The European Association of Internal Combustion Engine Manufacturers

EUROMOT

EUROMOT POSITION

23 January 2015

Comments on Maltese Plant Data Submitted by EEB (European Environmental Bureau) on 3 December 2014

Executive Summary

EUROMOT has reviewed the above submitted EEB-material (measurement results and documents) in detail. Our position continues to be after this review:

- **The dry $NaHCO_3$ FGD process is not a proven BAT for a (bigger) HFO fired stationary diesel engine power plant.**
- **In general it appears that the SCR systems still need substantial adjustments in order to function satisfactorily before any BAT conclusions can be drawn. The set filtering limits for NOx/NH_3 values seem in general to be too low for the SCR systems and the measurement results strongly indicate that limits should be increased in order to avoid "instabilities".**

A Background

As we have earlier stated: To provide the highest environmental, economic and social benefits for the society, we believe that any technology that is regarded BAT has to demonstrate that it is technically and economically feasible (for BAT definition we refer to the preface of current LCP BREF 2006 /1/).

Most of the proposed BAT-span emission limits (namely NO_x, SO_2 and dust) in the LCP BREF D1 (2013 update) document for a HFO (Heavy Fuel Oil) fired stationary diesel engine plant are based on emission information from the Enemalta (Delimara) combined cycle diesel engine plant. Obtained measurement data from the other 8 reference HFO (Heavy Fuel Oil) engine plants situated in Greece, UK and Portugal seem to have been largely disregarded when drawing the BAT conclusions in the LCP BREF D1. It should be noted that Malta offered this plant as a **case study only** (questionnaire in BATIS dated November 2012 states: " ... *Note: The Combined Cycle Diesel Engine plant which is being proposed as a ´**Case Study**` is currently during its testing and commissioning phase. Data submitted in this questionnaire is **based on design values or operating data during a one month Reliability Test in September 2012** and not a full reference year"*).

In September 2013 EUROMOT made a Position paper /2/ on these "BAT" measurement results and the same document was submitted to BATIS. We stated amongst all then " ... *A new plant in general shows excellent performance and a skewed emission picture of the performance will probably be obtained after limited operation hours. Only time and wear and tear will show the real long term performance*" and " ... ***the proposed BAT emission associated spans in BREF D1 for liquid fired stationary RICE are not generally applicable/feasible on all HFO fired stationary plants***". EUROMOT made also in this document counter proposals for feasible BAT emission limits, for more information see document /2/.

In June 2014 EUROMOT made presentation slides /3/ based on the " *updated questionnaire to cover whole year 2013*" submitted to BATIS by Malta in April 2014. In this material, amongst others, the following information was included: "*Conversion of the engines to dual fuel (gas or liquid fuel) is planned in 2015 due to planned availability of natural gas (LNG) in mid 2015*". In the submitted Euromot material we presented arguments why we still **do not consider the Maltese plant to be BAT candidate plant.** These EUROMOT slides were submitted to BATIS for the interim TWG meeting in June. In July 2014 CEFIC submitted a feedback to BATIS on the Euromot submitted June material. In end of November EUROMOT /4/ (document is also available in BATIS) replied item per item on the CEFIC statements (to BATIS) with the **overall conclusion that " ... *the dry $NaHCO_3$ FGD process <u>is not a proven BAT</u> for a (bigger) HFO fired stationary diesel engine power plant***" .

On 3 December 2014 EEB (European Environmental Bureau) submitted a full set of emission measurement results for the year 2013 to BATIS (obtained from the Maltese Environment and Planning Authority (MEPA)). In this material it is also mentioned that Enemalta is working with an engine supplier **on the conversion of the plant to LNG**. EEB made, based on the submitted material, following conclusion: "*Following to an ATD request by the EEB submitted on 13 August 2014 we hereby provide additional information that was kindly provided by the Maltese EPA for this existing reference plant for SIS **we consider as a genuine BAT candidate***"**.**

EUROMOT has reviewed the above submitted EEB-material (measurement results and documents) in detail. Our position continues to be after this review:

- **The dry $NaHCO_3$ FGD process is not a proven BAT for a (bigger) HFO fired stationary diesel engine power plant.**
- **In general it appears that the SCR systems still need substantial adjustments in order to function satisfactorily before any BAT conclusions can be drawn. The set filtering limits for NOx/NH_3 values seem in general to be too low for the SCR systems and the measurement results strongly indicate that limits should be increased in order to avoid "instabilities".**

Below you can find our detailed analysis of the Enemalta (Delimara) documents submitted to BATIS on 3 December 2014.

B Enemalta (Delimara plant) FGD and SCR technologies

General:

MEPA provided in end of October 2014 EEB with hourly averaged emission measurement data for four stacks "6A", "6B", "6C" and "6D" from the Enemalta (Delimara) plant for the time period 01.01 - 31.12 2013. Each exhaust gas train consists of 2 diesel engines (17.1 MWe each), 2 SCR (Selective Catalytic Reduction) units, 2 heat recovery boilers and a common FGD (Flue Gas Desulfurization) unit of a dry type and a stack. Amongst others a data file with hourly average raw emission data and with filtered hourly average emissions were provided in the material.

In ANNEX 1 it is described how Enemalta handled the raw and filtered data, e.g. higher measurement results of SO_2 (> 120 mg/Nm^3 (15 % O_2)), dust (> 20 mg/Nm^3 (15 % O_2)), NOx (> 185 mg/Nm^3 (15 % O_2) or below 50 mg/Nm^3 (15 % O_2)) and ammonia (> 15 mg/Nm^3 (15 % O_2)) have been removed and marked as "FAULT" in the filtered emission sheet **since assumption was then a "fault" in the SO_2 or NOx abatement systems**. In the filtered data also all SO_2 levels below 60 mg/Nm^3 (15 % O_2) (operation on gas oil) were marked "GASOIL".

B.1 Dry FGD (Flue Gas Desulphurization) unit:
(Filtered /raw measurement data 2013 submitted by EEB/MEPA to BATIS as basis for below calculations)

1. *Availability of FGD technology*

   A. *Filtered data (1h average) table* (of totally 8520 hours during year 2013). FGD operation, **SO_2 measurements**:

- "Stack 6A":
  - 983 "**GASOIL**" hours
  - 129 "fault" hours
  - 2067 no operation "-" hours
    - ➔ (8520 – above hours) = 5341 hourly emission "HFO" average figures

- "Stack 6B":
  - 1791 "**GASOIL**" hours
  - 78 "fault" hours
  - 2000 no operation "-" hours
    - ➔ (8520 – above hours) = 4651 hourly emission "HFO" average figures

- "Stack 6C":
  - *2358 "**GASOIL**" hours*
  - *34 "fault" hours*
  - *1933 no operation "-" hours*

➔ (8520 – above hours) = 4195 hourly emission "HFO" average figures

- “Stack 6D“:
  - o *2398 “**GASOIL**” hours*
  - o *55 “fault” hours*
  - o *1445 no operation “-“ hours*
    - ➔ (8520 – above hours) = 4622 hourly emission “HFO” average figures

