Technical Appendix: Final Motivation for the Additional Postponement of Compliance Timeframes in terms of Regulation 11 of Section 21 NEM:AQA Minimum Emissions Standards

Report Prepared by

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Foreword

This technical appendix presents technical information regarding Sasol's investigations into solutions for compliance with existing plant standards and new plant standards as prescribed in the MES, specified in Part 3 of GN 893.

Each chapter represents technical information pertaining to a particular listed activity, and is structured as follows:

- Applicable MES for the given process or listed activity is provided.
- A short description of the production process involved is presented (as included in the main report, but with more detail, as pertinent).
- A discussion on the various technology options investigated to achieve compliance with the applicable MES and the constraints involved in implementing them.
- Proposed alternative emissions limits informed by all these inputs.

This technical work on technology options for compliance with the MES informed Chapter 4 ("Reasons for applying for postponement from default application of the MES") in the accompanying Sasol Infrachem motivation report, and also informed the alternative emissions limits requested.

Although this additional postponement application relates to the 2015 existing plant standards, for completeness' sake, this appendix also outlines the challenges faced in meeting new plant standards.

A note on the assessment of feasibility of compliance with the prescribed MES

In this technical appendix, statements are incorporated regarding the feasibility of identified technologies as emissions abatement solutions. Assessments of these technologies were triggered in some instances by Sasol's internal policies regarding continuous improvement, and in others, by the requirement to comply with the MES. The assessment of feasibility is a holistic assessment of the implications of compliance from multiple perspectives, including but not limited to:

- The viability of a technology to achieve the desired emission reduction outcome.
- The unintended consequences of implementing a technology, including upstream and downstream impacts.
- Operability of the technology.
- Implementation considerations including process safety risks, construction risks, production risks and integrated planned maintenance scheduling implications.
- Financial implications, including upfront capital expenditure and lifecycle operating costs;
- Environmental cross-media impacts.
- Ambient air quality benefits arising.

These assessments inform decision-making regarding the holistic 'feasibility' of a compliance technology.

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Glossary

Definitions of terms as per GN 893, that have relevance to this application:

Existing Plant - any plant or process that was legally authorized to operate before 1 April 2010 or any plant where an application for authorisation in terms of the National Environmental Management Act 1998 (Act No.107 of 1998), was made before 1 April 2010.

Fugitive emissions - emissions to the air from a facility, other than those emitted from a point source.

New Plant - any plant or process where the application for authorisation in terms of the National Environmental Management Act 1998 (Act No.107 of 1998), was made on or after 1 April 2010.

Point source - a single identifiable source and fixed location of atmospheric emission, and includes smoke stacks.

Point of compliance – means any point within the off gas line, where a sample can be taken, from the last vessel closest to the point source of an individual listed activity to the open-end of the point source or in the case of a combination of listed activities sharing a common point source, any point from the last vessel closest to the point source up to the point within the point source prior to the combination/interference from another Listed Activity.

Definitions of terms as per the NEM:AQA that have relevance to this application:

Priority area - means an area declared as such in terms of Section 18.

Priority area air quality management plan - means a plan referred to in Section 19.

Additional terms provided for the purpose of clarity in this application:

Additional postponement applications – Sasol submitted draft applications for exemption in terms of Section 59 of NEM:AQA from certain MES, along with draft applications for postponement from certain MES. These exemptions were motivated on the basis that the applicable standards were infeasible based on, amongst others, technology, brownfields, environmental and economic constraints. Since the conclusion of the stakeholder engagement process, Sasol has been directed to rather seek postponement from the compliance timeframes in the MES to address its challenges. Consequently the exemption application will instead be submitted as a postponement application, in addition to its existing postponement applications which have already been submitted to the National Air Quality Officer. Natref now therefore makes application for postponement in respect of those applications which were previously submitted, advertised and made available for public comment, as exemption applications. These are referred to herein as *additional postponement applications*.

Alternative emissions limits – the standard proposed by Sasol based on what is considered reasonable and achievable as a consequence of the assessments conducted and which Sasol proposes as an alternative standard with which it must comply. The alternative emissions limits are specified as *ceiling emissions limits*, as defined in this Glossary. In all instances, these alternative emission limits seek either to maintain emission levels under normal operating conditions as per current plant operations, or to reduce current emission levels, but to some standard which is not identical to the promulgated minimum emissions standards. Specifically, these alternative emissions limits do not propose an increase in current average baseline emissions.

Atmospheric Impact Report - in terms of the Minimum Emission Standards an application for postponement must be accompanied by an Atmospheric Impact Report as per Section 30 of NEM:AQA. Regulations Prescribing the Format of the Atmospheric Impact Report (AIR) were published in Government Notice 747 of 2013).

Ambient standard - The maximum tolerable concentration of any outdoor air pollutant as set out in the National Ambient Air Quality Standards in terms of Section 9(1) of the NEM:AQA.

Ceiling emissions limit – Synonymous with "maximum emission concentrations". The administrative basis of the Minimum Emissions Standards is to require compliance with the prescribed emission limits specified for existing plant standards and new plant standards under all operational conditions, except shut down, start up and upset conditions, based on daily average concentrations as defined in Part 2 of the MES. Whereas average emission values reflect the arithmetic mean value of emissions measurements for a given process under all operational conditions over a 3 year period, the ceiling emission would be the highest daily average emission concentration obtained. Hence, ceiling emission values would be higher than average emission values, and the difference between ceiling and average values being dependent on the range of emission levels seen under different operational conditions. Since the Minimum Emissions Standards specify emissions limits as ceiling emissions limits or maximum emission concentrations, Sasol Infrachem has aligned its alternative emissions limits with this format, to indicate what the 100^{th} percentile emissions measurement value would be under any operational condition (excluding shut down, start up and upset conditions). It is reiterated that Sasol Infrachem does not seek to increase emission levels relative to its current emissions baseline through its additional postponement applications and proposed alternative emissions limits (specified as ceiling emission limits), but rather proposes these limits to conform to the administrative basis of the Minimum Emissions Standards.

Criteria pollutants – Section 9 of NEM:AQA provides a mandate for the Minister to identify a national list of pollutants in the ambient environment which present a threat to human health, well-being or the environment, which are referred to in the National Framework for Air Quality Management as "criteria pollutants". In terms of Section 9, the Minister must establish national standards for ambient air quality in respect of these criteria pollutants. Presently, eight criteria pollutants have been identified, including sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), lead (Pb), particulate matter (PM_{10}), particulate matter ($PM_{2.5}$), benzene (C_6H_6). In this document, any pollutant not specified in the National Ambient Air Quality Standards ("NAAQS") is called a "non-criteria pollutant".

Existing plant standards - The emission standards which existing plants are required to meet. Emission parameters are set for various substances which may be emitted, including, for example, particulate matter, nitrogen oxides and sulphur dioxide.

Listed activity - In terms of Section 21 of NEM:AQA, the Minister of Water and Environmental Affairs has listed activities that require an atmospheric emissions licence. Listed Activities must comply with prescribed emission standards. The standards are predominantly based on 'point sources', which are single identifiable sources of emissions, with fixed location, including industrial emission stacks.

Maximum emission concentrations – Synonymous with "ceiling emissions limits". Refer to glossary definition for ceiling emissions limits.

Minimum emissions standards – prescribed maximum emission limits and the manner in which they must be measured, for specified pollutants. These standards are published in Part 3 of GN 893.

Minister – the Minister of Environmental Affairs.

New plant standards - The emission standards which existing plants are required to meet, by April 2020, and which new plants have to meet with immediate effect. Emission parameters are set for various substances which may be emitted, including, for example, particulate matter, nitrogen oxides and sulphur dioxide.

Postponement – a postponement of compliance timeframes for existing plant standards and new plant standards and their associated special arrangements, in terms of Regulations 11 and 12 of GN 893. In the context of Sasol's applications, these postponements are referred to as *initial postponements* and *additional postponements*, as defined in this Glossary.

GN 893 – Government Notice No. 893, 22 November 2013, published in terms of Section 21 of the National Environmental Management: Air Quality Act (Act No 39 of 2004) and entitled '*List of Activities which Result in Atmospheric Emissions which have or may have a Significant Detrimental Effect on the Environment, Including Health and Social Conditions, Economic Conditions, Ecological Conditions or Cultural Heritage'*. GN 893 repeals the prior publication in terms of Section 21, namely Government Notice No. 248, 31 March 2010. GN 893 deal with aspects including: the identification of activities which result in atmospheric emissions; establishing minimum emissions standards for listed activities; prescribing compliance timeframes by which minimum emissions standards must be achieved; detailing the requirements for applications for postponement of stipulated compliance timeframes.

Sasol Infrachem – the entity now known as Sasol Chemical Industries (Pty) Limited operating through its Sasolburg Operations. To avoid unnecessary confusion, the name "Sasol Infrachem" has been retained in this report.

Special arrangements – specific compliance requirements associated with a listed activity's prescribed emissions limits in Part 3 of GN 893. These include, among others, reference conditions applicable to the listed activity prescribed emission limits, abatement technology prescriptions and transitional arrangements.

List of Abbreviations

AEL – Atmospheric Emissions Licence

AIR - Atmospheric Impact Report

ALNB – Advanced Low NOx Burner

BAT - Best Available Techniques

BOFA – Boosted Overfire Air

CO_2 – Carbon dioxide

DSI - Direct sorbent injection ESP – Electrostatic Precipitator

FGD - Flue-gas desulphurisation

HSP – High Sulfur Pitch

HEA – Heavy Ends A

HEB – Heavy Ends B

I&APs - Interested and Affected Parties

LNB – Low NOx Burner

NAAQS - National Ambient Air Quality Standards

NAQF – National Framework for Air Quality Management

NAQO - National Air Quality Officer

NEMA - National Environmental Management Act (Act 107 of 1998)

NEM:AQA - National Environmental Management: Air Quality Act (Act 39 of 2004)

NH_3 - Ammonia

NO_x – Oxides of nitrogen

NO_2 – Nitrogen dioxide

MES - Minimum Emissions Standards

OFA – Over Fire Air

$PM_{2.5}$ – Particulate Matter with radius of less than 2.5 µm

PM_{10} – Particulate Matter with radius of less than 10 µm

SCR - Selective Catalytic Reduction

SNCR – Selective Non-Catalytic Reduction

SO_2 - Sulphur dioxide

t/h – tons per hour

VOCs or TVOCs – (Total) Volatile Organic Compounds

VTAPA – Vaal Triangle Air-shed Priority Area

1 Steam Station 1: Postponement Request for PM, SO_2, NO_X

1.1 Applicable standards

Minimum Emission Standards (MES) Category 1.1 prescribes emission limits applicable to solid fuel combustion installations.

Table 1: Category 1: Combustion Installations, Subcategory 1.1: Solid Fuel Combustion Installations

Description:	Solid fuels combustion installations used primarily for steam raising or electricity generation.		
Application:	All installations with design capacity equal to or greater than 50 MW heat input per unit, based on the lower calorific value of the fuel used.		
Substance or mixture of substances		**Plant status**	**mg/Nm^3 under normal conditions of 10% 0_2, 273 Kelvin and 101.3 kPa.**
Common name	**Chemical symbol**		
Particulate matter	N/A	New	50
		Existing	100
Sulphur dioxide	SO_2	New	500
		Existing	3 500
Oxides of nitrogen	NO_x expressed as NO_2	New	750
		Existing	100

1.2 Description of the plant

Steam is a critical industrial process requirement for various business units within the Sasolburg Industrial Complex (SIC), including Sasol business units and external customers. Process steam must be available at the right quality (correct temperature and pressure) and quantity (volume of steam demanded) at all times, and at all processes where steam is required. To meet these exacting steam requirements a large fleet of small boilers was built rather than a small fleet of large boilers. The fleet of boilers allows for the management of both planned and unplanned disruptions to steam generation, without compromising the supply of steam to users across the complex.

Steam Station 1 comprises five boilers and in addition to steam, it supplies electricity to the Infrachem site. The facility also exports part of its electricity production into the national grid. Steam Station 1 is an integral part of the steam and electricity distribution infrastructure for the Sasolburg complex as it is critical to the hydraulic and thermal balance of the Infrachem site. The Steam Station 1 boiler availability is critical to the production of these facilities and additional outage time on the boilers means not only that electricity production is lost, but also has a direct impact on the production of these facilities.

All boiler work, including maintenance and upgrades is driven by a strictly applied general overhaul (GO) schedule, to ensure that process steam is not interrupted. The GO schedule is also aligned with other statutory inspections prescribed for pressure vessels. The net effect of the GO schedule is to ensure that boilers are shut down individually in a routine, sequential manner. A single cycle of boiler shutdowns through the entire fleet of Steam Station 1 and 2 boilers takes several years. Atmospheric emissions from the boilers include carbon dioxide (CO_2), sulphur dioxide (SO_2), oxides of nitrogen (NO_x) and particulate matter (PM).

