FICHTNER

Consulting Engineers Limited

Rivenhall IWMF EP Variation

Gent Fairhead

Schedule 5 Notice – Response

ENGINEERING CONSULTING

Document approval

	Name	Signature	Position	Date
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Checked by:	James Sturman		Senior Environmental Consultant	23/04/19

Document revision record

Revision no	Date	Details of revisions	Prepared by	Checked by
0	23/04/19	First Draft	SMO	JRS
1	26/04/19	Issue to EA	SMO	JRS

Contents

1 Advanced SNCR

Section 2.2 of your Environmental Permit Variation Supporting Information document (reference S1552-0740-0001SMO) states that reduced emission limits for nitrogen oxides would be achieved using an advanced version of the currently permitted SNCR system.

Provide further quantifiable evidence and representative operational data from an equivalent representative plant or plants to demonstrate why your proposal can be considered to represent Best Available Techniques (BAT).

The Applicant notes that relatively few plants in Europe are required to achieve an emission limit of 100 mg/Nm^3 using SNCR. Existing plants generally have an emission limit of 200 mg/Nm^3 with SNCR or 70 mg/Nm^3 with SCR. The applicant can provide the following evidence to support the assertion that the proposed emission limits can be achieved on a consistent basis.

1. As part of the data gathering exercise to support the new waste incineration BREF, emissions data was collected from a variety of energy-from-waste plants across Europe. The data is for plants operating in 2015. This data is published in Annex 8.6 of the draft final WI BREF. Figure 8.15, reproduced in Appendix A, shows the plants with the lowest NOx emissions (Figures 8.16 and 8.17 show the plants with higher emissions). The figure shows, for each plant, the annual average (blue diamond), the highest daily average excluding other than normal operating conditions ("daily fine", pink circles) and the highest daily average except for maintenance and when the plant is burning support fuel ("daily base", green triangle). These are explained on page 149 of the draft final WI BREF. Of these, the most relevant is the "daily fine" as this shows the emissions data which are achieved on a consistent basis.

   The figure shows that there are at least 9 lines across Europe which achieved annual average emissions of NOx below 100 mg/Nm^3 with SNCR only (DE48-1, DE47-1R, DE48-2, DE47-2R, FR019R, DK02-2, IT1-2, IT1-1, FR087-3R) and that for seven of these lines, this emission level was achieved on a daily basis, excluding other than normal operating conditions (the "daily fine" concentration). The seven lines range from 7.5 tph to 320,000 tpa and are considered to be representative of the proposed capacity for the CHP Plant.
2. The Applicant also notes that the range of achieved emissions with SNCR is shown in the final draft WI BREF as 80-180 mg/Nm^3 (Table 4.31 on page 397). Therefore, the proposed emission limit falls within this range.
3. The Applicant's consultant is involved with a number of different proposed energy-from-waste plants and has received proposals from a number of leading technology suppliers. While we cannot provide this information directly, we can confirm that a number of these companies are happy to guarantee a daily emission limit of 100 mg/Nm^3 with ammonia slip of 10 mg/Nm^3, and we note that these companies would be subject to significant financial penalties if these guarantees are not achieved.
4. The Applicant has consulted ERC-Technik GmbH, a supplier of SCR and SNCR systems. ERC has provided a partial reference list (included in Appendix B) which includes 9 plants with guaranteed emission limits for NOx of 100 mg/Nm^3 or less and guaranteed ammonia emissions of 10 mg/Nm^3 or less. These are Avesta (26 MWth capacity, constructed in 2001), Linkoping (68 MWth, 2004), Klemetsrud (2 x 30 MWth, 2004), Finspangs (50 MWth, 2004), Amsterdam (2 x 113 tph, 2006), Borlange (60 t/h, 2008), Passy (18.5 tph, 2012), Giessen (10 MWth, 2015) and Bonn (33 t/h, 2016). There are also two plants with guaranteed NOx of 100 mg/Nm^3 or less and guaranteed ammonia of 15 mg/Nm^3.

   All of these plants are equipped with grates and SNCR systems. They all process household waste. They have been installed in Sweden, Austria, Germany and France. They cover a range of plant sizes, from 10 MWth to 113 tph. This compares to the CHP Plant, which would have a thermal capacity of 92 MWth per stream and a waste throughput of 37.5 tph per stream.

5. ERC has provided operational data) from one of these plants – the first Linkoping plant -for a period of one month. This is a grate plant processing household waste with a thermal capacity of 68 MWth, which is about 75% of the capacity of each stream of the CHP Plant. It began operations in 2007 and the data provided is from October 2008. It is also included in Appendix B. The data presented has been adjusted to the appropriate reference conditions. It can be seen that the daily nitrogen dioxide emissions were below 100 mg/Nm^3 for every day in the dataset.

The Applicant considers that this evidence shows that the proposed emission limits have been achieved at a number of European plants, that they are consistent with the draft WI BREF and that companies which are developing, selling and guaranteeing this technology are confident that they can be achieved.

The Applicant has shown how this evidence responds to each of the specific points below.

This must include but not necessarily be limited to the following:

- **Evidence and data to demonstrate that the stated reduction in long term (daily) NOx emissions from 150 mg/m3 to 100 mg/m3 and short term (half hourly) emissions from 400 mg/m3 to 200 mg/m3 will be achievable in practice on a consistent basis.**

All of the evidence above demonstrates that the reduction in daily NOx emissions can be achieved in practice on a consistent basis.

The second graph in Appendix B.2 shows the instantaneous nitrogen dioxide emissions (the light blue line) and it can be seen that these do not exceed 200 mg/Nm^3.

- **Evidence and data to demonstrate that the stated increase in tonnes of NOx emissions abated by the advanced SNCR system from 500 to 650 tonnes per year will be achievable in practice on a consistent basis**

The Applicant cannot provide evidence for the specific number of tonnes of NOx abated, as this will depend on the NOx produced in the first place. The figures of 500 and 650 tonnes per year are based on the reduction in long term emissions from 150 mg/Nm^3 to 100 mg/Nm^3, which is addressed under the first bullet point, and on the estimated unabated concentration of 315 mg/Nm^3.

- **Evidence and data to support ammonia slip reduction taking into account that you are proposing a reduction in the daily NOx emission limit from 150 mg/m3 to 100 mg/m3.**

The second graph in Appendix B.2 shows the ammonia emissions (the purple line). While there are some instantaneous peaks, the average concentration is below 2 mg/Nm^3.

- **A justification of why the plant or plants from which the operational data has been obtained can be considered to be representative of the proposed plant at Rivenhall including consideration of furnace design, waste type, feedstock, throughput, advanced SNCR design and any other relevant factors.**

All of the plants listed under items 1, 4 and 5 above are equipped with moving grates, conventional boilers and SNCR systems. The precise design details of the SNCR systems are not available, but all operate by injecting the reagent into the boiler at the correct points and all achieve the required emission limit.

All of the plants listed under items 1,4 and 5 process municipal solid waste.

The throughputs of the plants vary but they include plants with smaller, similar and larger capacities than the CHP plant. The fact that plants with a range of throughputs can achieve the required emission limit provides reassurance that this does not depend on the size of the plant.

2 Equivalent Emissions

In section 4.2 of the application supporting information document (reference S1552-0740-0001SMO) you have justified Best Available Techniques (BAT) on the basis that impacts have not changed significantly from those previously accepted as BAT.

Our web guidance in line with the requirements of the Industrial Emissions Directive (IED) states:

"If your alternative technique will provide a level of environmental protection that's equivalent to the BAT, you need to explain how it will do so in the operating techniques section of the application form. If your technique won't provide equivalent environmental protection, but you want to make a case that it's justified on cost benefit grounds, you'll need to provide a justification in the operating techniques section of the form and through your risk assessment and cost benefit analysis.

https://www.gov.uk/guidance/best-available-techniques-environmental-permits#how-to-propose-an-alternative-technique."