The different FGD (Flue Gas Desulphurization) units were during the year 2013 operated on “GASOIL” (of the total operation time):

“FGD 6A”: about 15.2 %

“FGD 6B”: about 27.5 %

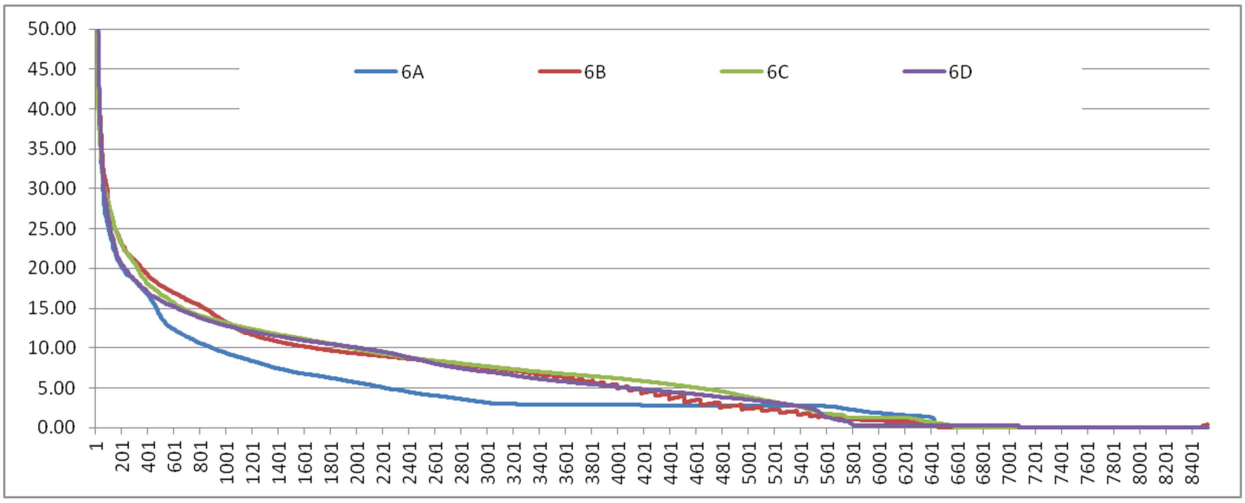
“FGD 6C”: about 35.8 %

“FGD 6D”: about 33.9 %

Gas Oil or Light fuel oil (LFO) is **<u>much more expensive</u> than low sulphur (1 wt-% S) HFO**, according to source /5/ (table 2) the price difference is typically in order of 1.6 ... 2.4 times depending on the year.

→ The <u>technical feasibility of the FGD seems still not to be on a satisfactorily level</u> when gasoil operation ratio has been in these (15.2 ..35.8 %) high ratios of total operation hours for the different exhaust gas trains.

B. In below graph 1 the measured dust figures (based on 1 hour average raw measurement data 2013) in all the stacks during year 2013 are shown.



Graph 1: Frequency of measured 1 hour averaged Dust values (”raw measurement data”) in unit mg/Nm^3 (15 % O_2) for the different stacks during year 2013. On the y-axis dust emission and on the x-axis operational hours of the year.

Above graph 1 shows that any BAT evaluation based on the data provided from the installation needs to be performed on a thorough assessment, using also the complete unfiltered data set, i.e. the raw data. According to above graph 1 measurement data, e.g. the proposed dust limit of 5 mg/Nm3 (proposed BAT-AEL yearly average upper span limit in LCP BREF D1), was **frequently exceeded:**

- **Stack 6A: 2212 times (1h-average value) or about 34 % of total operation time of plant**
- **Stack 6B: 4062 times or about 62 % of total operation time of plant**
- **Stack 6C: 4606 times or about 70 % of total operation time of plant**
- **Stack 6D: 4056 times or about 57 % of total operation time of plant**

The above information indicates that looking only at the filtered data and run calculations based on this gives a misleading picture. The plant has been outside the proposed BAT – AEL ranges for a significant part of the operation time.

➔ In the LCP BREF D1 set BAT-AEL dust levels are too low, FGD feasibility seems also to be low.

C. Source /6/ states (November 20th 2013): "*Eight engines at the BWSC Delimara plant have clocked up almost **two months of inactivity this year because of faults**, Times of Malta has learnt. In 10 moths a number of generating units had to be shut down for a total of at least 1419 hours, equivalent to nearly 60 days.*"

Submitted measurement data shows also (see above), depending on exhaust gas train, that the reported stand still hours were about 1445 ... 2067 by the end of the year 2013.

Conclusion 1:
Above information gives a strong indication that the availability of the FGD technology used in the plant is very low and it is not mature enough to be determined as a BAT candidate for a heavy fuel oil fired diesel engine plant.

2. *Attached (ANNEX 1) Enemalta document (part of EEB submitted documents) states:*

"Minor dust problems continued to occur due to filter bags leaking from tearing of bags as a result of abrasion or movement. Most of these faults are a result of cyclic operation. Continuous operation could have reduce such faults."

Source /7/ shows that the Enemalta plant is in practice "almost" a base load plant and not a peak plant:

Base load: plant/s run for 24 hours; **two-shift operation:** Plant/s run for 16 to 18 hours per day.

Due to changes in current markets for electrical power supply with a lot (and increasing) of renewable installed electrical generation capacity there are increasing demands for fast reacting peak power plants in many parts of the world including Europe. Reciprocating internal combustion engines (RICE) are more and more used for grid peaking. When “challenges” in context with the FGD occurred in the Enemalta plant which is “almost” a base load plant (see above), one can conclude that this technique is not suitable for many RICE plants operating according to todays’ (dynamic) grid needs.

We have also earlier highlighted other special features that will be required in diesel engine plants using this FGD technology such as a proper flue gas cooling (a big heat demand is to exist or a combined cycle which is not the case/feasible in many plants) in order not to destroy (“burn”) the bag filters, special infrastructure aspects, etc. For more information see sources /2/, /3/.

Conclusion 2:
The dry FGD is not feasible as a universal BAT for liquid fired diesel engine plants.

3. HFO (low – high sulphur) brand cost differences:

In EUROMOT document /4/ it is shown that usage of high sulphur HFO (Heavy Fuel Oil) in place of low sulphur HFO would largely raise the needed reagent amount and thus the OPEX (operational expenditure). EUROMOT conclusion was that a dry FGD is not suitable for high sulphur HFO. In the Enemalta (Delimara) plant a 0.7 wt-% S HFO has been used as the fuel. In the EEB to BATIS submitted (MEPA) material is stated “ ... *Using HFO with < 1 % sulphur content also contributes, at a cost, to keeping SO_x emission levels below 104 mg/Nm^3 (around 2 % more expensive than higher sulphur HFO)* ....”.

As EUROMOT earlier /4/ has stated a power plant is built to operate for an extended period typically 10 ... 20 years or a longer time depending on the specific case and thus the impact of OPEX is large. The prices of different oil brands (and price differences between these) might also vary quite a lot during the years. Therefore in economical feasible studies for a power plant long term trends are to be studied and not only short term ones.

