Application EPR/RP3133LD/V014 Response to Schedule 5

Aberthaw Power Station EP RP3133LD

Reference Number: RP3133LD/V014/Sch5

June 2017

RWE
The energy to lead

This document is supplied on and subject to the terms and conditions of the Contractual Agreement relating to this work, under which this document has been supplied, in particular:

Confidentiality
This document is unrestricted.

Liability
In preparation of this document RWE Generation UK plc has made reasonable efforts to ensure that the content is accurate, up to date and complete for the purpose for which it was contracted. RWE Generation UK plc makes no warranty as to the accuracy or completeness of material supplied by the client or their agent. Other than any liability on RWE Generation UK plc detailed in the contracts between the parties for this work RWE Generation UK plc shall have no liability for any loss, damage, injury, claim, expense, cost or other consequence arising as a result of use or reliance upon any information contained in or omitted from this document.

Any persons intending to use this document should satisfy themselves as to its applicability for their intended purpose.

The user of this document has the obligation to employ safe working practices for any activities referred to and to adopt specific practices appropriate to local conditions.

RWE Generation UK plc Aberthaw Power Station
EPR/RP3133LD/V014/Sch5

Response to Schedule 5

Prepared for Natural Resources Wales

This report is intended to respond to further questions in regards to the Environmental Permit Variation to allow burning of higher volatile matter coals (HMVCs) at Aberthaw Power Station.

CONTENTS

1. Introduction

This document is submitted to respond to further questions on a permit variation to allow changes to the fuel diet and corresponding fuel handling systems at Aberthaw Power Station.

2. OPRA Profile

Please provide an updated electronic copy of the OPRA spreadsheet for the installation. The updated spreadsheet must include the revised emissions profile for the site following the issue of variation notice EPR/RP3133LD/V013.

See attached RP3133LD_AberthawOPRA_250517

3. Variation application supporting document – Higher volatile matter coal use – Response to questions

A) Page 4 of the application supporting document (ASD), explains that additional dust suppression systems have been identified as necessary at potentially high dust generation areas. Please provide a written list and description of these areas. Please also describe what specific measures are being implemented to suppress dust in these high dust generation areas.

Dust suppression is currently fitted to the heads of Conveyors 3 and 4 and 13 and 14. These are water spray systems located inside the chutes. These are fitted for health and safety and not environmental reasons as they dampen the coal dust to minimise exposure.

The additional dust suppression system described above is where the high carbon ash returns back onto conveyors 7 & 8. These measures are good housekeeping measures as opposed to environmental measures, allowing easier identification of areas of coal dust build up, this area is within an enclosed conveyor structure. Due to the expected limited future generation and hence expected reduction in the high carbon ash return, we have reviewed the requirement for additional measures and will not currently be progressing with the dust suppression system (cost circa £12k), this will however be kept under review.

B) Page 4 of the ASD states that the existing vacuum cleaning plant is to be extended to enable cleaning of more of the fuel route. Please confirm that there are no release points associated with the vacuum cleaning plant or increases in proposed emissions to air.

There are no release points associated with the vacuum cleaning plant or proposed increases in emissions to air.

C) Page 4 of the ASD proposes out of service mill drum rotation activated by carbon monoxide (CO) detection to prevent coal self-heating in mill. Please confirm and justify whether routine out of service mill drum rotation has been considered as a more robust fire prevention measure, as an alternative to out of service mill drum rotation activated by CO detection.

RWE can confirm that the routine rotation of the mill drum was considered as an option. That method has proven effective for high load factor operation when mills are expected to be out of service only for short periods (e.g. weekend outages). For Aberthaw's expected future operating regime it was considered that rotation at a fixed frequency during longer off-load periods a) would increase the risk of contamination of the level instrumentation and seal boxes with consequent operability risks and b) increase the amount of fine material within the mill drum thus increasing the self-heating risk. CO monitoring is an effective technique for detecting self-heating and fire in out-of-service mills and the approach adopted by RWE is to: -

- force-cool the mills prior to shut-down to limit the temperatures in the mill when it is out-of-service and so minimise the potential for self-heating;
- vent the interspace of the hot air shut-off damper seal when the mill is out-of-service to minimise the ingress of hot air into the mill;
- monitor CO concentrations and process temperatures (suitable alarms are provided) during the period that the mill is out-of-service;
- spin the mill drum only if CO concentrations indicate the onset of self-heating within the mill (as opposed to detection of a fire);
- prevent the spinning of the mill drum if CO concentrations or process temperatures indicate a fire in the mill.

RWE's approach is practiced at similar installations but, in any case, will be subject to review following operational experience at Aberthaw.

D) Page 4 of the ASD explains that dynamic classifier speeds will be lowered in order to maintain the required throughput and achieve the required Pulverised Fuel (PF) fineness for combustion of High Volatile Matter Coal (HVMC). This will increase the particle size distribution. In view of this, please confirm whether the PF particle size distribution changes will impact on the Continuous Emissions Monitor (CEM) set up for dust and therefore require recalibration of the CEM.

It is anticipated that dust particle size will only change slightly due to running the dynamic classifiers at a lower speed and therefore the impact on the CEM should also be slight. However the stack dust CEMs will be checked in 2017 during their Annual Surveillance Tests (AST), and QAL 2s of the dust CEMs are planned to be undertaken in early 2018 following the commissioning of the units on HVMC.

E) Page 5 of the ASD states that:

"the proportion of NO:NO_2 is expected to remain similar".

Please explain whether the NO:NO_2 ratio will be reconfirmed by measurement during commissioning of each upgrade unit?

