MEMORANDUM

TO Matthew Lawson - Manager, Health Hazards Program **DATE** 19 March 2015

CC

FROM Anthony Ciccone, Ph.D., P.Eng. **PROJECT No.** 1522171

REVIEW OF AIR QUALITY ASSESSMENT REPORT – PORT FUELS & MATERIAL SERVICES HAMILTON ENERGY-FROM-WASTE PROJECT (DECEMBER 2014) PREPARED BY CRA (PROJECT #084692(5)&(6))

Introduction

The City of Hamilton – Health Department requested a review of the Air Quality Assessment Report (Appendix F) of the Port Fuels & Material Service (PFMS) proposed Energy From Waste (EFW) project as found in the December 2014 Environmental Screening Report (ESR) as prepared by Conestoga-Rovers & Associates (CRA). The City wish to have an understanding whether the air quality assessment as presented in the ESR is adequate and reliable such that Hamilton Health Office can make further recommendations on the Project.

The ESR and accompanying appendices were downloaded from the PFMS website (http://www.pfmsi.net/#!environmental-assessment/cbur) on the 6 February 2015. Golder Associates Ltd (Golder) scope of work includes reviewing, evaluating and providing comment on the adequacy of the methodology, data and results of the air quality assessment, including emission estimations, modelling and data analysis.

Summary of Project

PFMS are proposing to build and operate an EFW facility on a 17 acre parcel of leased land on Pier 15 in the Port of Hamilton. The EFW facility can process 170,000 tonnes/yr of waste through the Gasplasma system and an additional 30,000 tonnes/yr through the Direct Plasma system. The facility is proposed to accept waste 282 business days per year.

The waste accepted by Gasplasma includes Industrial, Commercial and Institutional (IC&I), Construction & Demolition (C&D), Municipal Solid Waste (MSW), biomass, biosoilds, Tires and liquid waste. The incoming material is processed into Refuse-Derived Fuel (RDF) which is used to generate syngas. The maximum and average waste received is 1,200 tonnes/day and 605 tonnes/day, respectively. The syngas generated by the Gasplasma system will be conveyed to a gas cleaning system to remove impurities and subsequently to seven (7) engines where the gas in combusted to generate electricity and steam. The steam will be used in a steam generator to generate additional electricity. The total electrical output is 20 MWe. The exhaust gases from the engines are conveyed to an air pollution control system to reduce emissions and subsequently to a single stack where the residue emissions are released into the atmosphere.

The Gasplasma process includes the following:

1) Fuel receiving and preparation including material recovery and RDF drying,
2) Syngas generation,
3) Syngas conditioning and cleaning,
4) Power generation and exhaust gas treatment, and

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5) Bypass Thermal Oxidizer

The Direct Plasma will accept scrap metal with precious residues and contaminated soils. This technology will not generate electricity but is used to recover precious metals from the waste with the aid of intense heat from the plasma arc system. This system has a maximum and average capacity of 220 tonnes/day and 110 tonnes/day, respectively. The exhaust gases are conveyed to a thermal oxidizer and baghouse prior to release to the atmosphere.

The Direct Plasma system includes:

1) Blending inorganic waste with lime and coke
2) Separation of metals in Plasma Furnace
3) Treating off-gases prior to release to atmosphere

Residual material from each process is subsequently taken offsite by a suitable transporter.

In addition, the facility includes a back-up steam generator as well as an emergency diesel generator. Waste and feedstock will be received via truck, rail and barge and any residual waste/material will be removed using truck, rail or barge. Once received on-site, the front-end loaders are used to move material to processing areas internal where appropriate.

The Air Quality Assessment was carried out for two (2) scenarios, namely:

1. Normal Operating Conditions refers to all stationary equipment operating at maximum operating rates with the exception of the Bypass Oxidizer
2. Bypass Syngas Conditions refers to all stationary equipment operating at maximum operating rates including the Bypass Oxidizer but the engines are all off line.

General Comments

The effects of the releases to the atmosphere from the Project are addressed in Appendix F of the ESR and include estimates of air concentrations and deposition of compounds released from the Project. The Air Quality Assessment Report (AQAR) addresses the change to airborne concentrations while the deposition data, along with the concentration data, are used in the Human Health Risk Assessment (HHRA). The AQAR summaries existing air quality based on ambient air monitoring data provided by the Hamilton Air Monitoring Network (HAMN) and future concentrations of the Project from dispersion modelling based on the Emission Summary and Dispersion Modelling (ESDM) report of the Project as prepared by CRA.