Market price data trends on oil is not easily available in the open literature, it has in practice to be bought and compiled from companies such as Bloomberg which also relies on third party sources. Therefore the information obtained is an approximate but it shows the trend and we asked our member companies to give a helping hand with this. A look on the average price difference between the period end of September 2006 and beginning of December 2014, i.e. a period of more than 8 years, was done. We concluded that the average price difference between a low sulphur (< 1 wt-% S) and high sulphur (< 3.5 wt-%) HFO in the Mediterranean region has in average been about 6.8 % during this time period. Note that big variations might appear: in year 2012 price difference was in average about 7.9 %, but a big peak price difference of an about 44 % average occurred in year 2008 between these HFO grades. Source /9/ figure on page 51 in chapter 4.3.1 (price difference trends 1990 ... 2001) also shows that changes in the price differences between low and high sulphur HFO:s occur occasionally between years.

The MEPA given price difference of 2 % between the low vs. high sulphur HFO grades seems to be valid only for a very short term period; as the situation end of October 2014 indicated when the price difference had decreased to one of the lowest levels during year 2014. We conclude based on this that in the by MEPA submitted cost difference figure of 2 % others than a temporary low fuel premium cost difference has not been taken into account. Moreover **such as the extra cost for the increased end product disposal for the FDG, etc. has not been included.**

Conclusion 3:
Above shows that in general the economic feasibility of a dry FGD in a bigger HFO fired diesel engine plant is doubtful and needs to be judged thoroughly case by case.

General conclusion on the used dry FGD type:
Based on above conclusions 1, 2 and 3 EUROMOT maintains the position that the dry $NaHCO_3$ FGD process cannot be considered to represent a proven BAT technique for a (bigger) HFO fired stationary diesel engine plant.

B.2 SCR (Selective Catalytic Reduction) unit:
(Filtered / raw measurement data 2013 submitted by EEB/MEPA to BATIS are based on below calculations)

1. *Filtered data table* (of totally 8520 hours during year 2013), NO_x:

   - “Stack 6A“:
     - 809 “**fault**” hours
     - 2067 no operation “-“ hours

   - “Stack 6B“:
     - 2099 “**fault**” hours
     - 2000 no operation “-“ hours

   - “Stack 6C“:
     - 681 “**fault**” hours
     - 1933 no operation “-“ hours

   - “Stack 6D“:
     - 503 “**fault**” hours
     - 1445 no operation “-“ hours

The different exhaust gas train SCR results during year 2013 were thus registered as "FAULT" of total operation hours:

"Stack 6A": about 12.5 %

"Stack 6B": about 32.2 %

"Stack 6C": about 10.3 %

"Stack 6D": about 7.1 %

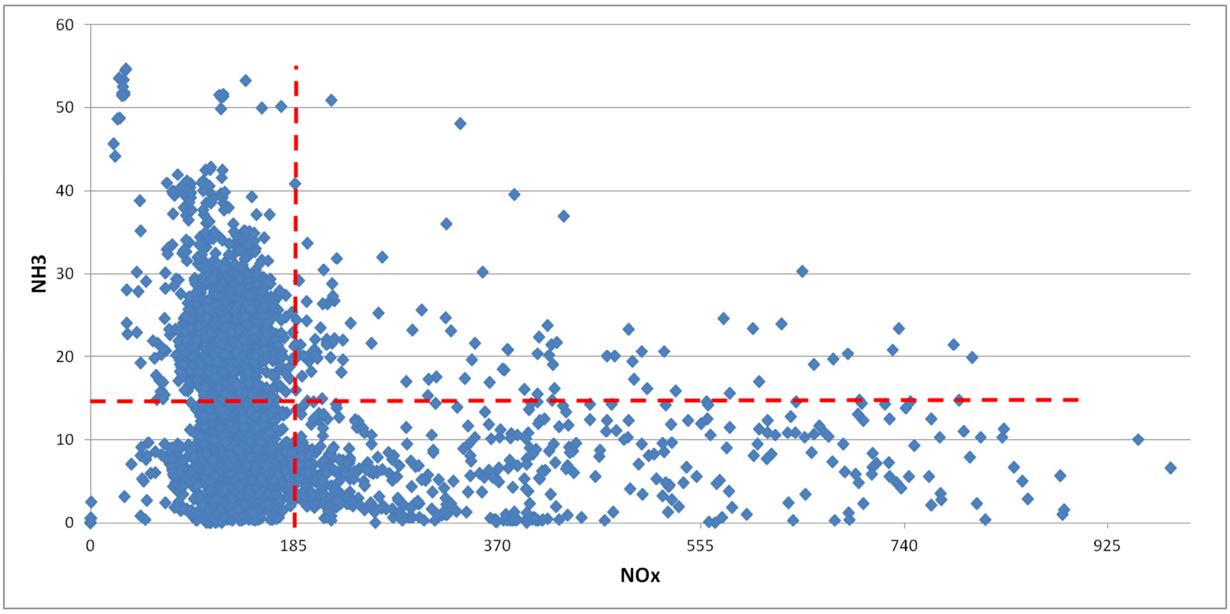
In Annex 1 is stated regarding the SCR:

c) "With regards to NO_x emissions, there was a particular problem during the first year of operation - instability of NO_x abatement due to the following faults: (a) UREA injection; (b) feedback control system".

Based on above "fault" %-figures (7.1 … 32.2 %) big availability issues with the SCR seem to exist in the Delimara plant, the current performance is not at a satisfactory level yet (still after one year of operation) and still the final tunings/adjustments, etc. are to be conducted.