As you are proposing alternative techniques to those considered BAT, you are required to demonstrate that the alternative stack height and abatement proposals provide an equivalent or a higher level of environmental protection to those already determined to be BAT.

At present your application suggests there would be an increase in process contributions (as shown below), but does not demonstrate why this increase is equivalent or better than the existing proposal.

- **Table 3.2 predicts an increase in NOx annual process contribution from 2.19% to 3.27% of the Environmental Standard (ES).**
- **Table 3.3 predicts an increase in NOx annual process contribution at one receptor (All Shots Farm) from 0.60% to 1.40% of the ES so that it cannot be screened out as insignificant**
- **Table 3.2 VOCs process contribution (as benzene) increases from 2.97% to 6.56% of the ES**
- **Table 3.2 VOCs process contribution (as 1, 3-butadiene) increases from 6.60% to 15.57% of the ES**

In line with the requirements for demonstrating alternative BAT techniques, provide further information to demonstrate why your proposals for a 35 m metre stack with advanced SNCR abatement will provide a level of environmental protection that's better than or equivalent to the 58 m stack and SNCR design which has previously been determined as BAT.

This must include a justification for the differences (as shown above) in the following emissions:

a. **Oxides of Nitrogen**
b. **Volatile Organic Compounds**
c. **Heavy metals**

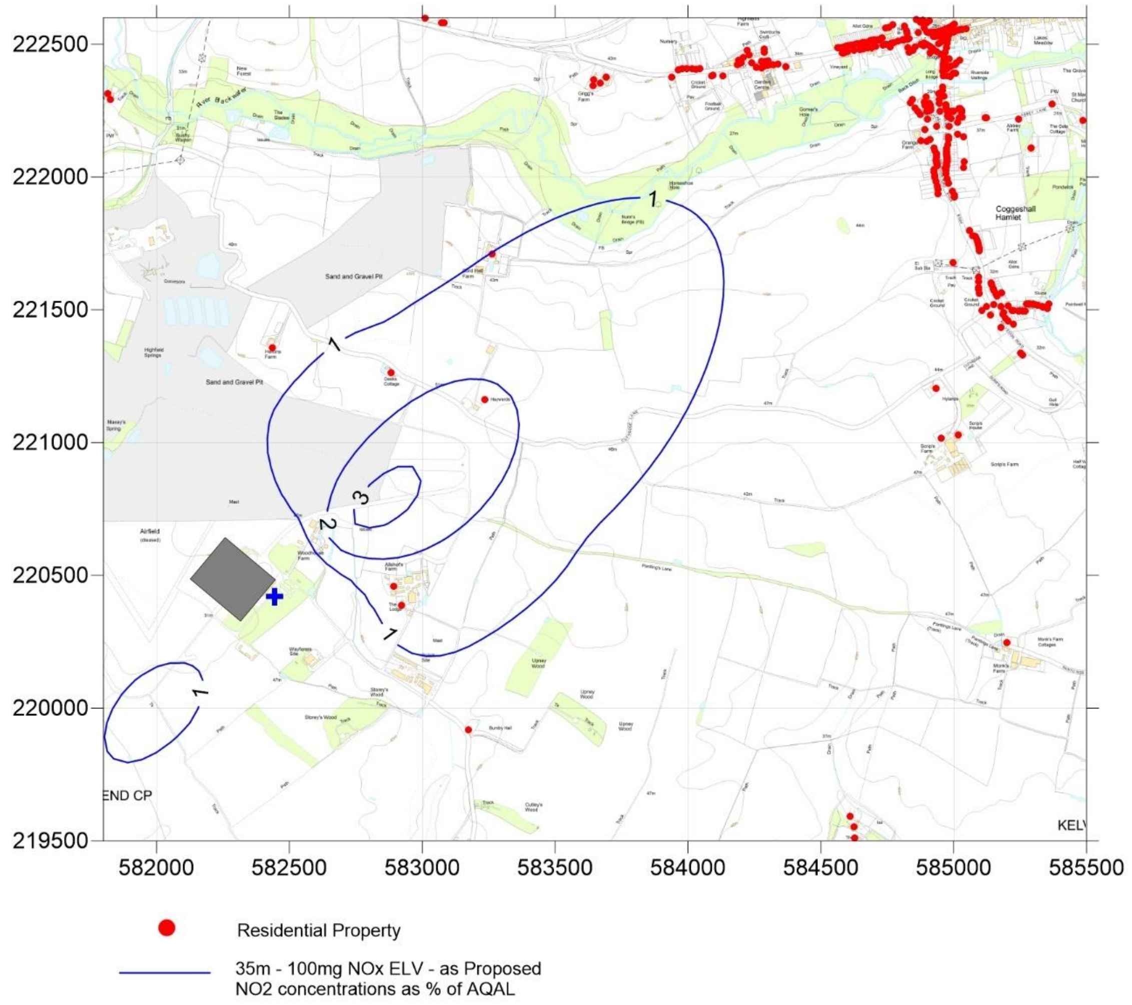
Before addressing the specific questions, the Applicant notes that "an equivalent level of environmental protection" does not mean that the impacts should be identical in every location. It is possible for an increase in impact in one location to be balanced by a reduction elsewhere. The Applicant also notes that, if the impact is considered to be "insignificant" both with a 58m stack and with a 35m stack, then the level of environmental protection should also be considered to be equivalent.

Oxides of Nitrogen

The EA has focussed on two concerns.

First, the EA notes that the predicted process contribution at the point of maximum impact has increased. While this is correct, it does not mean that this will have any environmental effects. The point of maximum impact with the 35m stack is closer to the IWMF (the Facility), as would be expected. This location is uninhabited, as shown in Figure 1 below, and so there is no risk to human health from the change in process contribution at the point of maximum impact.

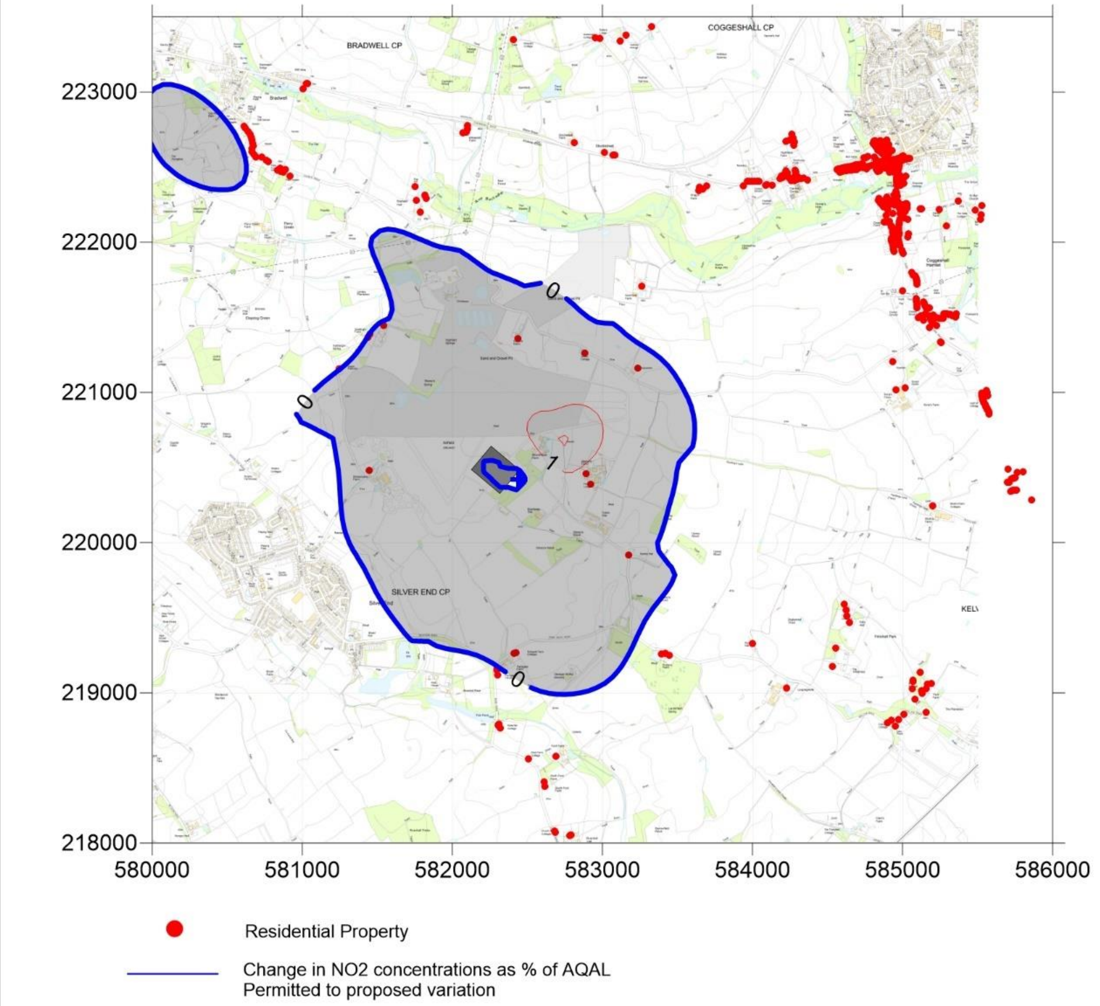
Figure 1: Nitrogen dioxide process contribution