An ESDM report is used to support Environmental Compliance Approval (ECA) applications and is the minimal requirement for the application. The MOECC have provided guidelines to follow when applying for an ECA as can be found in MOECC document *Air Dispersion Modelling Guideline for Ontario*. As this is not an application for an ECA the exclusion of various sources such as truck traffic, on-site vehicles (indoor and outdoor), comfort heating, etc is not common practice for an environmental assessment.

The selection of the AERMOD model to calculate airborne concentrations and deposition flux of the ground is acceptable. AERMOD was executed assuming that all the facility wide emissions were released from the Engine stack during Normal Conditions or from the Bypass Thermal Oxidizer stack during bypass situations. This needs to be collaborated by reviewing the AERMOD input files but this is an unrealistic model

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parameterization of the Project. In addition, no sensitivity analysis was provided in situations where less than seven engines were in operation. These could lead to higher airborne concentrations even though the emissions have decreased. Further, start-up and shutdown scenarios were not evaluated or explained thoroughly.

The emissions for the Project Gasplasma system are based on source testing of a pilot scale facility in the UK. The composition of the pilot plant feedstock is not provided nor is the composition of the resulting syngas. The engine sizes of neither the pilot plant nor the Project engines are provided but given the exhaust volume from the Project engine, these are significantly larger than the Pilot plant. These are likely internal combustion gas engines and the emissions do not scale linearly based on experience with other systems. Further information is required to confirm the scalability of the engines.

The Project has been designed to accept biomass, biosolids or liquid waste but no information is provided on the storage and handling of these feedstocks.

Emissions from the Bypass Thermal Oxidizer are assumed to be similar to the pilot plant test results although the combustion technologies are different. There is inconsistency between the text, emission tables provided and description provided by the technology provider.

There are a number of errors and inconsistencies in the reports and appendices including meeting the Ontario A7. The in-stack concentrations provide for the Project are referenced to Normal conditions (aka. 0C, 101.3 kPa, dry & 11% O_2) while Ontario A7 guideline use (25C, 101.3 kPA, dry & 11% O_2). Further, the Total Organic Compounds (TOC) and CO in-stack concentration at the engines is reported to be 27.2 and 1460 mg/m^3 in the appendices after controls which are two orders of magnitude different from the AQAR report and the CO is well above the A7 guideline of 40 mg/m^3.

The net effect on carbon dioxide was not proven and is questionable given the quantity of natural gas consumed by the Bypass Thermal Oxidizer.

The impact of the Project on air quality requires significantly more attention and explanation.

Specific Comments and Concerns

A. Baseline/Existing Conditions

1. Appendix A presents the Ambient Air Monitoring Data from the Hamilton Air Monitoring Network (HAMN). Four of the HAMN stations were used to establish baseline conditions primarily because they were located in residential areas of interest. It is unclear why only three years (2011-2013) were used to establish baseline. In addition, US Steel has reduced productivity in 2011 and the results of background levels may be lower due to the reduction in activity.

2. The report refers to two MOECC ambient air monitoring stations in Downtown (Stn 29000) and Hamilton Mountain (29114) as reporting NOx, SO2, PM2.5 and CO. These stations are collocated with Environment Canada NAPS stations 060512 (Downtown) and 060513 (Hamilton Mountain) which report additional metals and VOC data.

3. Data from NPRI for the region of interest are not discussed or present. It is important to compare projected emissions from the Project with existing emissions to understand the potential change in

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atmospheric loadings. In addition, the NPRI data shows compounds which are not captured through ambient air monitoring.

4. The background or baseline levels as presented in Appendix A do not match with the background levels presented in Table 3 -6 of the AQRA.
5. Greenhouse gas emissions from the Project can be compared to the Ontario inventory for context.

