proportionally to those calculated above.
- The high-end fisher scenarios assume 25% of the fish consumed is from the local waterbody. Based on conversations[19] with local residents and park officials, it is unlikely that anyone uses the France Park lakes as a primary food source as the park has a daily entrance fee and the lakes are not currently stocked with fish.
- Other factors related to the calculation of non-cancer risk of mercury from fish exposure were updated in the 2005 HHRAP guidance and were not specifically evaluated in this analysis. Since the main factors affecting risk from fish consumption were addressed in this comparative analysis, it is believed that other adjustments to the HQ values would be overshadowed by the comparative analysis shown. Therefore, adjustment of other factors not evaluated by this analysis are not expected to have a significant impact on the estimated risk values.

The comparative analysis using the quantitative factors in the body of this report, in addition to the qualitative discussion in this uncertainty section documents that the results of the original 2003 assessment were overestimated, and that anticipated results for receptors consuming fish in the vicinity of the facility are not expected to have non-cancer risks that would be adverse to human health.

[19]Schrieber, Yonley & Associates 2009 conversations with facility employees/local residents and France Park Superintendant Sandy Heckard and Indiana Northern Region Fisheries Biologist's Assistant Chip Long.

# ATTACHMENT 1

# AIR DISPERSION AND DEPOSITION MODELING FILES