Secondly, the EA notes that the predicted process contribution at one receptor (Allshots Farm/The Lodge) has increased so that it can no longer be screened out as insignificant. This is correct. However, it should be balanced against the reduction in process contribution at a number of other receptors. The maximum process contribution at Curd Hall Farm has reduced, so that it can nearly be screened out as insignificant, and the concentration in Coggleshall and Silver End has reduced; therefore, reducing the overall impact at the more populated areas which will be affected by emissions from the IWMF.

This is illustrated in Figure 2 below, which shows the change in maximum annual average nitrogen process contribution of dioxide as a percentage of the AQAL. The maximum process contribution increases in the shaded area, which includes a small number of isolated receptors, and decreases outside this area, which includes Coggleshall and Silver End. The area in which the process contribution increases by more than 1% of the AQAL is very small and contains no receptors.

Figure 2: Change in annual average nitrogen dioxide concentration.



The Applicant continues to consider, for the reasons stated in section 3.2.1 of the supporting information and taking account of the responses above, that the proposed reduction in stack height and reduction in NOx emission limit will give an equivalent level of environmental protection as a whole.

The Applicant also wishes to re-emphasise that the actual environmental impact of nitrogen dioxide emissions remains extremely small. In particular:

1. The maximum process contribution occurs in an area with no human habitation and is lower than all but three of the thirteen large energy-from-waste plants which have been permitted by the Environment Agency and which are referred to in the original decision document;

2. The predicted environmental concentration at the point of maximum impact is less than half of the air quality objective and lower than all of the thirteen large energy-from-waste plants which have been permitted; and
3. The area in which the process contribution is larger than 1% contains only five residential properties.

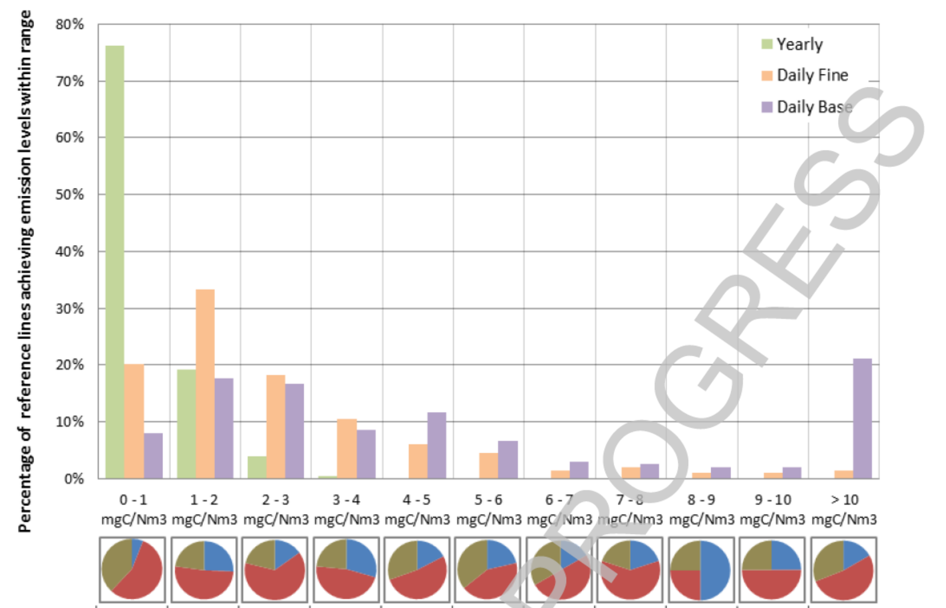
Given this extremely low impact, there is no significant risk to human health and the Applicant would suggest, therefore, that the stack height "safeguards human health", as required by Article 46(1) of the IED.

VOCs

As explained in section 3.2.2 of the supporting information, although the predicted process contribution of benzene and 1,3-butadiene has increased, emissions of these substances are still unlikely to give rise to significant pollution and so the level of environmental protection is the same.

There are two main reasons for this conclusion.

1. First, the assessment is based on the assumption that the Facility will operate at the emission limit of 10 mg/Nm^3 for VOCs for the entire time and that the emissions of VOCs will consist of entirely benzene or entirely 1,3-butadiene. Both of these assumptions are considered to be very conservative.
   a. Figure 3.17 in the final draft WI BREF, reproduced below, shows that the annual average VOC emissions were less than 1 mg/Nm^3 for 76% of municipal waste to energy plants in the sample in 2015, less than 2 mg/Nm^3 for 95% of them and less than 3 mg/Nm^3 for virtually all of them. This indicates that the actual emissions of VOCs are likely to be less than 20% of the emission limit.



	0 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 - 10	> 10
Small	6%	26%	15%	29%	17%	21%	17%	20%	50%	25%	17%
Medium	56%	51%	64%	47%	52%	43%	50%	60%	25%	50%	52%
Large	38%	23%	21%	24%	30%	36%	33%	20%	25%	25%	31%

Source: [81, TWG 2016]

Figure 3.17: Continuously monitored TVOC emissions to air from reference lines incinerating predominantly MSW

b. While there is limited data on the speciation of VOC emissions from energy-from-waste plants, the data which does exist suggests that benzene and 1,3-butadiene make up small percentages of the total VOC emissions.
   i. A 2005 report on behalf of the Swedish Association of Waste Management (included as Appendix C.1) includes measurements of VOC concentrations at grate-based energy-from-waste plant. The results are shown in Table 3 in the paper. Under normal operation, the total VOC concentration was only 0.16 mg/Nm^3 and the only species detected was methane. Even when operated in a sub-optimal manner to produce more VOCs, 1,3-butadiene was never more than 0.7% of the total VOC emissions and benzene was no more than 6%.
   ii. A 2016 report from Empa and ETH Zurich (included as Appendix C.1) includes measurements of VOCs from two energy-from-waste plants in Switzerland. These have different abatement technologies than those proposed for the CHP Plant, but these would not be expected to have a significant effect on VOC concentrations. The total VOC concentrations are, again, very low (50 ug/m^3 and 30 ug/m^3). The concentration of 1,3-butadiene is not reported. The total concentration of aromatic compounds (which includes benzene) is about 10-12%.