B. Project Description (Section 4.0)

6. The Project will receive and process 170,000 tonne/yr of Gasplasma waste over 282 business days. The Project subsequently states the average per regular business day is 605 tonne/day. Over 282 days, this amounts to 170,610 tonne/yr. Similarly for the Direct Plasma which consumes 110 tonne/day, results in 31,020 tonne/yr as compare to the stated capacity of 30,000 tonne/yr.
7. The Project identifies maximum and average consumption/receiving quantifies but it is not clear what quantity of waste is used to generate syngas at maximum capacity.
8. The report states that 20 MWe will be generated from seven (7) gas engines and a steam turbine. The size of the engines and combustion gas usage is not provided. It is unknown how these engines differ from the pilot test engines used to develop the emission releases.
9. The composition of feedstock of the Project versus the pilot plant is not discussed and this would seem to be an important aspect to scale up the Project.
10. Start-up and shut-down conditions are not examined in the operating scenarios. Information on the time required to start the engines or whether they all start in unison or sequentially should be addressed. Under the normal operating scenario, the Project assumes that no syngas is consumed at the By-pass Oxidizer.
11. Quantity of off-spec syngas consumed by the Bypass Oxidizer is not provided. As found in *Appendix E App Document: 166-MB-140523-ASP4 – Emission Data*, the Bypass Oxidizer has three modes of operation, namely Standby, Processing combustion gas during start-up and shut-down and Processing syngas are described. The impact of start-up and shut-down should be addressed.
12. The ESDM report notes that the Auxiliary Steam Boiler will be used during start-up after annual maintenance.
13. There is no information provided on start-up or shut-down of the Direct Plasma system.
14. There is a lack of information on on-site mobile sources such as front-end loaders, forklifts, truck traffic or queueing. These have been ignored in the assessment claiming them to be insignificant sources. More detailed justification is required.
15. There is no information provided on how feedstock from rail and barge will be conveyed to the Waste Reception Building.

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16. There is no information on how biosolids and biomass will be received, stored or handled. The emission profiles do not seem to be reflective of this type of feedstock.

C. Emission Estimations

17. Emission calculations are detailed in the ESDM Appendix A with our comments provided below.

Source to Atmosphere	Yes/No	Comments
A1 – Waste Reception & Fuel Preparation	Yes	Baghouse loading of 5 is low as compared to MOECC recommended 20 mg/m^3 Odour emissions are controlled with RTO are acceptable
A2 – RDF Drier Exhaust	Yes	Baghouse loading of 5 is low as compared to MOECC recommended 20 mg/m^3 Odour emissions are controlled with RTO are acceptable
A3 & A4 – Gas Plasma Extraction Exhaust	Yes/No	Baghouse loading of 10 is low as compared to MOECC recommended 20 mg/m^3 No information provide on A4
A7 – Bypass Thermal Oxidizer	Yes	See below
A8 – Gas Engine Exhaust	Yes	See below
A11 – Direct Plasma Exhaust	Yes	See below
A9 – Auxiliary Steam Boiler	No	No information but Appendix F and ESDM note that the boiler will consume 8.5 MW of natural gas
A10 – Emergency Diesel Generator	Yes	Based on manufacture guarantee

18. Emissions from on-site vehicles have not been estimated including trucks, fork lifts, front end loaders as well as for building heating. These emissions should be calculated and included in modelling for environmental assessments.

D. Gas Engine Exhaust

Gas Engine Exhaust (A8) emissions have been based on stack testing data from a pilot plant (Swindon Plant) in Swindon, UK as well as Durham-York EFW and the Algonquin EFW. The results of the three (3) source testing campaigns are provided in ESDM Appendix D – *Catalyst Environmental Test Reports* for the pilot plant. The average of the three in stack concentrations tests are used to determine the uncontrolled emission rates for the various compounds (Table A.3). These uncontrolled emissions are adjusted to account for emission control equipment proposed for the Project.

19. The size of the pilot engine, the load on the engine and the consumption rate of syngas are not provided in reports but it is likely they are smaller than the engines proposed for the Project. The volumetric flowrate for the pilot plant engine is 149 Nm^3/hr or 0.041 Nm^3/s as compared to 3.81 Nm^3/s per engine

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(i.e., 26.71 Nm^3/s divided by seven engines) for the Project. Extrapolating the emissions to a larger size may not be appropriate. Larger engines will tend to have inefficiencies and generate higher emissions. It is not apparent how the Project flowrates have been developed.

20. The in-stack concentrations are referenced to normal (N) conditions defined as 273K (0C), 101.3 kPa, dry and 11% O_2 while the Ontario in stack emission limits (as per MOECC A7 Guideline) are referenced to 298K (25C), 101.3 kPa, dry and 11% O_2 (i.e. R conditions). Table A.3 presents concentrations based on R conditions but they are actually Normal conditions.