1.3 Technology options for compliance: PM

The current boiler fleet has installed PM abatement technology, in the form of electrostatic precipitators (ESPs) combined with flue gas conditioning through ammonia dosing, to enhance particulate matter capture. The current collection efficiency of ESPs is in excess of 99%. Although the ESPs were originally designed for PM emission rates of 400mg/m^3, Sasol Infrachem has been able to currently achieve an average emission concentration of below 200 mg/m^3, through ammonia dosing to improve particle agglomeration (which incurs additional operating costs). Annual maintenance is performed on the ESPs to maintain this average emission level.

Sasol Infrachem has investigated the following options for compliance with PM emission limits for existing and new plant standards:

a) **Addition of two additional fields to each ESP**: The Steam Station 1 boilers were designed with two field precipitators. An additional two fields would further reduce emissions to below the existing plant standard. In practice the addition of the additional fields to the ESPs would not be possible due to space constraints at the Steam Station 1 site. As illustrated in Figure 1:

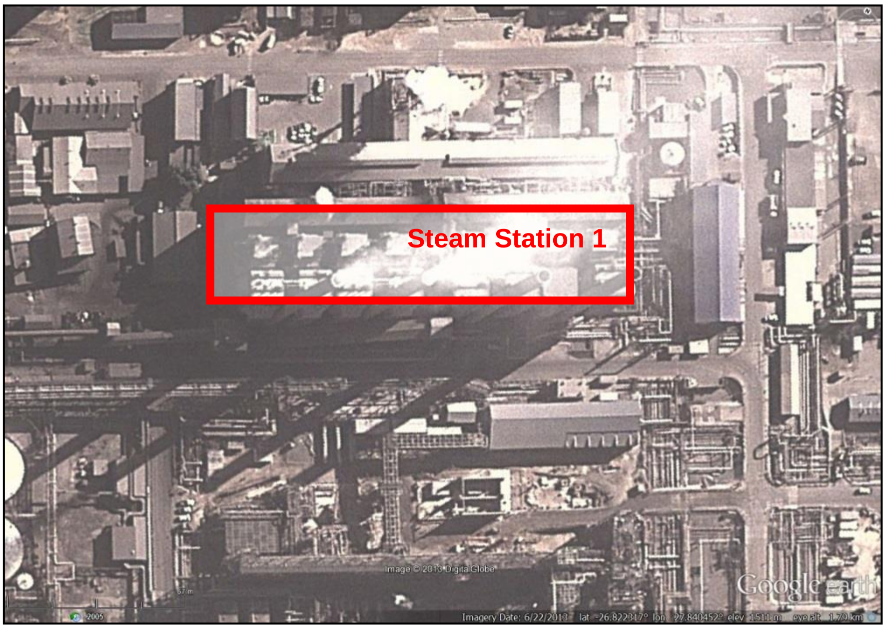

Figure 1: Space constraints at Steam Station 1

b) **Replacement of ESP internals with fabric filters**: The Infrachem boilers were designed without economisers, and therefore the flue gas temperature is higher (typically 175°C) than most coal fired power stations. Standard filter bags are unable to withstand these extreme temperatures, thus specialised bag material would be required. The specialised bags have high maintenance requirements (bag replacements every +/- 4 years) and high energy requirements to compensate for the large pressure drop over the baghouse. The bag filters are not considered a sustainable abatement technology for the Sasol Infrachem operation as a result of the impacts described above.

c) **SO_3 (sulphur trioxide) injection** was also explored as a means to enhance the performance of the current ESPs. This option was found not to be feasible as temperatures at the inlet of the Steam Station 1 ESPs are too high to implement this technology effectively. This technology operates optimally at 120 – 130 ^{0}C and is not effective at the high temperature at which the Steam Station 1 ESPs operate (typically 175 ^{0}C). Investigations were conducted into lowering flue gas temperatures to improve the efficacy of SO_3 injection for PM removal. The option of lowering temperatures was not seen as a viable option due to the technical risks associated with upgrading air heaters in the relatively small boilers at Steam Station 1.

Table 2: Summary of technology feasibility assessment associated with installation of PM abatement technologies at the Sasol Infrachem Steam Station 1 Plant

TECHNICAL OPTION	ASSESSMENT OF TECHNOLOGY FEASIBILITY	SUMMARY OF REASONS FOR FEASIBILITY ASSESSMENT
Additional two fields per precipitator	Not feasible	• Space constraints. • Extended General Overhauls, resulting in loss of generation capacity.
Replacement with bag filters	Not feasible	• Negative operational impacts due to increased risk of unplanned boiler outages as a result of bag damage at high temperatures, leading to flaring and production loss. • Higher auxiliary power requirement, resulting in reduced boiler fleet steam output. • Less steam output for same amount of coal used.
SO_3 (sulphur trioxide) injection	Not feasible	• High ESP inlet temperatures render the technology ineffective. • SO_3 contributes to visible emissions.
Renewal of electrostatic precipitator fields	Feasible	• Implemented.
Optimisation of emissions through ammonia dosing	Feasible	• Implemented.

1.4 Technology options for compliance with new plant standard: SO_2

The steam plant currently meets the existing plant standard for SO_2. SO_2 emissions result from the combustion of sulphur present in the coal feedstock. As such, emissions are directly related to the sulphur content of coal, which in South Africa is fairly low, typically in the 0.7 – 0.9% range. An international technology scan was conducted, and a variety of flue gas desulphurisation (FGD) technologies were investigated for the purpose of bringing SO_2 emissions into compliance with the 2020 new plant standard of 500 mg/Nm^3. The following options for compliance with SO_2 emission limits for new plant standards were investigated:

- Wet FGD.
- Dry FGD (spray dry technology).
- Semi-dry FGD.
- Direct sorbent injection (DSI) with lime.

The semi-dry technology, with the smallest space footprint, was identified as the most promising technology for SO_x reduction due to the space constraints on the Steam Station 1 site. However, several challenges are associated with the implementation of semi-dry technology, as with all FGD technologies. Implementation of the semi-dry FGD technology is a high capital-cost and high operating-cost technology. Semi-dry FGD is also associated with high levels of technical and operational risk given the constrained space within which the plant would need to be built and installed, where the steam plant is integrated into the production process. All FGD technologies have significant negative operational impacts on the plants which would influence operation of the Sasol Infrachem facility. These include:

- Significant additional plot space adjacent to the boilers is required for the abatement equipment. As visible from Figure 1 above, plot space is very constrained at Steam Station 1, since available space has been optimised over the plant's lifetime. Globally, there is no reference plant where this technology has been implemented under the same extent of space constraints while the balance of the plant needs to continue being operational for production purposes. This lack of reference creates significant uncertainties for production stability at Sasol Infrachem during the lengthy construction process.
- The installation of FGD technology would reduce the plume temperature. As a result of the temperature reduction in the stack, the buoyancy of the plume would be negatively affected and pollutants exit the stack would not be as effectively dispersed, causing an increased ambient impact of other emissions. To overcome the negative dispersion impacts of the pressure drop of the FGD equipment (and its negative impacts on plume buoyancy described above), significant additional power input would be required for booster fans. This large reduction in net energy output from the boiler fleet represents much lower energy efficiency of the steam plant, and correspondingly higher carbon intensity and lower water efficiency of steam production.
- Impact on plant availability during construction and operation due to tie-in requirements and the requirements to construct on an operational plant.
- Retrofitting onto old facilities is more costly and technically more complex than specifically designing a new build facility to incorporate FGD technology.
- Lime or limestone is required as the sorbent for the desulphurisation reaction. Sasol Infrachem would require up to 24 000 tons per year of lime. Within the Sasol Infrachem factory site, the increase in lime transport logistics from a large centralised lime storage facility to smaller day silos at Steam Station 1, where the lime would be consumed, is a significant obstacle due to site space constraints.
- The lime quality and particle size distribution of the lime has a significant impact on the efficiency of the process. Variations in lime quality will negatively impact the operation of the plant.

Furthermore, the installation of FGD technology would result in negative environmental impacts:

- The process generates approximately 47,000 tons per year of additional solid waste for disposal
- The environmental footprint of mining and transportation of lime to Sasolburg must be considered –24,000 tons per year of lime will be required.
- Additional water requirements of 840 megalitres of water per year. The FGD process will generate an effluent that will require treatment. The salt load in the Vaal River is already problematic and will be aggravated by additional load to the system. Indications from the Department of Water Affairs are that water quality standards will become stricter.

Sasol has also investigated the removal of sulphur upstream of the boilers in order to reduce SO_2 emissions. Sulphur can be removed by a process is called de-stoning. It involves removing a portion of the ash with some pyritic sulphur (in the form of iron sulphide). The investigation concluded that the technology was infeasible due to the following negative impacts:

- De-stoning is a water-intensive process requiring additional raw water to wash the coal. After coal washing, this would become waste water, which requires treatment.
- Only the sulphur associated with the non-organic fraction in coal could theoretically be removed, at high capital cost. De-stoning would therefore not reduce SO_2 emissions to below new plant standards.
- De-stoning results in increased coal consumption and reduced mine life as a portion of the coal mined is discarded in the de-stoning process.
- Increased waste footprint due to a portion of the high ash coal being discarded.

Table 3: Summary of technology feasibility assessment associated with installation of SO_2 abatement technologies at the Sasol Infrachem Steam Station 1 plant

TECHNICAL OPTION	OUTCOME OF TECHNOLOGY FEASIBILITY ASSESSMENT	SUMMARY OF REASONS FOR FEASIBILITY ASSESSMENT OUTCOME
Flue Gas Desulphurisation	Not feasible	• Space constraints. • Negative logistics implications outside of Sasolburg, and within the factory complex. • Environmental footprint of mining and transporting lime. • High capital and operating costs. • Reduced plume buoyancy resulting in increased ambient impacts of other emissions emitted via common stacks, if energy losses are not compensated for. • Negative environmental cross-media impact: additional waste stream of 47,000 tons per year, additional water use of 840 megalitres per year resulting in additional effluent generation.
De-stoning	Not feasible	• Increased water demand. • Reduction of coal mine lifetime. • Increased waste footprint, resulting in disposal of additional carbon-containing tailings.

1.5 Technology options for compliance: NO_x

Steam Station 1's current emissions operate above the existing plant standard ceiling limit of 1,100 mg/Nm^3. Sasol undertook a pre-feasibility study on available technologies to reduce NO_x emissions from the Steam Station 1. The options considered were the installation of: Low NO_x burners (LNB), LNB with over fire air (OFA) or flue gas recirculation, selective non-catalytic reduction (SNCR), and Selective catalytic reduction (SCR). The approach to reducing NO_x is generally staged, where technologies are implemented in an order which depends on the promulgated emission reduction required. Technology costs increase as more stringent controls are implemented. It is expected that compliance with new plant standards under most normal operating conditions could theoretically be achieved by installing LNBs, although this would likely be the upper limit of abatement potential for LNB technology alone.

Sasol Infrachem investigated the following options for compliance with NO_x emission limits for existing and new plant standards:

a) **Replacement of current burners with Low NO_x Burner (LNB) Systems**: Due to the small size of the boilers, NO_x reduction technologies commonly used for pulverised fuel (PF) boilers will not be suitable for retrofit at Steam Station 1, because LNBs result in longer flames which would impinge on these small boilers' walls, leading to boiler damage. Custom-designed LNBs would be required. Even if LNBs could be installed, there would be an additional risk of reduced boiler efficiency.

b) If LNBs alone would not realise the required emission reductions, then **Over Fire Air (OFA)** or selective non-catalytic reduction (SNCR) would be required in addition to LNBs to abate further. OFA is a further air-staging method that inhibits the formation of NO_x by introducing a portion of the combustion air in "ports" above the last burner level. This is a technically risky option, requiring significant structural modification of the boilers and boiler tube arrangements as well as the installation of additional booster fans, which would require additional energy input. As a result of technology risks, OFA is deemed an infeasible technology option. In addition, for air staging to be effective, sufficient height is required for adequate mixing in order to ensure complete burnout of the coal. Due to the small size of the boiler, air staging is not an effective technique for NO_x reduction.

c) **Selective non-catalytic reduction (SNCR):** SNCR involves the injection of ammonia into the flue gas. The reaction only occurs in a limited temperature window between 900 and 1100°C. Below this temperature, the ammonia does not react and ammonia slip will occur. Above this temperature window, sticky ammonium bisulphate forms which will cause fouling of the air heaters. Fouling of the air heaters is a serious concern as it will require additional downtime for cleaning and may increase corrosion of the air heaters, leading to boiler downtime which affects the production capacity of the processes to which the boilers supply steam. The technology is selected for implementation less often than conventional LNB and OFA technology. The reason for this is due to relatively low NO_x reduction achievable (typically 20-30%) as well as operational risk to the boiler if it is not operated and controlled carefully. SNCR alone will not be able to achieve the required reduction to NO_x new plant standards from the current Steam Station 1 baseline.

d) **Selective Catalytic Reduction (SCR)**: This technology is not seen as a viable option for the Steam Stations as it is a very expensive technology, both in terms of initial capital cost, as well as operating cost. The high operating costs are a result of the high replacement costs of the catalyst. In addition to the cost requirements, SCR would require significant plot space, which is not available at Steam Station 1. SCR has similar space requirements to the semi-dry FGD system discussed in Section 0. SCR would have to be implemented between the existing air heater and the ESP of each boiler, for which there is not enough space available on the plant. This would furthermore require extended boiler outages for installation, owing to the fact that the system is installed in the very constrained space between the air heater and ESP, with high costs associated with lost steam and power production during this period. Safety risks are also associated with construction in this very constrained space, due to working in a fully operating production area.