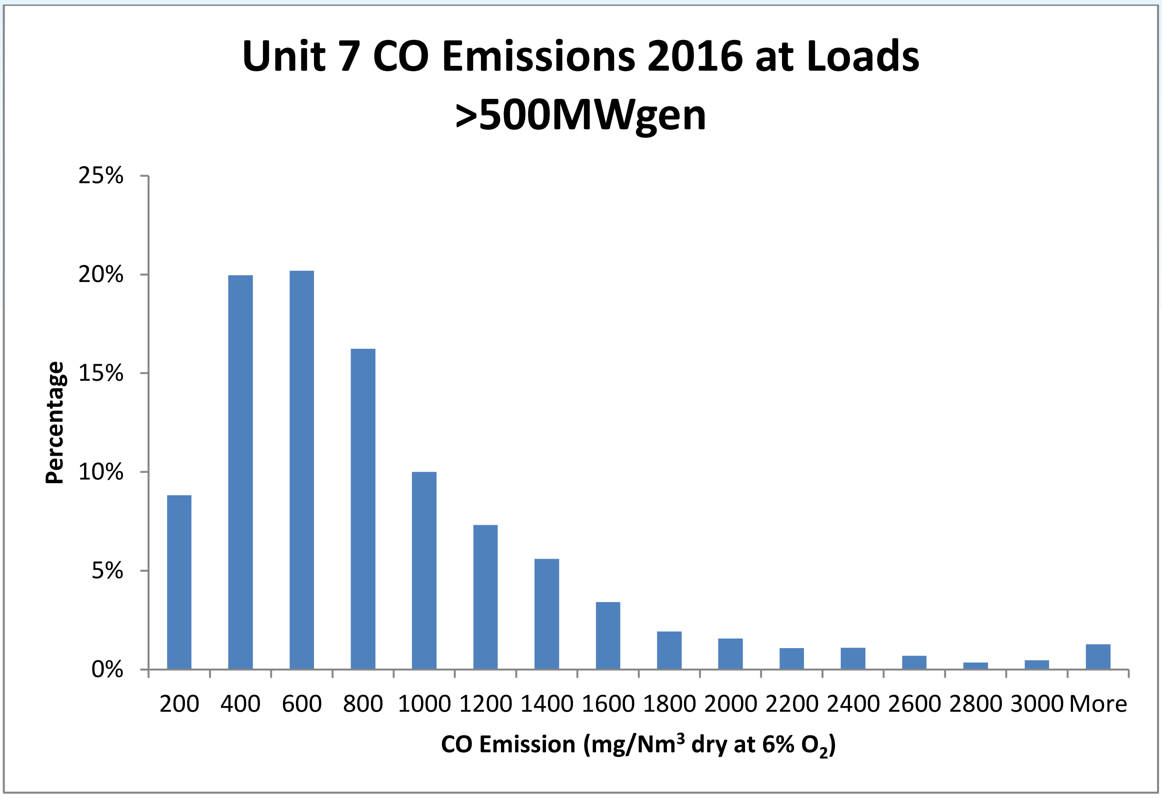
During commissioning total NOx (NO & NO_2) will be measured using a Horiba gas analyser at the FGD inlet. This will be compared to the unit's stack NOx emission to determine if the ratio of NO to NO2 has changed. ASTs are planned on each of the units in 2017 in addition to QAL2s in 2018 following commissioning of the units on HVMC.

F) Figure 1 on Page 6 of the ASD shows that the projected oxides of nitrogen (NO and NO_2, expressed as NO_2) (NO_x) emission levels from converted units 7 and 8 are higher than the sector Best Available Techniques (BAT) monthly average Emission Limit Value (ELV) of 450 mg/m^3, although it is noted that the station stack emissions with Unit 9 in operation will achieve the sector BAT ELV during the Transitional National Plan (TNP). Please explain what measures are proposed for implementation during the TNP to enable emissions below the sector BAT ELV to be achieved without Unit 9 in operation?

NRW initiated a permit variation (EPR/RP3133/V013) which revised Aberthaw's emission limit values to align with the findings of the CJEU judgement and it is our understanding that these revised emission limit values will apply until the end of the TNP. These emission limits are 500 mg/Nm^3 (monthly average) and 605 mg/Nm^3 (95th percentile of daily averages). In terms of meeting the 500 mg/Nm^3 (monthly average), there is currently very limited data available to assess NOx performance on HVMC coals as for safety reasons the duration of trials prior to the conversion was kept to a minimum. However, the available data and analysis presented in Figures 1 and 2 of the ASD indicate that we expect to achieve around 500 mg/Nm^3 on Units 7 and 8 (with Unit 9 achieving approximately 300 to 375 mg/Nm^3). Once the conversion is complete we will be able to gain a detailed understanding of NOx performance on HVMC on all the units and will use this to determine how the limits will be achieved under the variety of expected operating scenarios.