21. Table 4.b presents in-stack concentrations used for the Project based on the Durham-York EFW and emission factors for the Algonquin EFW which are both mass burn systems. The in-stack concentrations for the Durham-York EFW are referenced to R conditions not Normal conditions, so the wrong volume flowrate is used to calculate the emissions. The flowrate should be slightly greater for R conditions generating higher emission rates. Further, the use of emission factors based on hourly RDF is not appropriate given that the two technologies (gasification vs mass burner) are significantly different.

22. On AQAR Table 1, the in-stack concentrations after controls from the Project are compared to MOECC Guideline A-7 Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Treatment Facilities (October, 2010). The Ontario Guidelines are reference to R conditions while those used for the Project are Normal conditions. In addition, the TOC and CO were incorrectly transcribed from ESDM Table A.3 showing them to be two orders of magnitude greater than presented on Table 1 of the AQAR. This shows that the CO is well over the A-7 guideline value.

	Source A8 **mg/Nm^3**	**Source A8** **mg/Rm^3**	**A-7 Guideline** **mg/Rm^3**	**% of A7**
Total Organic Compounds (TOC)	27.2	24.92	33	75.5%
Carbon Monoxide	1456	1333.85	40	3334.6%
Hydrogen Chloride	0.52	0.48	27	1.8%
Nitrogen Oxides	44.27	40.56	198	20.5%
Sulphur Dioxide	20.16	18.47	56	33.0%
Total Particulate Matter	0.3	0.27	14	2.0%
Cadmium	0.0018	0.0016	0.007	23.6%
Lead	0.0058	0.0053	0.06	8.9%
Mercury	0.0005	0.0005	0.02	2.3%
Dioxins and Furans (TEQ) (pg/m3)	17	15.57	80	19.5%

E. Bypass Thermal Oxidizer

Bypass Thermal Oxidizer (A7) operates under two modes, namely hot standby (Normal Conditions) and Bypass condition.

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23. Under hot standby, the Thermal Oxidizer consumes about 42 m^3/hr (1.5 MMBTU/hr) of natural gas or 440 kW. US EPA emission factors were used to calculate the emissions from the consumption of natural gas. A summary of the emissions is presented on ESDM Table A.5a but the Rated Capacity of the Thermal Oxidizer is presented at 29,029.022 BTU/hr or 8500 kW.

24. The stack exit temperature and flowrate is shown as 800C and 23.57 Am3/s on ESDM Table 2.A. No reference or calculation is provided for the flowrate under ESDM Appendix A or Appendix E.

25. Under Bypass Conditions, the off-spec syngas is conveyed to the Thermal Oxidizer and combusted. The quantity or composition of syngas is not provided in reports or Appendices. In ESDM Appendix A, the report states that the emission profile for the Thermal Oxidizer will be similar to that of the engines and emission data used for the engines can be used for the Thermal Oxidizer. Although the text states the emissions from the Thermal Oxidizer presented on ESDM Table A.5b the gaseous compounds (CO, etc) in-stack concentrations (or emission factor) do not match those of Table A.4a or A.4.b but are provided in Appendix E. The NOx and CO emissions are lower in Table A5.b than provide in Appendix E. It is unclear how the reduction is achieved.

26. The AQAR states that the Project "will be a reduction in carbon dioxide equivalent emissions because the facility will use existing waste including organic materials that will displace fossil fuel emissions and reduce methane". No information is provided to support this claim on the amount of CO2e reduction. Given the information provided for the Bypass Thermal Oxidizer on hot standby and taking into account that it is operating 95% of the year, the amount of natural gas it would consume is 350,000 m^3/yr which is enough to heat about 160 homes. This amounts to over 700 tonnes CO2e/yr.

27. Direct Plasma (A11) is used to extract precious metal dust from steel shavings or turnings but the AQAR states that it can accept contaminant soils. The data provided only addresses stainless steel waste.

    i. Start-up and shut down conditions are not addressed.
    ii. The system adds lime and coke to the process but no information is provided on storage, handling of these two feeds.

F. Dispersion Modelling

28. Modelling for airborne concentrations was carried out following the MOECC guidelines (*Air Dispersion Modelling Guideline for Ontario*) and detailed in Appendix B - ESDM report of Appendix F using the MOECC accepted model AERMOD. MOECC pre-processed meteorological data (2004-2008) and terrain data were also utilized.

29. As per guideline, a nested receptor grid out to 5 km was used to evaluate the impact of the Project. The grid was extended to 10 km as initial results showed the impact to be near the 5 km limit as well as the addition of three sensitive receptor grid groups around the communities of Keith, South Sherman and Hamilton Mountain. These four receptor grids were used to determine the maximum airborne concentrations of the various compounds.