Table 4: Summary of technology feasibility assessment associated with installation of NO_x abatement technologies at the Sasol Infrachem Steam Station 1 plant

TECHNICAL OPTION	ASSESSMENT OF TECHNOLOGY FEASIBILITY	SUMMARY OF REASONS FOR FEASIBILITY ASSESSMENT
Low NO_x burners (LNBs)	Not feasible	• Risk of boiler damage as a result of small size of boiler and elongated flames of LNBs. • Reduction in boiler efficiency, requiring compensation with additional coal consumption. • Increased greenhouse gas emissions due to lower efficiencies. • Technology may not achieve the new plant standards consistently.
Overfire Air (OFA)	Not feasible	• Insufficient boiler height. • Major structural modifications to boilers and boiler tube arrangement required.
Selective non-catalytic reduction (SNCR)	Not feasible	• Risk of fouling of air heaters or ammonia slip if operated outside temperature window – significant risk to plants supplied by the steam stations. • Reduction of boiler efficiency and availability. • Increased greenhouse gas emissions as a result of lower efficiencies.
Selective catalytic Reduction (SCR)	Not feasible	• Space Constraints. • High capital and operating cost technology. • Safety risks associated with construction in a very constrained space.

1.6 Postponement request

Sasol Infrachem applies for a five-year postponement from the existing plant standard for its Steam Station 1, as detailed in Table 5. In place of the MES, Sasol Infrachem proposes ceiling limits as alternative emissions limits to be incorporated in its Atmospheric Emissions Licence, to prevail during the period of postponement.

Table 5: Alternative emissions limit proposal for Steam Station 1

Emission component(s)	Emission standard for existing plants	Emission standard for new plants	Alternative Emission Limit Requested (*ceiling limit*)[a]	Averaging period for compliance monitoring
	All values specified at 10% O_2 273 K and 101.3 kPa, mg/Nm^3			
SO_2	3 500	500	2 000*	Daily average
NO_x	1 100	750	1 450	Daily average
Particulates	100	50	165	Daily average

[a] *Refer to the accompanying motivation report for an explanation of the reasons for specifying a ceiling or maximum emission concentration limit*

*As confirmed in the foreword to this appendix, this application relates to postponement of the 2015 existing plant standard only. However, for completeness' sake, these are the limits which Sasol could meet in the longer term, based on current available information.

Current average emissions are as shown in Table 5. Since the MES prescribes ceiling limits, or maximum emission concentrations, the alternative emissions limits requested to apply during the period of postponement are aligned to the maximum emission levels expected under all normal operating conditions. In practice, emission concentrations are not expected to materially differ from the current average emission concentrations reported above.

1.7 Summary of AIR results: Steam Station 1

1.7.1 Particulate Matter

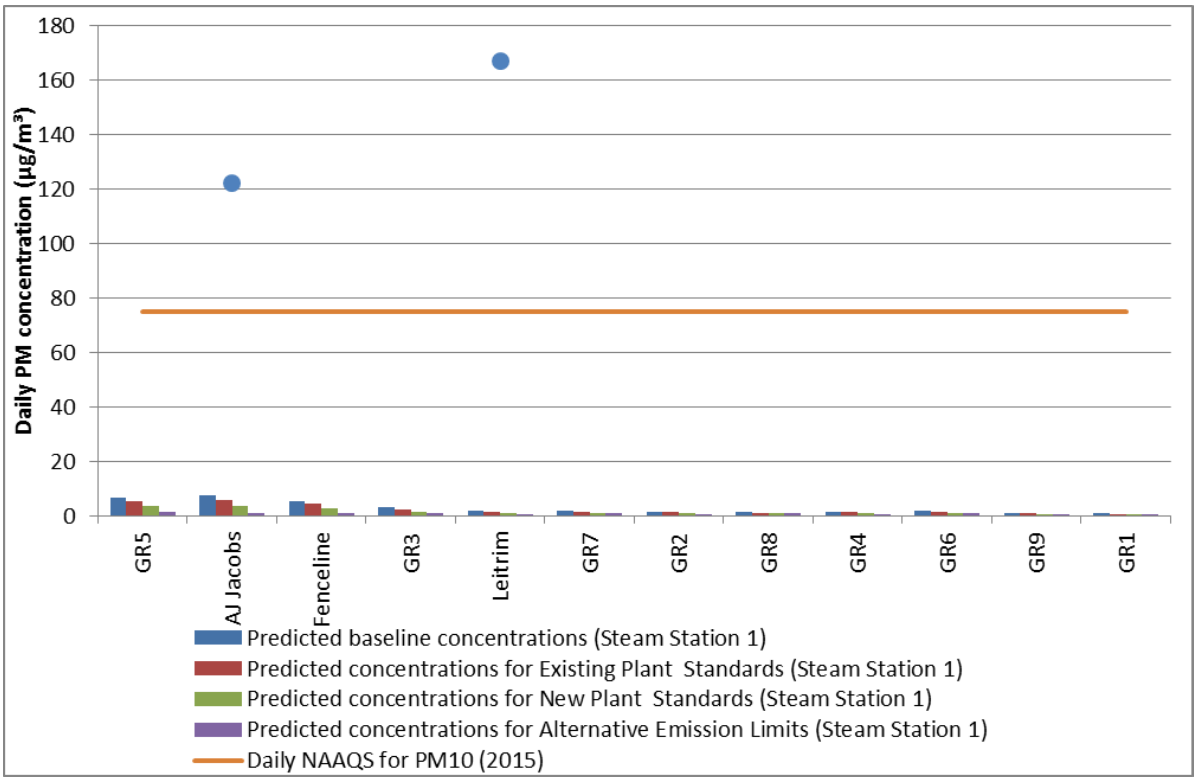

Figure 2: Predicted 99th percentile hourly PM concentration at identified receptors for Sasol Infrachem Steam Station 1

Figure 2 demonstrates high ambient PM_{10} concentrations of 166 to 252 µg/m^3 at the selected receptors; shown as dots in the figure above; are significantly in excess of the NAAQS. The dispersion model demonstrates that Steam Station 1 contributes around 0.73% and 3.9% of ground level PM_{10} concentrations measured at the Leitrim and AJ Jacobs monitoring stations. Compliance with the MES will have a small impact on the ambient concentrations and therefore will not have a significant impact on the current status of ambient PM_{10}, since, based on dispersion modelling results, the non-compliance with the NAAQS is mainly caused by other sources in the local air shed.

The highest impact is modelled for the alternative emissions limit, as expected. As discussed in the motivation document, the alternative emissions limits proposed are ceiling limits, or maximum emission concentrations, as the MES requires plants to operate below this level during all normal operating conditions. The results therefore indicate an apparent increased ambient impact.

1.7.2 Sulphur dioxide

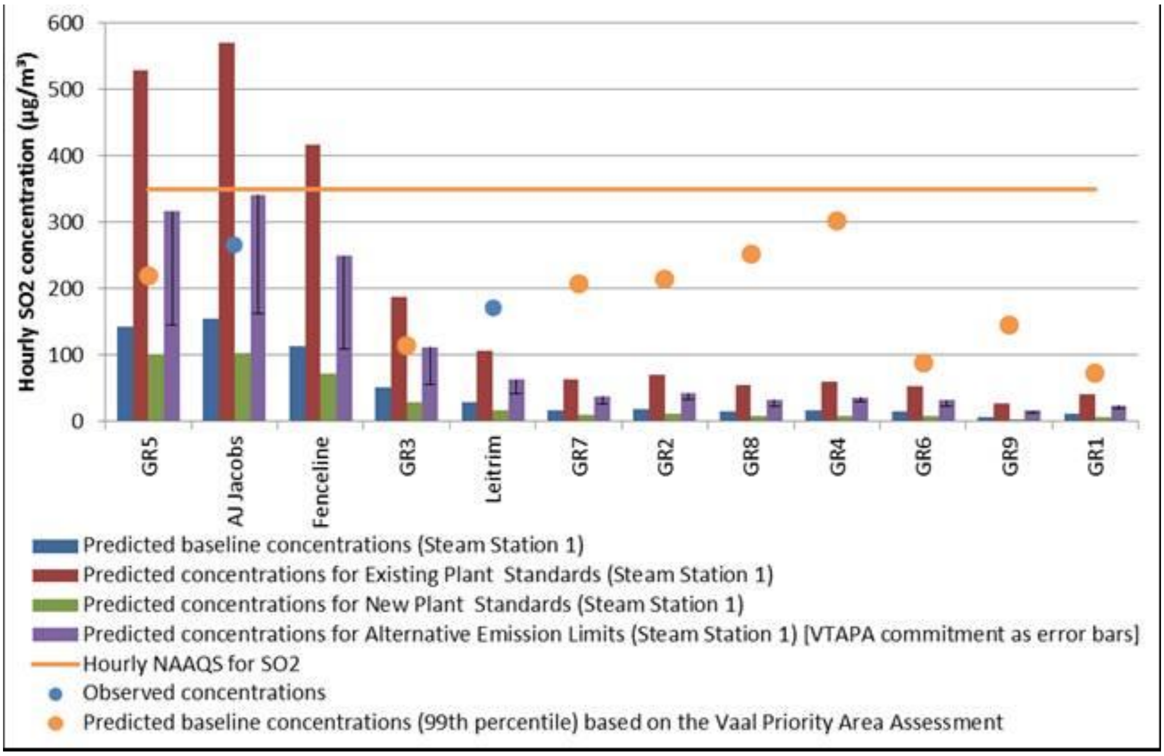

Figure 3: Predicted 99th percentile hourly SO_2 concentration at identified receptors for Sasol Infrachem Steam Station 1

The ambient hourly SO_2 concentrations in the area around the plant are within the 350 µg/m^3 limit value specified by the NAAQS. Limited hourly exceedances of the NAAQS are experienced, however these are within the permitted limit and the overwhelming majority of values are much lower – for Leitrim, for example, 90 % of the average concentration of SO_2 over the 3 year monitoring period is 51.7 µg/m^3 or less and for AJ Jacobs it is 86.4 µg/m^3 or less, compared with the NAAQS of 350 µg/m^3.

Unlike in the case of PM, in the areas close to the plant (GR5, AJ Jacobs, Fenceline, GR3, and Leitrim), Steam Station 1 contributes a higher percentage to the observed SO_2 in these areas (Figure 3). The modelling indicates that the SO_2 footprint associated with Steam Station 1 declines rapidly further away from the source.

The results indicate that compliance with the existing plant standard will result in exceedances of the NAAQS. Sasol Infrachem's proposed alternative emissions limit is consequently below the existing plant standard. Steam Station 1 currently operates well below this limit, as indicated by the baseline. However, as discussed in the motivation document, the alternative emissions limits proposed are ceiling limits, as the MES requires plants to operate below this level during 100% of normal operating conditions. The results therefore indicate an apparent increased ambient impact. The error bar indicates the Vaal Triangle Airshed Priority Area (VTAPA) commitments, which Sasol Infrachem will operate at on a cumulative basis. Sasol Infrachem will therefore not operate at the alternative emissions limit as shown on the basis of Steam Station 1, but rather at the VTAPA level (for all Sasol Infrachem sources cumulatively).

1.7.3 Oxides of Nitrogen

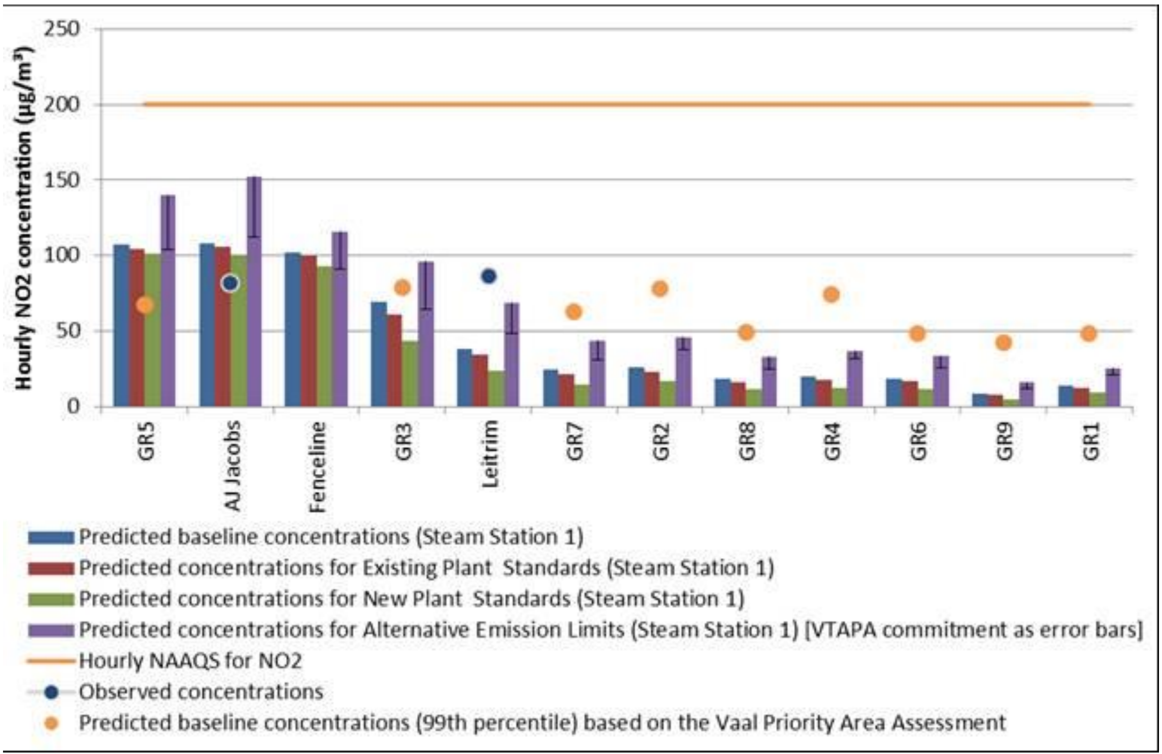

Figure 4: Predicted 99th percentile hourly NO_x concentration at identified receptors for Infrachem Steam Station 1

The ambient hourly NO_2 concentrations in the area around the plant are well within the 200 µg/m^3 limit value specified by the NAAQS, with the 99th percentile value at the AJ Jacobs and Leitrim monitoring stations being 74.6 µg/m^3 and 82.9 µg/m^3 respectively, and only 3 exceedances recorded over the 3 year monitoring period (compared with the 88 allowed per year by the NAAQS).