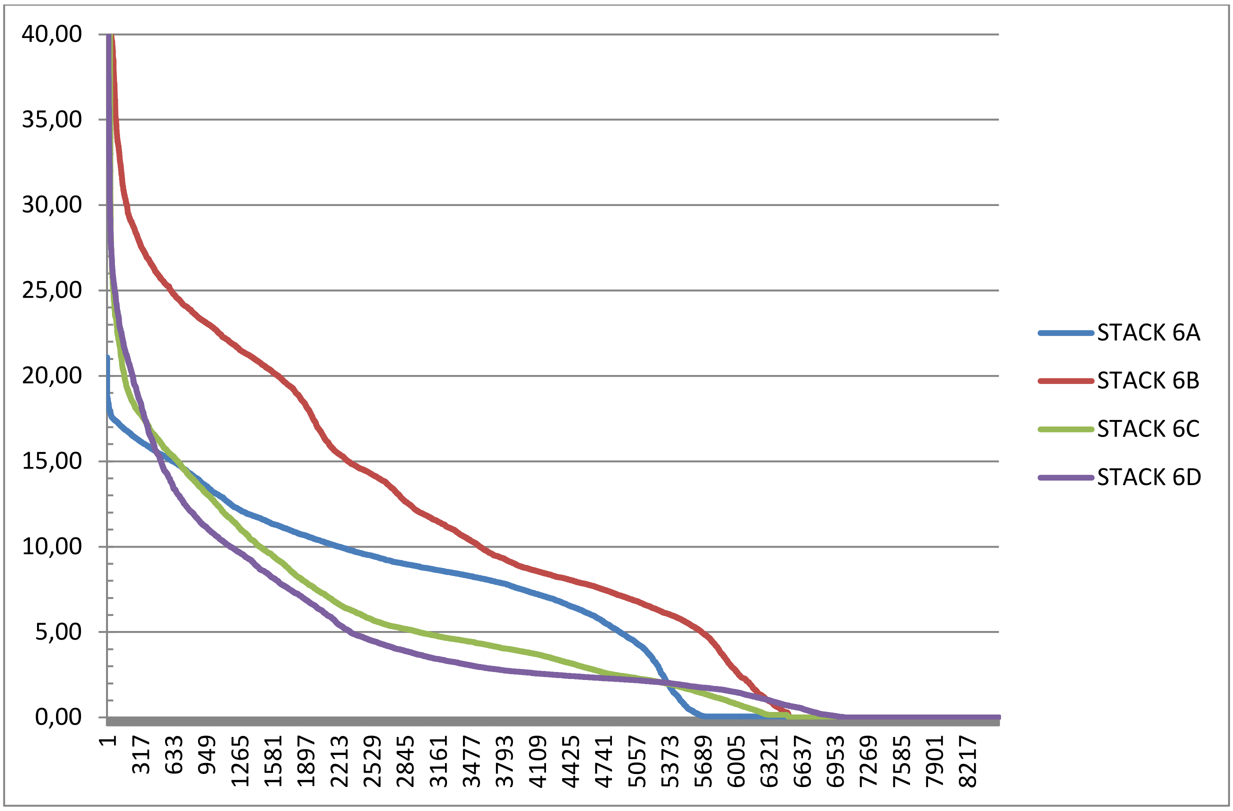
2. Raw data examples:

In below graph 2 the measured (raw data), NO_x and NH_3 figures from "Stack 6B" are shown:



Graph 2: Stack "6B" measured NH_3 and NOx one-hour averaged values year 2013, emission unit mg/Nm^3 (15 % O_2). With "filter lines" (see Annex 1 for more information): for NH_3 15 mg/Nm^3 and NO_x 185 mg/Nm^3. Concentration reference point 15 % O_2.

In below graph 3 measured NH_3 figures (raw data) from “all the 4 stacks (6A, 6B, 6C, 6D) are shown:



Graph 3: Frequency of NH_3 one-hour averaged values year 2013, emission unit mg/Nm^3 (15 % O_2) for all the 4 (6A, 6B, 6C, 6D) stacks.

Above graph 3 shows that a BAT evaluation based on the data provided from an installation needs to be performed on a thorough assessment using **also** the complete unfiltered data set, i.e. the raw data. According to above graph 3 the measurement data shows e.g. the proposed ammonia limit of < 5 mg/Nm^3 (proposed BAT-AEL yearly average NH_3 limit in the LCP BREF D1) was **frequently <u>exceeded</u>**:

- **Stack 6A: 4894 times (1h-average value) or about 76 % of total operation time of the plant**
- **Stack 6B: 5673 times or about 87 % of total operation time of the plant**
- **Stack 6C: 2974 times or about 46 % of total operation time of the plant**
- **Stack 6D: 2324 times or about 33 % of total operation time of the plant**

Above information indicates that looking only at the filtered data and calculations based on this might give a complete different and misleading picture. <u>The plant seems to have been outside the proposed BAT – AEL ranges for a significant part of the operation time</u>.

The high frequencies of NH_3 “exceedences” strongly indicate that substantial adjustments are still needed in the SCR systems before meaningful BAT conclusions can be drawn.

In Annex 3 the NO_x/NH_3-graphs for stacks “6A”, “6B”, “6C” and “6D” are shown based on the raw data measurement results (available in BATIS) for year 2013 from the Enemalta (Delimara) plant. Some of the “exceeding” NO_x-values are likely due to starts and stops of the engines; others are due to “instabilities”, etc. of the SCR systems (see also page 2 of Annex 1).

<u>General conclusion on SCR</u>:

Above text shows that the SCR system does not yet function satisfactorily and still needs to undergo major adjustments and corrections. The set filtering limits for NO_x/NH_3 values seem in general to be too low for the SCR systems, measurements indicate that these should be increased (Note that there is an interconnection between NH_3/NO_x – more NH_3 fed to a SCR (associated with a higher NH_3-slip especially if SCR is operating on or close of its’ NO_x reduction capacity upper limit) enables lower NO_x).

Any BAT evaluation based on the data provided from the installation needs to be performed on a thorough assessment using the complete unfiltered data set, i.e. also the raw data. Looking only at the filtered data would indicate that the set levels (15 mg/Nm^3, 15 % O_2, dry for ammonia and 185 mg/Nm^3, 15 % O_2, dry for NO_x) are almost acceptable. However, a more thorough analysis of the data on the contrary shows that operation inside the set filtering levels has not been satisfactorily enough. A significant part of the operation time of the plant has been outside of the set filtering limits due to technical reasons.

The only conclusion that can be that based on the data ; set filtering levels of 15 mg/Nm^3, 15 % O_2, dry for ammonia and 185 mg/Nm^3, 15 % O_2, dry for NOx are too low; is: Many of the <u>BAT conclusions presented in LCP BREF D1 are not consistent with the (longer term) performance data of the studied (Enemalta) plant.</u>

Only when the SCR system is adjusted to function satisfactorily the emission levels achieved could become the base for the BAT levels of this reference. Current (LCP BREF D1) BAT conclusion limits are to be <u>too optimistic in the light of the above stated SCR performance</u>.

C Other aspects

In the latest (3rd December 2014) submitted Enemalta (Delimara) (MEPA) documents it is stated “ ... *Please note that currently, Enemalta Projects ... is working … on the conversion of this plant to LNG.* ... ”.

Based on above chapter “B” discussions more operating time is needed of the plant before it can be judged to have such availability that it can be deemed to be a possible BAT candidate, especially when this plant is also equipped with a novel FGD technique for the liquid fired diesel engine power plant.

Thus there is a big risk that sufficient long term performance experience of the applied secondary emission techniques will not be achieved and wrong BAT conclusions might be drawn for the HFO fired diesel engine installations.
See also our submitted material /3/ to BATIS for more information.

D Overall conclusion

Enemalta (Delimara) is a power plant consisting of eight identical type/sized big diesel engines. The plant consists of four identical exhaust gas trains consisting each of 2 diesel engines equipped with one “own” SCR and boiler unit per engine and a common dry FGD unit for the flue gases from the 2 engines (see Annex 2). All exhaust gas trains were installed and commissioned during the same time period. In total, 8 diesel engine exhaust gas boilers are generating steam for a common steam turbine in the plant. ➔ **Thus this plant is representing one reference plant and not several ones**.