   It is clear, therefore, that the actual emissions of VOCs will be approximately 30% (or less) of the emission limit and that benzene will make up less than 20%, probably less than 10%, of the VOCs released. Hence, the actual emissions of benzene will be less than 6% of the emission limit. This means that the process contribution will be 6% of 0.33 µg/m^3, or 0.0198 µg/m^3, which is 0.4% of the AQAL. The actual emissions of 1,3-butadiene will be even lower than this, but even a process contribution of 0.0198 µg/m^3 would be less than 0.9% of the AQAL.

2. Secondly, the background concentration of benzene and 1,3-butadiene is less than 10% of the relevant AQAL.

This means that the actual process contribution from VOC emissions could be screened out as insignificant and that there is no significant risk of exceeding the AQAL. Hence, as before, the proposed stack height “safeguards human health”, as required by Article 46(1) of the IED.

Heavy metals

Although the EA has asked for comment on heavy metals, the question does not explain the specific concern. The Applicant notes the conclusions of sections 3.2.3.1 and 3.2.3.2 of the supporting information, which were that there is no risk of exceeding the long term or short term AQAL for any metal and no risk of significant pollution. As this conclusion is consistent with the conclusions of the assessment submitted for the permitted plant, the Applicant considers that the level of environmental protection is equivalent.

3 Change in Sulphur dioxide limits

Section 2.3 of the application states that "The Applicant is confident that the control system will be able to control peak concentrations of sulphur dioxide to ensure that the half-hourly concentration remains below 90 mg/Nm3".

Demonstrate and provide evidence to support why the Applicant is confident this emission limit is now achievable and explain why emissions are now proposed to be lower than in the previous application.

As explained in the original air quality assessment, the CHP plant will be designed to operate below the daily emission limit for sulphur dioxide of 50 mg/Nm^3 and would only operate above this on rare occasions. The standard half-hourly emission limit is 200 mg/Nm^3 but the Applicant will commit to a reduced half-hourly emission limit of 90 mg/Nm^3.

The CHP plant will include sulphur dioxide measurements in the raw flue gas and the clean flue gas, which will be used in the control system to vary the lime injection rate, in order to keep the concentration below 50 mg/Nm^3. On some occasions, the sulphur content of waste can vary quickly and the sulphur dioxide concentration can then exceed the daily emission limit for a short period, but will be kept below the half-hourly emission limit. By applying for a reduced half-hourly emission limit, the Applicant is committing to keeping the sulphur dioxide emissions under even closer control, while continuing to be committed to meeting the daily emission limit.

The applicant is not aware of any other plant which is required to achieve a half-hourly emission limit of 90 mg/Nm^3. However, as part of the process to develop the waste incineration BREF, a large amount of emissions data was collected and published in the final draft WI BREF. Figures 8.57, 8.58 and 8.59 summarise the half-hourly emissions of sulphur dioxide from 204 reference lines which predominantly burn municipal waste. These have been reproduced in Appendix D.

There is a lot of data on these graphs, but we wish to focus on the pink solid circles which show the 61st highest recorded half-hourly concentration of sulphur dioxide, excluding periods of abnormal operation. (The 60 highest figures are excluded, which covers around 0.03% of the 17,520 measurements over a year and so this shows the level which can be achieved for the vast majority of the time). It can be seen that this figure is below 90 mg/Nm^3 for all of the lines on Figures 8.57 and 8.58 (and actually is at or below 50 mg/Nm^3 for these lines) and below 90 mg/Nm^3 for over half of the lines on Figure 8.59. There were only 32 lines for which the figure exceeded 90 mg/Nm^3, and it should be noted that these lines were not required to achieve this figure.

The Applicant concludes from this data that it is possible for current lines to control short term emissions of sulphur dioxide to meet the requested emissions limit. However, it is important to note that there is no risk that the short term AQAL would be exceeded even if the half-hourly emission limit remained at 200 mg/Nm^3. The maximum process contribution would be 19.62% of the AQAL, but the PEC would only be 24.2%. The data analysed above demonstrates that high concentrations of sulphur dioxide would only occur very rarely; and therefore, there is a low probability that it would happen at the same time as the weather conditions which lead to peak ground level concentrations.

The EA has questioned why emissions are proposed to be lower than in the application for the permitted plant. The premise of this question is incorrect. The Applicant always intended to operate the CHP plant to achieve the daily emission limit at all times, but the higher half-hourly emission limit is included to allow for occasional peak concentrations. With the proposed lower half-hourly emission limit, the Applicant will have less leeway for occasional peak concentrations, but the longer term emissions will be unchanged.

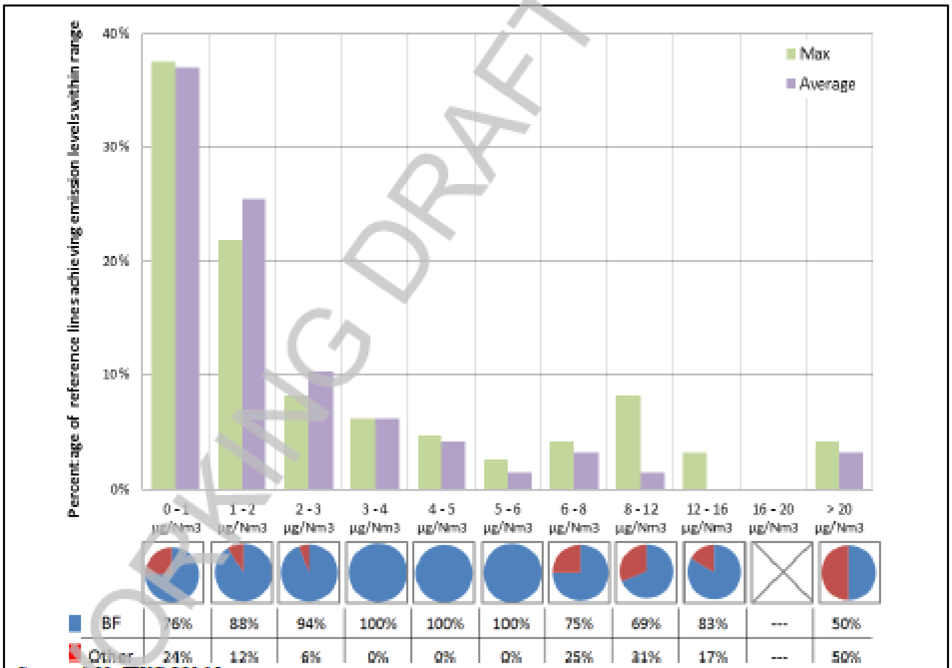
4 Cadmium and thallium limits

The application proposes to reduce the cadmium and thallium emission limits for A1 and A2 from 0.05 mg/Nm3 to 0.02 mg/Nm3. The Applicant has committed to achieve this BAT-AEL from the commencement of operations and prior to implementation of the requirements of the BREF.

Demonstrate and provide evidence to support why the Applicant is confident this emission limit is now achievable and explain why emissions are now proposed to be lower than in the previous application.

The Applicant notes that the proposed emission limit is the higher end of the BAT-AEL range in the final draft WI BREF, which means that it is the emission level associated with the Best Available Techniques (BAT). The Applicant considers that it is not reasonable for the EA to ask for further evidence to show that this emission level can be achieved, given that the facility already includes bag filters, which the EA has agreed are BAT. Hence, the BAT-AEL range in the final draft WI BREF is representative of emission levels which are already being achieved by plants equipped with the proposed technology. However, the Applicant has provided supporting evidence for this position.

The emissions of cadmium and thallium from European EfW plants are shown in the final draft WI BREF. Figure 3.33 from page 180 of the final draft WI BREF is reproduced below and summarises emissions data from 197 municipal waste-to-energy lines. Only six of the reference lines had emissions which exceeded the BAT-AEL. This was the evidence used to set the BAT-AEL and clearly shows that it can be consistently achieved.