According to the modelling results, in the areas close to the plant (GR5, AJ Jacobs, Fenceline, GR3), Steam Station 1 is the largest contributor of ambient NO_2 (Figure 4). Further away, the contribution decreases drastically, suggesting that the balance is increasingly made up by other sources. Due to the shorter stacks, the impact is more pronounced closer to the facility.

The highest impact is modelled for the alternative emission limits, as expected. As discussed in the motivation document, the alternative emissions limits proposed are ceiling limits, as the MES requires plants to operate below this level during 100% of normal operating conditions. The results therefore indicate an apparent increased ambient impact. The error bar indicates the VTAPA commitments, which Sasol Infrachem will operate at cumulatively. Sasol Infrachem will therefore not operate at the alternative emissions limit as shown on the basis of Steam Station 1, rather at the VTAPA level (for all Sasol Infrachem sources cumulatively).

2 Steam Station 2: Postponement Request for PM, SO_2, NO_x

2.1 Applicable standards

Table 6: Category 1: Combustion Installations, Subcategory 1.1: Solid Fuel Combustion Installations

Description:	Solid fuels combustion installations used primarily for steam raising or electricity generation.		
Application:	All installations with design capacity equal to or greater than 50 MW heat input per unit, based on the lower calorific value of the fuel used.		
Substance or mixture of substances		**Plant status**	**mg/Nm^3 under normal conditions of 10% 0_2 , 273 Kelvin and 101.3 kPa.**
Common name	**Chemical symbol**		
Particulate matter	N/A	New	50
		Existing	100
Sulphur dioxide	SO_2	New	500
		Existing	3 500
Oxides of nitrogen	NO_x expressed as NO_2	New	750
		Existing	1 100

2.2 Description of the plant

Steam is a critical industrial process requirement for various business units within the Sasolburg area, including Sasol business units as well as external customers. Process steam must be available at the right quality (correct temperature and pressure) and quantity (volume of steam demanded) at all times, and at all processes where steam is required. To meet these exacting steam requirements a large fleet of small boilers was built rather than a small fleet of large boilers. The fleet of boilers allows both planned and unplanned disruptions to steam generation to be managed without compromising the supply of steam to users across the complex.

Steam station 2 consists of 7 boilers and supplies steam to various facilities within Sasolburg including Sasol Infrachem as well as external customers. The Steam Station 2 boiler availability is critical to the production of these facilities and additional outage time on the boilers has a direct impact on the production of these facilities. Steam Station 2 therefore fulfils an important role in the Sasolburg industrial area. Steam Station 2 produce superheated steam. The superheated steam is fed into common steam headers from where it is routed to the various users.

All boiler work, including maintenance and upgrades is driven by a strictly applied general overhaul (GO) schedule, to assure that process steam is not interrupted. The GO schedule is also aligned with other statutory inspections prescribed for pressure vessels. The net effect of the GO schedule is to ensure that boilers are shut down individually in a routine, sequential manner. A single cycle of boiler shutdowns through the entire fleet of Steam Station 1 and 2 boilers takes several years.

2.3 Technology options for compliance: PM

The current boiler fleet has installed PM abatement technology, in the form of electrostatic precipitators (ESPs) combined with flue gas conditioning through ammonia dosing, to enhance particulate matter capture. The current collection efficiency of ESPs is in excess of 99%. Although the ESPs were originally designed for PM emission rates of 200mg/m^3, Sasol Infrachem is currently able to achieve an average emission concentration of below 100 mg/m^3, through ammonia dosing (which incurs additional operating costs). Annual maintenance is performed on the ESPs to maintain this average emission level. While the 2015 existing plant standard is currently achieved (on average), maintenance alone cannot guarantee 100 mg/Nm^3 as a sustainable ceiling limit going forward. The ESPs are close to the end of their operational life; and a ceiling limit of 100 mg/Nm^3 is much more onerous than an average limit of 100 mg/Nm^3. In order to reduce the emissions from Steam Station 2, Sasol is in the process of upgrading the ESPs by replacing the ESP internals. High Frequency Inverters were installed on a pilot unit (Boiler 11), which further reduce emissions. The combined actions taken by Sasol Infrachem at Steam Station 2 have thus resulted in a significant PM emissions reduction of 50%.

Sasol Infrachem investigated the following options for compliance with PM emission limits for existing and new plant standards:

a) **Replacement of ESP internals with bag filters or the installation of new bag filters**: Bag filters were considered as a technology option because their theoretical PM removal efficiencies are higher than those of ESPs. In evaluating baghouses as a suitable option, gas temperature and gas conditions are major factors in determining the choice of bag material. When considering a baghouse operating at conditions for a typical PF boiler, the filter will treat acid gases at 140 to 150 °C. The Infrachem boilers were designed without economisers, resulting in high flue gas exit temperatures to ensure adequate dispersion from the tall stacks. At higher flue gas temperatures, standard materials will not be suitable and more expensive material will be required to handle the higher gas temperature. The filters will have to be replaced more regularly due to damage as a result of the high operating temperatures. This frequent replacement leads to high operating costs and increased boiler downtime. The theoretical emission reductions that are possible with bag filters will not be realised if bags fail prematurely, since emissions will be elevated during these periods. Inconsistencies in the coal quality of the coal fed to the Steam Station 2 boilers; specifically ash, moisture, and sulphur content, is often experienced. These inconsistencies result in damage to the boilers which can cause tube failures. When tube failures occur, the bag filters would be damaged and require replacement. This would lead to increased downtime of the boilers and high maintenance costs. Due to the high temperatures requiring very specialized bag material, high maintenance requirements (bag replacements every +/- 4 years or more frequently if tube bursts occur) and significant risk to boiler operations, bag filters are not seen as a viable option for PM reduction from Steam Station 2.

b) **SO_3 (sulphur trioxide) injection** was also explored as a means to enhance the performance of current ESPs. At Steam Station 2, the flue gas temperature is too high for a benefit to be realised by SO_3 injection. The positive effect of SO_3 on particle resistivity is optimal at 120 – 130°C and is not seen at the high temperature at which the Steam Station 2 ESPs operate.

c) **Upgrading of ESP internals and improved power supply**: The Steam Station 2 PM emissions can be significantly reduced by upgrading of the existing precipitator internals and by the installation of improved power supply to the ESPs. The Transformer Rectifier system can be replaced by a High Frequency Inverter. High Frequency Inverters increase the frequency and the efficiency of the power supply to the ESP fields, resulting in higher fields and therefore higher efficiencies. The High Frequency Inverters supply three-phase power to the ESPs. The supply of three-phase power to the ESPs reduces efficiency losses by balancing the power supply to the ESP fields. High frequency inverters have been installed on two of the ESP fields of one boiler, as a pilot project, and initial results are promising. The reduction of PM emissions depends on variables such as the boiler load as well as the ash content of the coal. The boiler loads are varied according to steam output demand, and ash content of the coal feedstock is variable and dependent on the area being mined. The reduction in PM therefore varies, but can be as high as 50%. An exact reduction in PM can therefore not be predicted. Precipitator internals are replaced when the precipitator reaches end of life. The upgrades are scheduled to coincide with the Boiler General Overhaul (GO) schedule to minimize boiler downtime. The timelines at which the upgrades can be completed will therefore depend on the GO schedule and the ESP end of life. The installation of High Frequency Inverters can be done during a mini GO as less downtime is required for this installation. Sasol's technical assessment concluded that the most suitable technology to implement would be to replace the ESP internals as they reach end of life and continue with the ammonia dosing regime to reduce emissions to the lowest practicable levels possible. The renewal of the ESP internals is expected to reduce emissions to below 100 mg/Nm^3 consistently. As the performance of the ESP deteriorates over time, keeping the emissions below 100 mg/Nm^3 will not only require the renewal of internals but also the continuous maintenance of these systems to prevent deterioration in PM emissions. Consistency of coal quality remains a major concern; in terms of the efficiency, operability and implement ability of abatement equipment. ESPs are sensitive to the volumetric flow rate through the ESP as well as the dust load – both of which vary with varied boiler loads. Boiler loads are varied according to demand. Due to the relatively small impact of the boiler PM emissions on ambient level, reducing emissions below the existing plant standard is not seen as a beneficial option.

Table 7: Summary of technology feasibility assessment associated with installation of PM abatement technologies at the Sasol Infrachem Steam Station 2

TECHNICAL OPTION	ASSESSMENT OF TECHNOLOGY FEASIBILITY	SUMMARY OF REASONS FOR FEASIBILITY ASSESSMENT
Replacement with bag filters	Not feasible	• Higher auxiliary power requirement. • Less steam output for same amount of coal used. • Negative operational impacts due to increased risk of unplanned boiler outages as a result of bag damage at high temperatures, and its negative effect on steam plant output – risk to operational plants reliant on steam. • High maintenance costs for frequent replacements of bag made from expensive temperature-resistant material.
SO_3 (sulphur trioxide) injection	Not feasible	• Temperature of flue gas incompatible with this technology.
Replacement of ESP internals	Feasible	• No significant negative impacts. • From a construction perspective can only be done during extended boiler outages cycle (150 days per boiler).

2.4 Technology options for compliance: SO_2

The steam plant currently meets the existing plant standard for SO_2. SO_2 emissions result from the combustion of sulphur present in the coal feedstock. As such, emissions are directly related to the sulphur content of coal, which in South Africa is fairly low, typically in the 0.7 – 0.9% range. An international technology scan was conducted, and a variety of flue gas desulphurisation (FGD) technologies were investigated for the purpose of bringing SO_2 emissions into compliance with the 2020 new plant standard of 500 mg/Nm^3. The following options for compliance with SO_2 emission limits for new plant standards were investigated:

- Wet FGD.
- Dry FGD (spray dry technology).
- Semi-dry FGD.
- Direct sorbent injection (DSI) with lime.

For Steam Station 2, a limestone/gypsum FGD process or a semi-dry process was considered. Steam Station 2 has sufficient space for the installation of any of the FGD technologies. Limestone/gypsum FGD was recommended by the study, as the potential theoretically exists for producing a saleable gypsum by-product.

Even though the Flue Gas Desulphurisation technology would reduce SO_x and PM emissions, the technology has the following negative environmental impacts:

- A waste by-product, 30% moisture gypsum waste sludge, would require significant waste handling infrastructure. This new significant waste stream would need a waste management solution. The production of a saleable gypsum product may reduce the volumes of solid waste to be disposed. In the South African context, mined gypsum is widely available and the long term use of this technology would be limited by the saturation of the gypsum market. In order to produce a saleable gypsum product, rigid product specifications will have to be complied with. Should the specifications not be met, the gypsum product cannot be sold and will have to be disposed of. Increased landfilling would therefore be required for the waste generated by the process.
- Lime would be required for FGD. Lime requires significant handling and transport infrastructure. The infrastructure requirements (rail and road transport) for handling the required amount of lime and waste production of the FGD units would be complex and would take a few years to implement. This infrastructure risk would be one of the key issues for operating this plant. Large quantities of lime would be required in Sasolburg, necessitating train transport of lime to the area. 30,000 tons of limestone would be required per year for Steam Station 2.
- CO_2 emissions would increase due to the increased power requirements of the FGD equipment; i.e. additional internal power consumption would occur due to power required for: overcoming the FGD differential pressure, operation of the absorber pumps, operation of the oxidation air compressor, and operation of the dewatering and limestone milling plants. This results in lower energy efficiency of the boiler plant, and consequently higher carbon intensity and lower water efficiency of steam production. These increased CO_2 emissions are contrary to the intent of South Africa's climate change policy.
- The limestone process has a high water demand, estimated at 320 megalitres of additional water per year. The process generates additional effluent that would have a negative impact on the salt balance of the Sasol Infrachem facility.
- The CO_2 footprint of the mining of the gypsum, the trucking of the gypsum to the site and direct CO_2 formed by the process must be considered. These increased CO_2 emissions are contrary to the intent of South Africa's climate change policy.
- The lime quality and particle size distribution of the lime has a significant impact on the efficiency of the process, and supply of lime of consistent quality in sufficient quantities would be required.
- The inlet temperature to the stack is currently above 170°C. The high stack temperature improves the buoyancy of the plume and ensures optimal dispersion of the plume. The installation of FGD technology will reduce the plume temperature to below 80°C. The reduction in the temperature will reduce the buoyancy of the plume and pollutants which exit the stack with the boiler off gas will not be as effectively dispersed. This can be seen in the dispersion

modelling results, particularly for SO_2 and NO_x emissions. To overcome the negative impacts on plume buoyancy, significant additional power input would be required for booster fans. This large reduction in net energy output from the boiler fleet represents much lower energy efficiency of the steam plant, and correspondingly higher carbon intensity and lower water efficiency of steam production.