EUROMOT thus want to stress the following paragraph 2.3.8 of “*Commission Implementing Decision ... on the collection of data and of drawing up of BAT reference documents* ... ” /8/:

”...

It should be noted that evidence (i.e. solid technical and economic information) to support a technique as being BAT can come from one or more installations applying the technique somewhere in the world. In cases where the information on the technique comes from only one installation and/or only from installations located in third regions, a thorough assessment of the applicability within the sector will be carried out by the TWG.

EUROMOT (participating in TWG work via nominated delegates) has earlier highlighted /3/ that in our opinion <u>no</u> thorough assessment has been done by TWG on this (Enemalta (Delimara)) novel plant case.
Enemalta (Delimara) plant has in our opinion not yet proved that it is a feasible BAT candidate (see above discussions on performance of FGD and SCR). In our opinion the Enemalta (Delimara) plant concept cannot either in any case be held as a feasible universal BAT candidate for the whole HFO fired diesel engine power plant sector. We have in our earlier submission /1/ included alternative proposals for feasible BAT emission conclusions.

EUROMOT – 2015-01-23 SchP/PT

For more information please contact:

European Association of Internal Combustion
Engine Manufacturers – EUROMOT
Dr Peter Scherm, +49 69 6603-1354, peter.scherm@euromot.eu
EU Transparency Register ID number: 6284937371-73

E Sources

/1/ LCP BREF 2006 at http://eippcb.jrc.ec.europa.eu/reference/lcp.html

/2/ EUROMOT Position: "DRAFT D1 Large Combustion Plants BREF – BAT AELs for HFO-fired Engines"; 23 September 2013; at http://www.euromot.eu/download/54383683de278fdcb4d093b1

/3/ EUROMOT Position: " HFO Engine Plants – Malta Case Study"; BREF LCP Meeting in Seville, 17/18 June 2014 submitted to BATIS June 2014

/4/ EUROMOT Position: "Euromot Response to CEFIC Comments as of 17 July 2014"; 20 November 2014. Submitted to BATIS 1 December 2014 at http://www.euromot.eu/download/5478c1c83efeb631842bcb77

/5/ EMSA (European Maritime Safety Agency): The 0.1 % sulphur in fuel requirement as from January 2015 in SECAs, An assessment of available impact studies and alternative means of compliance, Technical Report December 2010; at http://ec.europa.eu/environment/air/transport/pdf/Report_Sulphur_Requirement.pdf

/6/ Times of Malta article at http://www.timesofmalta.com/articles/view/20131120/local/Faults-are-still-dogging-power-station-engines.495446

/7/ "BAT Measures – New Plant Extension" at http://www.google.fi/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&cad=rja&uact=8&ved=0CCcQFjAA&url=http%3A%2F%2Fwww.mepa.org.mt%2Ffile.aspx%3Ff%3D6602&ei=QVdqU4PHJeaR7AatuYDYCQ&usg=AFQjCNF5Bxof1xewoh8RmRThfJhq4JjL9g

/8/ "Decisions, Commission Implementing Decision of February 2012 laying down rules concerning guidance on the collection of data and drawing up of BAT reference documents and on their quality assurance referred to in directive 2010/75/EU ..." at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:063:0001:0039:en:PDF

/9/ http://ec.europa.eu/environment/archives/air/pdf/020505bunkerfuelreport.pdf

F Annexes

1. Enemalta LCP-BREF Submission (5 September 2014)
2. Enemalta General Process Diagram
3. Year 2013 - Raw measurement data graphs - NOx and NH3 for stacks "6A", "6B", "6C and "6D"

ANNEX 1: Enemalta LCP-BREF Submission

enemalta

05.09.2014

Enemalta LCP-BREF Submission

Enemalta's is submitting to MEPA the hourly emission data for SO_2, as requested by the European Environmental Bureau, pursuant to the Aarhus acquis in relation to emissions monitoring results of the Large Combustion Plant of DELIMARA, reference year 2013 for a set of pollutants. This data is composed of the following:

1. Raw data: This data was filtered to cater for NO_x allowances given by MEPA for start ups. This filtering takes into consideration:
   a. First Engine Start: this refers to the start up of the first engine of a twin pair i.e. diesel engine (d/e) 41 if d/e 42 is still shut down (s/d) and vice versa and so on for the other pairs. In this case, the whole line of hourly average data for that instant is removed, for all pollutants.
   b. Second Engine Start: this refers to the start-up of say d/e 42 if d/e 41 is already in service (i/s). In this case, only the value of NO_x is copied from the previous hourly data, whereas the values of all other pollutants remain unchanged.

2. Filtered data: In order for Enemalta to come up with the hourly average values submitted on the 13th March 2014 in the LCP BREF Questionnaire Submission for Plant Ref No. 362-365, the raw data mentioned in Point (1) was reviewed and filtered to reflect NORMAL OPERATING CONDITIONS, as defined in the **Instructions** tab in the LCP Questionnaire. The sections defining the allowable filtering conditions are depicted in Figure 1 on Page 3.

   The hourly average data was calculated based on filtering of the raw data (hence start-ups already catered for as described in Point (1)) to exclude gasoil operation, shut-downs and faults on SCR & deSOX systems as explained in '6. Air Emissions' Sheet (see Figure 2 for Print Screen on Page 4) as follows:

   a) "The above figures exclude operation using gasoil which has an impact on lowering emissions."
      - The data was filtered for this condition by deleting the hourly average for all emissions in instances when SO_2 levels were below 60 mg/Nm^3. These instances are marked as **GASOIL** in the worksheet *Hourly Data filtered_SO2_2013* in the document **LCP-BREF data_SO2.xls**

   b) "As per industrial emissions directive, start-up and shut-down periods have been excluded when determining pollutant concentration; however, they have been included to determine the total pollutant emitted per year."
      - The raw data had already been filtered for start-ups as per Point (1).

enemalta

05.09.2014

c) "With regards to NO_x emissions, there was a particular problem during the first year of operation - instability of NO_x abatement due to the following faults: (a) UREA injection; (b) feedback control system".
   - When the data was filtered to fill the BREF questionnaire, only data for NO_x levels between 50 mg/Nm^3 and 185 mg/Nm^3 and ammonia level (urea slip) between 0 and 15 mg/Nm^3 were considered in the calculations. If the conditions for NO_x and/or ammonia were not met, then both values were removed for that instant, since this was assumed to be a fault in the NO_x abatement system.

d) "Minor dust problems continued to occur due to filter bags leaking from tearing of bags as a result of abrasion or movement. Most of these faults are a result of cyclic operation. Continuous operation could have reduce such faults."
   - When the data was filtered to fill the BREF questionnaire, only data for Dust levels between 0 mg/Nm^3 and 20 mg/Nm^3 were considered in the calculations. Higher values of dust emissions were removed for that instant, since this was assumed to be a fault due to the filter bags.