30. The following sources under the Normal and Bypass Oxidizer Scenarios were identified as elevated point sources (i.e. stacks).

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Source to Atmosphere	Normal	Bypass Oxidizer
A1 – Waste Reception & Fuel Preparation	Yes	Yes
A2 – RDF Drier Exhaust	Yes	Yes
A3 & A4 – Gas Plasma Extraction Exhaust	Yes	Yes
A7 – Bypass Thermal Oxidizer	Hot-Stand-by	Yes
A8 – Gas Engine Exhaust	Yes	No
A11 – Direct Plasma Exhaust	Yes	Yes
A9 – Auxiliary Steam Boiler	Yes	Yes
A10 – Emergency Diesel Generator	Yes	Yes

31. Emissions from on-site equipment, trucks and roads were not included in the modelling. In addition, emissions from building ventilation including comfort heating or indoors mobile equipment were not included. As part of environmental assessment these sources should be addressed.

32. Five years of processed meteorological data from the MOECC was obtained based on the Woodward station for the years 2004-2008. A more recent meteorological data set which coincides with the ambient air monitoring data would have been preferred. It is unclear if this data set also included precipitation which would be used for deposition modelling.

33. Modelling also allowed for building and stack tip downwash in calculating hourly, 24-hr and annual concentrations over the 5-year period. AERMOD calculates concentrations (and deposition) on an hour by hour basis over the entire computational grids described above. In addition, airborne concentrations were calculated without deposition (i.e. plume depletion) which maximises the airborne levels. These are acceptable assumptions.

34. As the Project will be located in an industrial area with US Steel and ArcelorMittal Dofasco, who have a large thermal footprint, the AERMOD URBANOPT which accounts for large surface heating should have been used. This will change the dispersion effects and change the location and magnitude of the impacts.

35. It is unclear how AERMOD was executed as the electronic files or copies on the input files are not on-line. The AQAR suggests that only the major sources engine stack (A8), Bypass Thermal Oxidizer (A7) and Direct Plasma (A11) were modelled individually and not as an aggregate or multi-stack scenario. The three stacks have different stack parameters which will not generate a realistic impact. As shown on AQAR Table 2A (Table 4A of ESDM), for the Normal Operating Condition, the facility wide emissions were modelled as if released through Source A8 as stated in Footnote 2. For the Bypass Operating Conditions (AQAR Table 2B; ESDM Table 4B), facility wide emissions are release through Source A7. Clarification is needed as why this was carried out and whether this was carried out for all compounds.

36. The Normal Operating Scenario assumes all seven (7) gas engines are on-line and exhaust gases are conveyed and vented through A8 which is the maximum production scenario. When less than seven units are in operation, the volume of exhaust gas will be reduced through A8 and this will generate a lower plume rise and potentially higher concentrations, even though fewer emissions are released. The

sensitivity to operating less than seven engines has not been examined to demonstrate the potential impact.

37. While there is no AAQC for PM2.5, the MOECC has set a guideline 25 µg/m³ for a single source to meet the Canada Wide Standard of 30 µg/m³. As shown in ESDM Table 4A and 4B, the Project is predicted to contribute 22.7 µg/m³ at the maximum point of impact as compared to the background of 16.3 µg/m³ (Table 1 of Appendix A – Ambient Air Monitoring).

38. For PM2.5, the Canada Wide Standard is calculated as the running 3-year average of the annual 98th percentile of the daily ambient measurements (MOECC, 2011). New Canadian Ambient Air Quality Standards (CAAQS) for particulate matter are set to be implemented in 2015 and include 24 hour and annual averages. A 24-hour average PM2.5 CAAQS of 28 µg/m³ will apply starting in 2015, and will be reduced to 27 µg/m³ in 2020. Starting in 2015, the annual PM2.5 CAAQS will be 10 µg/m³, which will be reduced to 8.8 µg/m³ in 2020.

G. Deposition Modelling

39. Deposition modelling was carried out in a similar fashion as the dispersion modelling but with plume depletion and wet and dry deposition options in the AERMOD model turned on. The annual deposition rates (or flux) of various compounds to the surface at the four gridded receptor groups were calculated. The airborne concentrations and deposition fluxes were provide to HHRA for further processing. The airborne concentrations passed to the HHRA with deposition are likely less than those found in the ESDM since plume depletion is included in the HHRA concentrations.

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