Sasol has also investigated the removal of sulphur upstream of the boilers in order to reduce SO_2 emissions. This process is called de-stoning. It involves removing a portion of the ash with some pyritic sulphur (in the form of iron sulphide). The investigation concluded that the technology was infeasible due to the following negative impacts:

- De-stoning is a water intensive process requiring additional raw water which is required to wash the coal. After coal washing, this would become waste water, requiring treatment.
- Only the sulphur associated with the non-organic fraction in coal could theoretically be removed, at high capital cost. De-stoning would therefore not reduce SO_2 emissions to below new plant standards.
- Destoning results in increased coal consumption and reduced mine life as a portion of the coal mined is discarded in the destoning process.
- Increased waste footprint due to a portion of the high ash coal being discarded.

While the theoretical installation of FGD technology would reduce SO_2 emissions, the environmental impact, potential negative ambient air quality impact on dispersion of other emissions from the stack, like NO_x, and limestone logistics concerns are very significant. Furthermore the technology comes at a very high capital and operating cost. The installation of FGD technology is therefore not seen as a viable technology option.

2.5 Technology options for compliance: NO_x

Sasol Infrachem investigated the following options for compliance with NO_x emission limits for existing and new plant standards:

a) **Replacement of current burners with Low NO_x Burner (LNB) Systems**: LNB is a widely used technology to reduce the emissions of NO_x in boilers, and is the most cost effective identified NO_x abatement technology. The efficient operation of low NO_x burners is dependent on the operating conditions of the boilers. Operating parameters such as the feed quality, feed size distribution, air flow distribution and fuel to air ratio affect the performance of the burners. If these factors are not within the design limits, the LNBs cannot achieve the required NO_x reduction. The pulverised fuel fed to the boilers at Steam Station 2 is not of constant quality, as the coal is sourced from one mine in the area, and therefore the air-to-fuel ratios, which are critical to the efficient operation of the LNBs, cannot simply be kept constant as required, but in theory would need to be adjusted for variations in calorific value (CV) and size distribution of the feed. A further concern with the installation of LNBs is the resulting decrease in boiler efficiency, which would necessitate feeding more coal into the boilers to achieve the same output. The environmental footprint of the additional coal required should also be taken into consideration: additional coal burning would lead to an increase in CO_2 emissions and require more coal to be mined for the same output.

b) In order to reduce emissions further, **Over Fire Air (OFA)** or selective non-catalytic reduction (SNCR) would be required in addition to LNBs. OFA is a further air-staging method that inhibits the formation of NO_x by introducing a portion of the combustion air in “ports” above the last burner level. This is a technically risky option, requiring significant structural modification of the boilers and boiler tube arrangements as well as the installation of additional booster fans, which would require additional energy input. As a result of the small size of the boiler, air staging may not be an effective technique for NO_x reduction, since sufficient height is required for adequate mixing in order to ensure complete burnout of coal.

c) **Selective non-catalytic reduction (SNCR):** Selective non-catalytic reduction (SNCR) involves the injection of ammonia into the flue gas. The ammonia reacts with NO_x to form N_2. The chemical reaction only occurs in a limited temperature window of between 900°C and 1,100°C. Below this temperature, the ammonia does not react and ammonia slip will occur, resulting in an ammonia plume from the stack. Above this temperature window, sticky ammonium bisulphate forms which would cause fouling of the air heaters. Fouling of the air heaters is a serious concern as it will require additional downtime for cleaning and may increase corrosion of the air heaters. Fouling of the air heater will lead to decreased boiler efficiency and higher flue gas exit temperatures. Higher temperatures in the presence of ammonia will also affect ESP efficiency negatively and increase PM emissions. Lower boiler efficiencies would further require more coal to be fed to the boilers to compensate for lost steam production.

d) **Selective Catalytic Reduction**: This technology is not seen as a viable option for Steam Stations as it is an expensive technology, both in terms of initial capital cost, as well as operating cost. The high operating costs are a result of the high replacement costs of the catalyst.

Table 8: Summary of technology feasibility assessment associated with installation of NO_x abatement technologies at the Sasol Infrachem Steam Station 2 plant

TECHNICAL OPTION	ASSESSMENT OF TECHNOLOGY FEASIBILITY	SUMMARY OF REASONS FOR FEASIBILITY ASSESSMENT
Low NO_x burners (LNBs)	Not feasible	• Uncertain NO_x reduction due to air in leakage. • Reduction in boiler efficiency, additional coal consumption resulting in higher CO_2 emissions. • Variations in coal quality negatively affect LNB performance.
Overfire Air (OFA)	Not feasible	• Major structural modifications to boilers and boiler tube arrangement required. • Risk of increased boiler downtime leading to costly steam and power production losses.
Selective non-catalytic reduction (SNCR)	Not feasible	• Risk of fouling of air heaters or ammonia slip if operated outside temperature window. • Reduction of boiler efficiency and availability. • Risk to production capacity of business units and other industries reliant on Steam Station 2 for steam generation. • Increased greenhouse gas emissions due to lower efficiencies.
Selective catalytic Reduction (SCR)	Not feasible	• High capital and operating costs.

2.6 Postponement request

Sasol Infrachem applies for a five-year postponement from the MES for its Steam Station 2, as indicated in Table 9. In place of the MES, Sasol Infrachem proposes the following ceiling limits as alternative emissions limits to be incorporated in its Atmospheric Emission Licence, as set out in the table below, to prevail during the period of postponement.

Table 9: Alternative emissions limit request for Steam Station 2

Emission component(s)	Emission standard for existing plants	Emission standard for new plants	Alternative Emission Limit Requested (*ceiling limit*)[a]	Averaging period for compliance monitoring
	All values specified at 10% O_2 273 K and 101.3 kPa, mg/Nm^3			
SO_2	3 500	500	2 000*	Daily average
NO_x	1 100	750	1 250	Daily average
Particulates	100	50	100	Daily average

[a] *Refer to the accompanying motivation report for an explanation of the reasons for specifying a ceiling limit*

* As confirmed in the foreword to this appendix, this application relates to postponement of the 2015 existing plant standard only. However, for completeness' sake, these are the limits which Sasol could meet in the longer term, based on current available information.

Current average emissions are as shown in Table 9. Since the MES prescribes ceiling limits, the alternative emission limits requested are aligned to the maximum emission levels expected under all normal operating conditions. In practice, emission concentrations are not expected to materially differ from the current average emission concentrations reported above.

2.7 Summary of AIR results

2.7.1 Particulate Matter

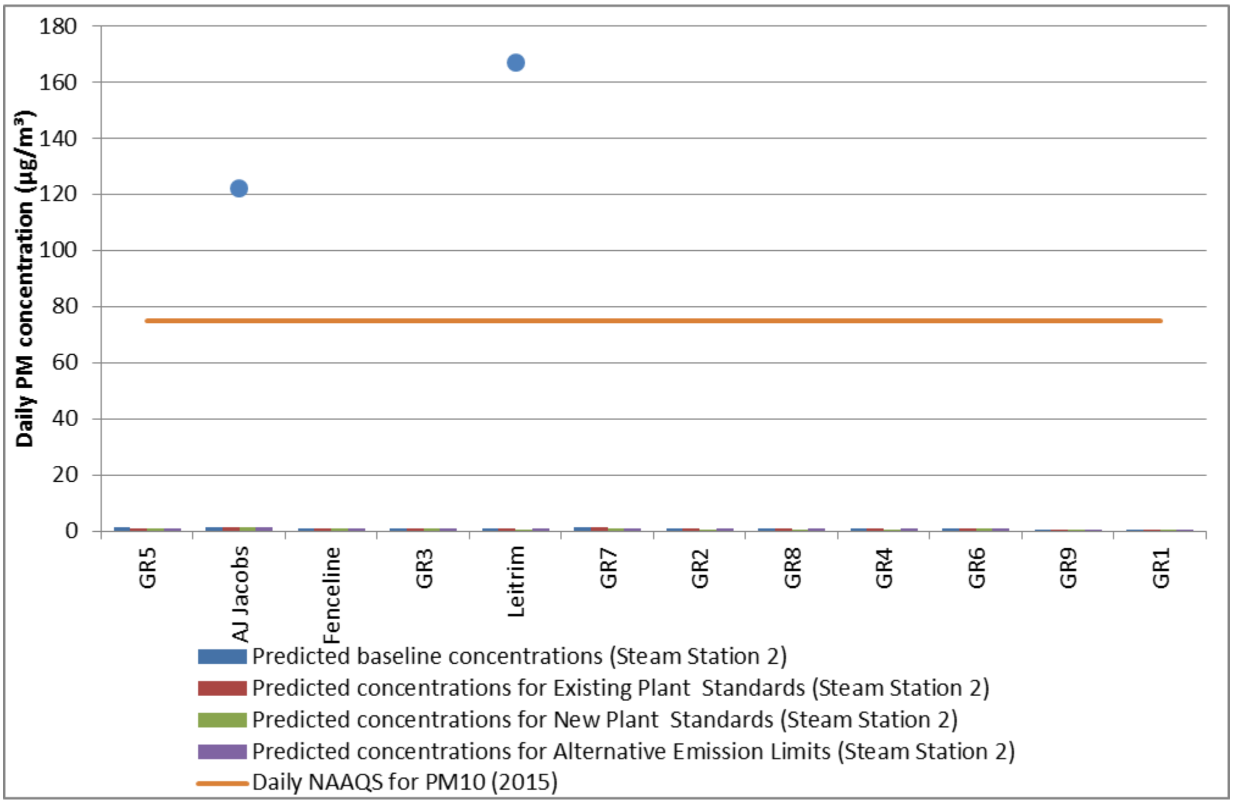

Figure 5: Predicted 99th percentile hourly PM concentration at identified receptors for Sasol Infrachem Steam Station 2

Steam Station 2 contributes very little to ground level PM_{10} concentrations at the selected receptors (Figure 5). Of the total average daily concentrations of 166 and 252 µg/m^3 measured at the AJ Jacobs and Leitrim monitoring stations, Steam Station 2 currently contributes a maximum of 0.69% to ambient concentrations at AJ Jacobs. Compliance with the MES will result in a maximum reduction in ambient concentrations of 0.3% at GR7, while at the AJ Jacobs monitoring station, ambient concentrations are actually expected to increase due to the decreased temperature of the flue gas, a phenomenon which is described in the AIR. Complying with the MES will therefore have an insignificant impact on the current status of ambient PM_{10}, since the non-compliance with the ambient standard is mainly attributable to other sources in the local airshed.