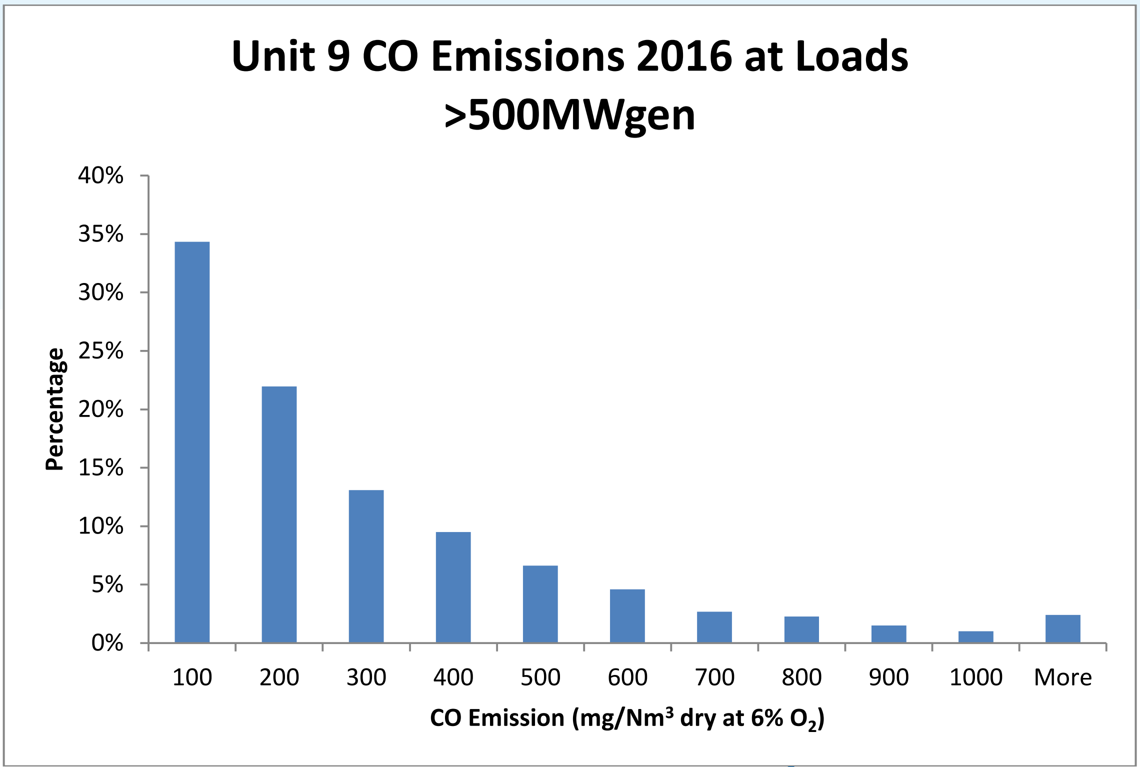
G) Page 7 of the ASD states that no significant change in carbon monoxide emissions is expected from the change to HVMCs. Please provide data from current operation and the HVMC firing trials to demonstrate that CO emissions will remain comparable to current levels.

Current Operating performance on Unit 7:-



CO during the Unit 7 HVMC trial was 1600mg/Nm^3 dry at 6% O_2 between 14:00 and 16:00 on the 8th of March 2016 when the unit was operated on 5 mills of Kedrovsky and one mill of Tower

Current Operating performance on Unit 9:-



CO during the Unit 9 HVMC trial was 160mg/Nm^3 dry at 6% O_2 between 12:00 and 16:00 on the 23rd of June 2016 when Unit 9 was operated on 5 mills of Kedrovsky and one mill of Tower.

.

CO emissions were slightly higher on Units 7 and 9 during the Kedrovsky trials however the trial data is limited. CO emissions are not expected to be significantly higher on HVMC.

H) Table 1, on page 7 of the ASD provides an example of the trace element analysis in typical HVMC compared to that found in typical welsh coal. Please provide trace element composition data for proposed HVMC delivered to the installation consistent with data currently required by the environmental permit, i.e. All List I and List II elements liable to be present plus selenium, (including iron, aluminium, molybdenum, uranium, beryllium, tin, cobalt, titanium and thallium).

See updated Table 1 below.

I) Table 1, on page 7 of the ASD provides an example of the trace element analysis in typical HVMC compared to that found in typical welsh coal. Please provide evidence to demonstrate that the typical Welsh coal trace element data presented in the table are consistent with the levels used to assess seawater discharge impacts in the original permit application.

On review of the information provided it has become clear that there were some errors in the table submitted. A revised table has been reproduced below which also includes the answers to question H). The first column contains data that was used in the original H1 assessment for FGD and therefore only includes those substances included then (this was mistakenly mislabelled in the recent application), the second column is 2016 coal data as submitted on Form Coal1 and the third column is data from analysis of some example HVMC that may be used in future at Aberthaw. It should be noted that this data is from a couple of samples and therefore should not be considered as wholly indicative of future coal diet, however in general the levels of trace elements are lower than the 2016 coal diet and the figures used during the original permit assessment. Aberthaw will continue to submit the form Coal1 and any changes in diet should be seen in this.

In terms of providing evidence that the data in the first column was used in the H1 assessment for FGD, we are including a document on coal diet (Coal analysis) that was submitted during the Schedule 4 process, as can be seen the substances included in the H1 were the ones included in the Pollution Inventory at that time.

	Previous H1 data	**2016 Welsh coal**	**Analysed example HVMCs**
Arsenic	15	7.3	1.8-5.1
Cadmium	0.11	0.32	0.2
Chromium	30	14.7	10.6-13.3
Copper	30	15.6	5.3-7.5
Lead	24	13.5	1.7-3.5
Mercury	0.09	0.059	<0.1
Nickel	33	32.7	6.4-10.8
Zinc	25	12.6	6.9-10.2
Antimony	1.6	0.98	1.0-1.7
Boron	28	18.2	31.7-51.9
Fluoride	75	41.8	<10.0-47.9
Manganese	93	57.0	23.3-54.7
Selenium	2.1	1.55	1.1-3.4
Vanadium	51	28.5	11.3-13.6
Aluminium	NA	20163	731-2300
Beryllium	NA	2.34	0.1-0.2
Cobalt	NA	8.8	1.3-2.6
Iron	NA	9001	3010-3760
Molybdenum	NA	1.98	1.8-2.4
Thallium	NA	0.85	0.1-1.1
Tin	NA	0.67	<0.5
Titanium	NA	812	31.2-33.2
Uranium	NA	0.57	0.7-1.4

Revised Table 1 Example trace element analysis in coals (mg/kg)

J) Please provide ash quality data demonstrating that trace element data currently monitored by the quarry landfill permit are consistent with current ash levels, i.e. mercury, cadmium, lead, arsenic, chromium, molybdenum, boron, selenium. Table 2 on page 8 of the ASD does not include data about these parameters. In addition, please refer to the ash quality data on these additional parameters to justify whether or not a review of the hydrogeological risk assessment is required.