Source: [81, TWG 2016]

Figure 3.33: Periodically monitored Cd+Tl emissions to air from reference lines incinerating predominantly MSW

The Applicant's advisor has also reviewed the detailed emission data submitted to the EIPPCB for UK plants during the data gathering exercise which informed the final draft WI BREF. This data is already available to the EA (and other members of the Technical Working Group) and can be extracted from figures 8.130, 8.131 and 8.132 in the draft WI BREF. It covered 17 lines, all of which are equipped with bag filters. The average recorded concentration was 0.0016 mg/m^3, the highest recorded concentration of cadmium and thallium was 0.014 mg/m^3 and only three lines recorded concentrations higher than 0.01 mg/m^3. This demonstrates that existing operational UK plants are already capable of achieving the proposed emission limit.

The EA asks why emissions are proposed to be lower than in the previous application. The premise of this question is incorrect. It was always anticipated that emissions of cadmium and thallium would be below the current limit of 0.05 mg/Nm^3, as was stated in section 7.5 of the original air quality assessment (included as Appendix D to the variation application):

"This assumes that the cadmium is released at the combined emission limit for cadmium and thallium. Monitoring from waste facilities has indicated that concentrations of cadmium are usually about 8% of the limit." [Note that 8% of the current limit is 0.004 mg/Nm^3, which is actually higher than the figures reported to the EIPPCB]

The Applicant is proposing a lower emission limit because this will be required in 2023 anyway, assuming that the final draft WI BREF is adopted later this year, and because this ensures that the process contribution of cadmium emissions at the permitted emission limit remains the same. In the original air quality assessment, the maximum process contribution was predicted to be 8.14% of the AQAL; this reduces to 7.19% of the AQAL in the new assessment. The Applicant notes that actual emissions from UK plants are even lower than the BAT-AEL so even this predicted process contribution is considered to be conservative.

5 Advanced SNCR increase in use of ammonia and impact on the environment.

The proposed use of advanced SNCR is projected to result in additional ammonia utilisation. How this effects emissions from the facility and impacts on sensitive receptors has not been accounted for in the emissions assessment in this application.

a. **Will the stated additional ammonia utilisation increase ammonia air emissions?**

   No, it will not. As explained in response to question 1, it is proposed that the ammonia emission limit will remain at 10 mg/Nm^3.

b. **If there is no increase in ammonia emissions, provide justification and evidence to demonstrate why.**

   The advanced SNCR system will use ammonia more effectively, through careful control of the injection rate of the reagent through the various nozzles. Hence, the excess ammonia which does not react will not increase and the proposed emission limit will remain the same.

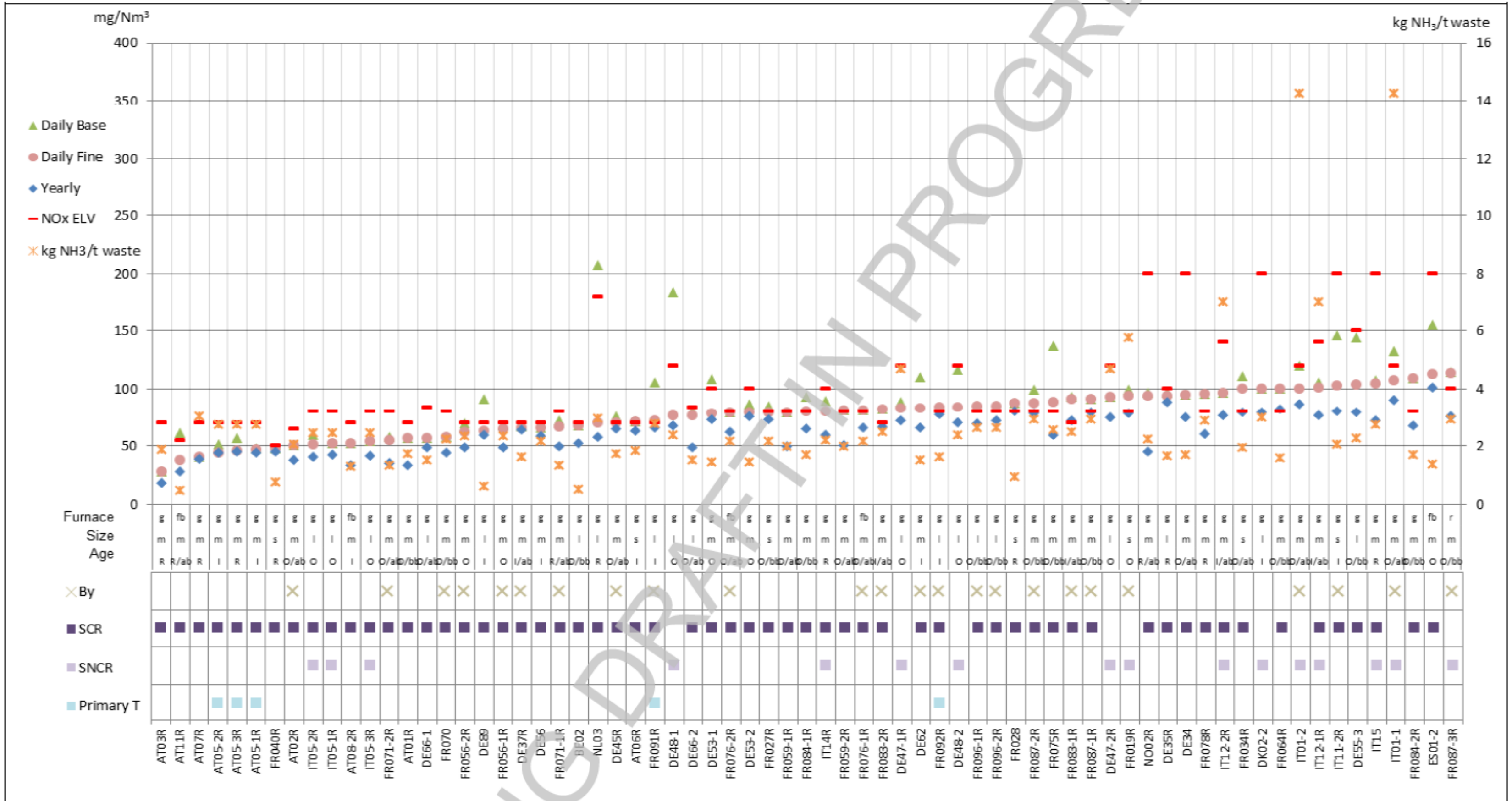
c. **If ammonia emissions will increase, provide updated modelling results to show the impact at all ecological sites within the relevant screening distance.**

   As explained in items a. and b., ammonia emissions will not increase. Therefore, no additional modelling is required.

   The Applicant notes that there are no statutory designated sites within 10 km of the Facility. For locally designated sites, the impact can be described as not significant if the process contribution is less than the Critical Load or Level. The highest process contribution for ammonia at a locally designated site is 1.8% of the Critical Level and the highest process contribution to nitrogen deposition, which is partly due to ammonia emissions, is 5.2% of the lower Critical Load. Therefore, even if the ammonia emissions were to increase, the impact on ecological receptors would remain not significant.