In order to point out problems in the SO_2 abatement process, values of SO_2 higher than 120 mg/Nm^3 were also filtered out for that instant, since this was assumed to be a fault in the SO_2 abatement system. These instances are marked as **FAULT** in the worksheet *Hourly Data filtered_SO2_2013* in the document **LCP-BREF data_SO2.xls**

High levels of CO and CO_2 were also filtered out at 200 mg/Nm^3 and 100 mg/Nm^3 respectively, indicating other-than-normal operating conditions relating to these two emission gases.

The criteria values chosen have been based on the reliability test carried out on Phase 3 in September 2012, where hourly data for normal operation were recorded and minimum and maximum levels for all emissions recorded during these normal operating condition were determined.

enemalta

05.09.2014

Please note that according to Directive 2010/75/EU on Industrial Emission (IED), emission levels associated with best available techniques (BAT-AELs) apply only for normal operating conditions, but the same directive specifies that permit conditions shall include measures relating to other-than-normal operating conditions (OTNOCs). Therefore, although the focus of the questionnaire is on emissions during normal operating conditions, some additional information on OTNOCs are also deemed necessary for the correct understanding of the overall plant performance (e.g. questions 3.2.14 to 3.2.19, 6.5 to 6.7).

All the data reported in the questionnaire should refer preferably to 2010. If data is not available for that year or if it does not appropriately represent the typical operational conditions (e.g. due to major breakdown), you may use 2011 or 2009.

Please note that during the periods of start-ups and shutdowns, as well as during operation under special permit conditions (see 'Glossary' for definition), other fuels different to the ones normally used may be needed. Since this is not the main focus of the data collection exercise through the questionnaire (which does not imply that the information on such periods are not relevant for the LCP BREF review process), separate *Fuel* sheet(s) should not be created for 'start-up'/'back-up' fuel(s).

Normal operating conditions	The conditions during which a combustion plant is operating and discharging emissions into the air, excluding other-than-normal operating conditions. Please note that normal operating conditions may include operation with higher load factors (i.e. closer to nominal load factor), as well as lower load factors (i.e. closer to minimal start-up load), depending on the plant demand/design.
Operation under special permit conditions	Derogation from the obligation to comply with the emission limit value granted by the competent authority under or in the sense of Article 30(5) and (6) and Article 37 of Directive 2010/75/EU.
Start-up and shutdown periods	Start-up period is defined as operation before reaching minimum start-up load for stable conditions. A start-up period can involve a (sometimes extended) period of process stabilisation. A shutdown period is defined as operation after reaching minimum shutdown load for stable conditions. A shutdown period can involve a gradual turning down of the process. Please note that minimum loads relate to technical characteristics of the combustion unit and not the minimum environmental requirements of the combustion plant and its auxiliary systems; emissions can be atypical during these operations, although not necessarily always higher. The periods during which a combustion plant is operating stably and safely with supply of the 'main fuel(s)' but without the export of heat and/or electricity are not included in the start-up or shutdown periods. For the combustion plant which consists of two or more combustion units, the start-up/shutdown period is defined by at least one combustion unit being in that phase.
	Instructions 12/14
Other-than-normal operating conditions	Apart from operation under special permit conditions and start-up and shutdown periods, the following examples are considered other-than-normal operating conditions: unplanned shutdowns, malfunctioning or breakdown of the abatement equipment or part of the equipment for which no derogation was granted by the competent authority under Article 37 of Directive 2010/75/EU, leaks, testing of new fuels/techniques, malfunctioning of instruments related to the process control, malfunctioning of instruments for emission monitoring.

Figure 1: Print Screen from BREF questionnaire defining the filtering allowable conditions and the definition of Normal Operating Conditions and Other-than-Normal operating conditions