Table 2 of the ASD presents available ash quality data from coal samples not from Pulverised Fuel Ash (PFA) samples. We do have both solid phase and leachate analysis data for the elements listed for the historical PFA deposited in the quarry however due to the limited nature of the trials we do not have comparison data from the combustion of HVMCs.
In addition, even if this information was available, it should be noted that leachate tests are not necessarily representative of actual field conditions and it is more appropriate to assess environmental impact by monitoring upstream (background) and downstream groundwater and surface water of a site. PFA solid phase and leachate analysis will continue to be undertaken once the conversion to HVMC has taken place and reviewed to provide an indication of the leachate composition. The downstream groundwater and surface water will continued to be monitored to determine any adverse environmental impact. Hence, a hydrogeological risk assessment is not proposed at this time, but will be carried out on the normal review timescales.

K) Section 2.13 “Noise”, on page 9 of the ASD, states that:

“There are no expected changes in noise as a result of the plant modifications to allow burning of HVMCs”.

Please provide details of proposed controls and any necessary communications with residents in relation to potential increases in steam safety valve venting during commissioning of the upgraded plant.

During commissioning, it will be necessary to test steam pressure safety valves, giving rise to a short term, temporary noise event. There is also a potential risk of a short term increase in steam safety valve venting during this period. It is therefore proposed that a letter is sent to local residents informing them of commissioning periods.

L) Section 2.14 “Monitoring”, on page 9 of the ASD states that:

“Once the plant has been fully commissioned a review will be required to determine if a new QAL test will be required due to the reduction in NO_x emissions from the stack”

Please confirm whether dust and SO_2 as well as NO_x CEM re-testing will be undertaken if necessary due to changes in emission levels associated with the conversion to HVMC firing.

All CEMS will be recalibrated following the commissioning of the conversion works, via the QAL2 process in 2018.

M) Section 4 of the ASD provides a justification of the option choice for the installation in terms of plant modifications. Please provide a sensitivity analysis of the options appraisal outcome to key parameter assumptions, providing justifications where necessary, including the LNBo NO_x levels achieved <400 mg/m^3, Opex, HVMC, air staging plates and load factor.

Sensitivity Study

The sensitivity of the predicted stack gas average NOx concentration and cost per tonne NOx abated has been calculated using the methodology previously presented in the ASD.

The sensitivity to the assumed load factor, baseline NOx emission with the windbox modification and abatement due to a switch to HVMC has been calculated.

The parameters examined are as follows:

- Load factor 6 to 28% with a default of 17%
- Abatement with HVMC 30 to 40%, default 30%
- Baseline NOx with windbox modification of 750 to 830mgNm^{-3}, default of 750mgNm^{-3}

As an actual capex cost (£15.2million) for the existing LNBo conversion of Unit 9 is now available this has been included in the analysis.

The methodology adopted for sensitivity study has been to vary one parameter at a time and calculate the emission and cost of abatement. The cost/tonne and annual emission are plotted for each option in the Appendix below.

Load factor

The base case assumption is for a load factor of 17% with a NOx emission with the wind box modification of 750mgNm^{-3} and a NOx abatement of 30% with a switch to HVMC.

The high load factor (high lifetime average) abatement costs have been calculated assuming a load factor of 28%, this reflects historic levels of load (50%) for three years followed by six years with a load factor of 17%. Whilst at the upper end of what may be possible it is an unlikely scenario given current market conditions. However, it provides an illustration of the influence of load factor on the option selection.

Other load factors have been used to illustrate costs and benefits under more plausible operational scenarios. Two low load factors of 10% and 6% have been used. The lowest of these represents the load factor assuming the plant were to run at 500 hours per year.

Table M1 Comparison costs and abatement

		Cost per tonne abated (£/tonne)			
Option	**Stack average NOx (mgNm^{-3})**	**Base case (17%)**	**High life time average (28%)**	**Low load factor (10%)**	**Low load factor (500 hours-6%)**
3 units LNBo	500	£1346	£829	£2265	£3755
1 unit LNBo + 2 units windbox, 3 units HVMC	467	£296	£226	£421	£623

Compared to the base case the higher load factor reduces the cost per tonne of NOx abatement. The reduction in the cost for the all LNBo option is greater than that for the option with two units of windbox modifications and a switch to HVMC.

The lower load factor relative to the base case increases the cost per tonne of the tabulated options. The relative increase in the cost per tonne for the three units LNBo conversion option is greater than that for the 1 unit LNBo + 2 units windbox modifications with all 3 units burning HVMC. The cost ratio for a change from 17% load factor to 6% is 2.8 for the all LNBo option and 2.1 for windbox modifications plus coal switch. .

Revised graphs can be seen in the Appendix to this document.

High end reduction in NOx with high volatile coal

The costs and abatement has been calculated assuming the base case conditions but with a 40% reduction in NOx due to a switch to HVMC.

Table M2 High end reduction in NOx due to coal switch: costs and abatement

Option	Cost per tonne abated (£/tonne)	Stack average NOx ($mgNm^{-3}$)
3 units LNBo	£1346	500
1 unit LNBo + 2 units windbox, 3 units high volatile coal	£253	400

As might be expected an increase in the NOx reduction due to switching coal diet, reduces the cost per tonne and the stack gas average for the 1 unit LNBo + 2 units windbox modifications with all 3 units burning high volatile coal option

Relatively low abatement with windbox modifications

The costs and abatement have been calculated with a relatively low NOx abatement from the windbox modification. For this case it has been assumed that the modifications result in a NOx emission of $830mgNm^{-3}$ on low volatile coal.

Table M3 Low NOx abatement due to windbox modifications: costs and abatement

Option	Cost per tonne abated (£/tonne)	Stack average NOx ($mgNm^{-3}$)
3 units LNBo	£1346	500
1 unit LNBo + 2 units windbox, 3 units high volatile coal	£326	504

With low abatement due to the windbox modifications and the low (base case) reduction with HVMC the stack average NOx concentration is just greater than $500mgNm^{-3}$.