Appendices

A WI BREF Nitrogen Dioxide Data



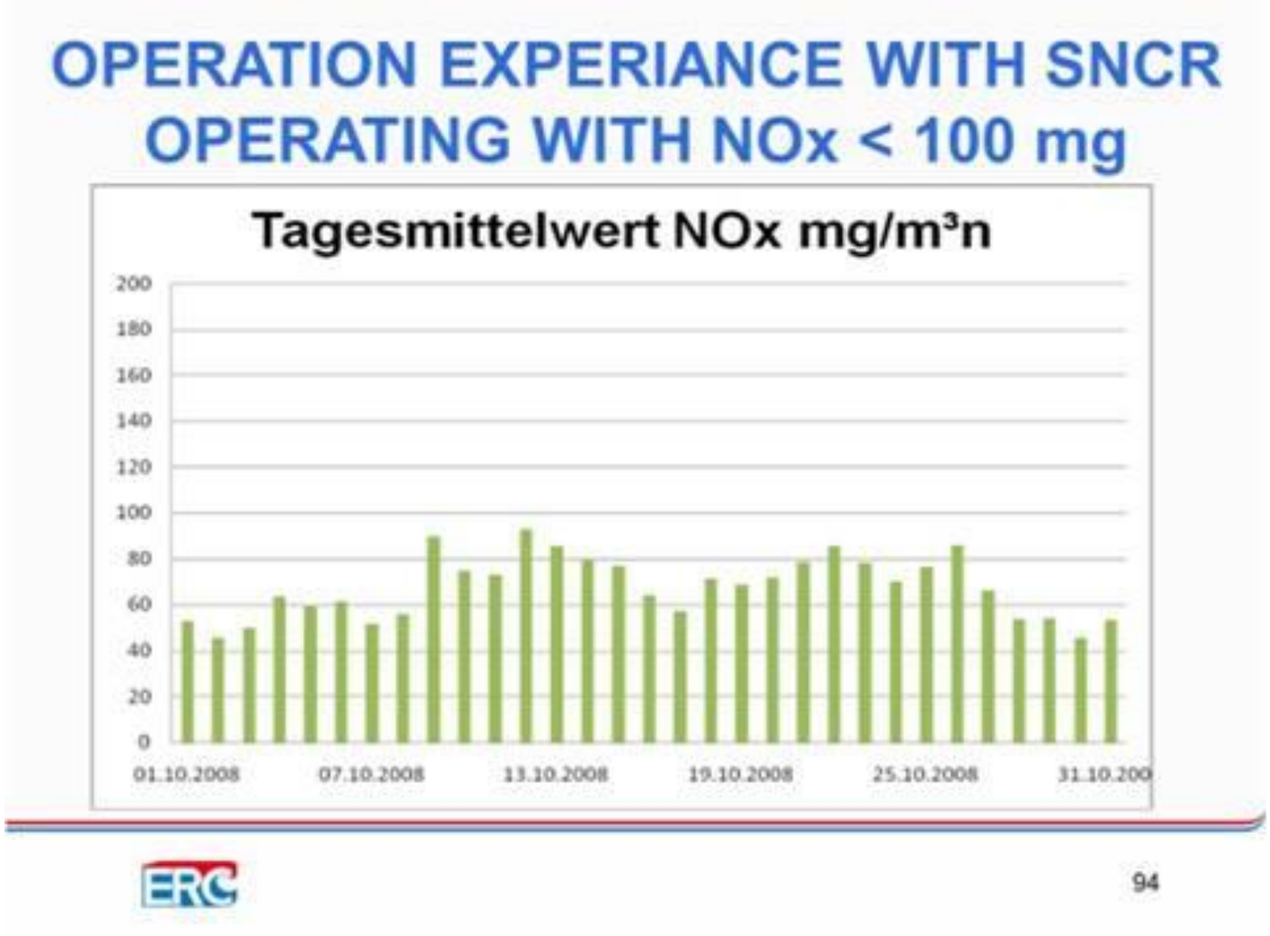
NB:
Furnace type: g = grate; r = Rotary kiln; fb = Fluidised bed; f = Furnace other than the former types; gas = Gasification; O = Other.
Plant size: s = small; m = medium; l = large.
Plant age: O = old ; I = intermediate ; R = recent // year of retrofitting: bb = before previous WI BREF (2006); ab = after previous WI BREF (2006).
By = bypass.
Techniques installed: SCR = selective catalytic reduction; SNCR = selective non-catalytic reduction; Primary T = primary technique.
Source: [81, TWG 2016]

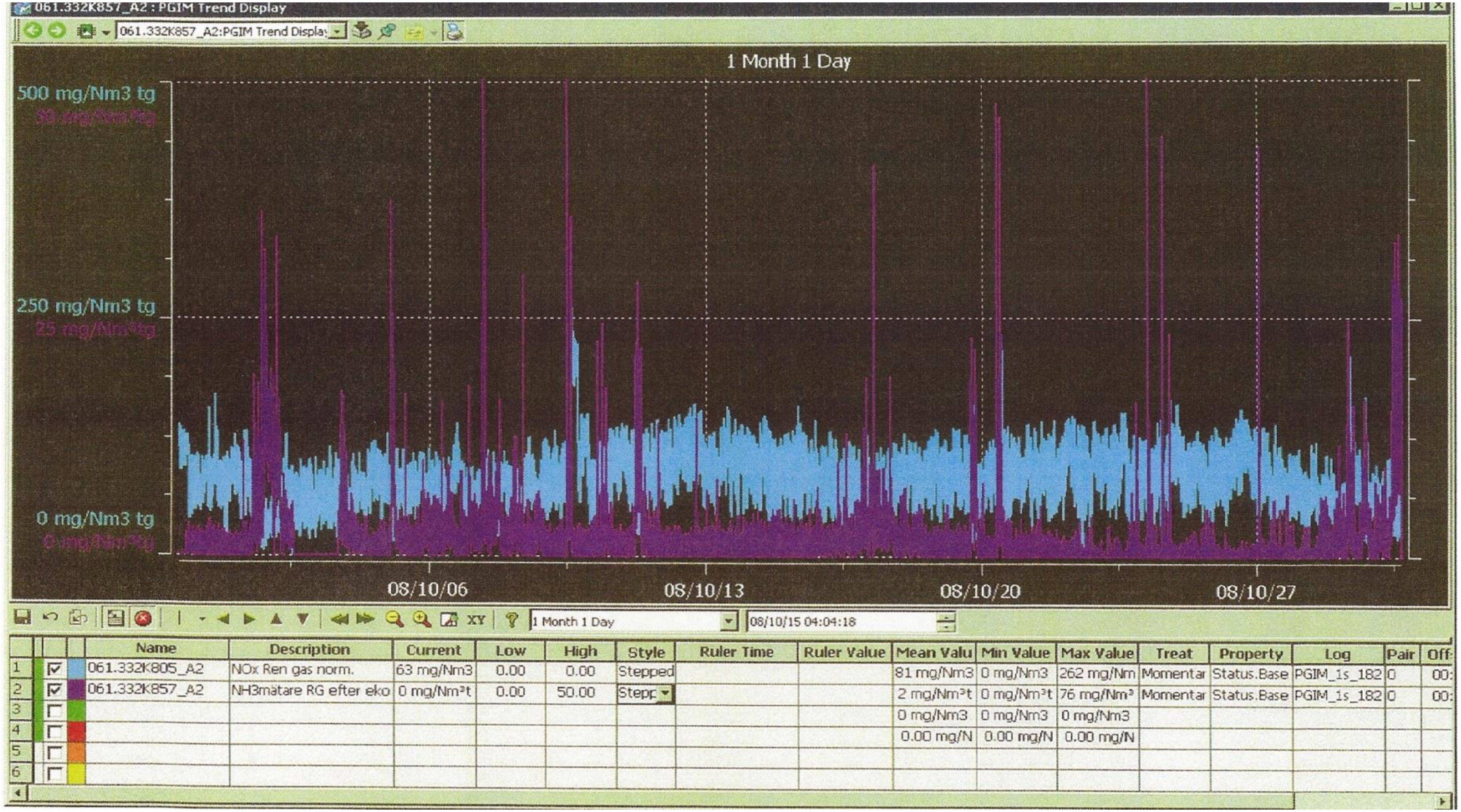
Figure 8.15: Daily and yearly average emission levels for continuously monitored NO_X emissions to air from reference lines incinerating predominantly MSW (1/3)