2.7.2 Sulphur dioxide

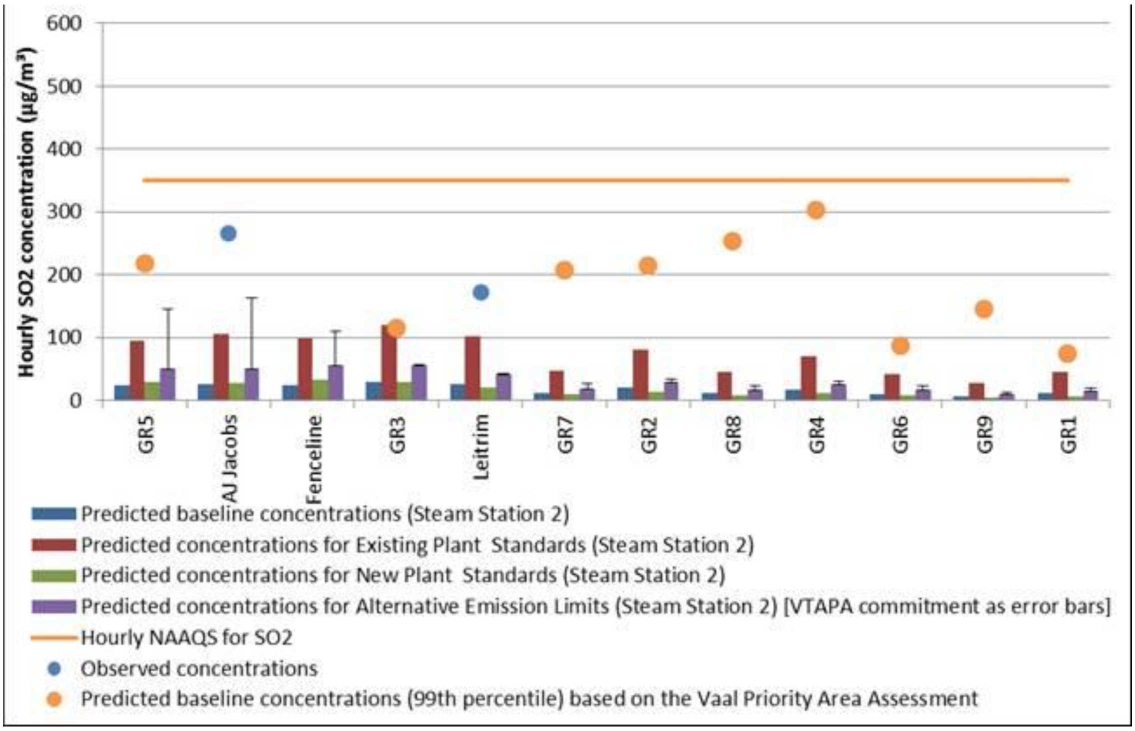

Figure 6: Predicted 99th percentile hourly SO_2 concentration at identified receptors for Sasol Infrachem Steam Station 2

The ambient hourly SO_2 concentrations in the area around the plant are within the 350 µg/m^3 limit value specified by the NAAQS. Limited hourly exceedances of the NAAQS are experienced, however these are within the permitted limit and the overwhelming majority of values are much lower – for Leitrim, for example, 90% of the average concentration of SO_2 over the 3-year monitoring period is 51.7 µg/m^3 or less and for AJ Jacobs is 86.4 µg/m^3 or less, compared to the NAAQS of 350 µg/m^3.

Steam Station 2 contributes a minor proportion of the ambient SO_2 in the surrounding airshed (Figure 6). The steam station contributes 10% of ambient SO_2 at the AJ Jacobs monitoring station and 15.7% at Leitrim. Due to the effect of the abatement technology on the temperature of the stack gases and consequent plume buoyancy from the stack, the contribution of the steam station at the nearest three receptors would actually increase as a result of compliance with the 2020 MES, with the AJ Jacobs receptor increasing the most (8.1% increase). For the other 9 receptors, the reduction in ambient SO_2 ranges from a maximum of 7.1% at GR2 to a minimum of 1.0% at GR3.

The highest impact is modelled for the alternative emission limits, as expected. As discussed in the motivation document, the alternative limits proposed are ceiling limits, as the MES requires plants to operate below this level during 100% of normal operating conditions. The results therefore indicate an apparent increased ambient impact. The error bar indicates the VTAPA commitments, which Infrachem will operate at cumulatively, and not just for Steam Station 2. Sasol Infrachem will therefore not operate at the alternative limit as shown, but rather at the VTAPA level (for all sources cumulatively).

2.7.3 Nitrogen dioxide

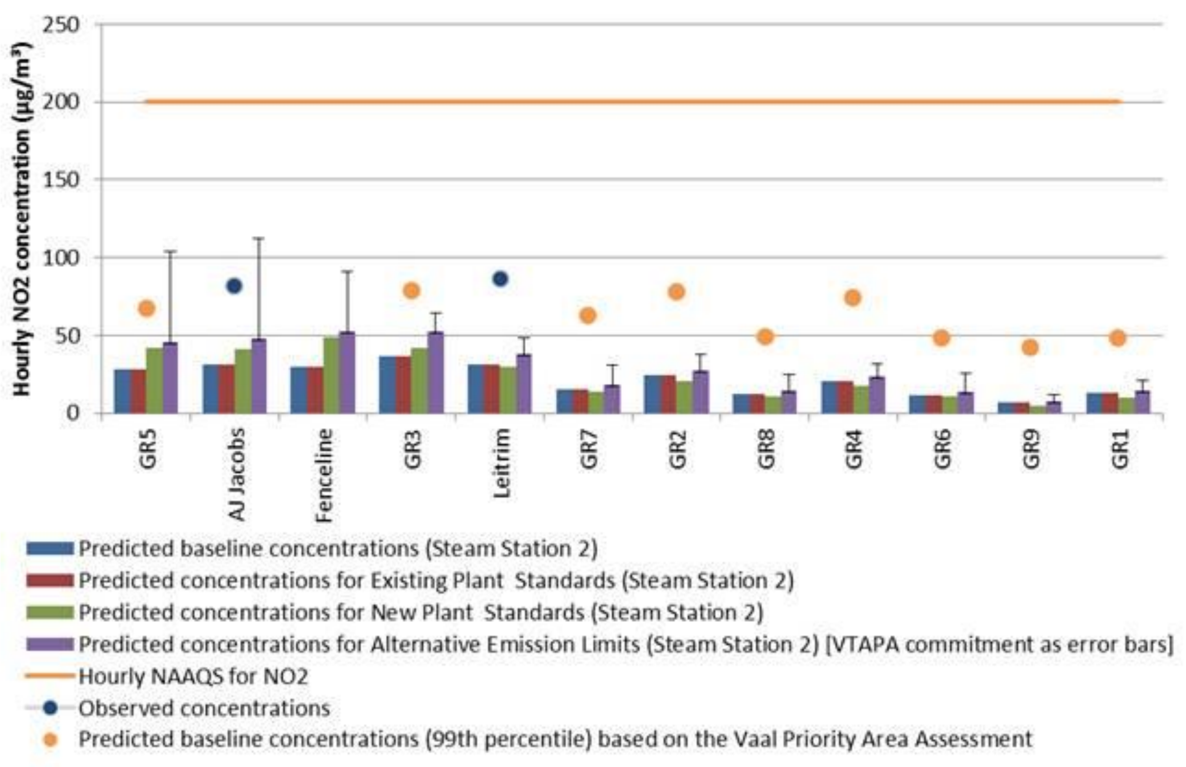

Figure 7: Predicted 99th percentile hourly NO_2 concentration at identified receptors for Sasol Infrachem Steam Station 2

The ambient hourly NO_2 concentrations in the area around the plant are well within the 200 µg/m^3 limit value specified by the NAAQS, with the 99th percentile value at the AJ Jacobs and Leitrim monitoring stations being 74.6 µg/m^3 and 82.9 µg/m^3 respectively, and only 3 exceedances recorded over the 3 year monitoring period (compared with the 88 per year allowed by the NAAQS).

The effect of the abatement technology on plume buoyancy has a significant impact on the effectiveness of compliance with the 2020 MES – the four receptors closest to the plant all experience predicted increases in ambient concentrations of NO_2 by between 5.5% and 14.5%. The remaining 8 receptors show small reductions in ambient NO_2 from 6.6% at GR1 to 2.2% at GR6.

The highest impact is modelled for the alternative emission limits, as expected. As discussed in the motivation document, the alternative limits proposed are ceiling limits, as the MES requires plants to operate below this level during 100% of normal operating conditions. The results therefore indicate an apparent increased ambient impact. The error bar indicates the VTAPA commitments, which Infrachem will operate at cumulatively, and not just for Steam Station 2. Sasol Infrachem will therefore not operate at the alternative limit as shown, but rather at the VTAPA level (for all Sasol Infrachem sources cumulatively).

3 Postponement Request: Incinerators at the Thermal Oxidation Plant

3.1 Applicable Standards

Table 10: Category 8.1: Thermal Treatment of Hazardous and General Waste

Description:	Facilities where general and hazardous waste are treated by the application of heat.		
Application:	All installations treating 10 Kg per day of waste.		
Substance or mixture of substances		**Plant status**	**mg/Nm^3 under normal conditions of 10% 0_2 , 273 Kelvin and 101.3 kPa.**
Common name	**Chemical symbol**		
Particulate matter	N/A	New	10
		Existing	20
Carbon Monoxide	CO	New	50
		Existing	75
Sulphur dioxide	SO_2	New	50
		Existing	50
Oxides of nitrogen	NO_x expressed as NO_2	New	200
		Existing	200
Hydrogen chloride	HCl	New	10
		Existing	10
Hydrogen fluoride	HF	New	1
		Existing	1
Sum of Lead, arsenic, antimony, chromium, cobalt, copper, manganese, nickel, vanadium	Pb+ As+ Sb+ Cr+ Co+ Cu+ Mn+ Ni V	New	0.5
		Existing	0.5
Mercury	Hg	New	0.05
		Existing	0.05
Cadmium Thallium	Cd TI	Existing	0.05
		New	10
Total Organic Compounds	N/A	Existing	10
		New	10
Ammonia	NH_3	Existing	10
		ng I-TEQ.Nm^3 under normal conditions of 10% 02 , 273 Kelvin and 101.3 kPa.	
		New	**0.1**
Total Organic Compounds	N/A	Existing	0.1

(a) The following special arrangements shall apply:

(vi) Exit gas temperatures must be maintained below 200 °C

Note: only special arrangement (vi) is listed in this appendix for brevity, since the other 20 arrangements are not the subject of this postponement application.

3.2 Description of the plant

At Thermal Oxidation, waste streams are thermally treated to produce a residue stream that can be disposed of safely and efficiently. The waste streams treated at the Infrachem Thermal Oxidation facility originate from three other divisions of Sasol Chemical Industries, namely Sasol Merisol, Sasol Solvents and Sasol Monomers. The operation of these plants depends on the ability to safely treat or dispose of these streams. These waste streams are oxidised in three incinerators:

- B6930 Incinerator: utilised for the incineration of a stream called “High Sulphur Pitch”. This stream comprises high-sulphur pitch, organic solvents and high-calorific-value organic waters; in a limestone fluidized bed unit.
- B6990 Incinerator: utilised for the incineration of a stream called “Heavy ends B”. This stream comprises heavy oils, off-specification waxes, Sasol spent catalyst, Funda filter cake, slop solvents and high-calorific-value organic waste. The flue gas exit temperature of the B6990 incinerator exceeds 200°C. Due to operating conditions on furnace B6990, the flue gas temperature exceeds viable temperatures for PM, metals, and dioxin/furans sampling (US EPA method 29).
- B6993 Incinerator: utilised for the incineration of a stream called “Spent Caustic”. This stream comprises spent caustic solution and off-specification solvent products in a down-fired incinerator.

Emissions from the incinerators could include PM, SO_2, NO_x, CO, HCl, TOCs, dioxins and furans, Metals, Mercury (Hg), Cadmium plus Thallium (Cd + Tl), Hydrogen fluoride (HF) and ammonia (NH_3). While some of these emissions are high in concentration, the streams are low in volume.

3.3 Technology options compliance: MES

Sasol Infrachem’s approach to further emission reductions from its incinerators is informed by the waste hierarchy, which places preference on solutions to avoid and reduce waste, over disposing of waste (either to landfill, or to atmosphere by incineration), since this averts negative environmental impacts. The alternative options evaluated in terms of the waste management hierarchy include the following, which would concurrently address the emission components not achieving the MES:

- Operational improvements.
- Installation of abatement technology on existing equipment.
- Installation of a new incinerator.
- Reduction of the waste streams being incinerated at source.
- Alternative, beneficial use of the incinerated streams.

A description of each solution investigated is described in the Sections to follow.

a) **Disposal of waste at a hazardous landfill as an alternative to incineration**: Disposal to landfill is the least preferred alternative in the Waste Hierarchy. Standards for disposal of waste to landfill (GN 636 of 2013) have been published in the Government Gazette which prohibits, within specified timeframes, the disposal to landfill of high calorific wastes and liquids. In the long term, the streams currently being incinerated cannot be disposed to landfill. Until a suitable alternative destination can be found for these streams, incineration within the current thermal oxidation facilities remains the only viable treatment.

b) **Source reduction of the waste streams being incinerated**: While this would be best practice, the contributions to the waste streams have already been optimized and there is no method that is achievable in the short or medium term that would significantly change the quantity or make - up of the feed to the incinerators. In addition, a reduction in quantity of feed, while decreasing the total mass of pollutants emitted, would not necessarily improve Sasol’s ability to comply with the emission standard, which is based on concentrations.

c) **Installation of abatement technology on existing equipment**: A pre-feasibility study was conducted to determine the best abatement retrofits for this option. Only proven, commercialised technologies were considered in the study, so as to limit operational risks. However, no commercially available technology has been proven for the unique Sasol Infrachem waste streams and, vendors are unlikely to be able to guarantee emission reductions under all of the incinerators' operating conditions. The installation of abatement equipment will, in many cases, lead to an increase in effluent and waste. Options for wet and dry flue gas treatment were considered.