Low abatement with windbox combined with higher abatement with coal switch

The cost and abatement associated with a case where the windbox modifications offer a low abatement ($830mgNm^{-3}$ on low volatile coal) combined with a higher than base case reduction due to switch to high volatile coal (40% compared with the 30% assumed in the base case) have been calculated.

Table M4 Low NOx abatement due to windbox modifications, higher abatement due to coal change: costs and abatement

Option	Cost per tonne abated (£/tonne)	Stack average NOx ($mgNm^{-3}$)
3 units LNBo	£1346	500
1 unit LNBo + 2 units windbox, 3 units high volatile coal	£272	432

As would be expected, compared to the case with low NOx abatement due to windbox modifications and base case assumption on reduction in NOx with coal change the combination of low windbox abatement and higher coal abatement reduces the stack average NOx concentration. The stack average is reduced to 432$mgNm^{-3}$ which is lower than the base case concentration. The calculated stack average NOx is relatively sensitive to the abatement from coal change. It should be noted that the base case coal change reduction is the low end of the predicted range.

Summary of the sensitivity study

The costs per tonne of NOx abated and annual abatement vary with assumptions but overall the relative abatement and costs per tonne are similar for all the cases considered. The costs per tonne abated for the option with three LNBo units is sensitive, compared to the proposed 2 units of windbox modifications and switch to HVMC, to load factor. The base case assumption of 17% is the limit that will apply after 2020 and hence the low load factor cases may be more realistic assumptions than the high end case. With a high capital cost (£15.2 million) the cost per tonne abated for the all LNBo options are relatively sensitive to changes in load factor.

The base case assumption is that the windbox modification results in a NOx emission of 750mg Nm^{-3}, using the low end of the predicted range of abatement (830mg Nm^{-3}) with the base line (low) reduction from a switch to a HVMC diet the stack average concentration is 504mg Nm^{-3} which is slightly greater than 500$mgNm^{-3}$ limit. However with the higher reduction from a coal change (40%) the stack average is well below the limit at 432mg Nm^{-3}, the stack average is more sensitive to the coal abatement assumption than to the assumption of the abatement from the windbox modification.

The sensitivity study does not change the conclusion that the use of one unit LNBo with two units with windbox modifications and a switch to a high volatile coal diet is the lowest cost means of achieving the required stack gas NOx concentration. This is particularly true if the actual load factor at Aberthaw is less than the maximum permitted post 2020.

Graphs of the costs per tonne against reduction in NOx over the year can be found in the Appendix below.