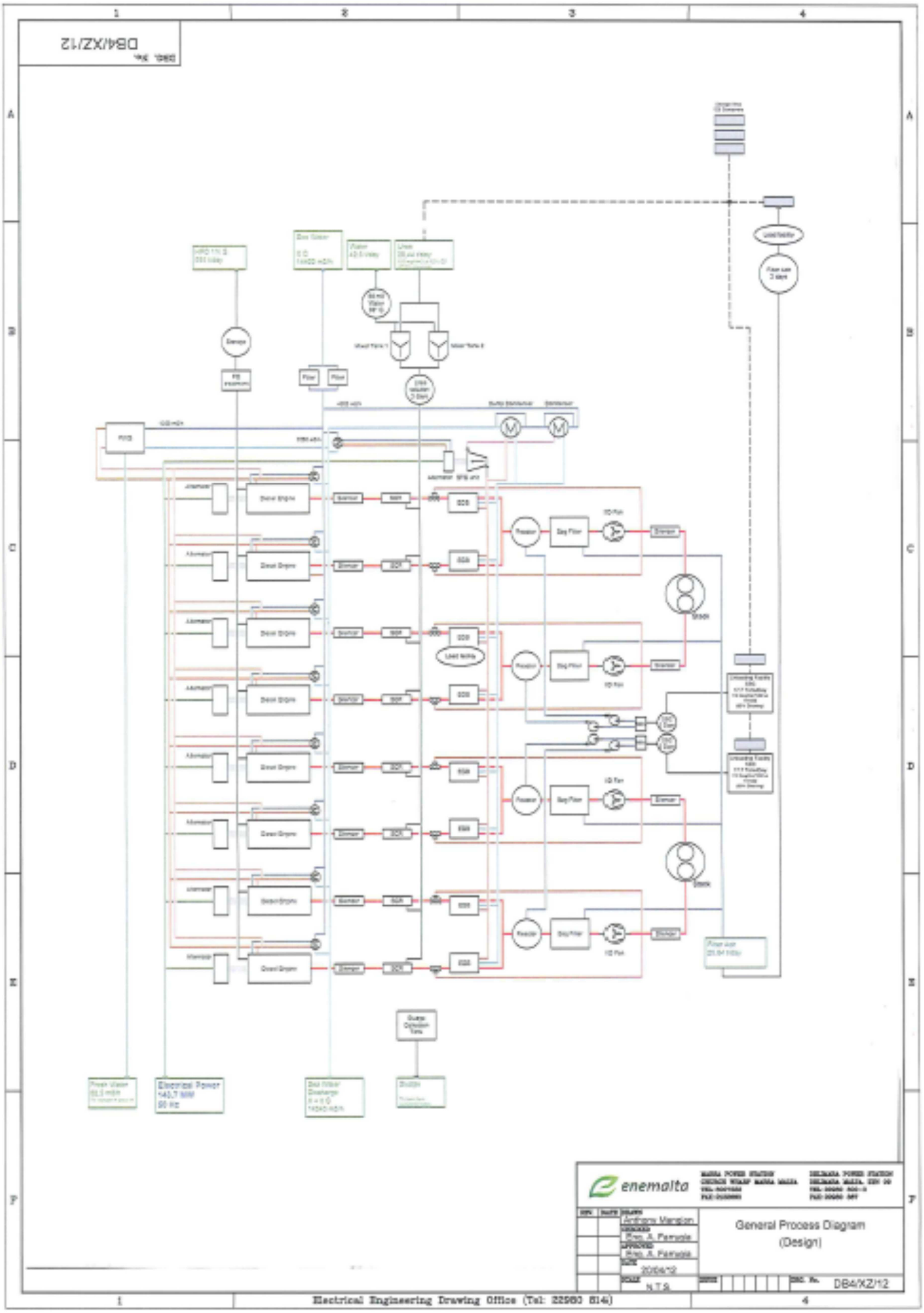
Page 3 of 4

05.09.2014

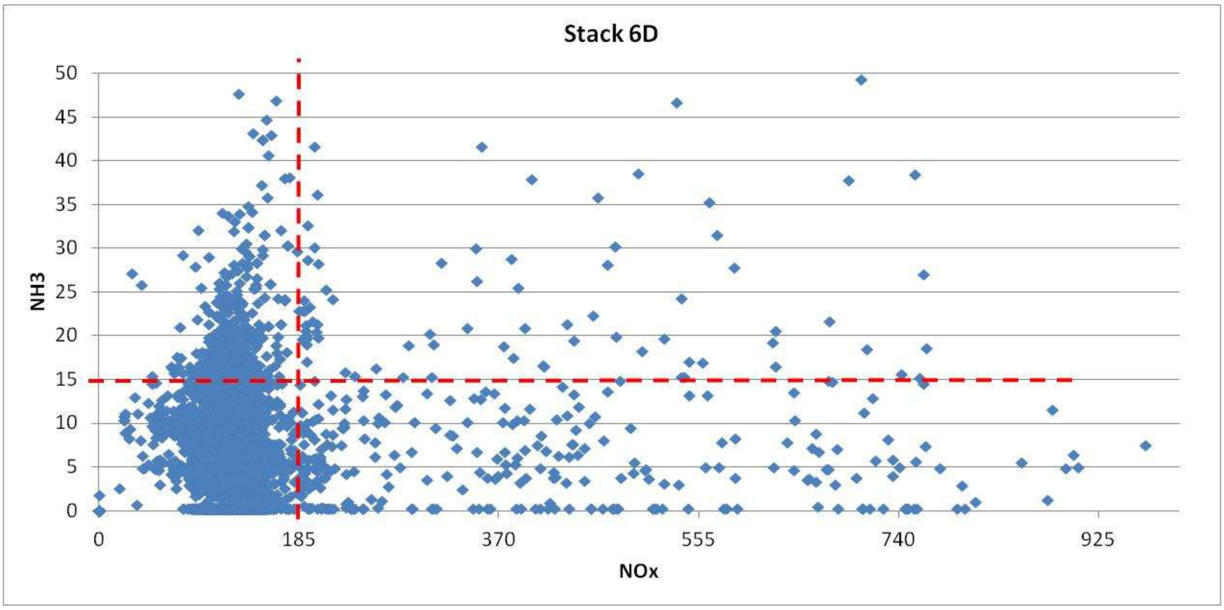
87	
88	The diesel plant was commissioned in December 2012. The plant has now been operational for more than a year. This case study is being resubmitted (based on a full year of operational data) as an update to questionnaire Ref 365 which was based on design values or operating data during a one month reliability test in September 2012. The above figures exclude operation using gasoil which has an impact on lowering emissions. As per industrial emissions directive, start-up and shut-down operation have not been included to determine pollutant concentration however they have been included to determine the total pollutant emitted per year. With regards to NOx emissions, there was a particular problem during the first year of operation - instability of NOx abatement due to the following faults: (a) UREA injection; (b) feedback control system. Minor dust problems continued to occur due to filter bags leaking from tearing of bags as a result of abrasion or movement. Most of these faults are a result of cyclic operation. Continuous operation could have reduce such faults. Values provided for Cadmium & Thallium, Chromium, Cobalt, Copper, Manganese, Lead, Antimony, Arsenic, Nickel and Vanadium are based on two discontinuous sampling events (September 2013 & December 2013). Values for (Cadmium & Thallium) and Arsenic are actually < 0.001mg/Nm3 respectively. Enemalta experienced difficulty to find certified third party laboratories to measure some pollutant concentration to the level of resolution required by the IPPC permit.
89	

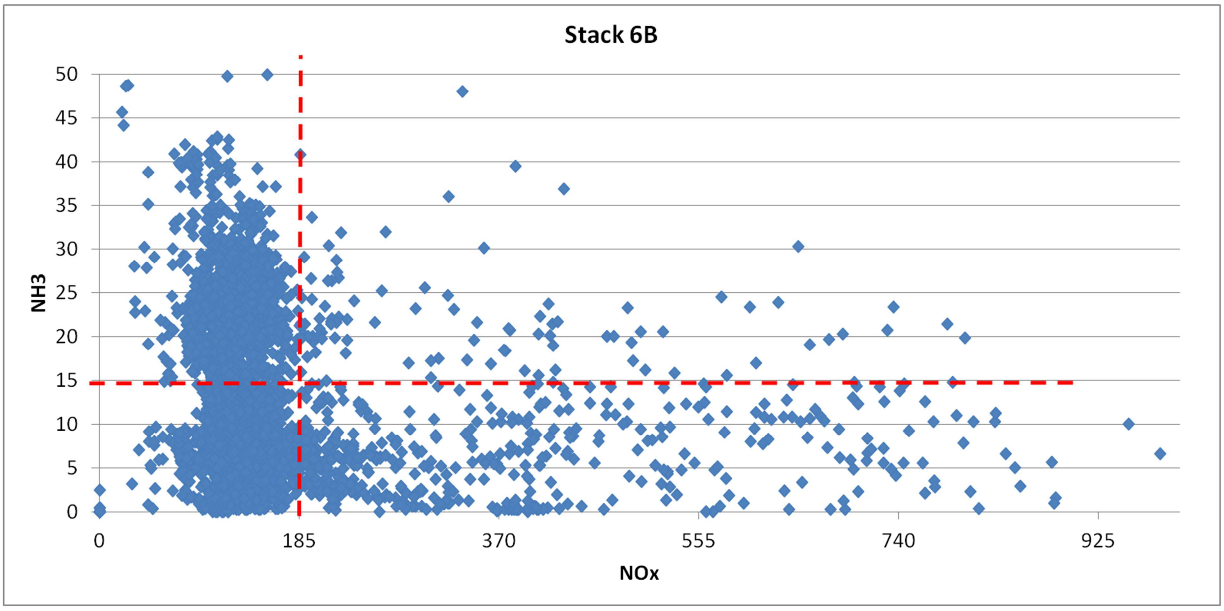
Figure 2: Print Screen of filtering conditions for Enemalta's BREF questionnaire