Table 11: Summary of technology feasibility assessment of technology options evaluated

Incinerator	Abatement technology	Impact of abatement option
B6930	**Wet treatment**: ESP and scrubber system	**Wet treatment**: Additional water requirements – in excess of 60,000 tons of water per year; production of dilute effluent streams (acid stream and a neutral stream) will put current production system under pressure
	Dry treatment: Cyclone and bag filter with activated carbon injection	**Dry treatment**: Production of contaminated waste requiring disposal
	Installation of Selective Non-Catalytic Reduction (SNCR)	Temperature control critical for SNCR. This is an operational risk due to the risk of by-product formation.
B6990	**Wet treatment**: ESP and scrubber system	**Wet treatment:** Additional water requirements – in excess of 45,000 tons of water per year; production of dilute effluent streams (acid stream and a neutral stream) will put current water treatment systems under pressure due to the increased load
	Dry treatment: Bag filters	**Dry treatment**: Production of contaminated waste requiring disposal
	Installation of Selective Non-Catalytic Reduction	Temperature control critical for SNCR. This is an operational risk due to the risk of by-product formation.
B6993	**Wet treatment**: Wet ESP	**Wet treatment:** Effluent stream to be treated (>12,000 tons per year with salt load of 16%)
	Replacement of existing burners with low NO_x burners	Efficiency of NO_x reduction is dependent on fuel-to-air ratio. Control of this ratio is complicated by variations in feed and design reductions may not be reached.

d) **Installation of new equipment:** A single, new incinerator will not be capable of handling all of the waste streams. It would only be possible to replace two of the incinerators (B6930 and B6990) with a single incinerator, while keeping the caustic incinerator (B6993). The availability of plot space on the incineration site is a further concern, as the area is congested, as seen in Figure 8 below. The new incinerator would need to be constructed concurrent to the operation of the existing incinerators and therefore requires sufficient plot space.

Figure 8: Plot space constraints at Thermal Oxidation plant

e) **Use of waste streams as alternative fuels:** In respect of the waste hierarchy, co-processing of waste in cement kilns would improve the status of waste management of the stream from thermal “disposal” to thermal “recovery”. This approach would bring about feedstock reduction at the incinerators and therefore a smaller environmental footprint from an air quality perspective. On-site incineration could potentially be significantly reduced in this way. A pilot study is currently underway to utilise High Sulphur Pitch (HSP) as an alternative fuel in the cement industry. Ten tons of HSP have been supplied to an external company for packaging and trial burn at a cement manufacturer. The technology application is well understood and has been practised for several decades in the EU and USA. However, the HSP stream is unique to Sasol’s processes. If the trial with HSP is completed successfully, trials will commence with Heavy Ends B (HEB). The use of the streams as alternative fuels (either in part, or the entire volumes generated) can only be confirmed on completion of the pilot, and hence an exemption will be required to complete the investigation and confirm viability of the solution. Subject to its success, the solution enables the reduction in stream volumes without necessarily changing the concentration of emissions, but while also concurrently achieving the objectives of the Waste Act.

Table 12: Summary of technology feasibility assessment associated with reaching the MES at the Sasol Infrachem Thermal Oxidation plant

TECHNICAL OPTION	ASSESSMENT OF TECHNOLOGY FEASIBILITY	SUMMARY OF REASONS FOR FEASIBILITY ASSESSMENT
Landfilling	Infeasible	Not a long-term solution due to impact on land and prohibition on landfilling high-calorific-value wastes
Installation of abatement technology	Infeasible	• Negative impacts on upstream operations during technology installation • Negative environmental cross-impacts associated with compliance • High cost
Installation of new incinerator	Infeasible	• Does not address emissions from all incinerators • Shutting down existing equipment before end of useful life is financially unsustainable • High cost
Alternative fuels	Potentially feasible Currently in pilot phase to establish cost implications	• Less raw material (coal) use by external company utilising the alternative fuel • Aligned with waste hierarchy priorities

3.4 Postponement Request

Sasol Infrachem is applying for a five-year postponement from the MES for its Thermal Oxidation facility, as indicated in Table 10. In place of the MES, Sasol Infrachem proposes the following ceiling limits as alternative emissions limits to be incorporated in its Atmospheric Emissions Licence, as set out in the tables below, to prevail during the postponement period.

Table 13: Alternative emissions limit request: Incinerator B6930

Emission component	MES for existing plants	MES for new plants	Alternative Emissions Limit Requested (ceiling limit) [a]	Averaging period for compliance monitoring
	All values specified at 10% O2, 273 K and 101.3 kPa, mg/Nm³			
PM	25	10	50	Daily average
CO	75	50	50	Daily average
SO_2	50	50	1,800	Daily average
NO_x expressed as NO_2	200	200	750	Daily average
NH_3	10	10	10	Daily average
HCl	10	10	10	Daily average
HF	1	1	1	Daily average
Pb+As+Sb+Cr+ Co+Cu+Mn+Ni+V	0.5	0.5	1	Daily average
Hg	0.05	0.05	0.05	Daily average
Cd+Tl	0.05	0.05	0.05	Daily average
TOC	10	10	50	Daily average
	ngTEQ/Nm³			
Dioxins / Furans	0.1	0.1	0.1	Daily average

[a] *Refer to the accompanying final motivation report for an explanation of the reasons for specifying a ceiling limit*

As confirmed in the foreword to this appendix, this application relates to postponement of the 2015 existing plant standard only. However, for completeness' sake, these are the limits which Sasol could meet in the longer term, based on current available information.

Table 14: Alternative emissions limit request: Incinerator B6993

Emission component	MES for existing plants	MES for new plants	Alternative Emission Limit Requested (ceiling limit) [a]	Averaging period for compliance monitoring
	All values specified at 10% O2, 273 K and 101.3 kPa, mg/Nm^3			
PM	25	10	180	Daily average
CO	75	50	1,050	Daily average
SO_2	50	50	50	Daily average
NOx expressed as NO_2	200	200	420	Daily average
NH_3	10	10	10	Daily average
HCl	10	10	15	Daily average
HF	1	1	1.2	Daily average
Pb+As+Sb+Cr+ Co+Cu+Mn+Ni+V	0.5	0.5	22	Daily average
Hg	0.05	0.05	0.05	Daily average
Cd+Tl	0.05	0.05	0.05	Daily average
TOC	10	10	10	Daily average
	$ngTEQ/Nm^3$			
Dioxins / Furans	0.1	0.1	0.1	Daily average

[a] *Refer to the accompanying Motivation Report for an explanation of the reasons for specifying a ceiling limit*

As confirmed in the foreword to this appendix, this application relates to postponement of the 2015 existing plant standard only. However, for completeness' sake, these are the limits which Sasol could meet in the longer term, based on current available information.

Due to operating conditions on furnace B6990, the flue gas temperature exceeds viable temperatures for PM, metals, and dioxin/furans sampling (US EPA method 29). Solutions for measurement of emissions from this point source are on-going. In the interim, Sasol Infrachem requests a postponement from Regulation 7(2) of the MES until a suitable solution to reduce flue gas outlet temperatures is identified and implemented. The postponement request is further detailed in the Sasol Infrachem initial postponement application. It should be noted that no halogens are fed to this furnace. As part of the licence conditions, in the interim, Sasol proposes the controls as indicated in Table 15Table 14.

Table 15: Alternative emissions limit request: Incinerator B6990

Emission component	MES for existing plants	MES for new plants	Alternative Emission Limit Requested (*ceiling limit*) [a]	Averaging period for compliance monitoring
	All values specified at 10% O_2, 273 K and 101.3 kPa, mg/Nm^3			
PM	25	10	Opacity measurements	Daily average
CO	75	50	50	Daily average
SO_2	50	50	50	Daily average
NO_x expressed as NO_2	200	200	360	Daily average
NH_3	10	10	10	Daily average
HCl	10	10	10	Daily average
HF	1	1	1.5	Daily average
Pb+As+Sb+Cr+ Co+Cu+Mn+Ni+V	0.5	0.5	Opacity measurements	Daily average
Hg	0.05	0.05	Feed analysis	Daily average
Cd+Tl	0.05	0.05	Opacity measurements	Daily average
TOC	10	10	25	Daily average
	$ngTEQ/Nm^3$			
Dioxins / Furans	0.1	0.1	Feed stream analysis (prohibition of any chlorinated compounds going into incinerators)	Daily average

[a] *Refer to the accompanying Motivation Report for an explanation of the reasons for specifying a ceiling limit*

As confirmed in the foreword to this appendix, this application relates to postponement of the 2015 existing plant standard only. However, for completeness' sake, these are the limits which Sasol could meet in the longer term, based on current available information.

As mentioned previously, due to the high exit temperature of the B6990 incinerator, PM. Metals, Hg, Cd + Tl and dioxin/furan concentrations cannot be measured. It is therefore not possible to provide alternative emission limits for these components. Sasol Infrachem has therefore proposed alternative means to assess compliance that is measurable. For PM emissions it is proposed that opacity measurements be used to assess the visibility and hence compliance of the exit plume. Opacity measurement is a well-known method for assessing the amount of dust (PM) in the flue gas. The metals, with the exclusion of mercury, will predominantly leave the stack as particulates and hence will be monitored by the opacity monitor. Therefore, with a low opacity, the metal concentration can be assumed to be in the lower range. For Hg, periodic feed stream analysis is proposed. This will ensure that Hg emissions are controlled. Similarly, a periodic feed stream analysis is proposed for the control of dioxins and furans. For dioxin and furan formation, certain precursors, most notable chlorinated compounds, are required. A feed stream analysis would ensure that no precursors to dioxin and furan formation are fed to the incinerator.

The alternative emissions limits were modelled and the results presented in the following section. The alternative emissions limits proposed are ceiling limits, as the MES requires plants to operate below this level during 100% of normal operating conditions. The results therefore indicate an apparent increased ambient impact. It should be noted that the alternative emissions limits modelled have a negligible impact on the ambient concentrations of the criteria pollutants and do not exceed any of the strictest health screening levels (see Section 3.5.4) for the non-criteria pollutants.

3.5 Summary of AIR results

3.5.1 Particulate Matter

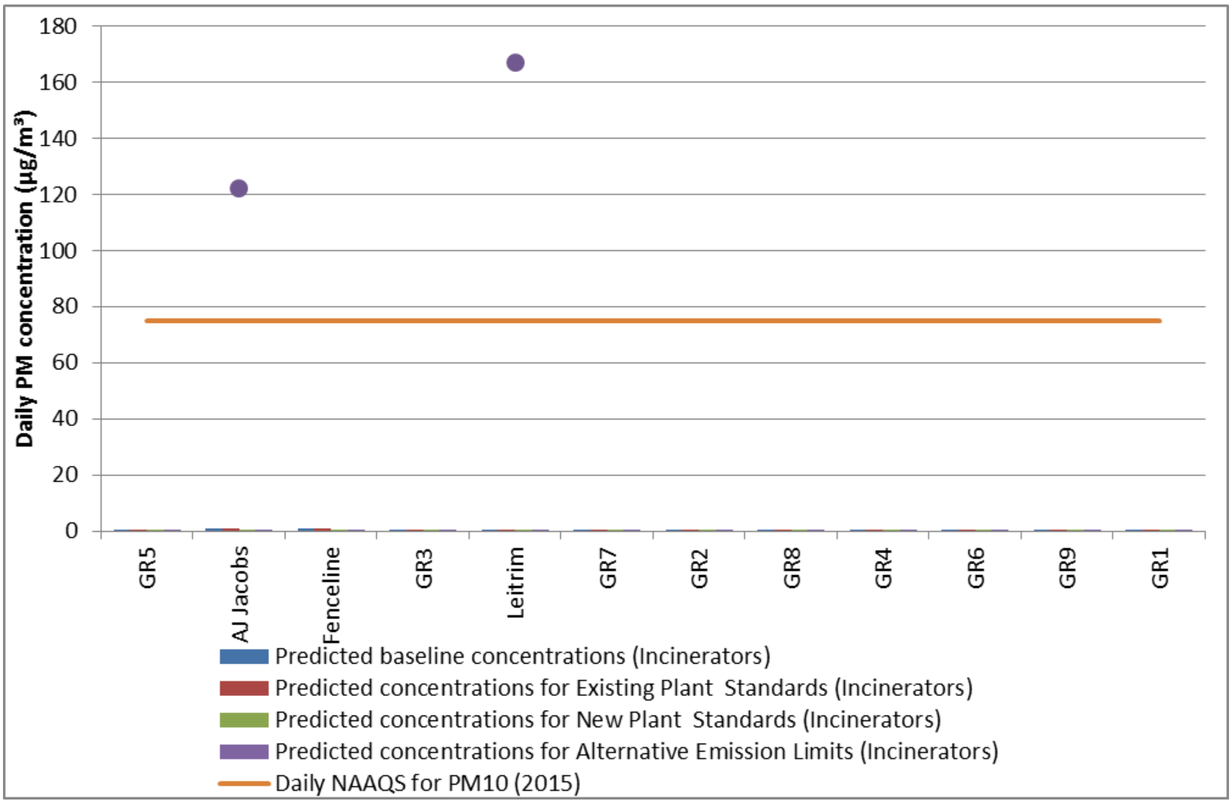

Figure 9: Predicted 99th percentile hourly PM concentration at identified receptors for Sasol Infrachem Incinerators (B6993 and B6930)

Note: The PM emissions from B6990 are not included in this model, as measurement of the emissions is currently not technically possible. The ambient PM impact of B6990 is expected to be similar to that of the other two incinerators.