Appendix 1

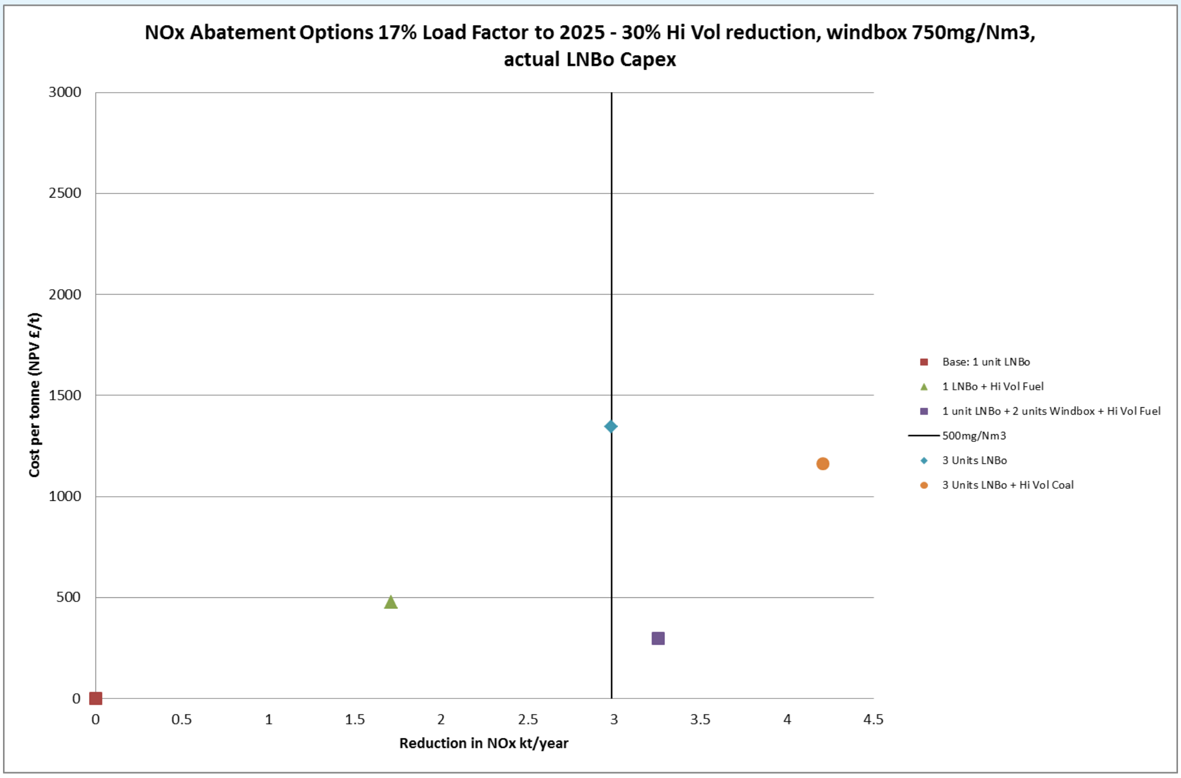


Figure 1 Cost/tonne and abatement: Base case assumptions

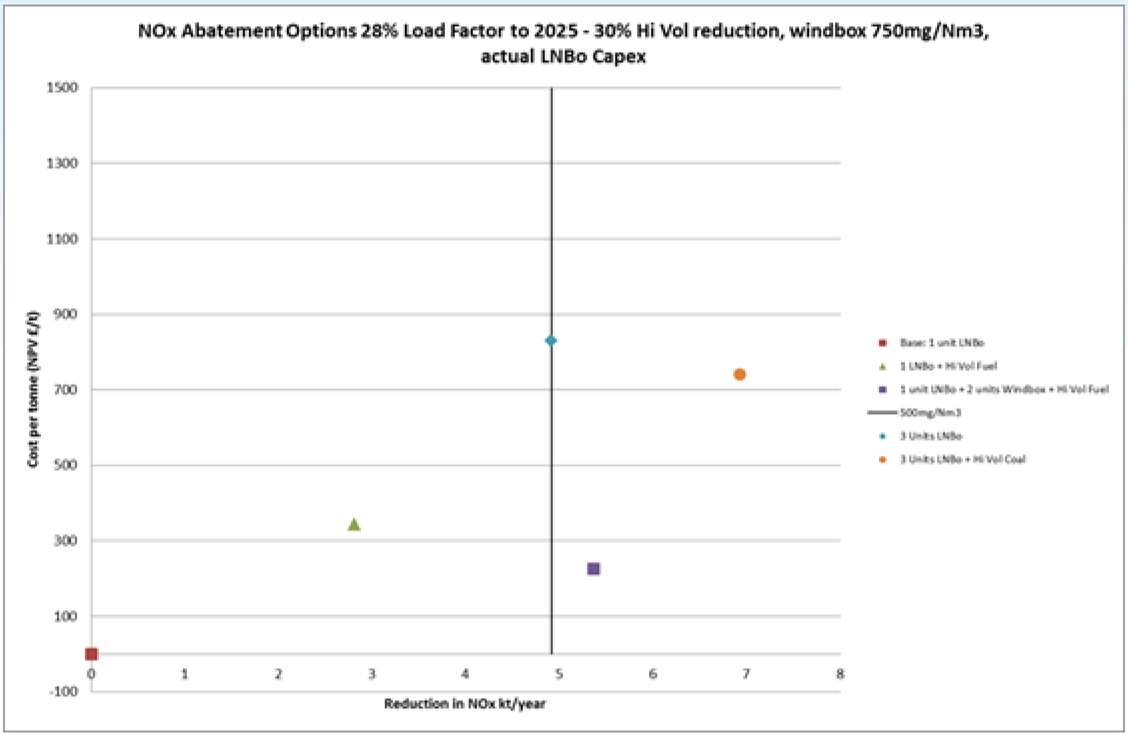


Figure 2 Cost/tonne and abatement: High Lifetime average

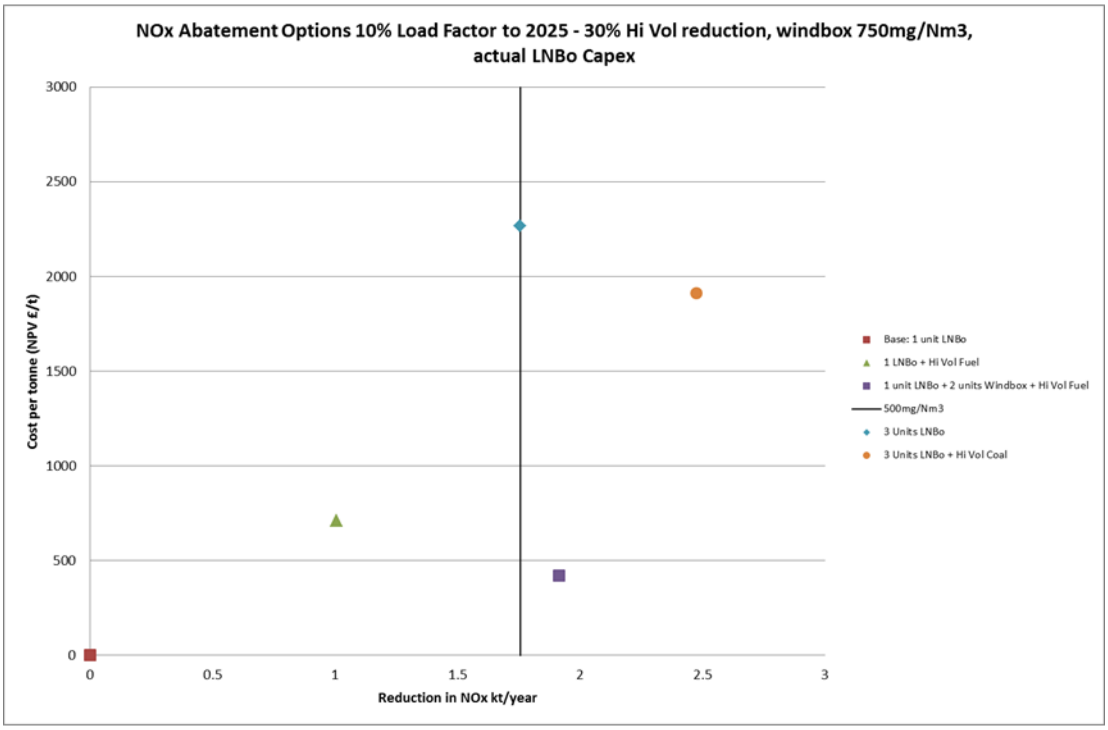


Figure 3 Cost/tonne and abatement: Low Load Factor 10%

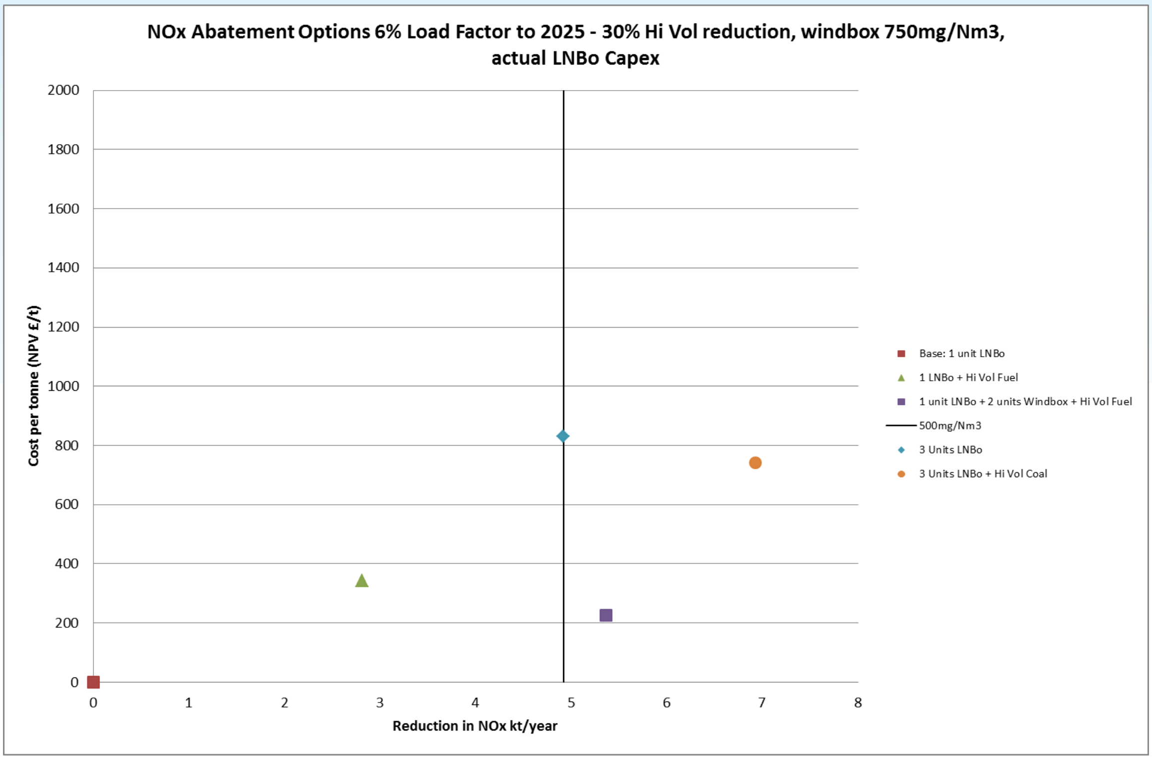


Figure 4 Cost/tonne and abatement: Low Load Factor 6%