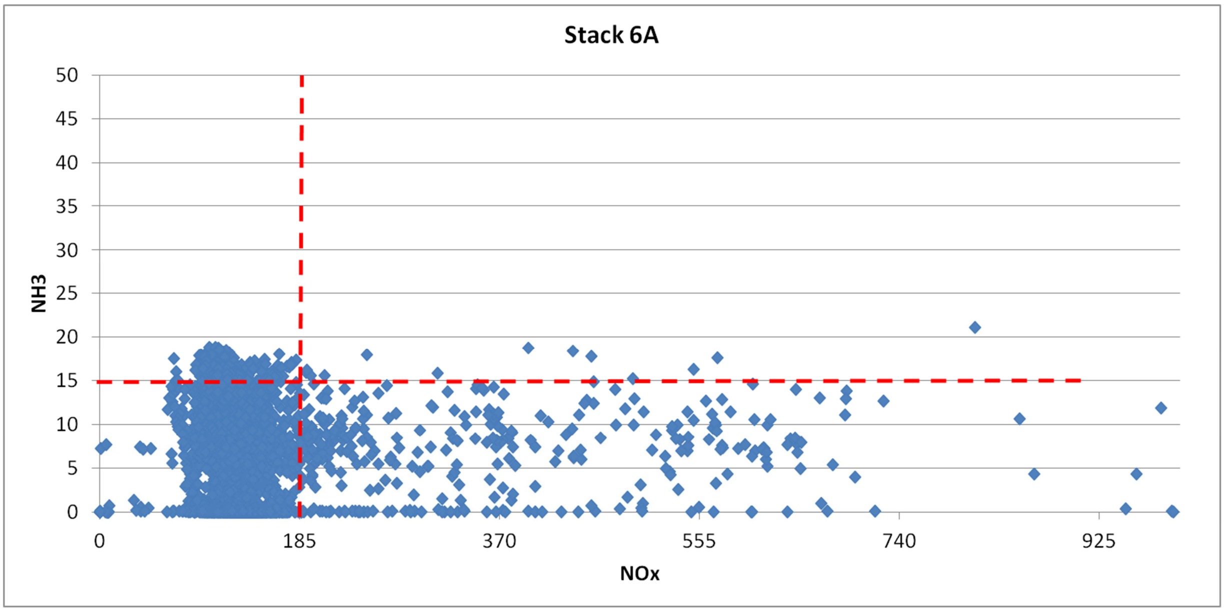
ANNEX 2: Enemalta General Process Diagram

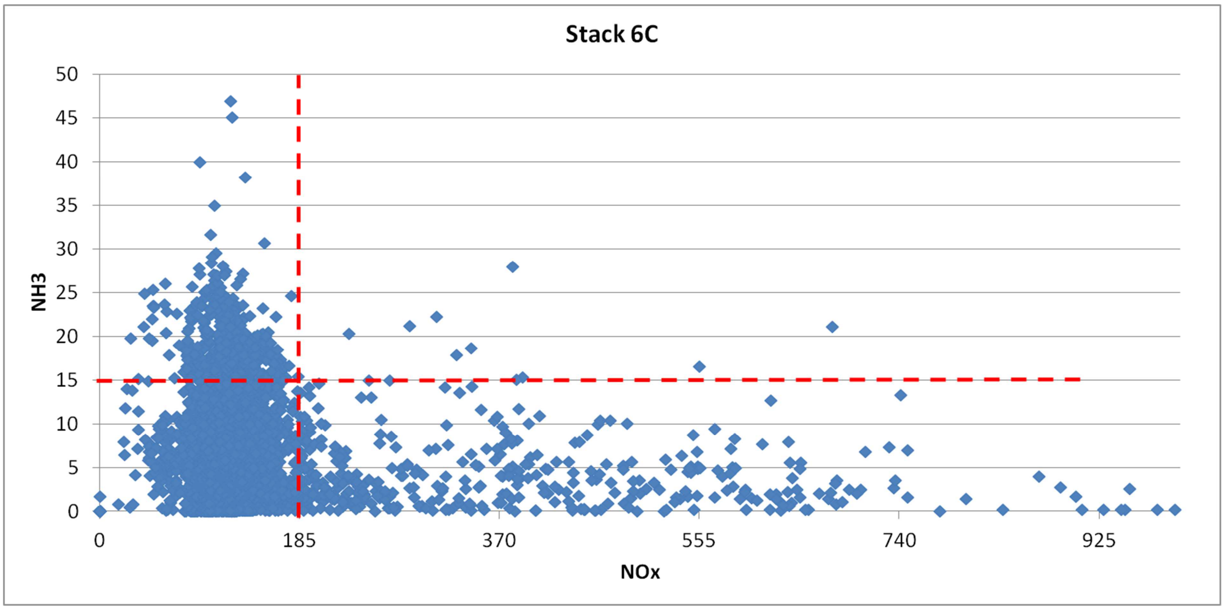


ANNEX 3: Year 2013 - Raw measurement data (1 hour averaged values year 2013, emission unit mg/Nm^3 (15 % O_2) graphs with “filter lines” inserted - NO_x and NH_3 for stacks “6A”, “6B”, “6C” and “6D”.






Stack 6A
NH3
50
45
40
35
30
25
20
15
10
5
0
0
185
370
555
740
925
NOx


Stack 6C
NH3
50
45
40
35
30
25
20
15
10
5
0
0
185
370
555
740
925
NOx

EUROMOT is the European Association of Internal Combustion Engine Manufacturers. It is committed to promoting the central role of the IC engine in modern society, reflects the importance of advanced technologies to sustain economic growth without endangering the global environment and communicates the assets of IC engine power to regulators worldwide. For more than 20 years we have been supporting our members - the leading manufacturers of internal combustion engines in Europe, USA and Japan - by providing expertise and up-to-date information and by campaigning on their behalf for internationally aligned legislation. The EUROMOT member companies employ all over the world about 200,000 highly skilled and motivated men and women. The European market turnover for the business represented exceeds 25 bn euros. Our **EU Transparency Register** identification number is **6284937371-73.**

http://www.euromot.eu – your bookmark for IC engine power worldwide

Our members are:

DIESEL AND GAS ENGINE MANUFACTURERS

AGCO POWER

CATERPILLAR ENERGY & TRANSPORTATION (GROUP)

CNH INDUSTRIAL (GROUP)

CUMMINS

DAIMLER

DEUTZ

DOOSAN

GE POWER, WATER & TRANSPORTATION (GROUP)

HATZ

ISUZU MOTORS GERMANY

JCB POWER SYSTEMS

JOHN DEERE

KOMATSU ENGINES

LIEBHERR

LOMBARDINI-KOHLER GLOBAL POWER (GROUP)

MAN GROUP

MITSUBISHI TURBO & ENGINE EUROPE

MOTEURS BAUDOUIN

ROLLS-ROYCE POWER SYSTEMS (GROUP)

SAME DEUTZ-FAHR

SCANIA

STEYR MOTORS

VOLKSWAGEN POWER SYSTEMS

VOLVO CONSTRUCTION EQUIPMENT

VOLVO PENTA

WÄRTSILÄ

YANMAR (GROUP)

ZETOR

SMALL SI ENGINE MANUFACTURERS

BRIGGS & STRATTON

DOLMAR

EMAK

HONDA EUROPE

HUSQVARNA (GROUP)

KAWASAKI EUROPE

KOHLER GLOBAL POWER GROUP

SOLO

STIHL

TORO EUROPE

WACKER NEUSON

YAMABIKO (GROUP)