B ERC-Technik information

B.1 Reference List

B.2 Operating data from Linkoping




061.332K857_A2 : PGIM Trend Display
061.332K857_A2:PGIM Trend Display
1 Month 1 Day
500 mg/Nm3 tg
250 mg/Nm3 tg
0 mg/Nm3 tg
08/10/06
08/10/13
08/10/20
08/10/27
1 Month 1 Day
08/10/15 04:04:18
Name
Description
Current
Low
High
Style
Ruler Time
Ruler Value
Mean Valu
Min Value
Max Value
Treat
Property
Log
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0 mg/Nm3
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0.00
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2 mg/Nm³t
0 mg/Nm³t
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0 mg/Nm3
0 mg/Nm3
0 mg/Nm3
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0.00 mg/N
0.00 mg/N

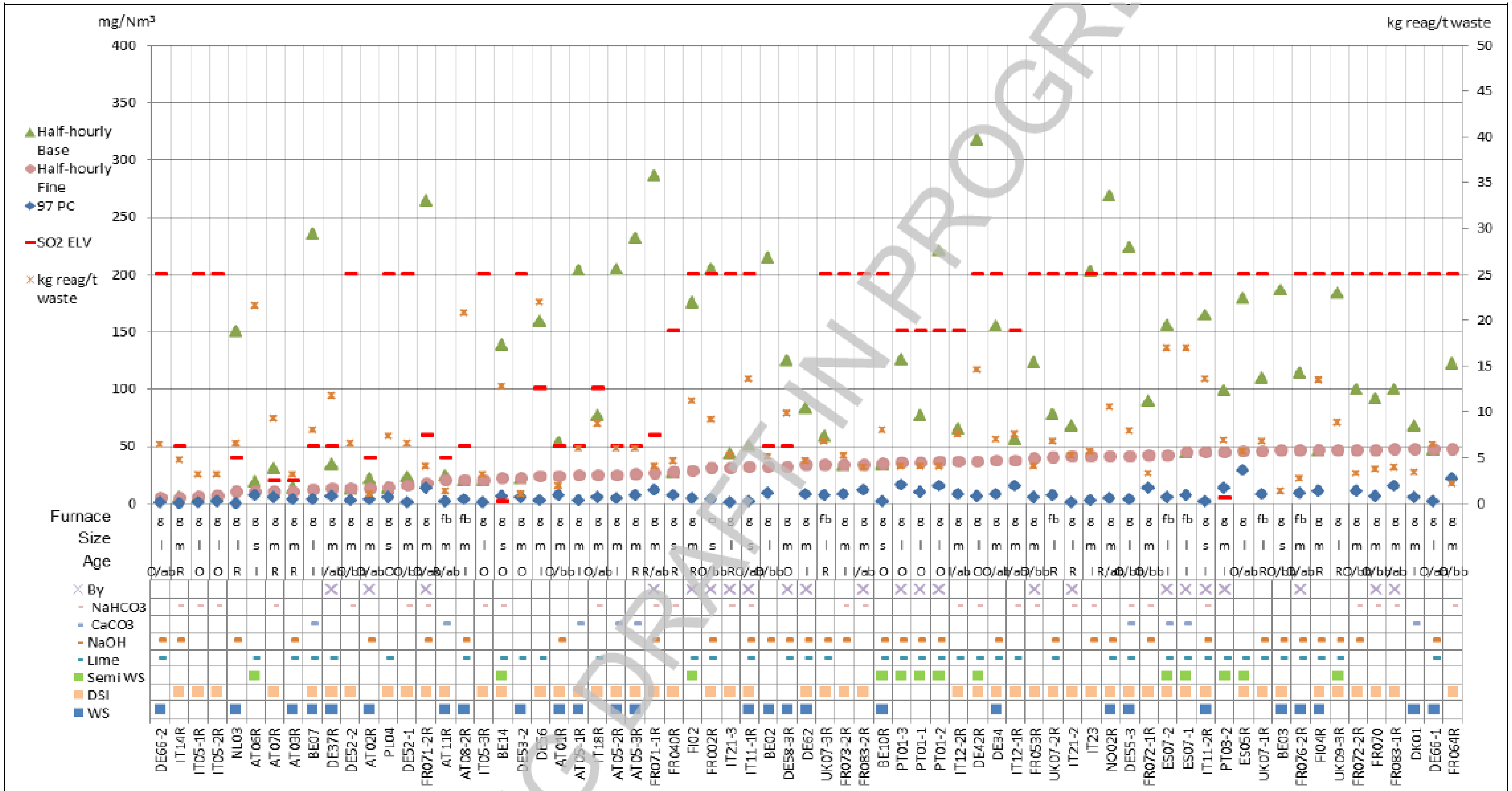
C VOC Speciation Reports

C.1 Comparison of existing on-line measurement methods for determination and monitoring of TOC emissions from waste incineration (2005)

C.2 Emissions of airborne pollutants from the municipal solid waste incineration plants of Giubiasco (TI) and Hinwil (ZH) (2016)

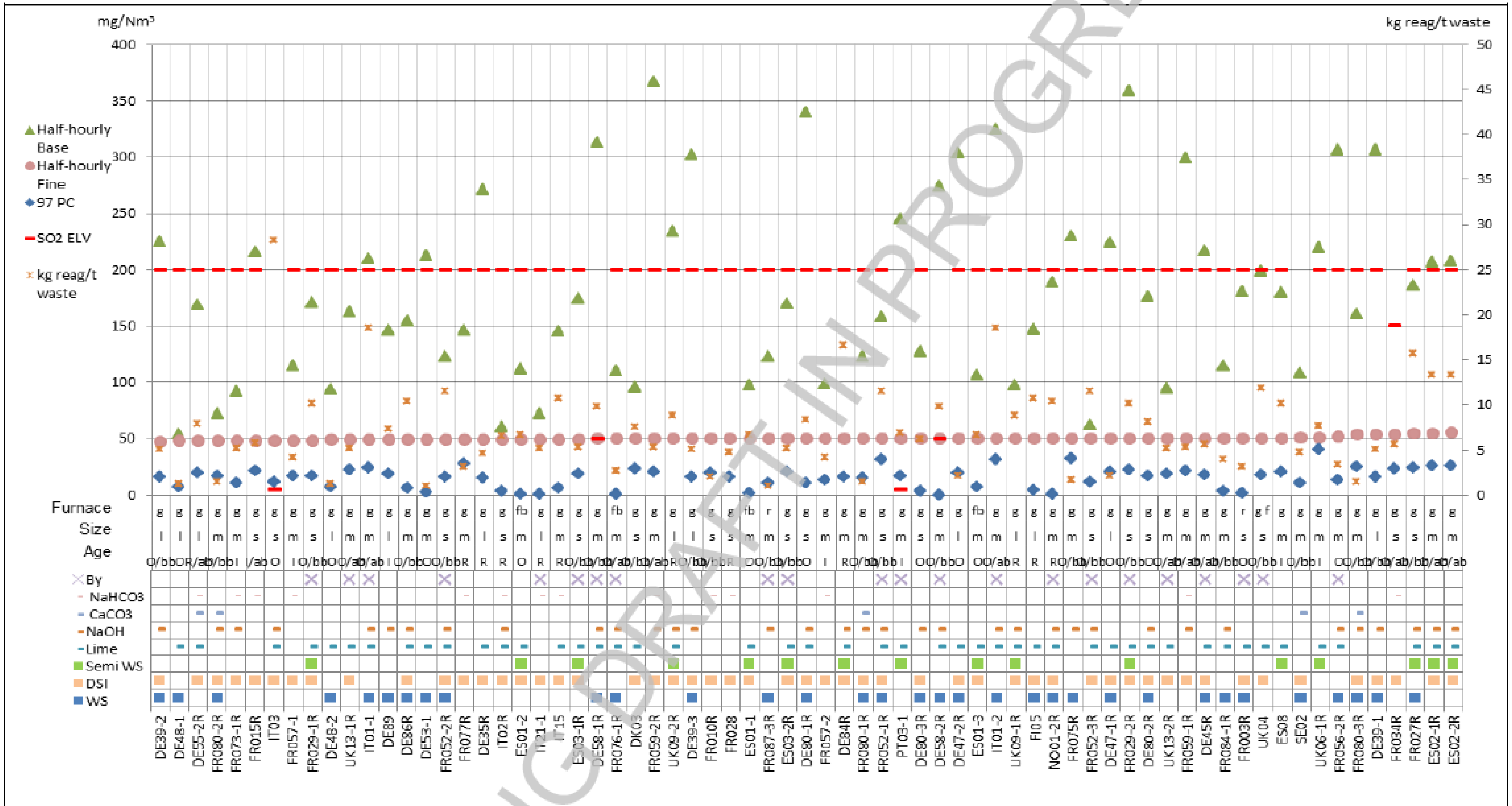
(Atmospheric Environment, Volume 166, p. 99-109)