Figure 9 demonstrates high ambient PM_{10} concentrations of 166 to 252 µg/m^3 at the selected receptors, significantly in excess of the national ambient air quality standards (NAAQS). The dispersion model demonstrates that Steam Station 1 contributes around 0.73% and 3.9% of ground level PM_{10} concentrations measured at the Leitrim and AJ Jacobs monitoring stations. Compliance with the MES will have a small impact on the ambient concentrations and therefore will not have a significant impact on the current status of ambient PM_{10}, since, based on dispersion modelling results, the non-compliance with the NAAQS is mainly caused by other sources in the local air shed.

As discussed in the Sasol Infrachem motivation document, the alternative emissions limits proposed are ceiling limits, or maximum emission concentrations, as the MES requires plants to operate below this level during all normal operating conditions. The results therefore indicate an apparent increased ambient impact. It should be noted that the alternative emissions limits modelled have a negligible impact on the ambient concentrations of the criteria pollutants and do not exceed any of the strictest health screening levels (see Section 3.5.4) for the non-criteria pollutants.

3.5.2 Sulphur dioxide

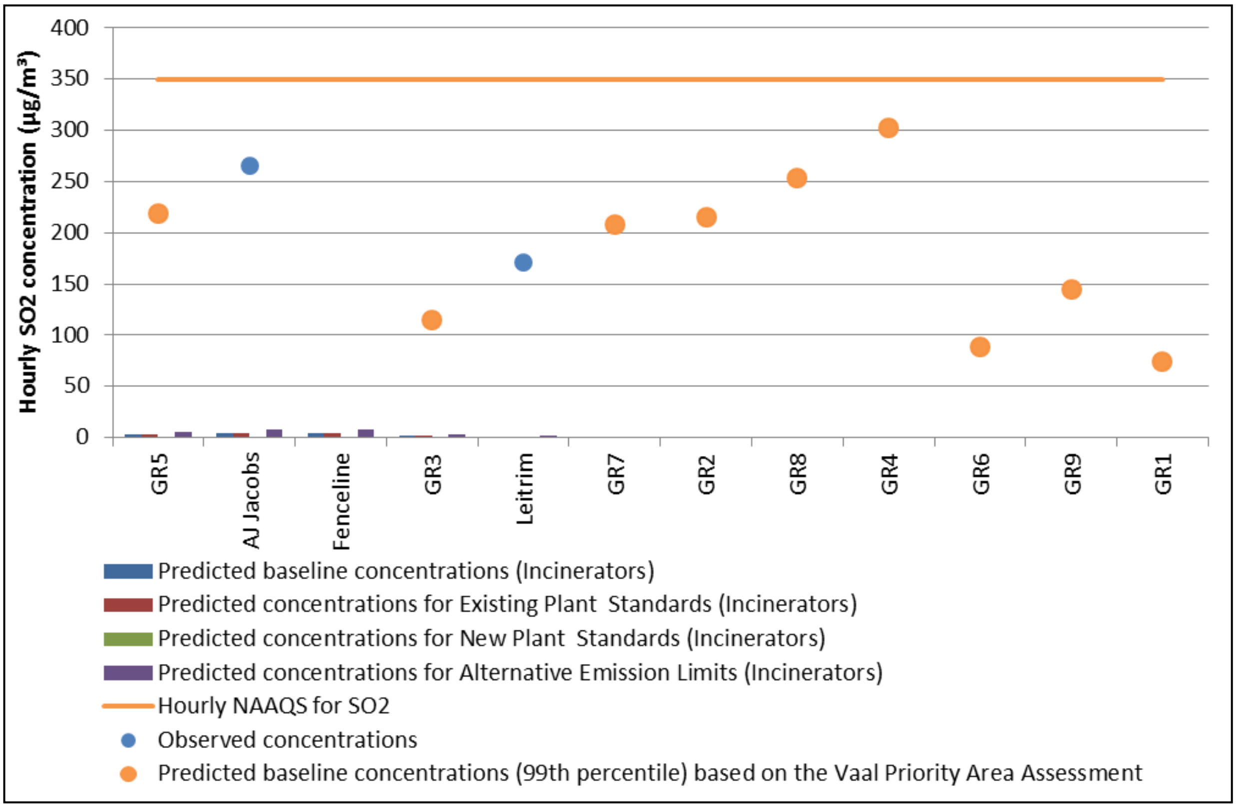

Figure 10: Predicted 99th percentile hourly SO_2 concentration at identified receptors for Sasol Infrachem Incinerators

The ambient hourly SO_2 concentrations in the area around the plant are within the 350 ug/m^3 limit value specified by the NAAQS. Limited hourly exceedances of the NAAQS are experienced, however these are within the permitted limit and the overwhelming majority of values are much lower – for Leitrim, for example, 90 % of the average concentration of SO_2 over the 3-year monitoring period is 51.7 µg/m^3 or less and for AJ Jacobs is 86.4 µg/m^3 or less, compared with the NAAQS of 350 µg/m^3.

The dispersion model results indicate that the incinerators have a very limited impact on ambient SO_2 concentrations. As discussed in the Sasol Infrachem motivation document, the alternative emissions limits proposed are ceiling limits, as the MES requires plants to operate below this level during 100% of normal operating conditions. The results therefore indicate an apparent increased ambient impact. It should be noted that the alternative emissions limits modelled have a negligible impact on the ambient concentrations of the criteria pollutants and do not exceed any of the strictest health screening levels (see Section 3.5.4) for the non-criteria pollutants.

3.5.3 Nitrogen dioxide

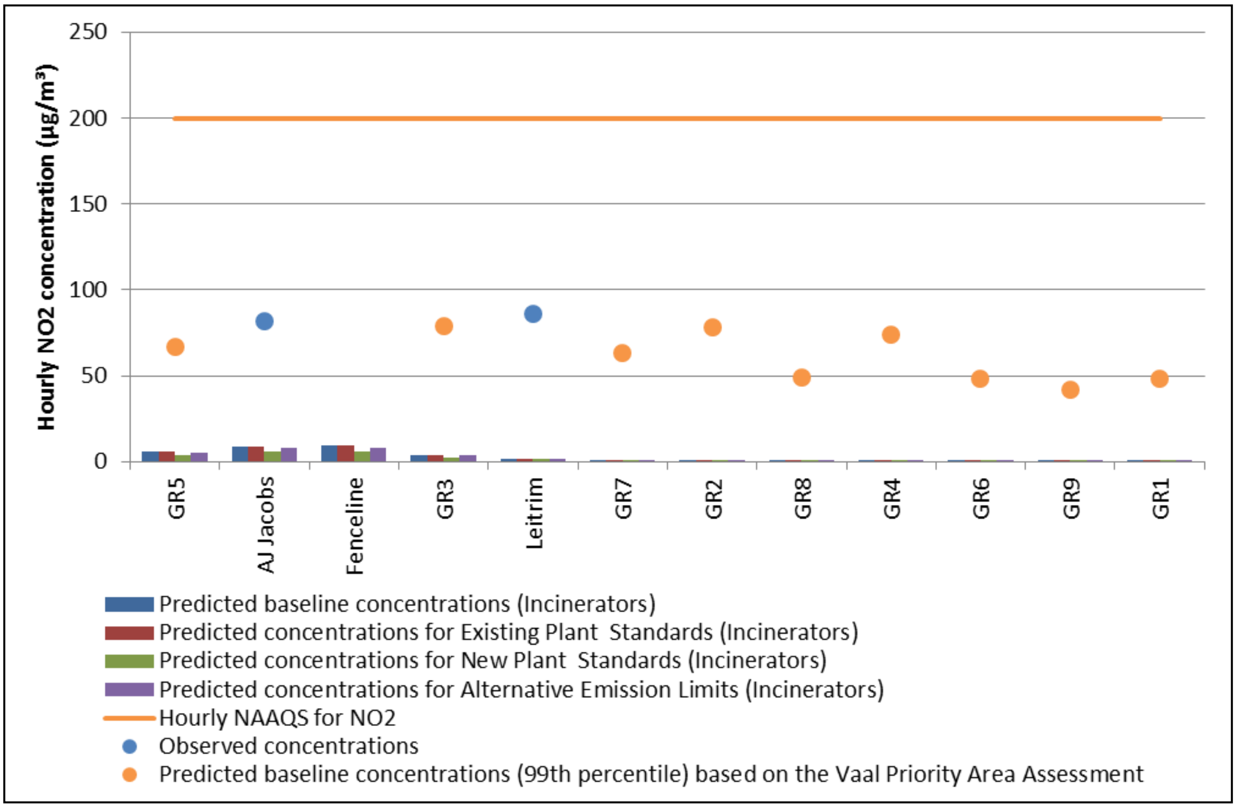

Figure 11: Predicted 99th percentile hourly NO_2 concentration at identified receptors for Sasol Infrachem Incinerators

The ambient hourly NO_2 concentrations in the area around the plant are well within the 200 µg/m^3 limit value specified by the NAAQS, with the 99th percentile value at the AJ Jacobs and Leitrim monitoring stations being 74.6 µg/m^3 and 82.9 µg/m^3 respectively, and only 3 exceedances recorded over the 3 year monitoring period (compared with the 88 per year allowed by the NAAQS).

The dispersion model results indicate that the incinerators have a very limited impact on ambient SO_2 concentrations. As discussed in the motivation document, the alternative emissions limits proposed are ceiling limits, as the MES requires plants to operate below this level during 100% of normal operating conditions. The results therefore indicate an apparent increased ambient impact. It should be noted that the alternative emissions limits modelled have a negligible impact on the ambient concentrations of the criteria pollutants and do not exceed any of the strictest health screening levels (see Section 3.5.4) for the non-criteria pollutants.

3.5.4 Non-criteria pollutants

A screening exercise of other non-criteria pollutants emitted from the incinerators at Thermal Oxidation was conducted, since no NAAQS exist against which to compare modelled impacts. The purpose of the assessment was to compare the modelled ambient concentrations of these pollutants to the strictest health effect screening levels derived from the following sources: World Health Organisation (WHO); US-EPA IRIS inhalation reference concentrations; Californian OEHHA; US ATSDR Maximum Risk Levels. The strictest health effect screening level used is illustrated in Table 16 below. Full results for all components analysed are presented in the AIR.

Table 16: Strictest health effect screening level for non-criteria pollutants assessed

Compound	Acute exposure[(a)] [units: µg/m^3]	Chronic exposure[(b)] [units: µg/m^3]
Lead (Pb)	[(c)]	[(d)]
Arsenic (As)	0.2 [(g)]	0.015 [(g)]
Antimony (Sb)	[(c)]	[(d)]
Chromium (Cr)	[(c)]	0.1 [(e)]
Cobalt (Co)	[(c)]	0.1 [(f)]
Copper (Cu)	100 [(g)]	[(d)]
Manganese (Mn)	[(c)]	0.05 [(e)]
Nickel (Ni)	0.2 [(g)]	0.014 [(g)]
Vanadium (V)	0.8 [(f)]	0.1 [(f)]
Ammonia (NH_3)	1184[(f)]	[(d)]
HCl	2100[(g)]	[(d)]
HF	240[(g)]	[(d)]

(a) Hourly concentrations compared with short-term / acute exposure health effect screening level
(b) Annual concentrations compared with long-term / chronic exposure health effect screening level
(c) No hourly health screening level
(d) No annual health screening level
(e) US-EPA IRIS Inhalation Reference Concentrations (µg/m^3) – chronic
(f) US ATSDR Maximum Risk Levels (MRLs) (µg/m^3) - acute
(g) Californian OEHHA (µg/m^3) – acute
(h) No annual health screening level

Table 17: Screening of non-criteria pollutants against health risk guidelines incinerators

Compound	Maximum concentration[(a)]	Screening level
Baseline operations		
Mn*	0.0005	0.05 [(b)]
NH_3	0.550	1184 [(c)]
HCl	0.174	2100 [(c)]
HF	0.050	240 [(c)]
Benzene	0.079	5 [(d)]
Existing and New Plant Standards		
Mn*	0.0001	0.05 [(b)]
NH_3	0.480	1184 [(c)]
HCl	0.147	2100 [(c)]
HF	0.050	240 [(c)]
Benzene	0.039	5 [(d)]
Alternative emissions limit scenario		
Mn*	0.0016	0.05 [(b)]
NH_3	0.542	1184 [(c)]
HCl	0.105	2100 [(c)]
HF	0.050	240 [(c)]
Benzene	0.03	5 [(d)]

(a) Maximum predicted concentration across the 12 receptors
(b) Chronic exposure level, µg/m³
(c) Acute exposure level, µg/m³
(d) South African NAAAQS
* *Includes Mn emissions from B6930 and B6993, not B6990*

Table 17 demonstrates that for all non-criteria pollutants both the strictest acute (hourly) and chronic (average annual) limits are not exceeded. Baseline emissions of the 'Sum of lead, arsenic, antimony, chromium, cobalt, copper, manganese, nickel and vanadium' from the Sasol Infrachem Thermal Oxidation incinerators will exceed the existing plant standards. The ambient impact of these emissions was modelled for the baseline emissions, and for the scenarios where existing plant standards and new plant standards were theoretically complied with. After accounting for the proportional contribution of each pollutant, predicted concentrations (99^{th} percentile hourly and annual average) were compared with the appropriate strictest health effect screening levels. No exceedances of hourly (acute) or annual (chronic) screening levels were found.