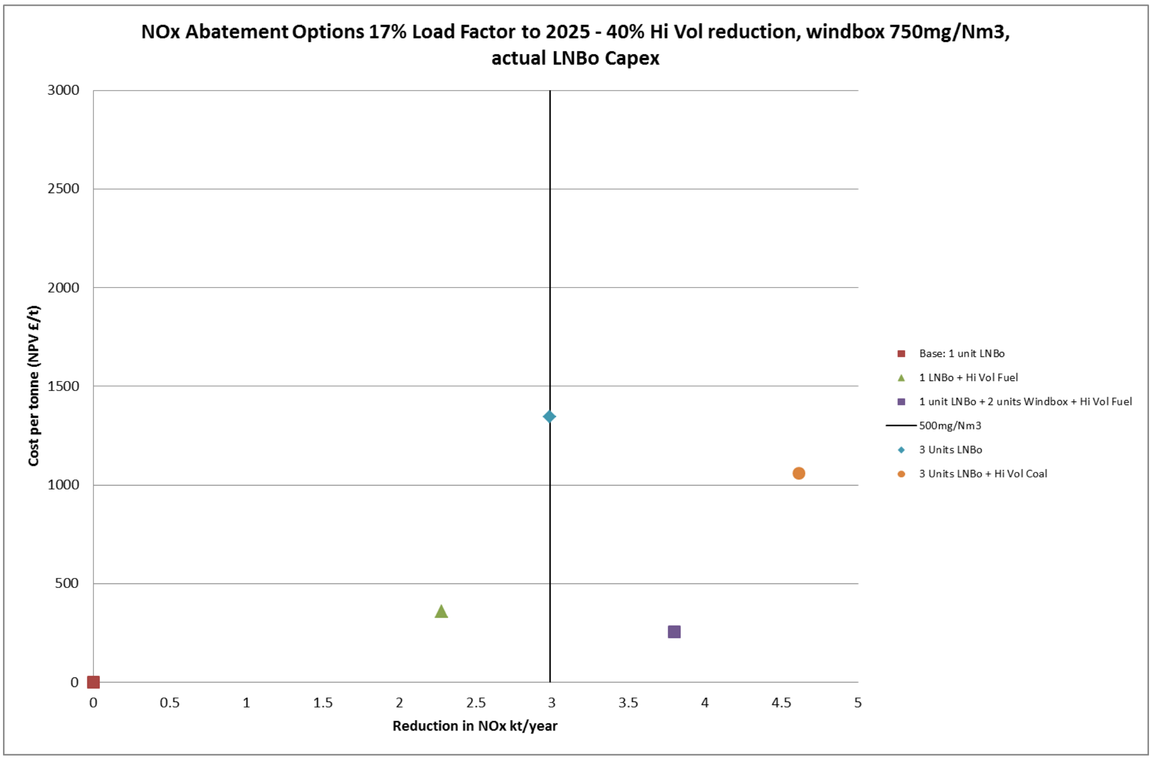


Figure 5 Cost/tonne and abatement: High end reduction due to coal switch

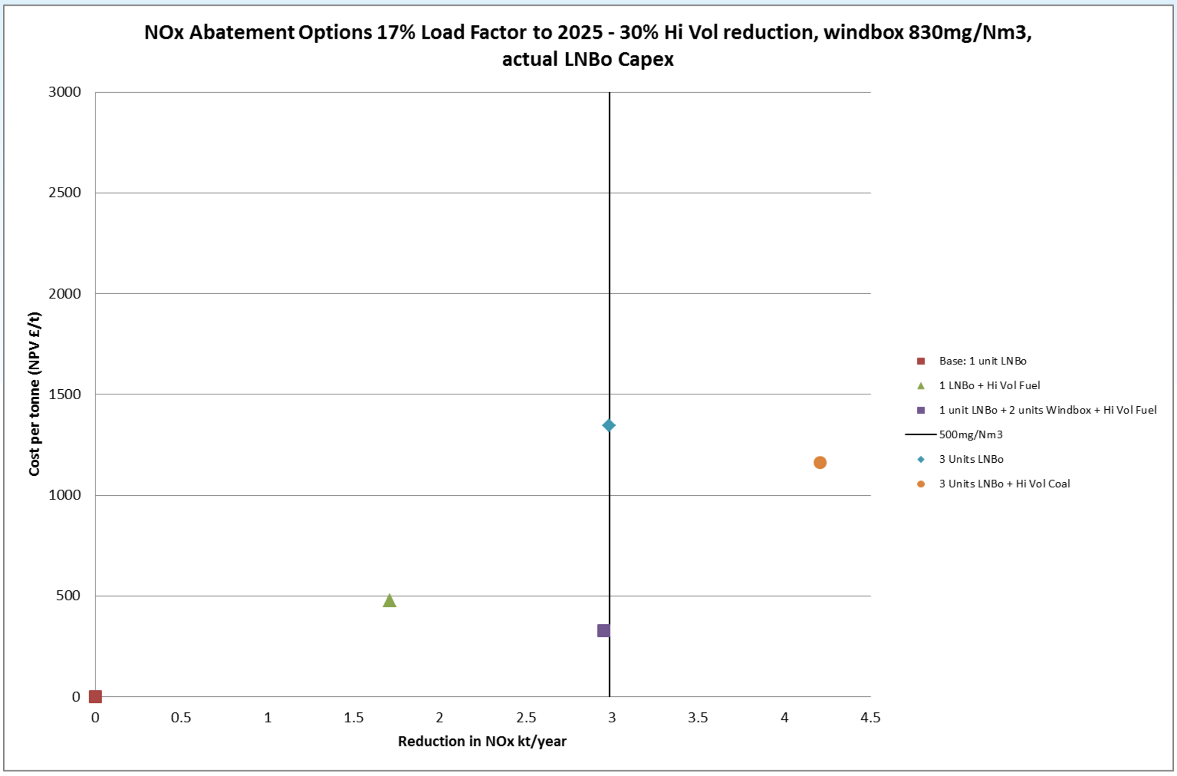


Figure 6 Cost/tonne and abatement: relatively low abatement with windbox modifications

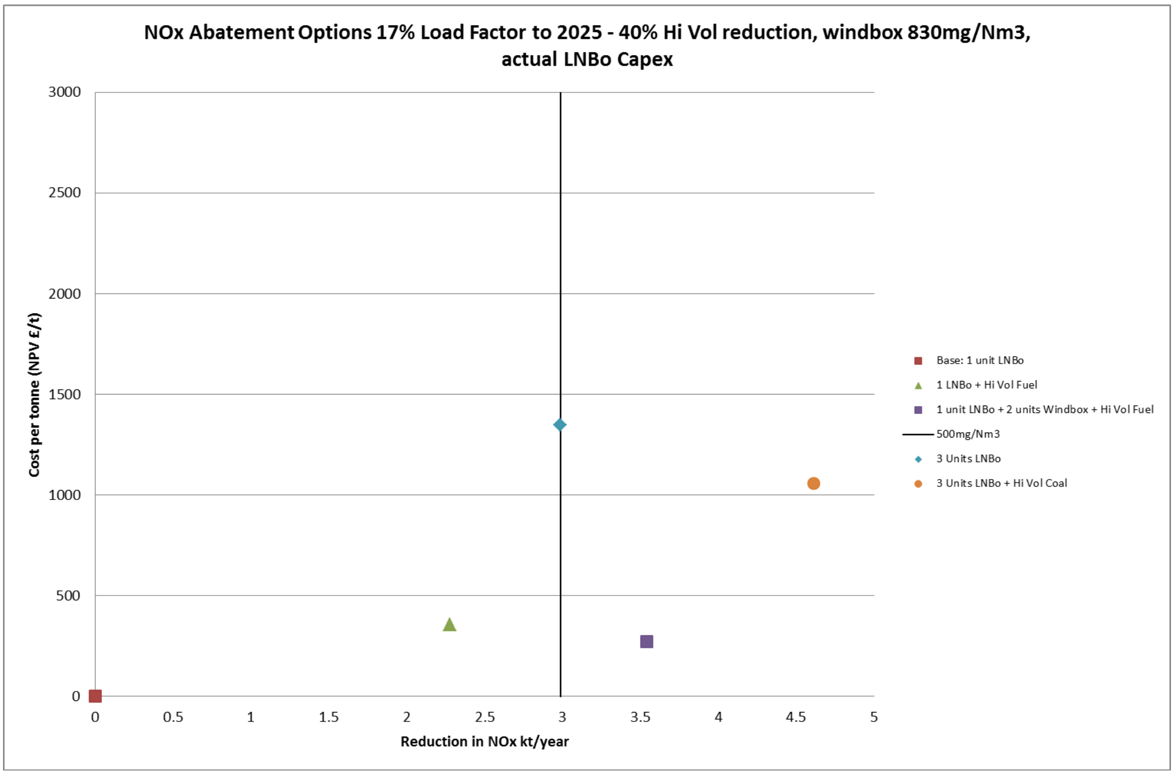


Figure 7 Cost/tonne and abatement: relatively low abatement with windbox modifications combined with higher abatement from switch to high vol coal

RWE Generation UK plc

RWE Generation UK plc
Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire
SN5 6PB

T +44 (0)1793 877777
F +44 (0)1793 892525
I http://www.rwegeneration.com

Registered Office:
RWE Generation UK plc
Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire
SN5 6PB
Registered in England
& Wales: No. 3892782