D WI BREF Sulphur Dioxide Data



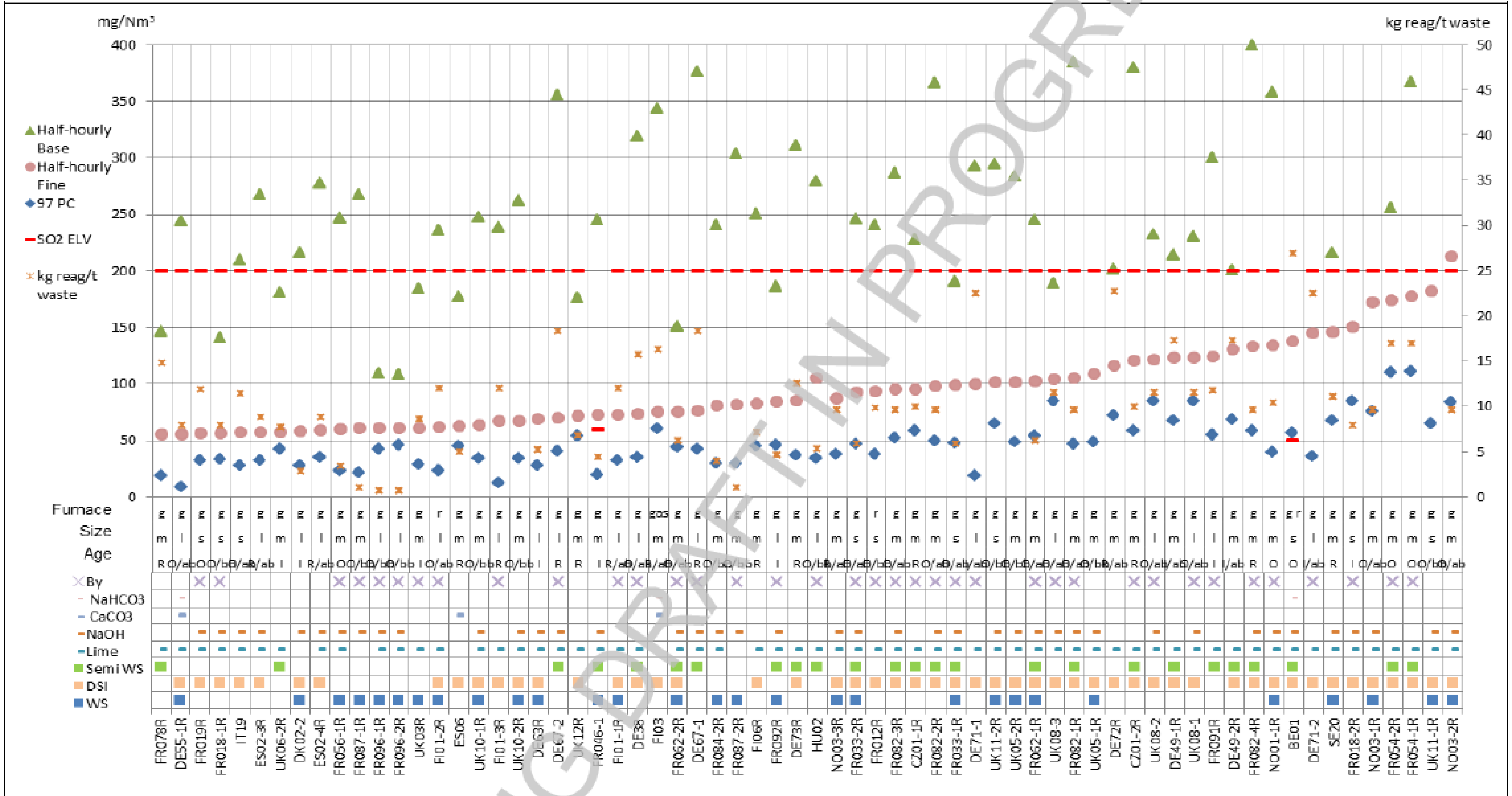
NB:
Furnace type: g = grate; r = rotary kiln; fb = fluidised bed; f = furnace other than the former types; gas = gasification; o = other.
Plant size: s = small; m = medium; l = large.
Plant age: O = old; I = intermediate; R = recent // year of retrofitting: bb = before previous WI BREF (2006); ab = after previous WI BREF (2006).
By = bypass.
Reagents used: NaHCO3 = sodium bicarbonate; CaCO3 = limestone; NaOH = sodium hydroxide; Lime includes: quicklime, hydrated lime, and high-surface/porosity hydrated lime.
Techniques installed: Semi WS = semi-wet scrubber; DSI = dry sorbent injection; WS = wet scrubber.
Source: [81, TWG 2016]

Figure 8.57: Half-hourly average emission levels for continuously monitored SO_2 emissions to air from reference lines incinerating predominantly MSW (1/3)



NB:
Furnace type: g = grate; r = rotary kiln; fb = fluidised bed; f = furnace other than the former types; gas = gasification; o = other.
Plant size: s = small; m = medium; l = large.
Plant age: O = old; I = intermediate; R = recent // year of retrofitting: bb = before previous WI BREF (2006); ab = after previous WI BREF (2006).
By = bypass.
Reagents used: NaHCO3 = sodium bicarbonate; CaCO3 = limestone; NaOH = sodium hydroxide; Lime includes: quicklime, hydrated lime, and high-surface/porosity hydrated lime.
Techniques installed: Semi WS = semi-wet scrubber; DSI = dry sorbent injection; WS = wet scrubber.
Source: [81, TWG 2016]

Figure 8.58: Half-hourly average emission levels for continuously monitored SO_2 emissions to air from reference lines incinerating predominantly MSW (2/3)



NB:
Furnace type: g = grate; r = rotary kiln; fb = fluidised bed; f = furnace other than the former types; gas = gasification; o = other.
Plant size: s = small; m = medium; l = large.
Plant age: O = old; I = intermediate; R = recent // year of retrofitting: bb = before previous WI BREF (2006); ab = after previous WI BREF (2006).
By = bypass.
Reagents used: NaHCO3 = sodium bicarbonate; CaCO3 = limestone; NaOH = sodium hydroxide; Lime includes: quicklime, hydrated lime, and high-surface/porosity hydrated lime.
Techniques installed: Semi WS = semi-wet scrubber; DSI = dry sorbent injection; WS = wet scrubber.
Source: [81, TWG 2016]

Figure 8.59: Half-hourly average emission levels for continuously monitored SO_2 emissions to air from reference lines incinerating predominantly MSW (3/3)

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